Ecological Assessment Report

CAROLINA NORTH

The UNIVERSITY of NORTH CAROLINA at CHAPEL HILL

October 2007
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I. INTRODUCTION

Biohabitats was engaged to perform an ecological assessment of a tract of land, herein referred to as Carolina North, owned by the University of North Carolina at Chapel Hill.

A. BRIEF HISTORY OF CAROLINA NORTH

Part of the Carolina North tract was bequeathed to the University of North Carolina at Chapel Hill by Henry Horace Williams upon his death in 1940. Williams was Professor of Philosophy at the University from 1890-1940 and Chairman of the department from 1890-1935. He was a Kenan Professor from 1921-1935 and Professor Emeritus from 1936-1940. Other properties comprising the rest of Carolina North were acquired at later times.

University planning for the Carolina North property began in the mid 1990s. The initial effort was completed in 1998 with the Johnson, Johnson and Roy (JJR) report, which established key elements of the planning and transportation systems for the development of the Horace Williams tract, now referred to as the Carolina North property. Then a Horace Williams Advisory Committee worked extensively with Ayers Saint Gross to develop a concept master plan using the JJR Report as a basis, for the highest and best use of the Horace Williams property to fulfill the strategic vision of the University over the near term (10–20 years) and long term (100 years). The work of this committee helped establish more specific design concepts for the type of innovative mixed-use research park that could be created at the property. Selected planning milestones from recent years are listed below.

NOTABLE PLANNING EVENTS

2003

Horace Williams Advisory Committee worked with Ayers Saint Gross architectural firm to design a conceptual plan for Carolina North

Initial planning sessions created several committees to address specific issues of the project-Executive Committee, Advisory Committee, External Relations, Infrastructure, New Business Development, and University Uses

Town of Chapel Hill’s Horace Williams Citizens’ Committee met and issued a report outlining the Town’s goals for Carolina North

2004

The Horace Williams Citizens’ Committee updated its report.

Ayers Saint Gross updated its conceptual plan.

2005

Talbert & Bright engineering and planning firm presented an airport relocation study to the Board of Trustees.

UNC Board of Trustees endorsed a vision for Carolina North
UNC responded to the Horace Williams Citizens' Committee report.

Chancellor Moeser calls for the formation of the Carolina North Leadership Advisory Committee (LAC), to provide input on how the site will be developed. Members included representatives from the Towns of Chapel Hill and Carrboro, Orange County, UNC-Chapel Hill administration and faculty, the Chapel Hill Carrboro School Board, the business community, EnPOWERment, the Orange Water and Sewer Authority, the N.C. Department of Transportation and a representative of the governor.

Dr. John P. Evans was named executive director of Carolina North.

Planning studies commence, reflecting new thoughts on vision for Carolina North as a sustainable campus.

The University created a website as a clearinghouse for information on the progress of Carolina North.

2007

LAC meetings ended in January. Guiding principles were issued by the LAC for the development of Carolina North.

B. SCOPE OF WORK, OBJECTIVES, AND SITE DESCRIPTION

Biohabitats was retained by Ayers Saint Gross in July, 2006 to perform an ecological assessment of the Carolina North property and, based on the ecological, cultural, historic and recreational characteristics of the site and to determine the suitability of the site to support development without compromising ecological stability and integrity. Biohabitats gathered pre-existing data, collected field data, inventoried and characterized the site, analyzed the data and generated inventory, analysis, and development suitability and resource conservation maps. Biohabitats used information gathered at a public review meeting on November 6, 2006 to inform the inventory maps. The assessment protocol and subsequent maps were peer reviewed by university professors and staff on November 28, 2006.

Two final public review sessions were held on December 13, 2006.

Biohabitats was assisted in this effort by the John R. McAdams Company, Inc. (JRM), who identified and documented federal, state and local environmental regulations pertaining to the site’s development and identified potential regulatory features on the site.

The site encompasses approximately 1,000 acres. It is located west of Martin Luther King, Jr. Boulevard and generally north of Estes Drive Extension, approximately 1.5 miles north of the main campus. The site is a mixture of disturbed areas (e.g., airport, Town of Chapel Hill operations, landfill, chemical waste site, railroad) and natural areas (e.g., woodlands, wetlands, and stream corridors). An informal network of trails is also present on the site.
II. DATA COLLECTION

Biohabitats collected existing digital information from federal, state, and local governments and agencies and the University. Information gathered from these sources included:

- Aerial photography (current and historic),
- Roads, railroads, utilities,
- Municipal boundaries,
- Hydrography,
- FEMA flood maps,
- Cultural and historic resources,
- Soils,
- Geology,
- Topography,
- Wetlands,
- The chemical waste site boundary,
- Natural resource conservation areas (N.C. Natural Heritage Program, Town of Carrboro, Friends of Bolin Creek).

