STORMWATER MANAGEMENT CALCULATIONS

For

HOTEL INDIGO

PREPARED FOR

Northern Riverfront Marina & Hotel LLLP
720 N. Third Street, Suite 301
Wilmington, NC 28401

Prepared by:

COASTAL SITE DESIGN, PC
PO Box 4041
Wilmington, NC 28406
Phone 910 791-4441
Fax: 910 791-1501
License # C-2710

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 025483 HOWARD RESNIK

FINAL DESIGN 9/24/12
NOT RELEASED
FOR CONSTRUCTION

Howard Resnik, P.E.
9/13/2012

COASTAL SITE DESIGN, PC

PO Box 4041
Wilmington, NC 28406
Phone: 910 791-4441
Fax: 910 791-1501
License # C-2710

Stormwater Narrative

October 24, 2012

PROJECT NAME: Hotel Indigo
City of Wilmington
New Hanover County

PROJECT DESCRIPTION: This project is for the construction of a hotel, parking lot and retail space located in the CBD (Central Business District) of the City of Wilmington. Land disturbance associated with the improvements will be approximately 1.60acres. The owner is Northern Riverfront Marina & Hotel LLLP.. There are no wetlands located within the area of the development.

The site where development will occur was once used a business and had a parking lot and a couple of buildings on the property. The buildings have been demolished but the slabs and parking lot are still onsite and will need to be demolished before construction can take place. The existing impervious onsite was recently surveyed and quantified to be approximately 38,424 sf. The proposed layout for the site is proposing approximately 50,302 sf which includes the drive aprons into the site. The amount of impervious that will be captured and treated will be 48,491 sf. Since the proposed impervious is an increase and more than 50% of the new impervious will be installed over the existing impervious then the site will need to be treated for the greater of the two of either the 1.5" storm or the difference between the 1 year pre/post. This site will be treated for the 1 year pre/post.

Stormwater from the site will drain to SC waters Cape Fear River located in the Cape Fear River Basin (Index # 18-71). The project will be high density utilizing a cartridge system that's in the final stages of approval through NCDENR as being an approved BMP. The site will have catch basins located in the parking lot that will connect to an underground network of 42" pipe that will be used to store the 1 year volume. Gutter drains from the retail and hotel building will also be directed into the conveyance pipe that discharges into the 42" pipe. The stored water will then be discharged into a vault housing 12 perlite cartridges that will be used to treat the stormwater. After treatment the water will be discharged into an existing City of Wilmington catch basin. Proposed impervious for the entire site is 90%. Water and sewer will be provided by the Cape Fear Public Utility Authority.

PROJECT BMP: high density cartridge system

STORMWATER ENGINEER/CONSULTANT: Coastal Site Design, PC
PO Box 4041
Wilmington, NC 28406

Rodney Wright
rodney@coastalsitedesign.com
910 791 4441 office
910 791 1501 fax

HYDROLOGIC DATA:

Total tract area	55,330 sf (1.27 acres)
Existing impervious areas:	
buildings	n/a sf (0.0 acres)
parking	7,070 sf (0.16 acres)
foundations	29,926 sf (0.69 acres)
sidewalks	1,428 sf (0.03 acres)
Total existing impervious area	**38,424 sf (0.88 acres)**
Proposed new impervious areas within drainage area of BMP:	
proposed buildings	25,847 sf (0.59 acres)
proposed asphalt/curb and gutter	19,837 sf (0.46 acres)
proposed sidewalk	2,807 sf (0.06 acres)
Total proposed impervious area	**48,491 sf (1.11 acres)**

Soil Types:

Abbreviation	Type and Description	Hydrologic Group	Area
Ur	Urban Land		(1.27 ac)

(See attached pages from Table 8.01d for soil properties)

HOTEL INDIGO CARTRIDGE SYSTEM

TOTAL LOT SIZE = 55,330 sf 1.27 ac

PROPOSED IMPERVIOUS ON SITE WITHIN DRAINAGE AREA TO STORMFILTER

parking =	19,837 sf	
*buildings =	25,847 sf	
sidewalk =	2,807 sf	
total =	48,491 sf	1.11 ac
percent imp. =	93.7 %	

*includes balconys but excludes footprint and balcony that is located over existing sidewalk on Nutt St.

1.5" VOLUME DETERMINATION:

DETERMINE IMPERVIOUS PERCENTAGE TO INFILTRATION BASIN

Drainage area captures an amount of impervious that is equal to or greater than the increase in impervious from existing to proposed

area to basin = 51,772 sf
= 1.19 acres

DETERMINE RUNOFF COEFFICIENT (Rv)

I = 93.7 percent impervious
Rv = ? (runoff coefficient, inches per inch)

Rv = 0.05 + 0.009 (I)
Rv = 0.89 in/in

DETERMINE VOLUME

design storm =	1.5	inch
Rv =	0.89	in/in
drainage area =	1.19	acres
volume =	?	

volume = (design storm)(Rv)(drainage area)
volume = 0.13 acre-ft
1.5" volume = **5,767 cf of required storage volume**

