BURGESS & NIPLE

Innsbrook Owners Association

INNSBROOK | *next*

Comprehensive Stormwater Management Report

January 15, 2010

Rev. 6/24/11

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1. Executive Summary

Redevelopment of Innsbrook to a vibrant, mixed use community for the benefit of all stakeholders is predicated on three integral components: (1) Urban Mixed Use ("UMU") designation on the Henrico County Comprehensive Plan, (2) Urban Development Area ("UDA") designation by the Board of Supervisors and (3) acceptance by Henrico County of the Innsbrook Comprehensive Stormwater Plan that incorporates the first two elements and allows them to be achieved. Close coordination is essential to making these advanced planning objectives a reality.

Stormwater Quantity: Burgess & Niple performed an analysis of the five Innsbrook lakes (the "Lakes") to determine the stormwater runoff that can be expected to be discharged from the Innsbrook development. It has been determined that the existing drainage area will generate a peak discharge of 216± cfs over the spillway of Lake Rooty (Lake No. 5) from a 1-year, 24-hour storm event. Furthermore, a 2-year storm has a peak discharge of 348± cfs, a 10-year storm has a peak discharge of 394± cfs, a 50-year storm has a peak discharge of 486± cfs and a 100-year storm has a peak discharge of 540± cfs.

Stormwater Quality: The five Innsbrook lakes are fed by 840± acres within Innsbrook, plus 51± acres of offsite commercial development and 71± acres of offsite residential development. The total drainage area to the Lakes is 962± acres. The five Lakes currently remove, under DCR requirements and regulations, a total of 457± pounds of phosphorus per year from 962± acres that drain to the Lakes.

The proposed Innsbrook redevelopment area contains 630± acres, and currently has 290± acres of impervious surface (46%), based on GIS calculations of the existing buildings, parking areas, roadways, and sidewalks. The redevelopment of the 630± acres could be developed with up to 442± impervious acres (70%), excluding 37± acres of lakes (see Water Quality Calculations Summary Table – sheet 22 for breakdown by lake). Under existing zoning conditions of Innsbrook, up to an impervious cover of 62% is allowable. Therefore, it can be concluded that the Innsbrook Redevelopment Area can be redeveloped to 70% impervious surface area within the capacity of the existing lake system, and using the 0.45 lbs/ac./yr phosphorous removal standard.

Innsbrook Architectural Review Committee: The development rights existing at Innsbrook will be allocated to all property owners at Innsbrook through the Architectural Review Committee ("ARC"). The ARC will track the development density and impervious surface area as part of its normal approval process in order to assure equitable allocation among all property owners.

Off-Site Redevelopment: Any redevelopment within the Innsbrook drainage area but not subject to the covenants of the Innsbrook Owners Association will have no right to use the Innsbrook lake system or other stormwater control measures to satisfy any redevelopment requirements, or additional requirements that may emanate from the proposed stormwater regulations. Any and all such redevelopment will be required to meet DCR and Henrico stormwater criteria as a stand-alone project.

Stormwater Regulations : The following stormwater regulations and guidelines were followed in the analysis and shall apply to the Innsbrook Redevelopment:

- Henrico County Erosion and Sediment Control (ESC) Program (Chapter 10, Article II of the County Code), required by Erosion and Sediment Control Law (Section 10.1-560 et seq. of the State Code), and compliance with the minimum standards of the Erosion and Sediment Control Regulations (VR 625-02-00); Virginia Erosion and Sediment Control Handbook (VESCH, 3rd Edition, 1992)

- The Chesapeake Bay Preservation Act (Section 10.1-2100 et seq. of the State Code) and the Chesapeake Bay Preservation Area Designation and Management Regulations (9VAC10-20 et seq.)

- The Virginia Stormwater Management Law (Section 10.1-603 et seq. of the State Code) and the Virginia Stormwater Management Regulations (4VAC3-20 et seq.)

- The National Pollutant Discharge Elimination System (NPDES) and Virginia Pollutant Discharge Elimination System (VPDES) developed under the authority of Section 402(p) of the Clean Water Act

2. Introduction

A proposed redevelopment of the commercial areas within the Innsbrook boundaries is being contemplated. This redevelopment would encompass approximately 630 acres within the Innsbrook boundaries. The 630± acre (portion of overall Innsbrook boundary which is 929± acre) Site is located north of West Broad Street, south of Interstate 295, west of Thorncroft Drive, and east of Sadler Road and the Nuckols Road/I-295 interchange in Henrico County (see Figure 1). The Site currently contains multiple zoning: One-Family Residential (R-2C, R-2A, R-3A, and R-3AC), General Residential (R-5C, and R-6C), Residential Townhouse (RTH), Conservation (C-1 and C-1C), Agriculture (A-1), Business (B-2C, and B-3C), Light Industrial (M-1C), and Office (O-2C, and O-3C). Conservation zoning is sparsely spaced throughout the Site and does not include the entire lake system.

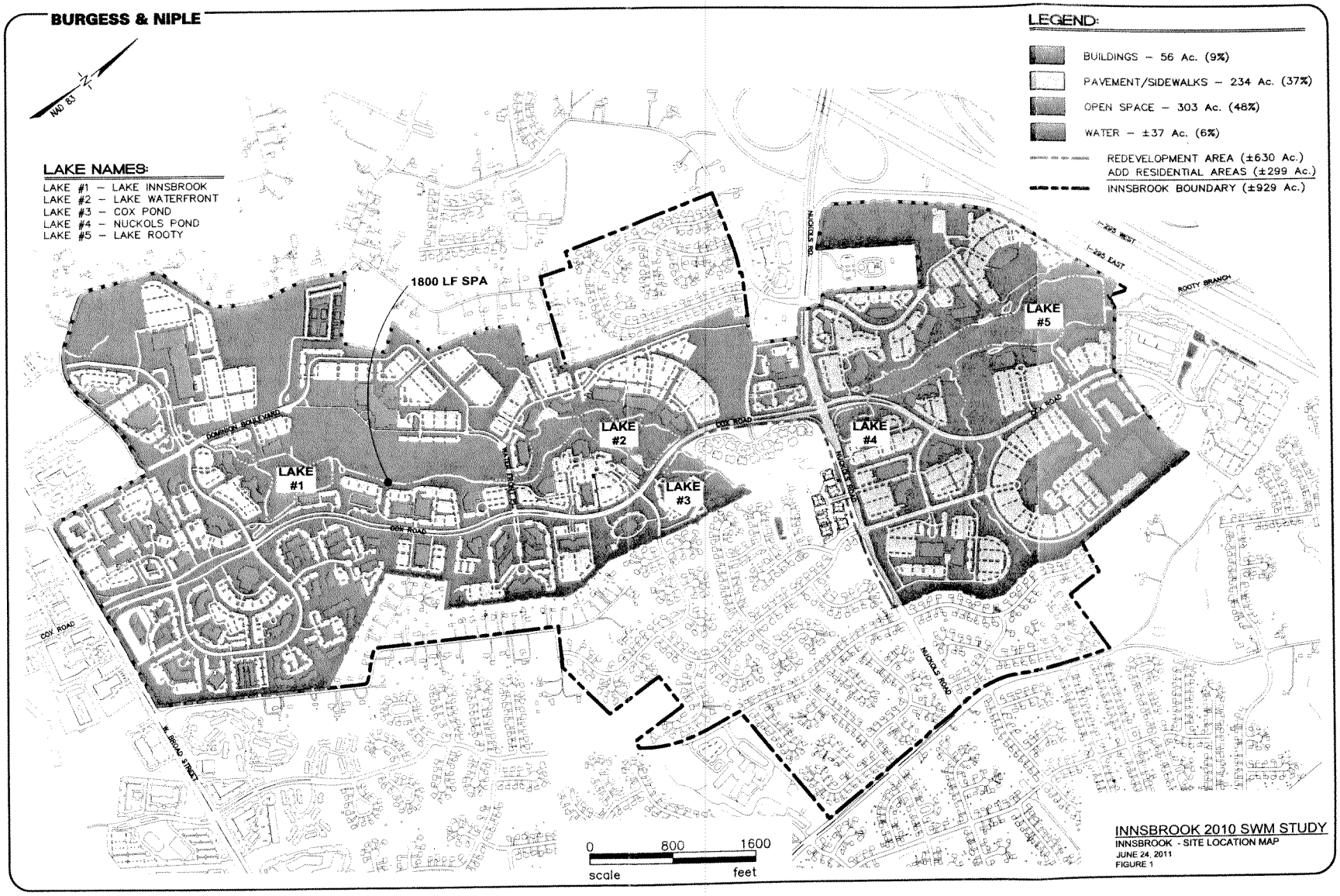
Currently, the Site is occupied by residential areas, various commercial uses, some light industrial uses, and five (5) lakes that are connected by various stormwater conveyance channels. Under existing conditions, most stormwater runoff is collected and treated by the lake system. Stormwater runoff starts at the Innsbrook boundary at West Broad Street. Upstream runoff is first treated by Lake Innsbrook (Lake 1). The discharge from Lake Innsbrook (Lake 1) traverses along a channel to Lake Waterfront (Lake 2), through Cox Pond (Lake 3), then Nuckols Pond (Lake 4), and ultimately to Lake Rooty (Lake 5). Along this drainage pattern, stormwater runoff is added from areas outside of Innsbrook and is treated by the existing lake system. A majority of the Site's stormwater runoff eventually passes through Lake Rooty (Lake 5), and discharges via a concrete weir and spillway to a channel located near the I-295/Innsbrook border to the north. Once offsite, Rooty Branch traverses the Henrico County landfill, connects with Allens Branch, then discharges to the Chickahominy River.

The redevelopment of the Site includes the promotion of mixed uses, which in turn will allow for greater density of the Site. It is assumed that there will be more 4-8 story buildings versus the current 1-4 story buildings. All proposed improvements, along with the rezoning of Innsbrook, will allow for greater density, thus considering additional impervious area than what presently exists. B&N analyzed existing conditions of the lake system for water quality and quantity treatment, as well as the potential for future redevelopment of 630± acres within Innsbrook.

Under proposed conditions, stormwater runoff will continue to be treated for stormwater quality/quantity by the five (5) existing lakes. Wherever possible, existing drainage and grading patterns will be maintained under proposed conditions. Although there is potential for the Site to contain additional measures to treat water quality/quantity in addition to the benefits provided by the lake system, it is deemed necessary to preserve the lake system, while providing a mechanism of which to establish, track, and mandate treatment credits for stakeholders of the Innsbrook community. The Innsbrook Architectural Review Committee will be tasked with such management of credits.

There are a handful of properties outside of Innsbrook that contribute stormwater runoff to the lake system. Although this stormwater runoff is currently treated by the lake system, it is understood that redevelopment of offsite areas will be strictly prohibited from utilizing credits afforded by the lake system. Redevelopment of offsite areas will warrant the provisions of standalone water quality and quantity measures, and thus, they will remain outside and not part of the Innsbrook redevelopment effort.