Additional print and graphical information gathered from various sources included:

- Characterization of the municipal landfill site,
- Wetland delineation on a portion of the property,
- Academic studies of fish and macroinvertebrate populations in local streams,
- Geologic formation descriptions of Orange County,
- Topsoil fertility guidelines,
- Chemical and physical soil series information,
- Characterizations of the flora and fauna of Orange County,
- Local municipal stream buffer regulations,
- Local municipal steep slope development regulations,
- Local greenway plans and,
- Ecosystem Enhancement Program Watershed Plan.

In addition to the above resources that were gathered, Biohabitats conducted a thorough literature search in peer-reviewed academic journals to document the latest scientific findings on topics including minimum wildlife corridor widths, minimum wildlife habitat patch size, minimum edge width ranges for interior forest habitat, and minimum width ranges for wetland buffers. A list of the peer-reviewed literature researched for this project is in Appendix 1. In addition, a list of reports and information from other sources such as local and state entities is included.

In August 2006, Biohabitats staff spent two weeks in the field with support from UNC staff to acquire more detailed information on the site and to ground truth conditions identified through the previous information-gathering process. Biohabitats staff collected data in the field which included information on:

- Vegetation community descriptions,
- Vegetation community boundaries,
- Percent canopy cover (overstory, midstory, shrub and herbaceous layers),
- Dominant tree species and tree age,
- Estimated age class of the stand,
- Invasive species presence,
- Stream channel characterization,
- Degree of channel incision,
- General bank stability,
- General aquatic habitat quality.

JRM staff conducted a review of jurisdictional laws pertaining to ecological features on the site, jurisdictional feature searches on the site including threatened and endangered species surveys, identification of wetlands and delineation of streams. The information collected by JRM is integrated into the Biohabitats analysis throughout this document. The JRM report is included in Appendix 2.

As an additional last step in soliciting input and feedback from stakeholders, a public listening session was conducted on November 6, 2006 (See Section VII for more detail). Dialogue included asking stakeholders about specific ecological studies and reports that they were aware of pertaining to the site and region. Biohabitats staff cross-referenced and verified that all sources recommended at the listening session had been part of the data discovery process. Stakeholders were also encouraged to share views on what site features or experiences were meaningful to them.
Biohabitats utilized the information gathered and an initial synthesis, integration and analysis of the data to produce a site base map (with aerial photography, site boundaries, roads, etc.), a site base map including a two-mile surrounding radius and site inventory maps for:

- Water Resources,
- Geologic Formations,
- Soils Groups,
- Approximate Tree Stand Age,
- Land Use/Land Cover,
- Morphology,
- Landscape Ecology,
- Regional Landscape Ecology,
- State and Local Government Natural Areas Designation,
- Cultural and Historic Resources.

The information included in the inventory maps consists of the previously mentioned digital, graphical, and print data, reviewed scientific literature information, and site data that was gathered in the field. This information was organized and incorporated into the inventory maps using accepted ecological principles and best professional judgment. Copies of the inventory maps are in Appendix 3. A description of each inventory map follows.

**A. WATER RESOURCES**

Information depicted on this map includes:
1. all streams and their flow regime (University shapefiles, JRM shapefiles and JRM field determinations),
2. stream order (Biohabitats analysis),
3. major and minor drainage divides (Biohabitats analysis),
4. wetlands (JRM and Arcadis analyses),
5. the impoundment on Crow Branch,
6. regulatory stream buffers for Carrboro and Chapel Hill (JRM, Town of Carrboro, and Town of Chapel Hill – Note: the Carrboro buffer boundaries are estimated based on slopes generated from digital topography and the Chapel Hill boundaries are based on estimates representing 3 feet above the elevation of the 100 year floodplain as determined by FEMA),
7. the FEMA 100-year floodway and floodplain and 500-year floodplain.

**B. GEOLOGIC FORMATIONS**

Information depicted on this map includes:
1. small circular-shaped formations where specific field data were recorded by the N.C. Geological Survey staff,
2. larger non-circular and irregular shaped formations that are interpretive estimations of the geology made by N.C. Geological Survey staff, and
3. the N.C. Geological Survey formation descriptive names.