Adjusted Water Quality Volume = **4,325 cf that must be contained**

1 YR 24 HR PRE/POST VOLUME:

Pre-development: Rv = 0.05 + 0.9 * (0.0 ac / 1.19 ac)
pre Rv = 0.05

Post-development: Rv = 0.05 + 0.9 * (1.11 ac / 1.19 ac)
post Rv = 0.89

DETERMINE VOLUME

24 hr rainfaill intensity (I) = 3.83 inch
Rv (post - pre) = 0.84 in/in
drainage area = 1.19 acres
volume = ?

volume = 3630 x I x (Rv post - Rv pre) x drainage area
volume = **13,897** cf of required storage volume

Adjusted Water Quality Volume = **10,423 cf that must be contained**

COASTAL SITE DESIGN, PC
PO BOX 4041
WILMINGTON, NC 28406

PIPE STORAGE - STORAGE TABLE

pipe size (in) = 42
pipe length (ft) = 1088
trench invert elevation (ft) = 16

d/D	area/D^2	STAGE	ELEVATION (FT)	TOTAL PIPE STORAGE (CF)
0	0	0.000	16.00	-
0.1	0.0409	0.350	16.35	545
0.2	0.1118	0.700	16.70	1,490
0.3	0.1982	1.050	17.05	2,642
0.4	0.2934	1.400	17.40	3,910
0.5	0.3927	1.750	17.75	5,234
0.6	0.4920	2.100	18.10	6,557
0.7	0.5872	2.450	18.45	7,826
0.8	0.6736	2.800	18.80	8,978
0.9	0.7445	3.150	19.15	9,923
1	0.7854	3.500	19.50	10,468

1 YR PRE/POST VOLUME STORAGE (elev. 19.5) = 10,468 cf ✓

COASTAL SITE DESIGN, PC
PO BOX 4041
WILMINGTON, NC 28406

CONTECH® ENGINEERED SOLUTIONS

The Stormwater Management StormFilter® Sizing Summary

Hotel Indigo
Stormwater Treatment System – Sizing Proposal
Wilmington, NC

Information provided:

- Total contributing area = 1.19 acres
- Impervious area = 1.11 acres
- Water Quality Volume (to be stored) = 10,423 ft^3
- Presiding agency = NCDENR / City of Wilmington

Assumptions:

- Mass load design method
- Design runoff volume = 3.83" (Per engineer of record)
- Cartridge operating flow rate = 1 gpm/sf (7.5 gpm or less using 18" Low-Drop cartridges)
- Media = Perlite
- Drop required from inlet to outlet = 1.5' (using 18" Low-Drop cartridges)

Size and cost estimates:

The Stormwater Management StormFilter® is a passive siphon-actuated, flow-through, stormwater filtration system consisting of a structure that houses rechargeable, media-filled filter cartridges. The StormFilter works by passing stormwater through the media-filled cartridges, which trap particulates and adsorb pollutants such as dissolved metals, nutrients, and hydrocarbons.

The StormFilter system is sized to treat the first 3.83" volume of runoff from the site. The system is sized according to the annual mass load method as described in the Stormwater Management, Inc. design manual. Essentially, this method models the total mass load of TSS, in pounds, generated from the site on an annualized basis, using the information above. The number of cartridges required to meet this mass load requirement is then calculated, as a function of the total mass than can be removed per cartridge prior to required filter changeout.

The StormFilter for this site was sized to provide (12) 18" Low-Drop cartridges in order to meet the mass load requirement. Contech can accommodate 12 cartridges using a precast 6'x12' StormFilter (see attached drawing). The 18" Low-Drop cartridge contains 7.5 sf of media surface area with a 7" media depth radially around the circumference of the cartridge. The estimated cost of this system, complete and delivered to the jobsite, is available upon request. The contractor is responsible for installing the vault and all external piping.

The water quality volume must be stored upstream of the StormFilter. Contech recommends using 1,088 linear feet of 42" CMP for this volume. A low flow water quality pipe is placed at the bottom of the system to direct the water quality volume to the StormFilter. A high flow bypass weir is required, set at the water quality volume elevation (crown of pipe) to divert larger storms away from the filter system. See the attached example layout for more information.

Maintenance:

The StormFilter requires regular maintenance to operate effectively. The expected maintenance interval is 12-18 months, but may vary depending on weather and site conditions. Please contact Contech or navigate to www.conteches.com for more information in this regard.

605 Global Way, Suite 113, Linthicum, MD 21090
Toll-free: 886-740-3318 Fax: 866-376.8511

CONTECH®
ENGINEERED SOLUTIONS

Determining Number of Cartridges for Volume-Based Design in NC

Design Engineer:	ATM	Blue Cells = Input
Date	10/25/2012	Black Cells = Calculation

Site Information

Project Name	Hotel Indigo	
Project State	North Carolina	
Project Location	Wilmington	
Drainage Area, Ad	1.17 ac	
Impervious Area, Ai	1.11 ac	
Pervious Area, Ap	0.06	
% Impervious	95%	
Runoff Coefficient, Rv	0.90	=0.05+0.9*(Ai/Ad)