Figure 1: Innsbrook - Site Location Map


BURGESS & NIPLE
NAD 83
LAKE NAMES:
LAKE #1 – LAKE INNSBROOK
LAKE #2 – LAKE WATERFRONT
LAKE #3 – COX POND
LAKE #4 – NUCKOLS POND
LAKE #5 – LAKE ROOTY
1800 LF SPA
LAKE #1
LAKE #2
LAKE #3
LAKE #4
LAKE #5
DOMINION BOULEVARD
COX ROAD
NUCKOLS ROAD
N. BROAD STREET
I-295 WEST
I-295 EAST
ROOTY BRANCH
0 800 1600
scale feet
LEGEND:
BUILDINGS – 56 Ac. (9%)
PAVEMENT/SIDEWALKS – 234 Ac. (37%)
OPEN SPACE – 303 Ac. (48%)
WATER – ±37 Ac. (6%)
REDEVELOPMENT AREA (±630 Ac.)
ADD RESIDENTIAL AREAS (±299 Ac.)
INNSBROOK BOUNDARY (±929 Ac.)
INNSBROOK 2010 SWM STUDY
INNSBROOK - SITE LOCATION MAP
JUNE 24, 2011
FIGURE 1

3. Existing Conditions

The 630± acre Site consists mostly of commercial and light industrial uses. The total impervious surfaces, covered by buildings, roadways, parking lots, and sidewalks equals 290± acres. Key natural resources in and around the property include the lake system and various surface channels that connect each lake. Additionally, the downstream channel from the Site's outfall leads to and traverses I-295 to Rooty Branch. An analysis of Rooty Branch has not been included in this study. However, a visual inspection of the 3,600± LF of Rooty Branch from the discharge point in Innsbrook to its confluence with Allens Branch does not reveal any indication that Rooty Branch is not a stable stream. In fact, over the past several years, Rooty Branch has handled several major storm events without any noticeable erosion to its banks. As indicated in the FEMA map (Appendix A), the flood plain is mapped along the lake system. Although this is the case for this study, it is encouraged that upon future redevelopment, the lake system's flood elevation should be further analyzed and preserved as to prevent flooding of existing and future occupancy.

The Site is gently sloping from the southern end of the property to the northern edge of the study area. There are five (5) lakes, and various channels that interconnect the lakes, throughout this analysis. The upper elevation of the study area is at 280'± (datum: NAVD 88) and the lower at elevation 219'±, consisting of a general longitudinal slope of 0.6% . Slopes leading downstream to each of the lakes are generally at 2-4%. Upon Site inspection, there is no known evidence of substantial erosion due to limited slopes and well-maintained green areas. This information is based on Henrico County GIS 2004 topo. The topo on future PODs must meet topographic survey requirements.

Of the total Innsbrook community (929± acres), 630± acres is considered the Site and redevelopment area, whereby a majority of the redevelopment area is within the drainage area to the existing lake system, less 15± acres. Offsite areas (areas outside of Innsbrook) that drain to the lakes entail 51± acres commercial use, and 71± acres single family residential (total of 122± acres offsite contribution). There are 210± acres of residential use within Innsbrook, and not all of that area contributes runoff to the lake system (see Table 1 and Figure 2 for a detailed summary).

Of the total 630± acre Site, 290± acres are currently covered with impervious surfaces, whereby 56± acres is covered by buildings, and 234± acres is parking lots, roadways, and sidewalks. The Site contains 303± acres open space and 37± acres of the lake system. The impervious areas in this report are based on information obtained from the 2004 Henrico County GIS.

For the existing conditions hydrologic analysis, B&N divided the Site into eight (8) drainage areas (See Figure 3). Seven (7) drainage areas contribute to the five existing lakes. One (1) drainage area is considered as part of the Site, but discharges runoff away from the lake system and towards the I-295/Nuckols Road interchange by surface flow. B&N evaluated peak discharge rates for two (2) design points within the Site's boundaries, for the 1, 2, 10, 50, and 100 year storm events. The Design Points are:

- Design Point 1 – the downstream location of the spillway located at Lake 5.
- Design Point 2 - the northwestern corner of the approximate 15 acre parcel located within the Site.

Figure 2: Innsbrook - Existing Conditions

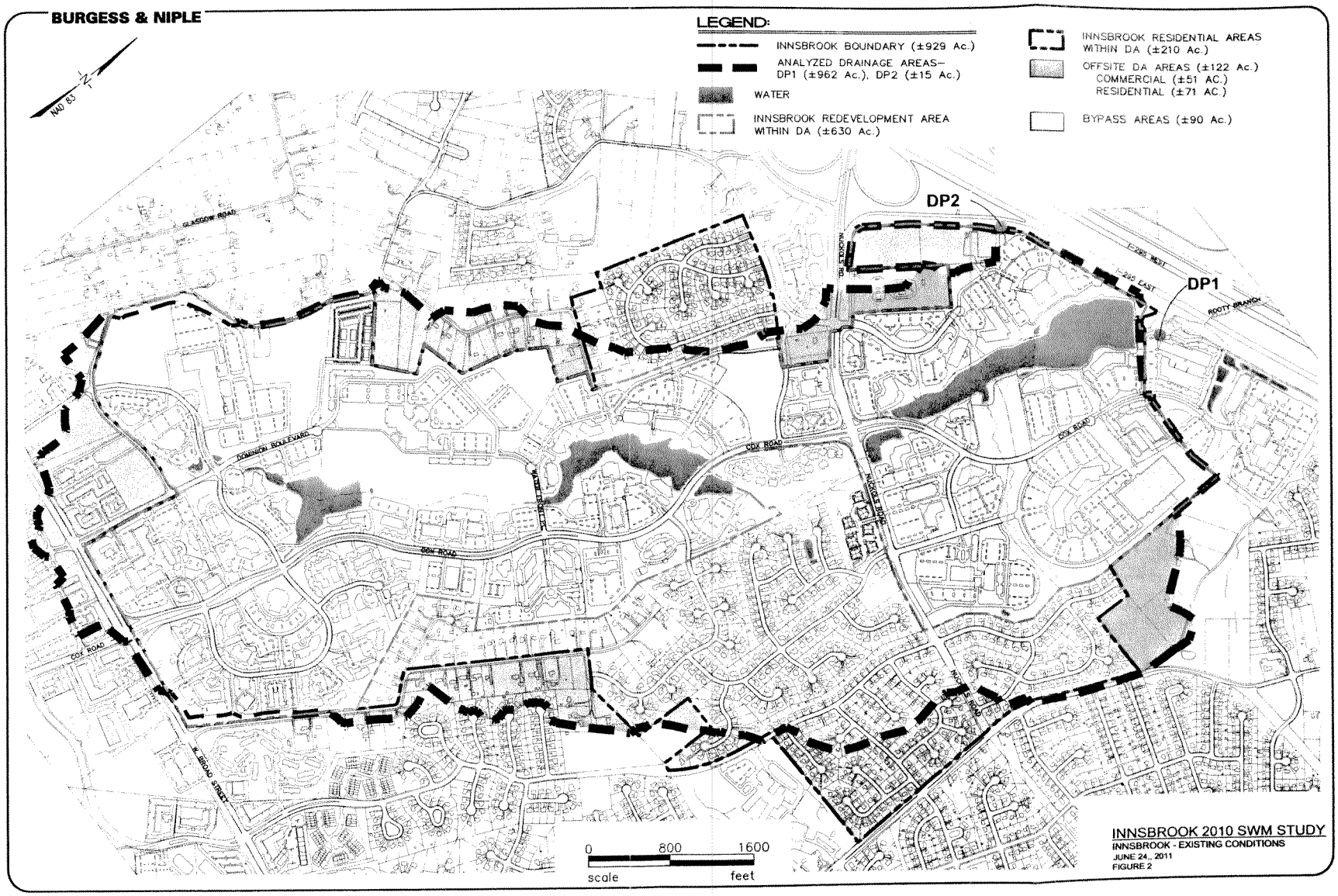

BURGESS & NIPLE
LEGEND:
INNSBROOK BOUNDARY (±929 Ac.)
ANALYZED DRAINAGE AREAS– DP1 (±962 Ac.), DP2 (±15 Ac.)
WATER
INNSBROOK REDEVELOPMENT AREA WITHIN DA (±630 Ac.)
INNSBROOK RESIDENTIAL AREAS WITHIN DA (±210 Ac.)
OFFSITE DA AREAS (±122 Ac.)
COMMERCIAL (±51 AC.)
RESIDENTIAL (±71 AC.)
BYPASS AREAS (±90 Ac.)
NAD 83
DP1
DP2
GLASGOW ROAD
DOMINION BOULEVARD
COX ROAD
NICHOLS ROAD
I-295 EAST
I-295 WEST
ROOTY BRANCH
N. BROAD STREET
0
800
1600
scale
feet
INNSBROOK 2010 SWM STUDY
INNSBROOK - EXISTING CONDITIONS
JUNE 24., 2011
FIGURE 2