**C. SOIL GROUPS**

Information depicted on this map includes:
1. individual soil series mapping from the Natural Resources Conservation Service and
2. soil series names, abbreviations and descriptions.

**D. APPROXIMATE TREE STAND AGE**

Information depicted on this map includes:
1. approximate tree stand age boundaries estimated from tree cores, field reconnaissance and analysis of historic aerial photography by Biohabitats,
2. stand age increments based on field data and historic aerial photography.

**E. LAND USE/LAND COVER**

Information depicted on this map includes:
1. project areas by land use cover type (system developed by Biohabitats based on field reconnaissance data and aerial photography),
2. the abandoned landfill boundary (estimated using the Phase I Remedial Investigation Report for UNC Old Sanitary Landfill Site, prepared by Rust Environment and Infrastructure, November 1997), and
3. the chemical waste site boundary (supplied by UNC).
F. MORPHOLOGY
Information depicted on this map includes:
1. topography and infrastructure footprint information from UNC (GIS analysis by Biohabitats).

G. LANDSCAPE ECOLOGY
Information depicted on this map includes:
1. streams and stream flow regimes (from UNC and JRM data),
2. riparian conservation buffers (150 and 300 meter widths, based on Biohabitats’ scientific literature search and GIS implementation), and
3. forest interior areas, 50 meter forest/edge transition areas and 100 meter forest edge areas (based on Biohabitats’ scientific literature search and GIS implementation).

H. REGIONAL LANDSCAPE ECOLOGY
1. streams and stream flow regimes (from UNC and JRM data) shown at the 2-mile radius scale,
2. conservation buffers (150 meter and 300 meter widths, based on Biohabitats’ scientific literature search and GIS implementation), and
3. Forest patches (delineated by Biohabitats).

Note that stream data outside of the Carolina North property was not always complete with perennial, intermittent, and ephemeral designations. These stream lines are shown as undefined and do not have associated buffers shown.

I. STATE, LOCAL GOVERNMENT, AND CITIZEN GROUP NATURAL AREA DESIGNATIONS AND PROPOSALS
Information depicted on this map includes:
1. the N.C. Natural Heritage Program’s Bolin Creek Natural Heritage Area,
2. area proposed by Friends of Bolin Creek, adopted by the Town of Carrboro, and subsequently updated for this assessment,
3. a federally protected species list (from the U.S. Fish and Wildlife Service). It should be noted that no federally protected species are known to be present on the Carolina North site.

J. CULTURAL AND HISTORIC RESOURCES
Information depicted on this map includes:
1. N.C. State Historic Preservation Office cultural sites and a list with comments.
IV. RESOURCE ANALYSIS-METRIC ATTRIBUTE DEVELOPMENT AND GIS ANALYSIS

To identify areas that are relatively more suitable for conservation or development, a process was developed and refined by Biohabitats that used landscape ecology principles, a site metric classification system, and GIS to facilitate resource valuation.

Physical and ecological site attributes identified in the site inventories were organized and Ecological Analysis Metric Attribute Maps were produced under the following metrics:

- Streams,
- Wetlands,
- Groundwater,
- Geomorphology,
- Vegetation,
- Landscape ecology,
- Wildlife habitat, and
- Cultural and Historic.

Attributes were selected and assigned to each metric after considering the amount of available pertinent information and accepted ecological principles, and then applying best professional judgment. The objective of this process was to establish appropriate data coverage for each metric. As a result, different metrics have different numbers of attributes assigned to them. The attributes of each metric were then mapped in GIS (the GIS maps for each of the metrics attributes are located in Appendix 4). A brief discussion of the metric attributes mapping follows.

A. STREAM METRIC ATTRIBUTES
Information depicted on this map includes:
1. all streams and their flow regime,
2. stream quality (habitat - high, medium and low, as determined through visual assessments made in the field by Biohabitats),
3. estimated regulatory stream buffers for Carrboro and Chapel Hill, and conservation buffers (150 and 300 meter), and
4. the 50 year floodplain (estimated as one third of the 100-year floodplain) and the FEMA 100-year floodplain.

B. WETLAND METRIC ATTRIBUTES
Information depicted on this map includes:
1. hydric soils,
2. special isolated wetlands such as vernal pools, and
3. conservation buffers (0-100 and 100-200 foot widths).