Water Quality Volume Calculations

Design storm rainfall depth, Rd	1.5 in	
Water quality volume, WQV	5758.1 ft^3	=Ad*Rv*Rd*(43560/12)

Storage Component Calculations

3.83" Storm Volume (Per Engineer of Record)	10423.0 ft^3	
Pretreatment credit (estimated or calculated), %pre	30%	

Mass loading calculations

Mean Annual Rainfall, P	45 in	
Agency required % removal	85%	
Percent Runoff Capture (% capture)	98%	1.0" = 90%, 2.4" = 95%
Mean Annual Runoff, V_t	169,288 ft^3	=P*Ad*Rv*(43560/12)*%capture
Event Mean Concentration of Pollutant, EMC	70.0 mg/l	(Typically 60 - Residential/Office, 70 - Commercial, 100 - Industrial)
Annual Mass Load, M_{total}	739.33 lbs	=EMC*Vt*(28.3)*(0.000001)*(2.2046)

Filter System

Filtration brand	StormFilter	
Cartridge height	18 in	

Cartridge Quantity Calculation

Mass removed by pretreatment system, M_{pre}	222 lbs	=Mtotal * %removal
Mass load to filters after pretreatment, M_{pass1}	518 lbs	=Mtotal - Mpre
Estimate the required filter efficiency, E_{filter}	79%	=1+(%removal - 1)/(1 - %pre)
Mass to be captured by filters, M_{filter}	407 lbs	=Mpass1 * Efilter
Maximum Cartridge Flow rate, Q_{cart}	7.5 gpm	=q * (7.5 ft2/cartridge)
Mass load per cartridge, M_{cart} (lbs)	36 lbs	=lookup mass load per cartridge
Number of Cartridges required, N_{mass}	12	=ROUNDUP(Mfilter/Mcart,0)
Maximum Treatment Capacity	0.20	=Nmass*(Qcart/449)

SUMMARY

Maximum Treatment Flow Rate, cfs	0.20
Cartridge Flow Rate, gpm	7.5
Number of Cartridges	12

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	25.000	0.09	0.34	0.95	0.09	0.32	5.0	21.0	5.0	0.96	13.55	1.08	15	4.40	17.70	18.80	19.50	19.49	22.80	23.80	OUTFALL TO JB
2	1	137.000	0.11	0.14	0.95	0.10	0.13	5.0	7.4	6.8	0.21	4.27	0.81	15	0.44	18.80	19.40	19.52	19.63	23.80	23.40	JB6 TO JB7
3	2	24.000	0.03	0.03	0.95	0.03	0.03	5.0	5.0	7.2	0.21	4.17	1.44	15	0.42	19.40	19.50	19.66	19.69	23.40	23.20	JB7 TO CB8
4	1	60.000	0.11	0.11	0.95	0.10	0.10	5.0	5.0	7.2	0.76	3.73	1.34	15	0.33	18.80	19.00	19.49	19.51	23.80	23.20	JB6 TO CB9

Project File: JB6 TO CB8.stm

Number of lines: 4

Run Date: 9/12/2012

NOTES:Intensity = 121.80 / (Inlet time + 23.50) ^ 0.84 ; Return period =Yrs. 10 ; Total flows limited to inlet captured flows. ; c = cir e = ellip b = box

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	25.000	0.09	0.34	0.95	0.09	0.32	5.0	18.0	6.6	1.18	13.55	1.34	15	4.40	17.70	18.80	19.50	19.48	22.80	23.80	OUTFALL TO JB
2	1	137.000	0.11	0.14	0.95	0.10	0.13	5.0	6.9	8.4	0.25	4.27	0.91	15	0.44	18.80	19.40	19.53	19.65	23.80	23.40	JB6 TO JB7
3	2	24.000	0.03	0.03	0.95	0.03	0.03	5.0	5.0	8.9	0.25	4.17	1.53	15	0.42	19.40	19.50	19.68	19.71	23.40	23.20	JB7 TO CB8
4	1	60.000	0.11	0.11	0.95	0.10	0.10	5.0	5.0	8.9	0.93	3.73	1.63	15	0.33	18.80	19.00	19.48	19.52	23.80	23.20	JB6 TO CB9

Project File: JB6 TO CB8.stm

NOTES:Intensity = 171.29 / (Inlet time + 27.30) ^ 0.85 ; Return period =Yrs. 50 ; Total flows limited to inlet captured flows. ; c = cir e = ellip b = box

Number of lines: 4

Run Date: 9/12/2012

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	5.000	0.07	0.36	0.95	0.07	0.34	5.0	5.5	7.1	2.44	9.13	1.99	15	2.00	17.70	17.80	19.50	19.51	22.00	22.30	OUTFALL TO CB
2	1	45.000	0.29	0.29	0.95	0.28	0.28	5.0	5.0	7.2	1.99	6.81	3.70	15	1.11	19.00	19.50	19.56	20.06	22.30	24.00	CB1 TO CB2

Project File: CB3 TO HOTEL.stm

Number of lines: 2

Run Date: 10/23/2012

NOTES:Intensity = 121.80 / (Inlet time + 23.50) ^ 0.84 ; Return period =Yrs. 10 ; c = cir e = ellip b = box