Figure 3: Innsbrook - Existing Drainage Areas

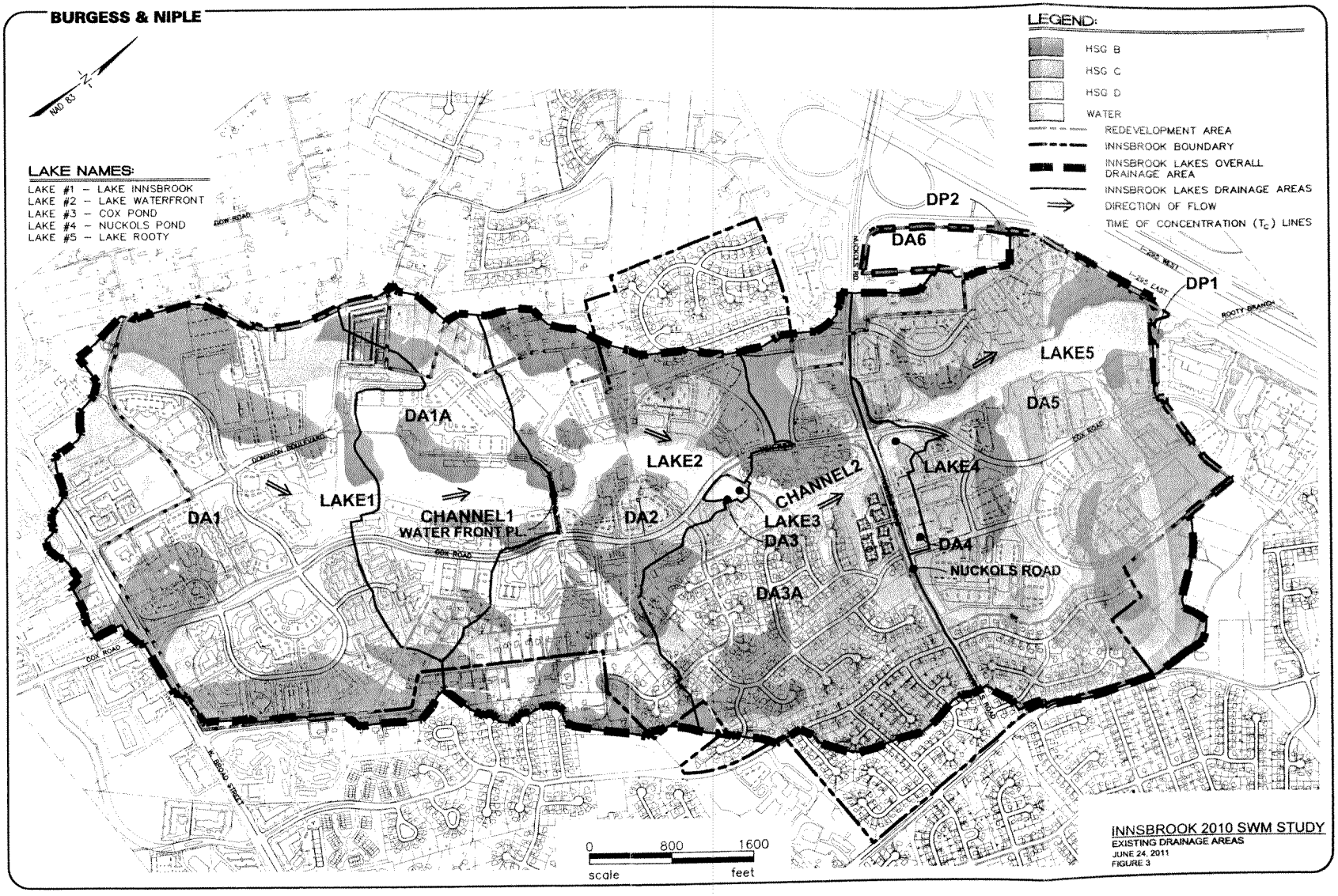

BURGESS & NIPLE
NAD 83
LAKE NAMES:
LAKE #1 – LAKE INNSBROOK
LAKE #2 – LAKE WATERFRONT
LAKE #3 – COX POND
LAKE #4 – NUCKOLS POND
LAKE #5 – LAKE ROOTY
LEGEND:
HSG B
HSG C
HSG D
WATER
REDEVELOPMENT AREA
INNSBROOK BOUNDARY
INNSBROOK LAKES OVERALL DRAINAGE AREA
INNSBROOK LAKES DRAINAGE AREAS
DIRECTION OF FLOW
TIME OF CONCENTRATION (T_C) LINES
DP1
DP2
DA1
DA1A
DA2
DA3
DA3A
DA4
DA5
DA6
LAKE1
LAKE2
LAKE3
LAKE4
LAKE5
CHANNEL1
CHANNEL2
WATER FRONT PL
NUCKOLS ROAD
COX ROAD
DOMINION BOULEVARD
ROOTY BRANCH
0
800
1600
scale
feet
INNSBROOK 2010 SWM STUDY
EXISTING DRAINAGE AREAS
JUNE 24, 2011
FIGURE 3

Table 1 summarizes the zoning use/location of contributing drainage areas to each Design Point (DP).

Table 1. Contributing Drainage Areas

Design Point	Zoning Use/ Location	*Area (acres)*	*Total Area (acres)*
DP1	Onsite Commercial	630	962
	Onsite Residential	210	
	Offsite Commercial	51	
	Offsite Residential	71	
DP2	Onsite Commercial	15	15

Note: Quantities are approximate

The USDA Soil Conservation Service Soil Survey of Henrico County, Virginia (Version 6, Dec 22, 2008) identifies soils onsite as Appling, Bourne, Colfax, Helena, Kinston and Mantachie, Pouncey, and Wedowee Series.

Soils that have the same runoff potential under similar storm and cover conditions belong to one of four Hydrologic Soil Groups established by the USDA. Runoff factors are assigned to each of these groups and these factors are used in equations that estimate runoff from rainfall.

USDA defines these soils groups as:

A Soils with low runoff potential. Soils having high infiltration rates even when thoroughly wetted and consisting largely of deep, well drained to excessively drained sands or gravels.

B Soils having moderate infiltration rates even when thoroughly wetted and consisting largely of moderately deep to deep, moderately well drained to well drained soils with moderately fine to moderately coarse textures.

C Soils having slow infiltration rates when thoroughly wetted and consisting largely of soils with a layer that impedes downward movement of water, or soils with moderately fine to fine textures.

D Soils with high runoff potentials. Soils having very slow infiltration rates when thoroughly wetted and consisting largely of clay soils with high swelling potentials, soils with a permanent high water table, soils with a claypan or clay layer at or near the ground surface, and shallow soils over nearly impervious material.

The hydrologic soil groups found on this Site are Groups B, C, and D.

B&N provided a hydrographic survey of each lake as to determine available volume of each (See Table 2 and Figures 4A-4E). Modeling of the lake systems was performed to determine the peak discharge at each lake outfall (Table 3) during each design storm event. Since the purpose of this report is to study the redevelopment area of Innsbrook as one area, B&N analyzed Design Point 1 as the comprehensive point of interest for the Site.

Table 2 summarizes the available capacity in the lakes and conveyance channels used in the existing conditions analysis.

Table 2. Existing Lake/Channel Capacity

Lake/Chan. ID #	Outfall/Top Elevation (ft)	Volume (Cyd)	Volume (Ac-Ft)
1	249.15	40,990	25.4
C1	235.75	980	0.61
2	235.75	63,560	39.4
3	227.1	2,785	1.73
C2	N/A	N/A	N/A
4	220.62	5,920	3.67
5	219.20	153,710	95.27

Note: Capacity stated as at the top of the outfall structure and at the normal pool elevation

Figure 4A: Innsbrook – Lake Innsbrook (Lake #1)

INNSBROOK

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LAKE INNSBROOK (LAKE #1) INFORMATION:

1.) WATER SURFACE ELEVATION: 249.15'

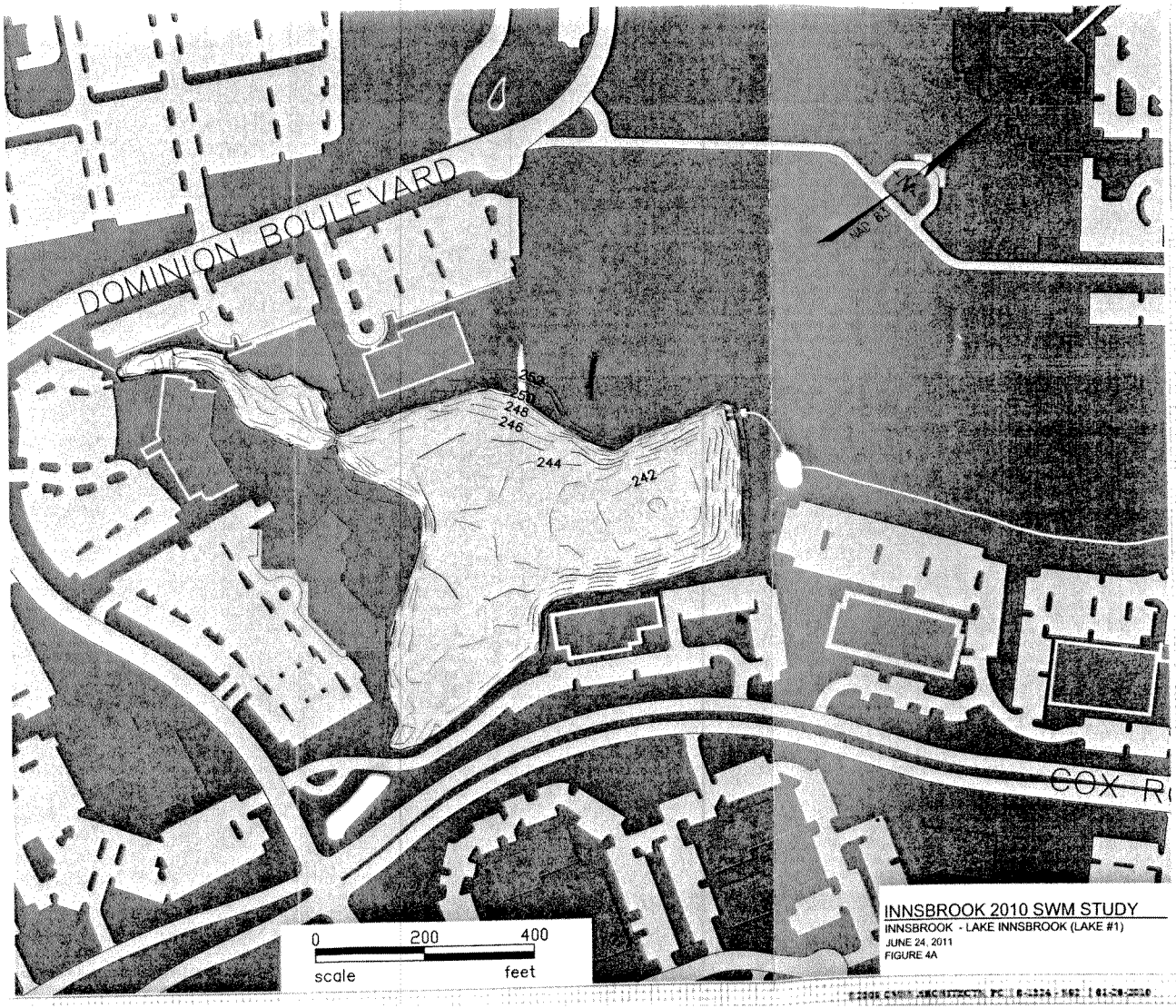
2.) SURFACE AREA: 278,451 SF = 6.4 AC

3.) MAX. DEPTH: 8.15'

4.) VOLUME (AT NORMAL POOL): 1,106,730 CF

5.) STORAGE VOLUME: 536,192 CF

6.) BOTTOM OF POND: 241.00'



INNSBROOK 2010 SWM STUDY
INNSBROOK - LAKE INNSBROOK (LAKE #1)
JUNE 24, 2011
FIGURE 4A

Figure 4B: Innsbrook – Lake Waterfront (Lake #2)

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LAKE WATERFRONT (LAKE #2) INFORMATION:

1.) WATER SURFACE ELEVATION: 235.75'

2.) SURFACE AREA: 435,177 SF = 10.0 AC

3.) MAX. DEPTH: 5.75'

4.) VOLUME (AT NORMAL POOL): 1,716,120 CF

5.) STORAGE VOLUME: 1,505,286 CF

6.) BOTTOM OF POND: 230.00'

INNSBROOK 2010 SWM STUDY
INNSBROOK - LAKE WATERFRONT (LAKE #2)
JUNE 24, 2011
FIGURE 4B

Figure 4C: Innsbrook – Cox Pond (Lake #3) & Nuckols Pond (Lake #4)

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COX POND (LAKE #3) INFORMATION:

1.) WATER SURFACE ELEVATION: 227.10'

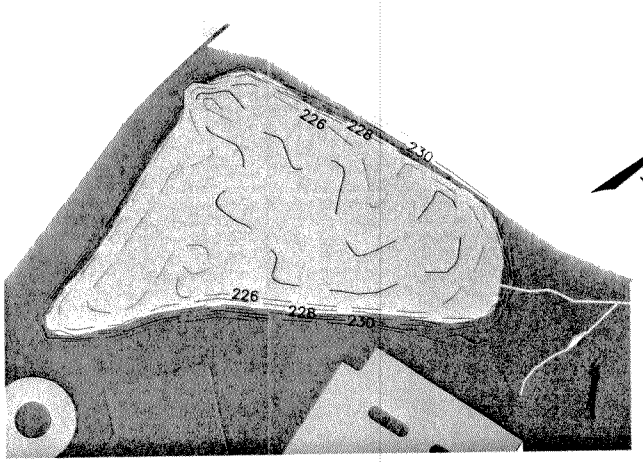
2.) SURFACE AREA: 48,729 SF = 1.1 AC

3.) MAX. DEPTH: 3.1'

4.) VOLUME (AT NORMAL POOL): 75,195 CF

5.) STORAGE VOLUME: 102,705 CF

6.) BOTTOM OF POND: 224.00'



NUCKOLS POND (LAKE #4) INFORMATION:

1.) WATER SURFACE ELEVATION: 220.62'