C. GROUNDWATER METRIC ATTRIBUTES
Information depicted on this map includes:
1. high, medium and low soil permeability (groundwater recharge) zones, and
2. high, medium and low depth to groundwater (<1.5 feet, 1.5-3 feet and >3 feet).

D. GEOMORPHOLOGY METRIC ATTRIBUTES
Information depicted on this map includes:
1. soil erodability (K factor*),
2. slope (0-15%, 15-25%, and >25%), and
3. morphological 50-year floodplain.

*Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

E. VEGETATION METRIC ATTRIBUTES
Information depicted on this map includes:
1. rare, threatened or endangered species or habitat,
2. tree age classes (0-50 years, 51-75 years, >75 years), and
3. relative species abundance (low, medium and high).

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F. LANDSCAPE ECOLOGY METRIC ATTRIBUTES

Information depicted on this map includes:
1. habitat corridors (primary, secondary and isolated),
2. habitat corridor widths (0-150 meters and 151-300 meters), and
3. corridor structural integrity (solid->90% forest cover, porous-50-90% forest cover and stepping stone-<50% forest cover).
4. Natural Heritage Program or other designation,
5. total forested patch size (0-24 acres, 25-39 acres, and > 40 acres), and

G. WILDLIFE HABITAT METRIC ATTRIBUTES

Information depicted on this map includes:
1. identified endangered species critical habitat,
2. hardwood stands (<50 years old and >50 years old),
3. migratory bird habitat (pond), and
4. vernal pool.

H. CULTURAL AND HISTORIC METRIC ATTRIBUTES

Information depicted on this map includes:
1. historic sites (nationally registered and identified occurrences).

I. EDGE EFFECT OUTPUTS OF CAROLINA NORTH TO THE REGION AND INPUTS OF THE REGION TO CAROLINA NORTH

During the public review sessions on December 13, 2006, two participants asked if Biohabitats had analyzed the effect that development on Carolina North might have on surrounding properties as part of the metrics and evaluation of the property.

Development near borders of any site may affect other property, and development that could adversely affect stream quality could affect properties downstream from that development. For example, development in the Bolin Creek watershed, either upstream from or on the Carolina North property could affect Bolin Creek and its tributaries that are located on the Carolina North property. However, detailed data on ecological attributes outside the Carolina North property were not available and the collection of those data was beyond the scope of this study. An analysis of potential impacts based on the established study protocol and metric approach was thus not feasible. Consequently, the Ecological Assessment that was conducted considered only the Carolina North property itself.
V. METRIC CLASSIFICATION SYSTEM AND SUITABILITY ANALYSIS

A simplified system was developed that grouped similar ecological attributes into metrics and then classified each attribute so that they could be differentiated and assessed geospatially. The classifications and values assigned to them were constructed based on the information synthesized in the metrics, accepted ecological principles, and best professional judgment. The Classifications for attributes are:

Classification 0 – Disturbance will result in no ecological impact*,
Classification 1 – Disturbance will result in marginal ecological impact,
Classification 2 – Disturbance is acceptable if Best Management Practices (BMPs) or restrictions are applied**,
Classification 3 – Disturbance will compromise ecological integrity,
Classification +1 – Regulatory restrictions or conservation areas are present.

* Disturbance is defined as those activities related to construction, development, and operations and maintenance of the site. It does not include activities such as prescribed burning that are used to improve the ecological integrity.

** BMPs refer to structural and non-structural practices that are applied in these areas to protect existing ecological resources and processes. These BMPs go beyond the standard level of practice BMPs that may be associated with typical construction and development activities in areas of the site. Examples might include redundancy of erosion and sediment control practices, expanded tree protection zones, use of trenchless technologies, etc.

The Metrics and Classifications Table is included in Appendix 5. In this system, attributes in Classifications 0-3 may also occur where regulatory restrictions apply or where conservation areas have been proposed or identified. In those cases, the Classification +1 is also applied to the attribute. The result for each attribute is a Land Suitability Index (LSI), which is a value that is assigned to that particular attribute in the GIS analysis. In the case where attributes are assigned a Classification between 0 and 3 and also assigned a Classification of +1, the Land Suitability Index is increased by one unit. The range of Land Suitability Index values in the Metrics Table is therefore 0-4. As an example, an attribute with a Classification of 3 and a Classification of +1 has a resultant LSI of 4, as in the case of perennial streams.