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	15.000	0.10	0.17	0.95	0.10	0.16	5.0	6.6	8.5	1.43	5.27	1.17	15	0.67	17.70	17.80	19.50	19.51	22.00	21.50	OUTFALL TO CB
2	1	45.000	0.07	0.07	0.95	0.07	0.07	5.0	5.0	8.9	0.59	4.30	0.48	15	0.44	17.80	18.00	19.52	19.53	21.50	21.00	CB1 TO CB2

Project File: CB1 TO CB2.stm

NOTES:Intensity = 171.29 / (Inlet time + 27.30) ^ 0.85 ; Return period =Yrs. 50 ; Total flows limited to inlet captured flows. ; c = cir e = ellip b = box

Number of lines: 2

Run Date: 10/24/2012

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	15.000	0.24	0.24	0.95	0.23	0.23	5.0	5.0	7.2	1.65	11.79	1.34	15	3.33	17.70	18.20	19.50	19.51	22.00	21.80	OUTFALL TO CB

Project File: CB5.stm

Number of lines: 1

Run Date: 10/26/2012

NOTES:Intensity = 121.80 / (Inlet time + 23.50) ^ 0.84 ; Return period =Yrs. 10 ; Total flows limited to inlet captured flows. ; c = cir e = ellip b = box

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	15.000	0.24	0.24	0.95	0.23	0.23	5.0	5.0	8.9	2.02	11.79	1.65	15	3.33	17.70	18.20	19.50	19.51	22.00	21.80	OUTFALL TO CB

Project File: CB5.stm

NOTES:Intensity = 171.29 / (Inlet time + 27.30) ^ 0.85 ; Return period =Yrs. 50 ; Total flows limited to inlet captured flows. ; c = cir e = ellip b = box

Number of lines: 1

Run Date: 10/26/2012

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	15.000	0.10	0.17	0.95	0.10	0.16	5.0	6.6	8.5	1.43	5.27	1.17	15	0.67	17.70	17.80	19.50	19.51	22.00	21.50	OUTFALL TO CB
2	1	45.000	0.07	0.07	0.95	0.07	0.07	5.0	5.0	8.9	0.59	4.30	0.48	15	0.44	17.80	18.00	19.52	19.53	21.50	21.00	CB1 TO CB2