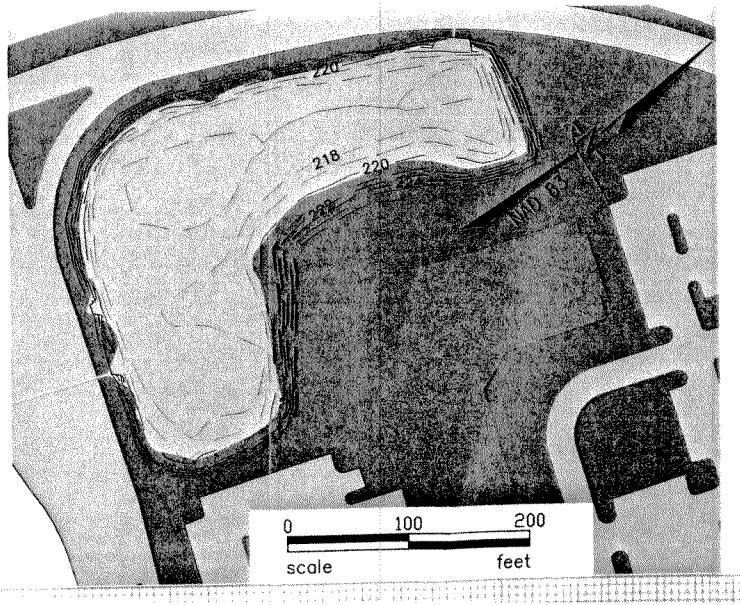
2.) SURFACE AREA: 60,014 SF = 1.4 AC

3.) MAX. DEPTH: 3.62'

4.) VOLUME (AT NORMAL POOL): 159,840 CF

5.) STORAGE VOLUME: 150,515 CF

6.) BOTTOM OF POND: 217.00'



INNSBROOK 2010 SWM STUDY
INNSBROOK - COX POND (LAKE #3) & NUCKOLS POND (LAKE #4)
JUNE 24, 2011
FIGURE 4C

Figure 4D: Innsbrook – Lake Rooty (Lake #5)

INNSBROOK

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LAKE ROOTY (LAKE #5) INFORMATION:

1.) WATER SURFACE ELEVATION: 219.2'

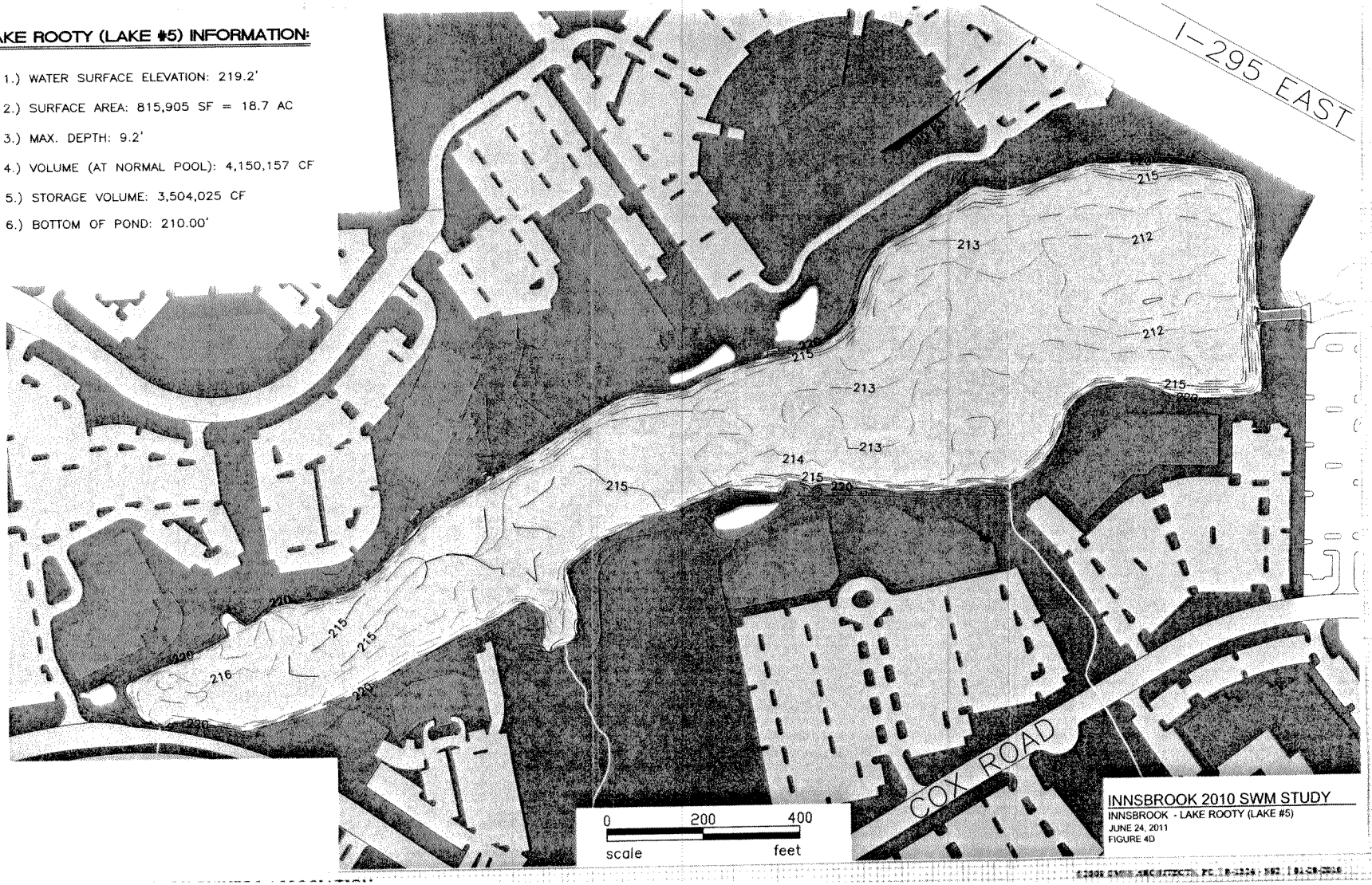
2.) SURFACE AREA: 815,905 SF = 18.7 AC

3.) MAX. DEPTH: 9.2'

4.) VOLUME (AT NORMAL POOL): 4,150,157 CF

5.) STORAGE VOLUME: 3,504,025 CF

6.) BOTTOM OF POND: 210.00'



INNSBROOK 2010 SWM STUDY
INNSBROOK - LAKE ROOTY (LAKE #5)
JUNE 24, 2011
FIGURE 4D

Figure 4E: Innsbrook – Lakes Summary Sheet

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LAKE INNSBROOK (LAKE #1) INFORMATION:

1.) WATER SURFACE ELEVATION: 249.15'
2.) SURFACE AREA: 278,451 SF = 6.4 AC
3.) MAX. DEPTH: 8.15'
4.) VOLUME (AT NORMAL POOL): 1,106,730 CF
5.) STORAGE VOLUME: 536,192 CF
6.) BOTTOM OF POND: 241.00'

LAKE WATERFRONT (LAKE #2) INFORMATION:

1.) WATER SURFACE ELEVATION: 235.75'
2.) SURFACE AREA: 435,177 SF = 10.0 AC
3.) MAX. DEPTH: 5.75'
4.) VOLUME (AT NORMAL POOL): 1,716,120 CF
5.) STORAGE VOLUME: 1,505,286 CF
6.) BOTTOM OF POND: 230.00'

COX POND (LAKE #3) INFORMATION:

1.) WATER SURFACE ELEVATION: 227.10'
2.) SURFACE AREA: 48,729 SF = 1.1 AC
3.) MAX. DEPTH: 3.1'
4.) VOLUME (AT NORMAL POOL): 75,195 CF
5.) STORAGE VOLUME: 102,705 CF
6.) BOTTOM OF POND: 224.00'

NUCKOLS POND (LAKE #4) INFORMATION:

1.) WATER SURFACE ELEVATION: 220.62'
2.) SURFACE AREA: 60,014 SF = 1.4 AC
3.) MAX. DEPTH: 3.62'
4.) VOLUME (AT NORMAL POOL): 159,840 CF
5.) STORAGE VOLUME: 150,515 CF
6.) BOTTOM OF POND: 217.00'

LAKE ROOTY (LAKE #5) INFORMATION:

1.) WATER SURFACE ELEVATION: 219.2'
2.) SURFACE AREA: 815,905 SF = 18.7 AC
3.) MAX. DEPTH: 9.2'
4.) VOLUME (AT NORMAL POOL): 4,150,170 CF
5.) STORAGE VOLUME: 3,504,025 CF
6.) BOTTOM OF POND: 210.00'

SURFACE AREA:

LAKE #1:	6.4 AC
LAKE #2:	10.0 AC
LAKE #3:	1.1 AC
LAKE #4:	1.4 AC
LAKE #5:	18.7 AC
TOTAL:	37.6 AC

VOLUME (AT NORMAL POOL):

LAKE #1:	1,106,730 CF	(40,990 CY)
LAKE #2:	1,716,120 CF	(63,560 CY)
LAKE #3:	75,195 CF	(2,785 CY)
LAKE #4:	159,840 CF	(5,920 CY)
LAKE #5:	4,150,170 CF	(153,710 CY)
TOTAL:	7,208,055 CF	(165.5 AC-FT)

STORAGE VOLUME:

LAKE #1:	536,192 CF
LAKE #2:	1,505,286 CF
LAKE #3:	102,705 CF
LAKE #4:	150,515 CF
LAKE #5:	3,504,025 CF
TOTAL:	5,798,723 CF (133.1 AC-FT)

INNSBROOK 2010 SWM STUDY
INNSBROOK - LAKES SUMMARY SHEET
JUNE 24, 2011
FIGURE 4E

Table 3 summarizes the key hydrologic parameters for each drainage area used in the existing conditions analysis.

Table 3. Existing Conditions Hydrologic Data

Description (Drainage Area #)	Discharge Location	Design Point	Area (acres)	Runoff Coeff.	Time of Concentration (min)
1	Lake 1	Out1	249	0.4859	35
1A	Channel 1	WP*	104	0.4534	25
2	Lake 2	Out2	170	0.4893	35
3	Lake 3	Out3	1.9	0.35	8
3A	Channel 2	NR**	173.2	0.4185	30
4	Lake 4	Out4	10	0.51	14
5	Lake 5 / DP1	Out5 / DP1	253.9	0.4893	40
6	DP2	DP2	15	0.35	16

*WP = Waterfront Place

**NR = Nuckols Road

Water Quantity Control Summary

Burgess and Niple (B&N) analyzed the Site and the existing lake system for its water quantity benefits. A PondPack model, using Modified Rational Methodology, was developed to evaluate water quantity benefits on the Site (See Figure 5). B&N calculated existing peak discharge rates of each lake in its hydrologic analysis, as well as the maximum water surface elevations for each design storm event in its hydraulic analysis.

Hydrologic Analysis

The rainfall-runoff response of the Site under existing conditions was evaluated for storm events with recurrence intervals of 1, 2, 10, 50, and 100-years. Rainfall volumes used for this analysis were based on the Natural Resources Conservation Service (NRCS) Type III, 24 hour storm event for Richmond, Virginia. Runoff coefficients for the pre-development conditions, as previously shown in Table 3, were calculated by B&N with best-available mapping of the Site.

Drainage areas used in the analysis of existing conditions were described in previous sections and shown on Figure 3. The PondPack model is based on Modified Rational Method for formulation of hydrologic conditions. Detailed printouts of the PondPack analyses are included in Appendix D. Table 4 presents a summary of the existing conditions peak discharge rates at each Design Point.