In the GIS analysis and mapping of each metric, Land Suitability Index categories were statistically derived in the ArcGIS software from the data. Each category was given a different, distinctive, light color shade for the category corresponding to the lowest index value areas (i.e., areas associated with the metric that are less sensitive to disturbance), and increasingly darker shades for the remaining index categories (i.e., corresponding to areas associated with the metric that are most sensitive to disturbance). The maps associated with the Metric Suitability Analysis are included in Appendix 6. It is important to remember that the ranges of sensitivity shown on each map are only with respect to the metric being analyzed. The full implication of the Metric Suitability Analysis is ultimately realized when all the metrics are combined, as is described and presented in the following sections.
VI. COMPOSITE MAPS

A summary of the ecological assessment methodology to this point may help clarify the purpose and usefulness of the composite maps discussed in this section. The steps in the analysis to this point have been:

- data gathering-GIS, maps, narrative, and field data were compiled and analyzed
- ecological inventory maps were made for pertinent ecological, and cultural and historic site characteristics
- similar ecological (and cultural and historic) attributes were combined to form site metrics
- attributes within each metric were assigned to classifications
- a Land Suitability Index was derived for each attribute based on classification(s)
- attributes were mapped in GIS for each metric using the Land Suitability Index, the lightest shading corresponding to the lowest Index value category, and darker shading corresponding to increasing Land Suitability Index category values.

When this basic approach is applied to all eight metrics it is then possible to use that data to conduct composite analyses, which merge metrics in various combinations. Several approaches and methods of analysis can be applied to render output, which in turn can effectively inform the master planning process in terms of identifying areas most suitable for conservation and areas most suitable for development. In the following sections, three different analysis methods are presented for consideration.

A. COMPOSITE MAP – BASELINE ANALYSIS

Using GIS, all the metric layers were brought together, by overlaying and collapsing on a single map all the Land Suitability Index values for all the attributes in all the metrics. The Land Suitability Index values for all the respective metrics were then compiled onto a composite map. The Land Suitability Index values generated by the compilation of metrics on the composite map ranged from 1 to 56.

An algorithm in ArcGIS software (Natural Breaks-Jenks Classification) was used to create 5 statistical Land Suitability Index categories for this 1-56 value range. The algorithm combines two methods. The first is Natural Breaks, where the data is partitioned into categories based on natural groups in distribution (low points in the data histogram). The second is the Jenks Classification, a method of statistical data classification that partitions data into classes using an algorithm that calculates groupings of data values based on the data distribution. Jenks optimization seeks to reduce variance within groups and maximize variance between groups.

With the five categories generated by the algorithm, GIS was then used to create a map with different color shades for each Land Suitability Index Category (LSIC). The LSIC's for the Composite Map are as follows:

- Category A: Disturbance will have marginal ecological impact,
- Category B: Disturbance will have relatively minimum to moderate ecological impact,
- Category C: Disturbance will have relatively moderate to high ecological impact unless BMPs or restrictions are applied,
- Category D: Disturbance will have relatively high ecological impact, even with BMPs or restrictions,
- Category E: Disturbance will compromise ecological integrity.

The lightest shading on the Composite Map corresponds to the lowest LSIC (i.e., Disturbance will have marginal ecological impact). With each subsequent LSIC category, the color shade is darker on the map, with Category E having the darkest shading (see Appendix 7 for the composite map). Table 1 shows the land area breakout for each LSIC.
TABLE 1. BASELINE ANALYSIS LAND AREAS BY LAND SUITABILITY INDEX CATEGORY

<table>
<thead>
<tr>
<th>Category ID</th>
<th>Category Name</th>
<th>Area (Acres)</th>
<th>Area (% of Total)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Suitable for Disturbance</td>
<td>211</td>
<td>21%</td>
</tr>
<tr>
<td>B</td>
<td>Suitable for Disturbance with Limited BMPs</td>
<td>420</td>
<td>41%</td>
</tr>
<tr>
<td>C</td>
<td>Suitable for Disturbance with BMPs</td>
<td>282</td>
<td>27%</td>
</tr>
<tr>
<td>D</td>
<td>Suitable for Conservation</td>
<td>95</td>
<td>9%</td>
</tr>
<tr>
<td>E</td>
<td>Most Suitable for Conservation</td>
<td>16</td>
<td>2%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>1,024</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