Project File: CB1 TO CB2.stm

Number of lines: 2

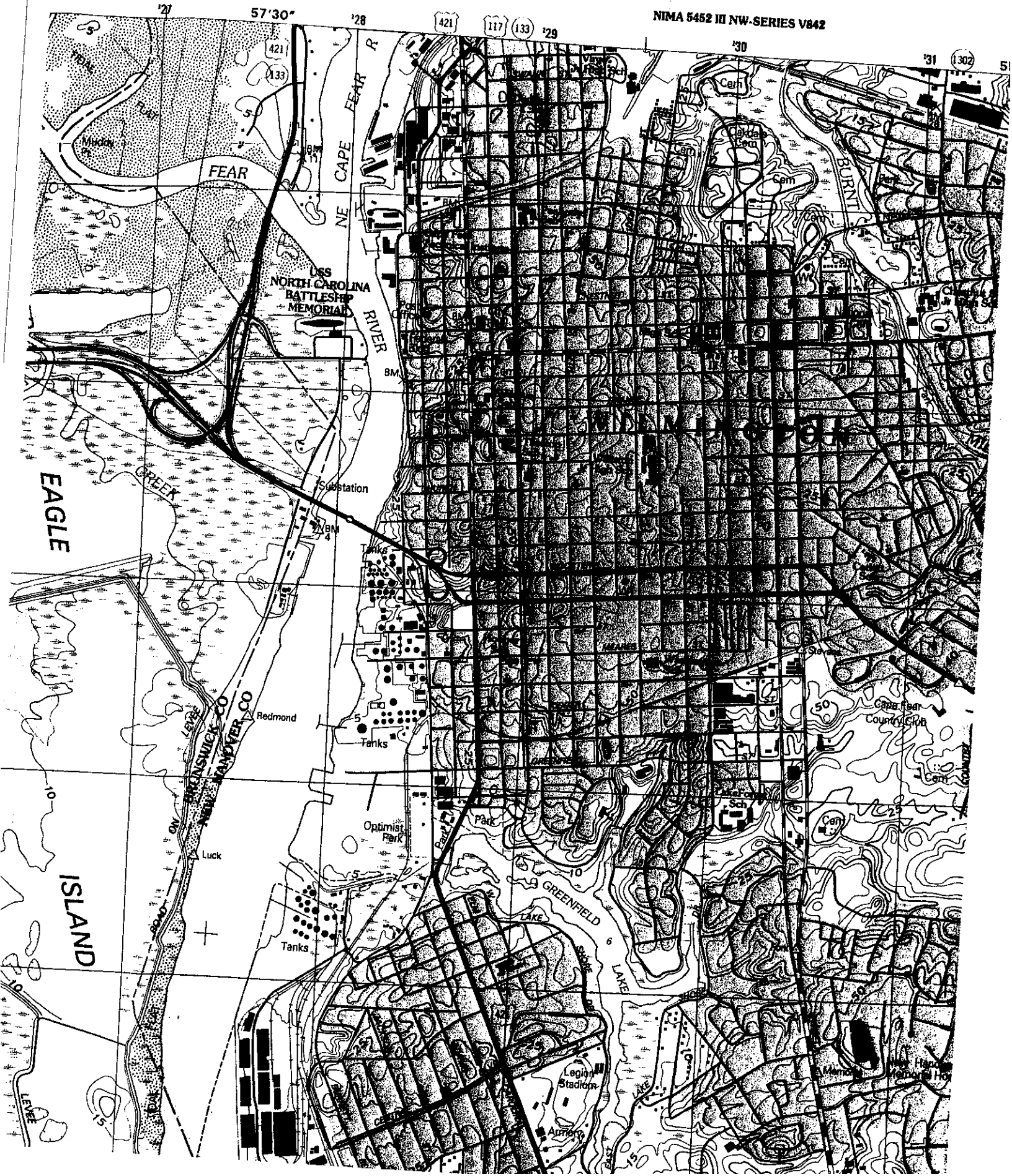
Run Date: 9/12/2012

NOTES:Intensity = 171.29 / (Inlet time + 27.30) ^ 0.85 ; Return period =Yrs. 50 ; Total flows limited to inlet captured flows. ; c = cir e = ellip b = box

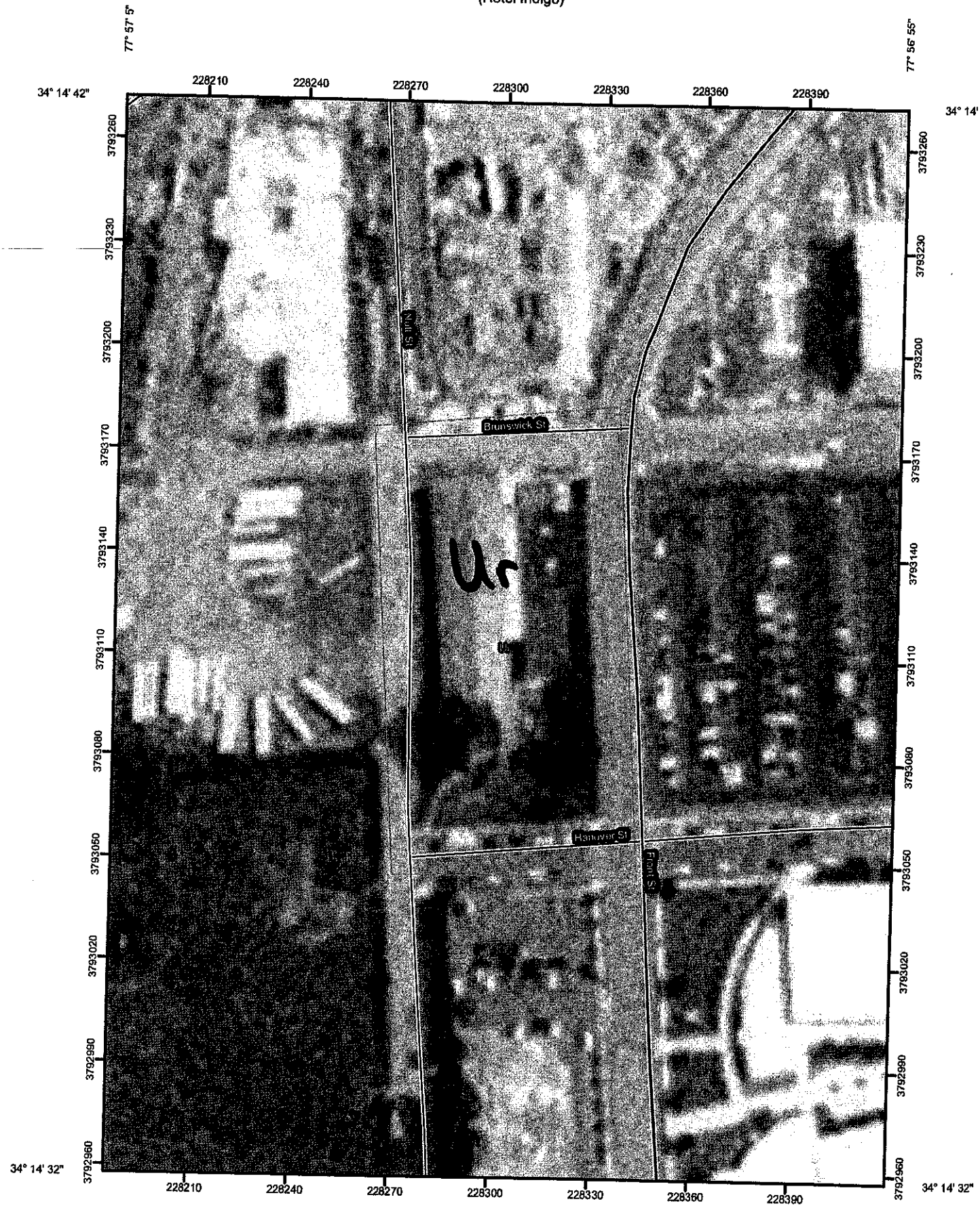
WILMINGTON, NC

1993

NIMA 5452 III NW-SERIES V842



Soil Map—New Hanover County, North Carolina
(Hotel Indigo)



Map Scale: 1:1,500 if printed on A size (8.5" x 11") sheet.