Figure 5: Innsbrook - Existing Conditions Network Summary

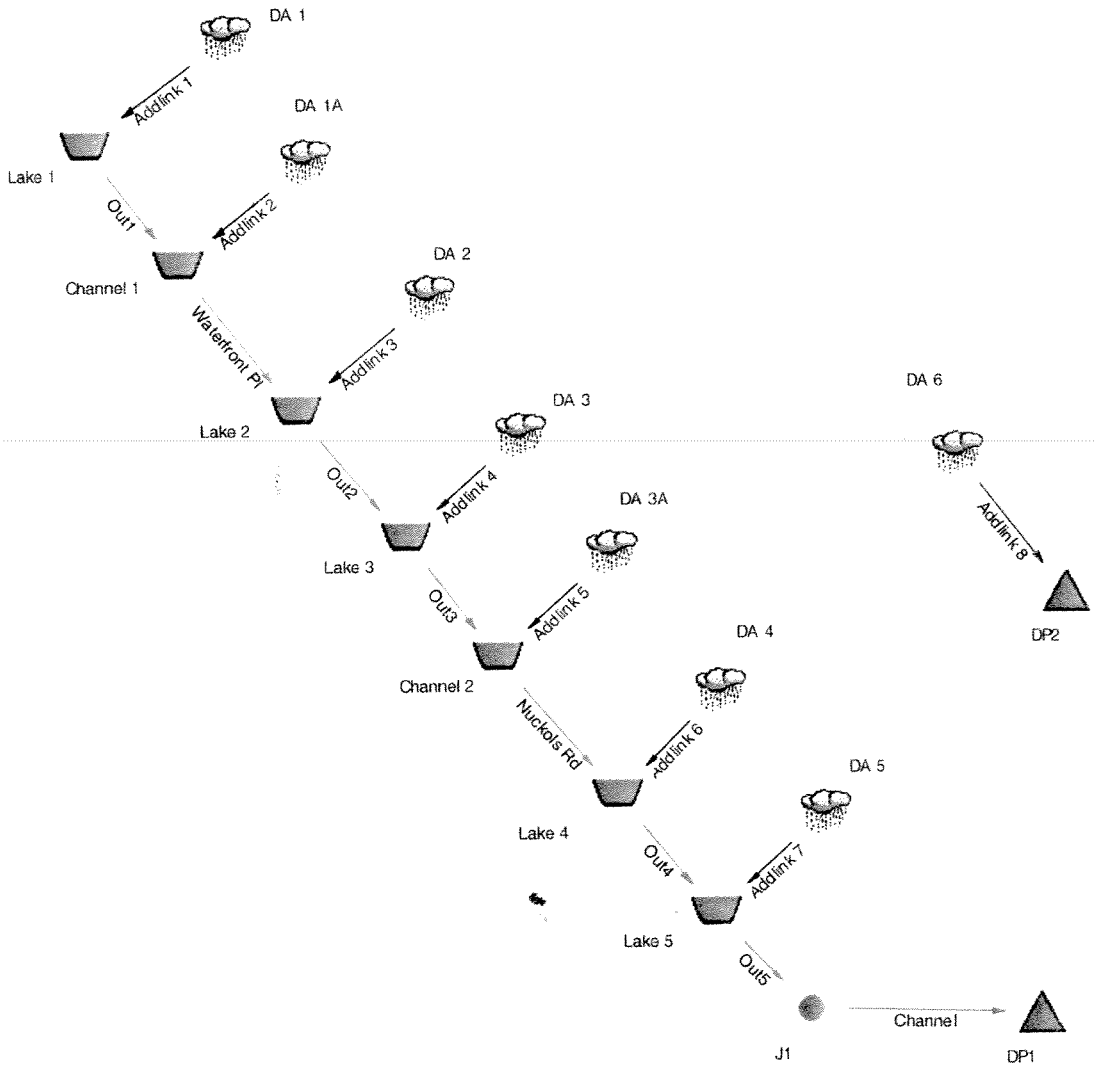


Table 4. Existing Conditions Peak Discharge Rates (cfs*)

Design Point	1-year	2-year	10-year	50-year	100-year
Design Point: 1	216.20	347.70	394.10	486.43	540.27
Design Point: 2	20.12	28.08	37.43	49.91	52.64

* expressed in cubic feet per second

Hydraulic Analysis

B&N analyzed the various outlet structures for each of the five (5) lakes in the Site. Hydraulic conditions of each of these structures have been provided in Appendix D, for the 1, 2, 10, 50 and 100 year storm events. Table 5 below presents the hydraulic stage located at each outfall of every lake for all design storm events. *Note: It shall be further analyzed the impacts of flood conditions on each structure in Innsbrook before redevelopment of the Site. It is understood that no pertinent structure shall be located within one (1) foot of freeboard of the 100 year flood elevation.*

Table 5. Maximum Water Surface Elevations* (WSE)

Lake ID #	NP	1-year	2-year	10-year	50-year	100-year
1	249.15	250.50	250.74	251.10	251.54	251.69
2	235.75	237.18	237.41	237.82	238.38	238.63
3	227.10	228.39	228.68	230.00	230.00	230.00
4	220.62	222.13	222.38	222.50	222.51	222.53
5	219.20	220.14	220.49	220.60	220.81	220.93

* expressed in feet

* NP = Normal Pool

All runoff from the Site discharges to Rooty Branch ultimately after conveyance through the five (5) lakes. The location of this discharge is at the bottom of the concrete spillway located at DP1 (Exhibit A-C).

Exhibit A

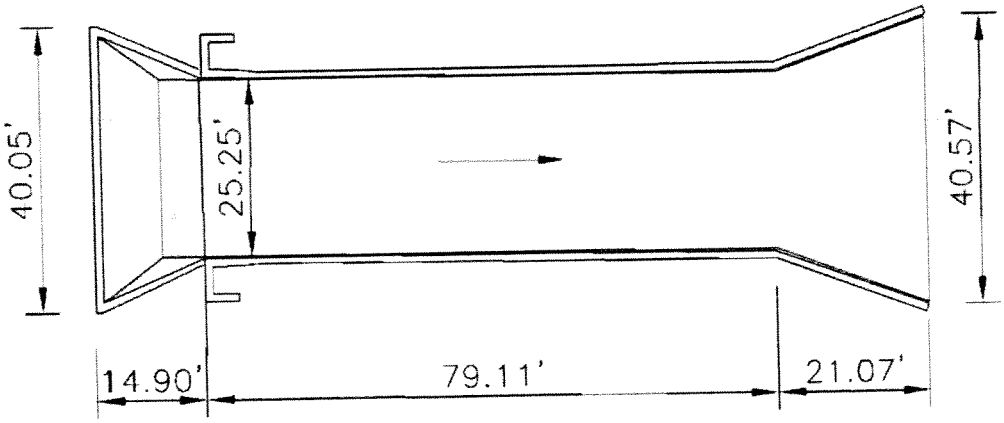
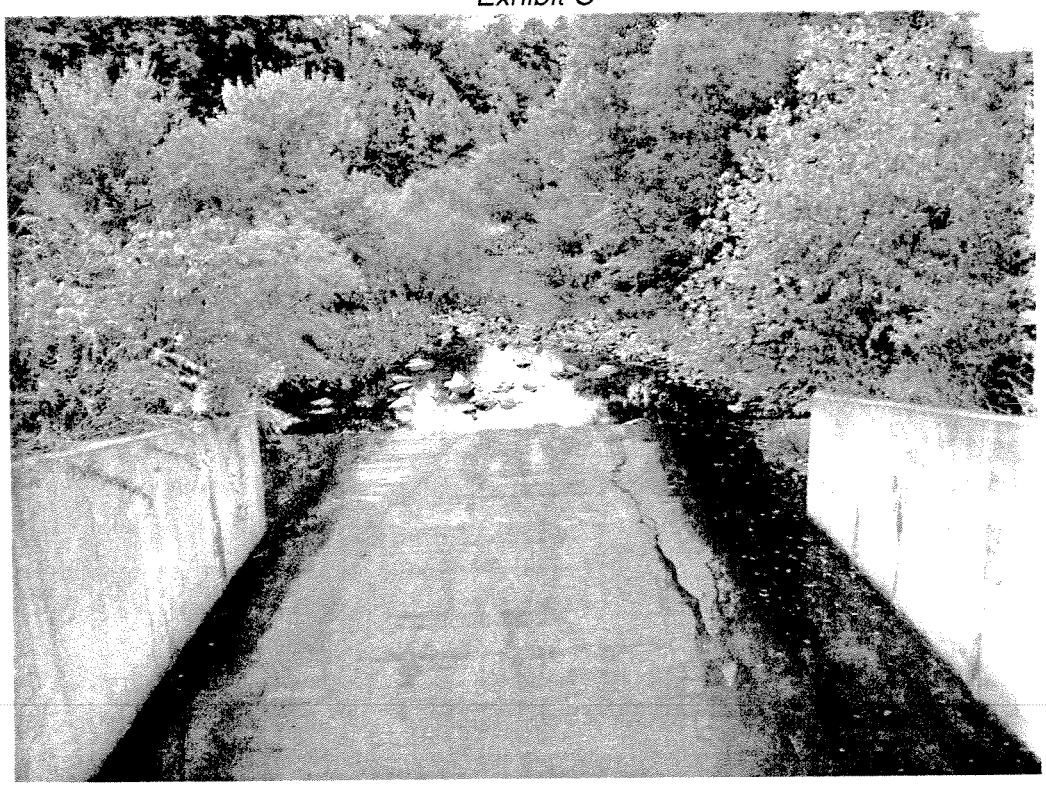


Exhibit B

Exhibit C



The outfall is a structure consisting of a concrete weir and sloped channel. The top of the concrete weir is at elevation 219.2 and the top of dam surrounding the structure is at 224.0. Hydraulic head on the structure has been analyzed and is presented in Table 5.

4. Proposed Conditions

Redevelopment of Innsbrook to a vibrant, mixed use community for the benefit of all stakeholders is predicated on three integral components: (1) Urban Mixed Use ("UMU") designation on the Henrico County Comprehensive Plan, (2) Urban Development Area ("UDA") designation by the Board of Supervisors and (3) acceptance by Henrico County of the Innsbrook Comprehensive Stormwater Plan that incorporates the first two elements and allows them to be achieved. Close coordination is essential to making these advanced planning objectives a reality.

Redevelopment of the Site will certainly entail higher density of uses, greater impervious area, and in turn a greater challenge in addressing stormwater management criteria. In accordance with the current zoning, the redevelopment area has an opportunity to reach 62% impervious cover. B&N analyzed the general criteria of the proposed Master Plan as provided by CMSS Architects (Figure 6), as well as current stormwater management regulations, in order to determine the excess impervious cover the existing stormwater management facilities would allow.

Under proposed conditions, stormwater runoff will continue to be treated for stormwater quality/quantity by the lake system. The lakes were constructed back in the early existence of Innsbrook, and it is understood that they will remain throughout the redevelopment. Wherever possible, existing drainage and grading patterns will be maintained throughout redevelopment. Additionally, it is understood that redevelopment may include additional water quality and quantity control measures or improvements to protect the surrounding natural resources from degradation as a result of stormwater runoff. Such measures include provisions for green roofs, Low-Impact Development, water reuse, and other features designed to improve water quality.