B. COMPOSITE MAP - WEIGHTED ANALYSIS

In order to observe how category areas can change as a function of weighing certain metrics and attributes more than others, a weighted analysis was performed. This analysis places twice as much emphasis on all the Landscape Ecology metric classification values, and illustrates the effect this weighting has on the comprehensive suite of metrics. Specifically, the weighted analysis emphasizes wildlife corridor regional importance, width, and structural integrity, as well as forest patch and forest interior patch sizes. The Landscape Ecology Metric was chosen based on the data quality and reliability, recognition that the metric encompasses critical ecological attributes that are not afforded regulatory protections comparable to floodplains and stream buffers, input received from stakeholders, and from best professional judgment. GIS was used in a similar way as described for the Baseline Analysis to generate the output (see Appendix 7 for map), again presented as five Land Suitability Index Categories. Table 2 shows the land area breakout for each LSIC.

TABLE 2. WEIGHTED ANALYSIS LAND AREAS BY LAND SUITABILITY INDEX CATEGORY

<table>
<thead>
<tr>
<th>Category ID*</th>
<th>Category Name</th>
<th>Area (Acres)</th>
<th>Area (% of Total)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AW</td>
<td>Suitable for Disturbance</td>
<td>181</td>
<td>18%</td>
</tr>
<tr>
<td>BW</td>
<td>Suitable for Disturbance with Limited BMPs</td>
<td>94</td>
<td>9%</td>
</tr>
<tr>
<td>CW</td>
<td>Suitable for Disturbance with BMPs</td>
<td>322</td>
<td>32%</td>
</tr>
<tr>
<td>DW</td>
<td>Suitable for Conservation</td>
<td>228</td>
<td>22%</td>
</tr>
<tr>
<td>EW</td>
<td>Most Suitable for Conservation</td>
<td>199</td>
<td>19%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>1,024</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

* The “W” notation in the Category ID signifies it is the weighted analysis
C. COMPOSITE MAP - VERTICAL ANALYSIS

During the peer review session on November 28, 2006, it was suggested by a participant that another analysis of the metric ecological attribute data should be performed in which all areas of the site that had received a classification of 3 are identified (see Section VII for more detail on the peer review session). Some areas received a classification of 3 more than once within a single metric (e.g., Landscape Ecology) and some areas received a classification of 3 more than once across all the metrics. GIS was used to count the number of instances that the classification of 3 was assigned to a particular area and delineate areas with similar numbers of counts or occurrences. Since all areas of the site that received a classification of 3 at least once are identified, this analysis is called a vertical analysis, which infers a concentration of attention on attribute areas in the classification 3 column (Disturbance will compromise ecological integrity) of the metrics Table (Appendix 5).

Similar to the Overlay Composite analysis described above, GIS-based statistical procedures were used to develop three Land Suitability Index Categories, and color shading schemes (see Appendix 7 for the map).

Since this analysis is based only on the Classification 3 areas, defined as “Disturbance will compromise ecological integrity,” the category names are as follows:

- Category AV  Disturbance will compromise ecological integrity - LOW
- Category BV  Disturbance will compromise ecological integrity - MEDIUM
- Category CV  Disturbance will compromise ecological integrity - HIGH

Table 3 shows the land area breakout for each LSIC.

<table>
<thead>
<tr>
<th>Category ID*</th>
<th>Category Name</th>
<th>Area** (Acres)</th>
<th>Area (% of Total)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AV</td>
<td>Disturbance will compromise ecological integrity-LOW</td>
<td>489</td>
<td>57%</td>
</tr>
<tr>
<td>BV</td>
<td>Disturbance will compromise ecological integrity-MEDIUM</td>
<td>338</td>
<td>40%</td>
</tr>
<tr>
<td>CV</td>
<td>Disturbance will compromise ecological integrity-HIGH</td>
<td>29</td>
<td>3%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>856</td>
<td>100%</td>
</tr>
</tbody>
</table>

* The “V” notation in the Category ID signifies it is the vertical analysis. In addition, approximately 165 acres of the site had no Classification 3 designations. These areas have no shading associated with them on the map in Appendix 7.

**Total acreage of the site may vary based on measurement technique and analyses conducted and associated rounding errors.