N

0 10 20 40 60 Meters

0 50 100 200 300 Feet

Map Unit Legend

New Hanover County, North Carolina (NC129)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
Ur	Urban land	2.4	100.0%
Totals for Area of Interest		**2.4**	**100.0%**

REPORT OF SUBSURFACE EXPLORATION AND GEOTECHNICAL ENGINEERING ANALYSIS
PROPOSED HOTEL & RETAIL COMPLEX
WILMINGTON, NEW HANOVER COUNTY, NORTH CAROLINA

PREPARED FOR:

MR. ADAM LISK
RIVERFRONT HOLDINGS 2
720 NORTH 3RD STREET
SUITE 202
WILMINGTON, NORTH CAROLINA 28401

PREPARED BY:

ECS CAROLINAS, LLP
7211 OGDEN BUSINESS PARK
SUITE 201
WILMINGTON, NORTH CAROLINA 28411

ECS CAROLINAS, LLP PROJECT NO.: 22.17378

FIRM NO. F-1087

WINSLOW E. COINS, P.E.

NORTH CAROLINA PROFESSIONAL SEAL 033751 ENGINEER WINSLOW E. COINS 2/6/12

NC LICENSE NO. 033751

FEBRUARY 6, 2012

TABLE OF CONTENTS

1.0 EXECUTIVE SUMMARY

This report contains the results of our subsurface exploration and geotechnical engineering analysis for the Proposed Hotel & Retail Complex project located on Nutt Street in Wilmington, New Hanover County, North Carolina. The site is bounded by N. Front Street, Hanover Street, Nutt Street and Brunswick Street. At the time of our field exploration, the site consisted of open areas and existing concrete slabs, footings and asphalt pavement.

A proposed eight-story hotel with approximately 15,000 square feet of retail space and on grade parking will be constructed at the site. The anticipated maximum column loads for the structure will be 650 kips. Additional project information including site grades was not available at the time this report was prepared.

No appreciable organic topsoil was reported by the drillers at the borings locations. At locations B-4 and B-5, the drillers encountered 3 inches of asphalt and 8 inches of ABC stone. Beneath the surface to a depth of approximately 12 feet, the test borings typically encountered intermittent layers of very loose to medium dense silty, clayey and clean sands (SM, SC, SP) Below depths of approximately 12 feet and to 40 feet, the borings typically penetrated loose to very dense silty and clayey sands (SM, SC) with cemented layers and. Below depths of approximately 40 feet and to 50 feet, the borings typically penetrated intermittent layers of dense to very dense weathered limestone.

In summary, the proposed structure can be supported by a deep foundation system consisting of either driven piles or auger cast piles. Please refer to section 5.3 of this report for detailed recommendations.

Specific information regarding the subsurface exploration procedures used, the site and subsurface conditions at the time of our exploration, and our conclusions and recommendations concerning the geotechnical design and construction aspects of the project are discussed in detail in the subsequent sections of this report. Please note this Executive Summary is an important part of this report and should be considered a ***"summary"*** only. The subsequent sections of this report constitute our findings, conclusions, and recommendations in their entirety.

Prepared By:
Winslow E. Goins, P.E.
Project Engineer

Reviewed By:
Walid M. Sobh, P.E.
Principal Engineer

2.0 PROJECT OVERVIEW

2.1 Project Information

ECS' understanding of the proposed construction is based upon our discussions with representatives of Riverfront Holdings 2 and the site map provided to ECS by Carolina Bay of Wilmington, LLC. The site is bounded by N. Front Street, Hanover Street, Nutt Street and Brunswick Street. At the time of our field exploration, the site consisted of open areas and existing concrete slabs, footings and asphalt pavement.

A proposed eight-story hotel with approximately 15,000 square feet of retail space and on grade parking will be constructed at the site. The anticipated maximum column loads for the structure will be 650 kips. Additional project information including site grades was not available at the time this report was prepared.

2.2 Scope of Work

The conclusions and recommendations contained in this report are based on the results of:

- six standard penetration test soil borings (SPT),
- two hand auger borings and infiltration test,
- visual examination of the samples obtained during our field exploration,
- engineering analyses of the field findings with respect to the provided project information.

2.3 Purposes of Exploration

The purpose of this exploration program was to determine the soil and groundwater conditions at the site and to develop engineering recommendations to assist in the design and construction of the proposed project. We accomplished these objectives by:

- performing a site reconnaissance to evaluate the existing site conditions,
- drilling test borings to explore the subsurface soil and groundwater conditions,
- perform hand auger borings to estimate seasonal high water table and determine infiltration rates,
- analyzing the field data to develop appropriate geotechnical engineering design and construction recommendations.