Burgess & Niple analyzed proposed conditions based on theoretical values of impervious cover, as well as calculated allowable capacity within the lake system. B&N analyzed water quantity and quality separately, while adhering to the current stormwater regulations at the time of this report.

Water Quantity Control Summary

In summary, the 630± acre redevelopment area could be developed to a standard 70% impervious cover. Under 70% impervious cover, or 442± acre impervious, 596± lbs/yr of phosphorous is required to be removed from the Site (see Water Quality Calculations Summary Table on sheet 22 for breakdown by Lake). Assuming 50% removal efficiency of a Design 3 retention (Wet) Pond for Lakes 1 & 2, 65% removal efficiency of a Design 4, retention (Wet) Pond for Lakes 3, 4, & 5, and an available WQV of 133± ac-ft (see Worksheet 9.05-1 on pages 38, 45, 50, & 63), 634± lbs/yr (see Table 7) will be removed. Existing flows will be maintained or additional information will be provided to show how additional flows are reduced to pre-development levels.

Water Quality Control Summary

Burgess and Niple (B&N) analyzed the Site and the existing lake system for its water quality benefits. B&N compiled the necessary Henrico County-generated worksheets that coincide with the Site conditions; 1) "Situation Three" – Worksheet 3.03; 2) "Situation Four" – Worksheet 3.04; 3) "Minimum Standard 9.05, Design 3, Retention Wet Pond" – Worksheet 9.05-1. "Situation Three"; and 4) "Minimum Standard 9.05, Design 4, Retention Wet Pond" – Worksheet 9.05-1. "Situation Three" – Worksheet 3.03 is required when the pre-developed condition is greater than 16% impervious, and is not served by an existing BMP. This worksheet determines the phosphorous removal requirement (RR) under proposed conditions. This situation also accounts for a 10% reduction in the pre-developed phosphorus loading. "Situation Four" – Worksheet 3.04 is required when the pre-developed condition is greater than 16% impervious, and is served by an existing BMP. This worksheet determines the phosphorous removal requirement (RR) under proposed conditions; or in other words, the difference between existing conditions and the proposed redevelopment. "Minimum Standard 9.05, Design 3 & Design 4, Retention Wet Pond" – Worksheets 9.05-1 are required to determine the required Water Quality Volume (WQV) that a particular BMP must provide in order to meet the calculated removal requirements as calculated in Worksheets 3.03 & 3.04.

Under existing conditions, there is 202± lbs/yr excess water quality treatment capacity in the existing lake system. Th excess water quality treatment capacity in the existing lake system was determined by adding up the remaining credits for each pond (See Table 7 below.) By analysis, Burgess & Niple deemed it appropriate to study how much additional impervious cover the Innsbrook Redevelopment could hold, while still utilizing available water quality credits in the current lake system. Many iterations of proposed impervious coverage and phosphorous removal requirements were calculated, while assuming a 50% phosphorus removal efficiency for Lakes 1 & 2, and 65% phosphorous removal efficiency for Lakes 3, 4, & 5 of the existing lake system, it was determined that if the 630± acre redevelopment area has an average impervious cover of 70%, the existing lake system would have the water quality capacity to treat the additional phosphorous loading.

Table 7. Available Pollutant Removal Credits Summary

Available Pollutant Removal Credits Based on Existing Land Cover and Associated Pollutant Loads to Lakes

Lake	Condition	Volume	Onsite DA	Onsite I	Onsite I%	Offsite DA	Offsite I	TP to Lake	Efficiency %	WQ Volume	TP Removed*	Credits Used	Credits Remaining
		(cf)	(ac)	(ac)		(ac)	(ac)	(lbs)		(cf)	(lbs)	(lbs)	(lbs)
1	Existing	1,106,730	194.4	90.8	47	54.6	8.7	229.9	50	722,768	116.9	63.2	53.7
2	Existing	1,716,120	188.5	87.3	46	85.5	13.7	241.1	50	733,664	118.6	49.6	69.1
3	Existing	75,195	1.9	0	0	0	0.0	0.2	65	0	0.1	0.0	0.1
4**	Existing	4,310,010	39.1	16.5	42	144.1	23.1	101.9	65	2,591,432	66.2	24.7***	41.5
5**	Existing	4,310,010	206.2	95.5	46	47.7	7.6	239.2	65	2,591,432	155.5	117.8***	37.7

* Not including forested SPA. (Lake #2 will have 0.5 lb extra of TP removed when counting forested SPA)

** Lakes #4 & #5 are considered one lake and meet the 10x WQV requirement for a 65% efficient BMP

*** Lake #4 Credits Used includes the Villas at Innsbrook (4.47lbs), Four Seasons (12.34 lbs), and the water quality credits claimed from sheet 30 (7.86 lbs).

*** Lake #5 Credits Used includes Winterberry Sec. A, B, & C (9.14 lbs) and the water quality credits claimed from sheet 31 (108.64 lbs).

Available Pollutant Removal Credits Based on Redeveloped Land Cover and Associated Pollutant Loads to Lakes

Lake	Condition	Volume	Onsite DA	Onsite I	Onsite I%	Offsite DA	Offsite I	TP to Lake	Efficiency %	WQ Volume	TP Removed*
		(cf)	(ac)	(ac)		(ac)	(ac)	(lbs)		(cf)	(lbs)
1	Proposed	1,106,730	194.4	132.3	68	54.6	8.7	317.6	50	1,024,224	158.8
2	Proposed	1,716,120	188.5	137.6	73	85.5	13.7	341.7	50	1,099,043	170.9
3	Proposed	75,195	1.9	1.06	56	0	0.0	2.4	65	19,250	1.6
4**	Proposed	4,310,010	39.1	28.6	73	144.1	23.1	126.7	65	3,661,056	82.4
5**	Proposed	4,310,010	206.2	142.3	69	47.7	7.6	336.6	65	3,661,056	218.8

* Not including and forested SPA. (Lake #2 will have 0.5 lb extra of TP removed when counting forested SPA)

** Lakes #4 & #5 are considered one lake and meet the 10x WQV requirement for a 65% efficient BMP

Note: Based on a field survey of the normal pool elevations for each lake, the current available WQV is listed under the volume column. (Figure 4E)
The WQV for existing conditions listed above is based on the following (4 x 1816 x existing impervious area) which is less than what is currently available based on the survey of the normal pool elevation. When you then look at the proposed conditions, even with the proposed increase in impervious area, the proposed WQV is still less than the current normal pool volume thus no changes need to be made to the heights of the existing structures and no additional grading will be necessary.

Table 8. Redevelopment Area - Pre WQ & Post WQ Summary

Redevelopment Area - Pre WQ - Summary (Situation 3)

Lake	Pre WQ-A_{SITE}	Pre I%	Pre I	Post I%	Post I	Pre WQ Removal
	(ac)		(ac)		(ac)	Requirement (lbs) *
1	109.2	43	46.5	68	74.3	66.9
2	123.9	43	53.5	73	90.4	88.6
3	1.9	0	0.0	56	1.06	1.6
4**	20.8	53	11.1	73	15.2	11.0
5**	51	38	19.5	69	35.2	37.0

A_{SITE}= Site Area, RR = Removal Requirement, DA = Drainage Area, WQ = Water Quality, I = Impervious

* Not including forested SPA. (Lake #2 will have 0.5 lb extra of TP removed when counting forested SPA)

** Lakes #4 & #5 have been combined to meet 10xWQV for a 65% phosphours removal efficiency

Redevelopment Area - Post WQ - Summary (Situation 4)

Lake	Post WQ-A_{SITE}	Pre I%	Pre I	Post I%	Post I	$RR_{PROJECT}$	$RR_{EXISTING}$	Post WQ - RR_{TOTAL}
	(ac)		(ac)		(ac)	(lbs)	(lbs)	(lbs)
1	85.2	52	44.3	68	58	28.0	63.2	91.2
2	64.6	52	33.8	73	47.2	27.8	49.5	77.3
4**	18.3	30	5.3	73	13.4	16.1	7.9	24.0
5**	155.2	49	76.0	69	107.1	63.7	108.6	172.3

A_{SITE}= Site Area, RR = Removal Requirement, DA = Drainage Area, WQ = Water Quality, I = Impervious

* Not including forested SPA. (Lake #2 will have 0.5 lb extra of TP removed when counting forested SPA)

** Lakes #4 & #5 have been combined to meet 10xWQV for a 65% phosphours removal efficiency

Table 9. Compliance after Redevelopment - Pre WQ & Post WQ Combined Summary

Compliance after Redevelopment (Pre & Post WQ Combined)

Lake	Onsite DA (ac)	Pre I%	Post I (ac)	Post I%	Offsite DA (ac)	Offsite I%	Project Removal Requirement (lbs)	TP Removed (lbs)	Credits Remaining (lbs)
1	194.4	47	132.3	68	54.6	16	158.1	158.8	0.7
2	188.5	46	137.6	73	85.5	16	165.9	171.4*	5.5
3	1.9	0	1.06	56	0	16	1.6	1.6	0.0
4**	39.1	42	28.6	73	144.1	16	51.81***	82.4	30.6
5**	206.2	46	142.3	69	47.7	16	218.44***	218.8	0.3
								Subtotal:	37.1

*Except for Lake #2 where 0.5 additional pounds of phosphorus credit is included due to SPA, no forested SPA will be used to provide additional credits for any other ponds unless specified.

** Lakes #4 & #5 have been combined to meet 10xWQV for a 65% phosphours removal efficiency

*** Lake #4 Project Removal Requirement includes Villas at Innsbrook (4.47lbs) & Four Seasons (12.34lbs)

*** Lake #5 Project Removal Requirement includes Winterberry Sections A,B, & C (total 9.14 lbs)

5. Stormwater Management Plan

The purpose of the Stormwater Management Plan (the "Plan") is to provide a comprehensive framework for the long-term protection of natural resources in and around the Site from degradation as a result of stormwater discharges. This is achieved through the use of a variety of water quality and quantity control measures designed to decrease the amount of pollutants discharged from the Site, increase the quality of stormwater recharged on the Site, and control discharge rates.

Summary of Analysis Findings/Recommendations

Water Quantity Control

Stormwater quantity at the Site will be controlled by use of multiple weir structures located at the respective lake outfalls. Stormwater discharge located at Lake 5 shall not exceed 904± cfs during the 10 year design storm event. Modifications to the existing outlet controls will be required if such discharge rates are introduced. Also, outlet control will be required to dictate WQV for the site, in regards to obtaining required treatment for water quality.

Water Quality Control

Stormwater quality at the Site will be controlled through the implementation of several structural and non-structural Best Management Practices (BMPs), as described in the following sections.

Non-Structural Methods

Site Layout. The proposed Site maintains a New-Urbanism type layout, with higher densities located at the interior of the Site, while tapering off to lower density construction towards the perimeter. This layout provides an advantage to provide a smooth transitional buffer to outlying communities. As the current soil conditions lay out, higher permeable soils remain at the perimeter of the Site, while lesser permeable/hydric soils remain central to the Site. Considering that lower density construction will reside at the outside perimeter of the Site and that more permeable soils are prevalent, natural absorption of stormwater runoff is expected in developed pervious areas.

Source Control. A comprehensive source control program will be implemented at the Site, which includes regular pavement sweeping, drop inlet cleaning, and enclosure and maintenance of all dumpsters, compactors, and loading areas. Further discussion of the maintenance plan is made in a subsequent section of this report.