Designated conservation areas and areas with regulatory restrictions occupy approximately 197 acres of the site and are shown on a map in Appendix 7.
VII. PEER REVIEW AND PUBLIC REVIEW

Four review sessions were held during the ecological assessment process of the site –

- A public listening session of November 6, 2006
- A peer-review session on November 28, 2006 and
- Two public review sessions on December 3, 2006

The public listening session on November 6, 2006 was held to gather information and input the public had on the site. Invited citizens and university faculty were shown maps of the site and were asked to write comments or indicate areas of interest on the maps. Biohabitats staff led the discussion, solicited pertinent information from the group, and recorded the major topics of discussion.

The peer review session on November 28, 2006 involved a more limited audience that included University professors, University staff, and invited members of the community. The process invited comments and suggestions from participants and provided a vetting process for the analyses completed to date. Excellent suggestions and recommendations were offered by attendees, which were factored into future analyses. Most notable of these was the suggestion to analyze the data as explained in the Vertical Analysis.

The final two public review sessions were held at different times on December 3, 2006. A broad group of interested parties attended and contributed useful insight and thoughtful questions. Where relevant and appropriate, Biohabitats incorporated suggestions into the analysis and this report (e.g., edge effect discussion).

Attendee lists and other information pertaining to the Public and Peer Review sessions is in Appendix 8.
 VIII. CONCLUSIONS

Biohabitats has conducted an ecological analysis and assessment of the Carolina North property to inform the master planning effort that is currently underway. The analysis relied on GIS as a powerful tool to compile, analyze and present a broad set of metrics and associated attributes. Three composite analyses were developed that can be used to determine areas most suitable for conservation, areas most suitable for development, and areas suitable for development with appropriate BMPs or restrictions.
APPENDIX 1

Literature Review List-Peer-Reviewed and State and Local Sources
RESEARCH JOURNAL ARTICLES


GOVERNMENT DOCUMENTS


N.C. Dept. of Natural Resources, Divisions of Water Quality (DWQ), Planning Branch, 2003. Assessment Report: Biological Impairment in the Little Creek Watershed, Cape Fear River Basin, Orange County, N.C.

N.C. Dept. of Natural Resources, Divisions of Water Quality (DWQ), Biological Assessment Unit, July 23, 1998. Memorandum, Chapel Hill Water Quality Investigation, Cape Fear River Basin (030306) Orange County.


Sorrie, Bruce and Rich Shaw, 2004. Inventory of Natural Areas and Wildlife Habitats for Orange County, North Carolina, Orange County Environment and Resource Conservation Department and N.C. Natural Heritage Program.

OTHER DOCUMENTS

Appendix 2

John R. McAdams Company, Inc. Report
November 22, 2006

Mr. Kevin Nunnery
Biohabitats, Inc.
Southeast Bioregion
8218 Creedmoor Road
Suite 200
Raleigh, NC 27613

Re: UNC - Ecological Assessment for Carolina North
UNC-06010

Dear Mr. Nunnery:

The John R. McAdams Company conducted an investigation for possible jurisdictional wetland and stream features, threatened and endangered species, cultural and historic resources, and environmental regulations pertaining to the subject property located on the University of North Carolina at Chapel Hill – Carolina North property. The Carolina North property is an approximately 990-acre property in the general vicinity of Airport Road between Airport Drive and Estes Drive located in both Carrboro and the Town of Chapel Hill within Orange County, North Carolina. The review consisted of an examination of natural resource information sources and an on-site inspection for jurisdictional wetland and stream features and threatened and endangered species. The goal was to provide an initial field review of jurisdictional waters of the United States as defined by the 1987 U.S. Army Corps of Engineers (USACE) Wetland Delineation Manual, locate any threatened and endangered species, identify potentially significant cultural resource sites, and review environmental regulations pertaining to the subject property. We are pleased to forward a summary of our findings.

A review of the U.S. Geological Survey (USGS) quadrangle "Chapel Hill, NC", U.S. Fish and Wildlife Service "National Wetland Inventory" (NWI) Maps, the U.S. Department of Agriculture Soil Survey of Orange County, NC, and North Carolina Flood Insurance Rate Maps (FIRM map # 3710978900J, 3710977900J, and 3710988000J, preliminary 4/28/05) revealed two named streams located on the subject property (Crow Branch and Bolin Creek) and several unnamed stream features associated with each named stream.

Stream/Wetland Locations:

A series of on-site inspections were initiated from August 8th through August 22nd, 2006 with the intent of locating jurisdictional wetland and stream features located on the subject property. The origination point of each jurisdictional stream was identified and GPS surveyed. The approximate location of wetland boundaries was also noted. Detailed flagging of the jurisdictional wetland and stream boundaries did not occur. The attached
Wetlands and Streams Exhibit depicts the approximate location and size prior to flagging and field surveying of the jurisdictional streams and wetlands located on the subject property.