3.0 EXPLORATION PROCEDURES

3.1 Subsurface Exploration Procedures

3.1.1 Soil Test Borings

The six soil test borings drilled on the site were performed using a track-mounted CME 450 drill rig utilizing various cutting bits and mud rotary drilling to advance the bore holes. Representative soil samples were obtained by means of the split-barrel sampling procedure in general conformance with ASTM D-1586. In this procedure, a 2-inch O.D., split-barrel sampler is driven into the soil a distance of 18 inches by a 140-pound hammer falling 30 inches. The number of blows required to drive the sampler through a 12-inch interval is termed the Standard Penetration Test (SPT) value and is indicated for each sample on the boring logs in Appendix B.

The SPT value can be used as a qualitative indication of the in-place relative density of cohesionless soils. In a less reliable way, it also indicates the consistency of cohesive soils. This indication is qualitative, since many factors can affect the standard penetration resistance value (i.e., differences between drill crews, drill rigs, drilling procedures, and hammer-rod-sampler assemblies) and prevent a direct correlation between SPT resistance value, or N-Value, and the consistency or relative density of the tested soil. Split-spoon samples were obtained at approximately 2.5-foot intervals within the upper 10 feet and at approximately 5-foot intervals thereafter. The approximate locations of the soil test borings are indicated on the Boring Location Plan in Appendix A of this report.

The drilling crew maintained a field log of the soils encountered in the borings. After recovery, each sample was removed from the sampler and visually classified. Representative portions of each soil sample were then sealed in air-tight containers and brought to our laboratory in Wilmington, North Carolina for visual examination and formal classification by a geotechnical engineer in general accordance with the Unified Soil Classification System guidelines.

3.1.2 Hand Auger Boring and Infiltration Tests

On January 30, 2012, two hand auger borings were performed on the site. The purpose of the hand auger boring was to stratify the subsurface soils and estimate the seasonal high water table of the subsurface soils. We evaluated the subsurface soil and ground water conditions by drilling the hand auger borings to depths of approximately 60 inches below the existing ground surface at the approximate location indicated on the Boring Location Plan in Appendix A of this report. We visually classified the subsurface soils on site. The results are provided in Section 4.5 and in Appendix C.

In the hand auger borings, redoximorphic depletions and concentrations of iron, known as "drainage mottles", are used as soil indicators to estimate the seasonal high water table. These soil indicator features can form in a matter of days in ideal conditions and remain unchanged for decades or more after the water table has changed.

4.0 EXPLORATION RESULTS

4.1 Site Conditions

The site is bounded by N. Front Street, Hanover Street, Nutt Street and Brunswick Street. At the time of our field exploration, the site consisted of open areas and existing concrete slabs, footings and asphalt pavement.

4.2 Regional Geology

The site is located in the Coastal Plain Physiographic Province of North Carolina. The Coastal Plain is composed of seven terraces, each representing a former level of the Atlantic Ocean. Soils in this area generally consist of sedimentary materials transported from other areas by the ocean or rivers. These deposits vary in thickness from a thin veneer along the western edge of the region to more than 10,000 feet near the coast. The sedimentary deposits of the Coastal Plain rest upon consolidated rocks similar to those underlying the Piedmont and Mountain Physiographic Provinces. In general, shallow unconfined groundwater movement within the overlying soils is largely controlled by topographic gradients. Recharge occurs primarily by infiltration along higher elevations and typically discharges into streams or other surface water bodies. The elevation of the shallow water table is transient and can vary greatly with seasonal fluctuations in precipitation.

4.3 Soil Conditions

No appreciable organic topsoil was reported by the drillers at the borings locations. At locations B-4 and B-5, the drillers encountered 3 inches of asphalt and 8 inches of ABC stone. Beneath the surface to a depth of approximately 12 feet, the test borings typically encountered intermittent layers of very loose to medium dense silty, clayey and clean sands (SM, SC, SP). Standard penetration test resistances (N-values) in these soils generally ranged from W.O.H. (Weight of Hammer) to 25 blows per foot (bpf).

Below depths of approximately 12 feet and to 40 feet, the borings typically penetrated loose to very dense silty and clayey sands (SM, SC) with cemented layers and. Standard penetration test resistances (N-values) in these soils generally ranged from 10 to in excess of 100 bpf.

Below depths of approximately 40 feet and to 50 feet, the borings typically penetrated intermittent layers of dense to very dense limestone. Standard penetration test resistances (N-values) in these soils ranged from 33 to in excess of 100 blows per foot (bpf).

4.4 Groundwater Conditions

Groundwater observations were made during the drilling operations at all boring locations. Furthermore, visual observations of the samples retrieved during drilling exploration were also used in evaluating the groundwater conditions. The groundwater level is typically at a depth of 3 to 3.5 feet, however, the shallow groundwater levels indicate a "perched" water condition due to the presence of clayey sand layers in the upper five feet of the subgrade.

The highest groundwater observations are normally encountered in the late winter and early spring, and our current groundwater observations are expected to be near or representative of the seasonal maximum water table. Variations in the location of the long-term water table may occur as a result of changes in precipitation, evaporation, surface water runoff, and other factors not immediately apparent at the time of this exploration. If long term water levels are crucial to the development of this site, it would be prudent to verify water levels with the use of perforated pipes or piezometers.