Structural Methods

Several structural BMPs currently exist on the Site to maintain water quality and to address current pollutant loads associated with stormwater runoff. The redevelopment considers use of existing best management practices, whereby proposed loading shall not exceed that of existing loading of nonpoint source pollution. The CBPA Regulations also specify that the following minimum standards shall apply:

1) Incorporation on the Site of BMP's that achieve the required control;

2) Compliance with a locally adopted regional stormwater management program incorporating pro-rata share payments pursuant to the authority provided in Section 15.2-2243 of the Code of Virginia that results in achievement of equivalent water quality protection;

3) Compliance with a state or locally implemented program of stormwater discharge permits pursuant to Section 402(p) of the federal Clean Water Act, as set forth in 40 C.F.R. Parts 122, 123 124, and 504; and

4) For a development Site that is completely impervious as currently developed, restoring a minimum 20% of the Site to vegetated open space (N/A to this development project).

If the Site's proposed target removal requirement exceeds a removal efficiency of 65%, the local program's requirement will be met if:

a. a BMP that achieves 65% removal efficiency or a combination of BMPs that achieve an overall removal efficiency of 65% is used, and
b. if 80% of the Site's impervious cover is served by one of the above BMP options.

The following sections describe the regulations pertinent to stormwater management and the specific components of the Stormwater Management Plan to be implemented at the Site.

Stormwater Regulations and Permitting

The following stormwater related regulations and guidelines apply to the proposed Site redevelopment:

- Henrico County Erosion and Sediment Control (ESC) Program (Chapter 10, Article II of the County Code), required by Erosion and Sediment Control Law (Section 10.1-560 et seq. of the State Code), and compliance with the minimum standards of the Erosion and Sediment Control Regulations (VR 625-02-00); Virginia Erosion and Sediment Control Handbook (VESCH, 3rd Edition, 1992)

- The Chesapeake Bay Preservation Act (Section 10.1-2100 et seq. of the State Code) and the Chesapeake Bay Preservation Area Designation and Management Regulations (9VAC10-20 et seq.)

- The Virginia Stormwater Management Law (Section 10.1-603 et seq. of the State Code) and the Virginia Stormwater Management Regulations (4VAC3-20 et seq.)

- The National Pollutant Discharge Elimination System (NPDES) and Virginia Pollutant Discharge Elimination System (VPDES) developed under the authority of Section 402(p) of the Clean Water Act

Compliance with these regulations is described in the following sections.

Compliance with DCR's 19 Minimum Standards (MS)

All regulated land-disturbing activities must comply with the nineteen (19) minimum standards (MS) as specified in Section 4VAC50-30-40 of the State Code that are applicable to this redevelopment project. The Henrico County ESC program must review all ESC plans and inspect construction activity so that they conform to the minimum standards. The Henrico County ESC program has the right to waive or modify these standards based on understood hardships with such development. These minimum standards were used as the foundation for the development of the site plan and the selection of non-structural and structural Best Management Practices (BMPs) on the site. The Stormwater Management Plan (the "Plan") includes numerous water quality and quantity controls designed to protect surface and groundwater resources, wetlands, and adjacent properties from potential impacts due to the proposed redevelopment project. The Plan addresses full-buildout conditions and construction activities.

The nineteen (19) minimum standards are as follows.

(1) Soil Stabilization.

- Permanent or temporary soil stabilization shall be applied to denuded areas within seven days after final grade is reached on any portion of the site.
- Temporary soil stabilization shall be applied within seven days to denuded areas that may not be at final grade but will remain dormant for longer than 30 days, but less than one year.
- Permanent stabilization shall be applied to areas that are to be left dormant for more than one year

(2) Soil Stockpile Stabilization.

During construction, soil stockpiles and borrow areas shall be stabilized or protected with sediment trapping measures. Temporary protection and permanent stabilization shall be applied to all soil stockpiles on site and borrow areas or soil intentionally transferred off site.

(3) Permanent Stabilization.

Permanent vegetative cover shall be established on denuded areas not otherwise permanently stabilized. Permanent vegetation shall not be considered established until a ground cover is achieved that is:

- Uniform
- Mature enough to survive
- Will inhibit erosion

(4) Sediment Basins & Traps.

Sediment basins, sediment traps, perimeter dikes, sediment barriers, and other measures intended to trap sediment shall be constructed as a first step in any land-disturbing activity and shall be made functional before upslope land disturbance takes place.

(5) Stabilization of Earthen Structures.

Stabilization measures shall be applied to earthen structures such as dams, dikes, and diversions immediately after installation.

(6) Sediment Traps & Sediment Basins.
Sediment traps and basins shall be designed and constructed based upon the total drainage area to be served by the trap or basin as follows:

- *Sediment Traps*
  - Only control drainage areas less than three acres
  - Minimum storage capacity of 134 cubic yards per acre of drainage area
- *Sediment Basins*
  - Control drainage areas greater than or equal to three acres
  - Minimum storage capacity of 134 cubic yards per acre of drainage area
  - The outfall system shall, at a minimum, maintain the structural integrity of the basin during a twenty-five year storm of 24-hour duration

(7) Cut and Fill Slopes Design & Construction.
Cut and fill slopes shall be designed and constructed in a manner that will minimize erosion. Slopes found to be eroding excessively within one year of permanent stabilization shall be provided with additional slope stabilizing measures until the problem is corrected.

(8) Concentrated Runoff Down Slopes.
Concentrated runoff shall not flow down cut or fill slopes unless contained within an adequate temporary or permanent channel, flume, or slope drain structure.

(9) Slope Maintenance.
Whenever water seeps from a slope face, adequate drainage or other protection shall be provided.

(10) Storm Sewer Inlet Protection.
All storm sewer inlets made operable during construction shall be protected so that sediment-laden water cannot enter the stormwater conveyance system without first being filtered/treated to remove sediment.

(11) Stormwater Conveyance Protection.
Before newly constructed stormwater conveyance channels or pipes are made operational, adequate outlet protection and any required temporary or permanent channel lining shall be installed in both the conveyance channel and the receiving channel.

(12) Work in Live Watercourse.
When work in a live watercourse is performed:

- Precautions shall be taken to minimize encroachment, control sediment transport, and stabilize the work area to the greatest extent possible during construction
- Nonerodible material shall be used for the construction of causeways and cofferdams
- Earthen fill may be used for these structures if armored by nonerodible cover materials

(13) Crossing Live Watercourse.
When a live watercourse must be crossed by construction vehicles more than twice in any six-month period, a temporary vehicular stream crossing constructed of nonerodible material shall be provided.

(14) Regulation of Watercourse Crossing.
All applicable federal, state and local regulations pertaining to working in or crossing live watercourses shall be met.

(15) Stabilization of Watercourse.
The bed and banks of a watercourse shall be stabilized immediately after work in the watercourse is completed.

(16) Underground Utility Line Installation.
Underground utility lines shall be installed in accordance with the following standards in addition to other applicable criteria:

- No more than 500 LF of trench may be opened at one time
- Excavated material shall be placed on the uphill side of trenches
- Effluent from dewatering operations shall be filtered or passed through an approved sediment trapping device, or both, and discharged in a manner that does not adversely affect flowing streams or off-site property
- Material used for backfilling trenches shall be properly compacted in order to minimize erosion and promote stabilization
- Restabilization shall be accomplished in accordance with these regulations
- Comply with applicable safety regulations

(17) Vehicular Sediment Tracking.
Where construction vehicle access routes intersect paved or public roads:

- Provisions shall be made to minimize the transport of sediment by vehicular tracking onto the paved surface
- Where sediment is transported onto a paved or public road surface, the road surface shall be cleaned thoroughly at the end of each day
- Sediment shall be removed from the roads by shoveling or sweeping and transported to a sediment control disposal area. Street washing shall be allowed only after sediment is removed in this manner

(18) Removal of Temporary Measures.
All temporary erosion and sediment control measures shall be removed within 30 days after final site stabilization or after the temporary measures are no longer needed, unless otherwise authorized by the program authority. Trapped sediment and the disturbed soil areas resulting from the disposition of temporary measures shall be permanently stabilized to prevent further erosion and sedimentation.

(19) Stormwater Management.
Properties and waterways downstream from development sites shall be protected from sediment deposition, erosion, and damage due to increases in volume, velocity, and peak flow rate of stormwater runoff for the stated frequency storm of 24-hour duration in accordance with the following standards and criteria:

- Concentrated stormwater runoff leaving a development site shall be discharged directly into an adequate natural or man-made receiving channel, pipe, or storm sewer system. For those sites where runoff is discharged into a pipe or pipe system, downstream stability analyses at the outfall of the pipe or pipe system shall be performed.
- Adequacy of all channels and pipes shall be verified:
  - Natural Channels – use 2-year storm event

- Manmade Channels – use 2- and 10-year storm event
- Pipe and Pipe Systems – use 10-year storm event

- If existing natural receiving channels or previously constructed man-made channels or pipes are not adequate, the applicant shall provide channel, pipe, or pipe system improvement or provide a combination of channel improvement, site design, stormwater detention, or other measures that is satisfactory to the program authority to prevent downstream erosion.
- Provide evidence of permission to make the improvements
- If the applicant chooses an option that includes stormwater detention he shall obtain approval from the locality of a plan for maintenance of the detention facilities. The plan shall set forth the maintenance requirements of the facility and the person responsible for performing the maintenance.
- Outfall from a detention facility shall be discharged to a receiving channel, and energy dissipators shall be placed at the outfall of all detention facilities as necessary to provide a stabilized transition from the facility to the receiving channel.
- Increased volumes of sheet flows that may cause erosion or sedimentation on adjacent property shall be diverted to a stable outlet, adequate channel, pipe or pipe system, or to a detention facility
- In applying these stormwater runoff criteria, individual lots or parcels in a residential, commercial or industrial development shall not be considered to be separate development projects. Instead, the development as a whole shall be considered to be a single development project.
- All measures used to protect properties and waterways shall be employed in a manner that minimizes impacts on the physical, chemical and biological integrity of rivers, streams and other waters of the state

The minimum standards issued by the Department of Conservation and Recreation (DCR) states that "all land-disturbing activities undertaken on private and public lands in the Commonwealth of Virginia must meet the 19 "minimum standards" for erosion and sediment control (ESC) in Section 4VAC50-30-40 of the Virginia Erosion and Sediment Control Regulations. The applicant who submits the ESC plan to the program authority for approval is responsible for ensuring compliance with the minimum standards that apply to his/her activities." The following sections describe the specific components included in the Plan designed to achieve these standards.

General BMP Maintenance Program

The following maintenance program is proposed to ensure the continued effectiveness of the structural water quality controls.

- Inspect stormwater basins once annually, in the spring, for cracking or erosion of side slopes, embankments, and accumulated sediment. Necessary sediment removal, earth repair, and/or reseeding will be performed immediately upon identification.

- Inspect sediment traps/forebays monthly for erosion of side slopes and accumulated sediment. Necessary sediment removal, earth repair and/or reseeding shall be performed immediately upon identification. Clean traps/ forebays approximately four times per year.

- Inspect water quality swales semi-annually; swales should be mowed once per year. Sediment and debris should be removed, at a minimum, once per year.

Clean all drop inlets twice annually to remove accumulated sand, sediment, and floatable products.

- Paved areas will be swept, at a minimum, one time per year. Routinely pick up and remove litter from the parking areas, islands and perimeter landscape areas in addition to regular pavement sweeping.
- Routinely inspect all dumpster and compactor locations for spills. Remove all trash litter from the enclosure and dispose of properly.

Erosion and Sedimentation Control Techniques and Permitting

Virginia Stormwater Management Permit (VSMP)

The proposed project will result in the disturbance of more than five acres of land and, therefore, will require the preparation and implementation of Virginia Stormwater Management Permit (VSMP) and a Stormwater Pollution Prevention Plan (SWPPP) by the Site contractor and owner in accordance with the state of Virginia's compliance with the Environmental Protection Agency's (EPA's) National Pollutant Discharge Elimination System (NPDES) General Permit Program for Stormwater Discharges from Construction Sites. Standard components of the Stormwater Pollution Prevention Plan that will be employed during the construction phases of the development by the Site contractor are described in the following section.

The following erosion and sedimentation controls will be employed to minimize erosion and transport of sediment to resource areas during the earthwork and construction phases of the project.

Silt Fencing

In areas where high runoff velocities or sediment loads are expected, silt fence will be installed along the toe of slopes and at the perimeter of conservation areas. This semi-permeable barrier made of a synthetic porous fabric will provide additional protection. The silt fences will be replaced/repaired as determined by periodic field inspections.

Inlet Protection

Newly constructed and existing drop inlets will be protected with stone and fabric throughout construction.

Construction Entrance

A typical, temporary crushed-stone construction entrance/exit will be constructed for each phase/section of the project. If deemed necessary, a wash rack may be included to wash off vehicle wheels before leaving the project Site, as to preserve the public roadways to the best extent possible.

Diversion Ditches

Diversion ditches will be used to collect runoff from construction areas and discharge to either temporary sedimentation basins/traps or to protected drop/culvert inlets.

Temporary Sediment Basins/Traps

Temporary sediment basins/traps will be designed either as excavations or bermed stormwater detention structures (depending on grading) that will retain runoff for a sufficient period of time to allow suspended soil particles to settle out prior to discharge. These temporary basins/traps will be located based on construction needs as determined by the contractor(s). Discharge from the sediment basins will be controlled by engineered risers with trash racks, and associated barrel to the point of outfall. Points of discharge from sediment basins will be stabilized to minimize erosion.

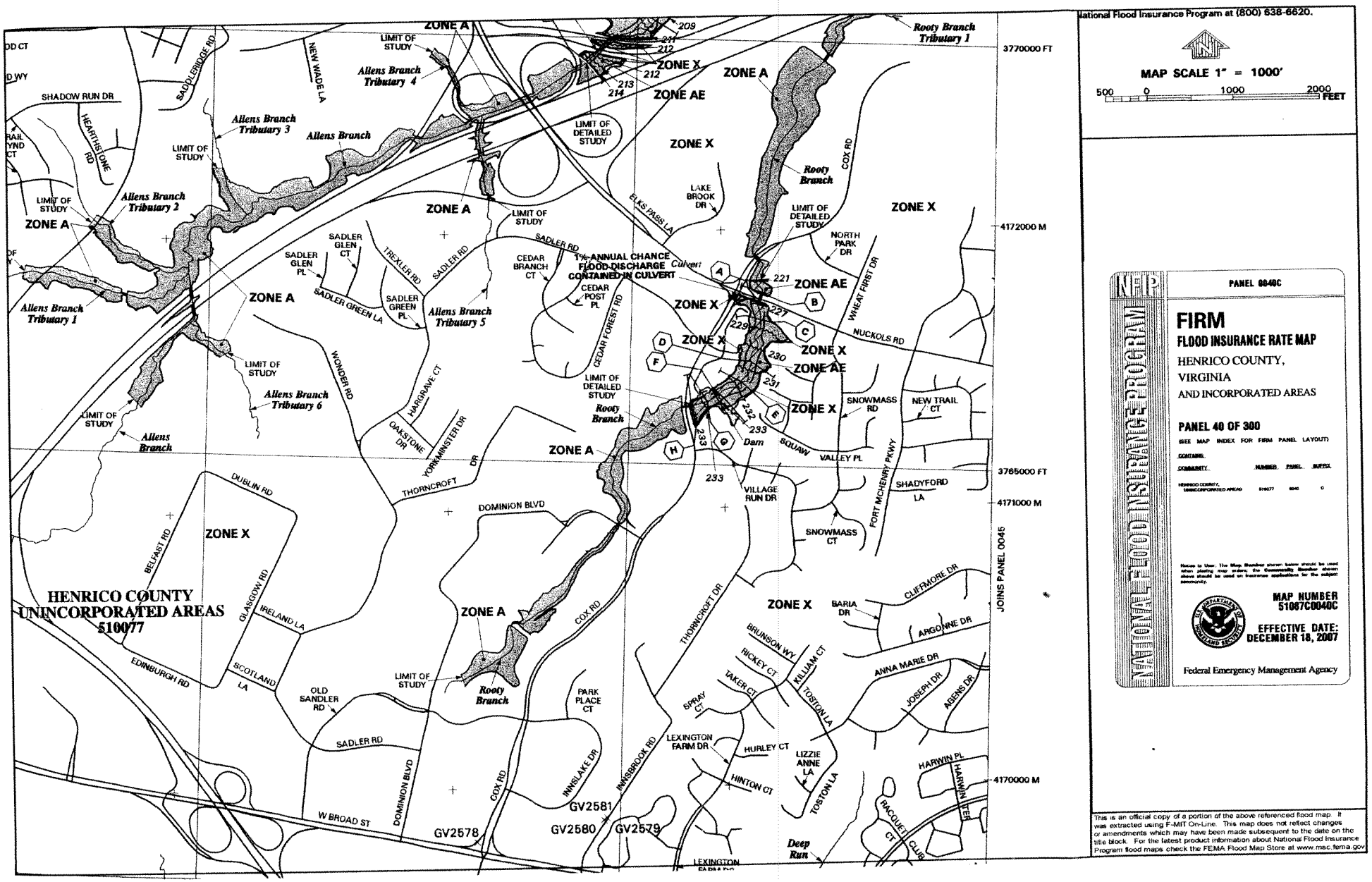
Vegetative Slope Stabilization

Stabilization of open soil surfaces will be implemented within 14 days after grading or construction activities have temporarily or permanently ceased, unless there is sufficient snow cover to prohibit implementation. Vegetative slope stabilization will be used to minimize erosion on slopes of 3:1 or flatter. Annual grasses, such as annual rye, will be used to ensure rapid germination and production of rootmass. Permanent stabilization will be completed with the planting of perennial grasses or legumes. Establishment of temporary and permanent vegetative cover may be established by hydro-seeding or sodding, if necessary. A suitable topsoil, good seedbed preparation, and adequate lime, fertilizer and water will be provided for effective establishment of these vegetative stabilization methods. Mulch will also be used after permanent seeding to protect soil from the impact of falling rain and to increase the capacity of the soil to absorb water.

ESC Maintenance

- The contractor or subcontractor will be responsible for implementing each control shown on the Sedimentation and Erosion Control Plan, and in accordance with the Virginia Erosion and Sediment Control Handbook (VESCH) and Virginia Stormwater Management Permit (VSMP) procedures. The contractor(s) must sign a registration statement, certifying that they will act as the Responsible Land Disturber (RLD) before work commences.
- The on-site contractor will inspect all sediment and erosion control structures periodically and after each rainfall event. Records of the inspections will be prepared and maintained within the Stormwater Pollution Prevention Plan (SWPPP), and will be kept on-site by the contractor.
- Silt shall be removed from behind silt fence barriers if greater than 6-inches deep or as needed.
- Damaged or deteriorated items will be repaired immediately after identification.
- The underside of the silt fence should be kept in close contact with the earth and reset as necessary.
- Sediment that is collected in structures shall be disposed of properly.
- Erosion control structures shall remain in place until all disturbed earth has been securely stabilized. After removal of structures, disturbed areas shall be regraded and stabilized as necessary.

Appendix A.
Floodplain Information



National Flood Insurance Program at (800) 638-6620.

MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

NFIP NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0040C

FIRM

FLOOD INSURANCE RATE MAP

HENRICO COUNTY, VIRGINIA AND INCORPORATED AREAS

PANEL 40 OF 300

SEE MAP INDEX FOR FIRM PANEL LAYOUT

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
HENRICO COUNTY, UNINCORPORATED AREAS	510077	0040	C

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

MAP NUMBER
51087C0040C

EFFECTIVE DATE:
DECEMBER 18, 2007

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

Appendix B.
NRCS Soil Survey Information

Soil Map—Henrico County, Virginia
(Innsbrook Comprehensive SWM Study)

USDA Natural Resources Conservation Service

Web Soil Survey
National Cooperative Soil Survey

1/13/2010
Page 1 of 3

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features
- Gully
- Short Steep Slope
- Other

Political Features
- Cities

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:21,600 if printed on B size (11" × 17") sheet.

The soil surveys that comprise your AOI were mapped at 1:15,840.

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 18N NAD83

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

Soil Survey Area: Henrico County, Virginia
Survey Area Data: Version 6, Dec 22, 2008

Date(s) aerial images were photographed: 6/25/2003

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.

Map Unit Legend

Henrico County, Virginia (VA087)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
AmB	Appling fine sandy loam, 2 to 6 percent slopes	599.2	15.7%
AmC2	Appling fine sandy loam, 6 to 15 percent slopes, eroded	214.0	5.6%
AoC3	Appling clay loam, 2 to 15 percent slopes, severely eroded	8.4	0.2%
AsD	Ashlar gravelly sandy loam, 6 to 15 percent slopes	11.0	0.3%
BoB	Bourne fine sandy loam, 2 to 6 percent slopes	304.0	7.9%
BoC	Bourne fine sandy loam, 6 to 10 percent slopes	10.2	0.3%
BP	Borrow pit	7.5	0.2%
Cm	Chewacla and Riverview soils	68.9	1.8%
CoB	Colfax fine sandy loam, indurated substratum, 0 to 6 percent slopes	762.2	19.9%
CvB	Creedmoor sandy loam, 2 to 6 percent slopes	38.6	1.0%
CvC2	Creedmoor sandy loam, 6 to 10 percent slopes, eroded	10.5	0.3%
HeB	Helena fine sandy loam, 2 to 6 percent slopes	372.4	9.7%
HeB2	Helena fine sandy loam, 2 to 6 percent slopes, eroded	90.4	2.4%
HeC2	Helena fine sandy loam, 6 to 15 percent slopes, eroded	3.8	0.1%
Kn	Kinston and Mantachie soils	173.1	4.5%
MdB2	Mayodan fine sandy loam, 2 to 6 percent slopes eroded	56.8	1.5%
Ov	Orange loam	55.3	1.4%
OW	Orthents-Udults-Mine pits complex	81.3	2.1%
PoE	Pinkston fine sandy loam, 6 to 25 percent slopes	0.0	0.0%
Ps	Pouncey sandy loam	599.8	15.7%
RuA	Ruston fine sandy loam, 0 to 2 percent slopes	5.3	0.1%
StB	State fine sandy loam, clayey substratum, 2 to 6 percent slopes	1.7	0.0%
UE	Udorthents, loamy	34.5	0.9%
W	Water	44.4	1.2%
WeB	Wedowee sandy loam, 2 to 6 percent slopes	165.1	4.3%
WeD	Wedowee sandy loam, 6 to 15 percent slopes	106.3	2.8%
Totals for Area of Interest		**3,824.9**	**100.0%**