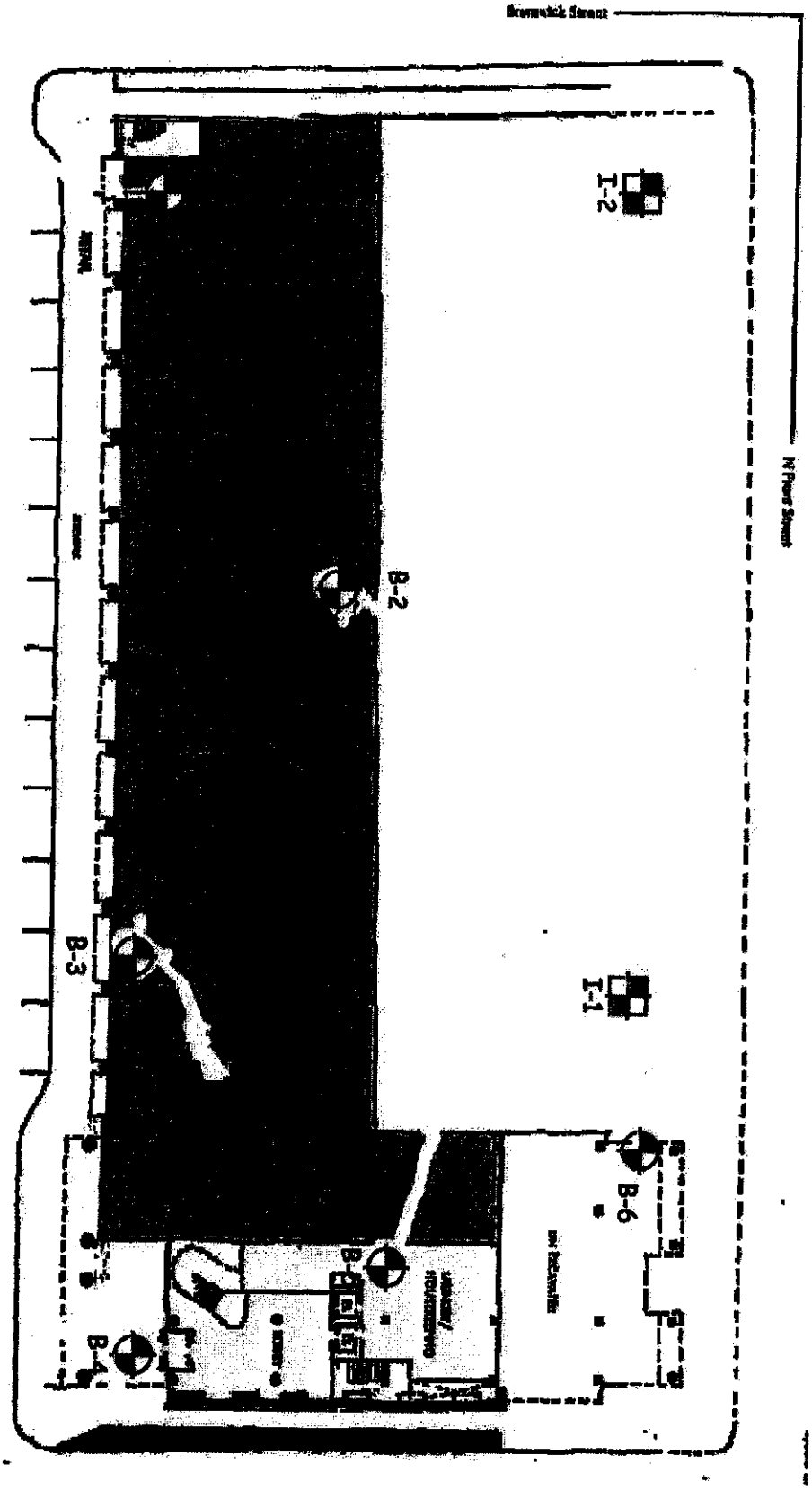
The relatively shallow groundwater conditions encountered within the boreholes are expected to impact utility excavations activities. However, this will depend on final site design grades. Consequently, the diversion of surface water should be expected in order to successfully complete site grading activities.

4.6 Seasonal High Water Table and Infiltration Test Results

Based on observations in the hand auger borings, the seasonal high water levels are estimated at each of the locations tested and infiltration testing was performed. The results are summarized below:

Boring	Seasonal High Water Table Elevation	Infiltration Rate
I-1	16"	0.39 in/hr
I-2	12"	2.3 in/hr

For detailed information on the hand auger borings, see the Infiltration Testing Form in Appendix C.



DENOTES APPROXIMATE LOCATION OF SOIL BORING

DENOTES APPROXIMATE LOCATION OF HAND AUGER BORING AND INFILTRATION TEST

BORING LOCATION DIAGRAM

ECS

Proposed Hotel Retail Complex

Wilmington, NC

ENGINEER WEG	SCALE NTS
DRAFTSMAN WEG	PROJECT NO. 22.17378
REVISIONS	SHEET 1
	DATE 2/3/12