**Wetland Permitting**

A Nationwide Permit (NWP) can be utilized if the project is designed to impact less than ½ acre of jurisdictional wetlands/waters of the U.S. including a maximum of 300 linear feet of important/mitigatable stream channel impact. A pre-construction notification to the USACE and DWQ will not be required for wetland impacts less than 1/10 acre. Pre-construction notification and approval will be required for wetland impacts that exceed 1/10 acre and/or any impacts to important/mitigatable streams. The processing time for a NWP pre-construction notification is 45 days with the USACE and 60 days for DWQ. All projects qualifying under a NWP are required to submit a report (post-construction notification) within 30 days of completing the construction activity describing and quantifying the impacts stating that the conditions of NWP have been adhered to.

Cumulative impacts for a project over the specific NWP thresholds of 0.5-acres of wetlands and/or 300 linear feet of stream channel will require an Individual Permit (IP). IPs require an analysis to determine that the proposed impact to waters of the U.S. is the least environmentally damaging practical alternative, typically require compensatory mitigation, notification to adjacent property owners, a public notice, and may require a public hearing. All projects, whether qualifying for a NWP or applying for an IP, require written justification for wetland impacts greater than 0.10-acres. In addition, any stream impacts within a buffered river basin require notification.

Development and land disturbing activity within the 100-year floodplain and floodway zones shall be prohibited, except as provided by certain development activities allowed in the floodplain and floodway zones, or allowed pursuant to a variance approved by the Board of Adjustment.

**Wetland Mitigation**

The USACE can require mitigation for any stream or wetland impacts. In most cases, stream mitigation is not triggered until impacts approach 150 linear feet; wetland mitigation is usually triggered when impacts exceed 1/10 acre. Table 1, below, is the current In-Lieu Fee Schedule (effective July 1, 2006) from the North Carolina Ecosystem Enhancement Program (EEP), in which monetary payment could be paid, to offset wetland and stream impacts. It should be noted, EEP is proposing to revise the In-Lieu Fee Schedule. Final revisions to
the In-Lieu Fee Schedule are forthcoming. Currently, fees are uniform across the state and reflect an average cost of mitigation. EEP proposes to specify three categories (Urban, Coastal, and Rural counties) based on varying costs incurred in different parts of the state in order to more accurately reflect actual costs. Table 1, below, indicates the proposed changes applicable to the subject property.

<table>
<thead>
<tr>
<th>Fee Category</th>
<th>Unit</th>
<th>Fee per Unit (Proposed Changes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stream</td>
<td>linear foot</td>
<td>$232 ($332)</td>
</tr>
<tr>
<td>Non-riparian wetland</td>
<td>acre</td>
<td>$13,924 ($21,000)</td>
</tr>
<tr>
<td>Riparian wetland</td>
<td>acre</td>
<td>$27,847 ($56,000)</td>
</tr>
<tr>
<td>Riparian Buffer</td>
<td>square foot</td>
<td>$0.96</td>
</tr>
</tbody>
</table>

In addition to mitigation, demonstration of avoidance and minimization of impacts to waters of the U.S. will be required as justification for impacts requested, as noted above. This will all be required during the permitting process.

**Natural Resource Areas within Municipalities:**

The subject property is located within the Cape Fear River Basin. Currently, the North Carolina Department of Environment and Natural Resources – Division of Water Quality (DWQ) does not have buffer rules for the Cape Fear River Basin. Orange County Buffer Regulations do not apply to the subject property; however, municipal jurisdictions (Chapel Hill/Carrboro) have instituted their own natural resource buffers as described below.

**Town of Chapel Hill**

**Resource Buffers**

Within the Town of Chapel Hill, a Resource Conservation District (RCD) overlay is applied to all perennial streams, intermittent streams and perennial water bodies, and any areas within 3-feet above 100-year floodplain elevations. These areas within the RCD have limited allowable uses, and are buffered per buffered the requirements described below. Streams determined to be ephemeral are excluded from the RCD and have separate restrictions and are discussed below within the Stormwater Management Requirement section of this letter. RCD determinations are made by the Town of Chapel Hill staff.
Located on the subject property are Crow Branch and Bolin Creek which have 100-year floodplain associated with them. The RCD applies to all land area in the floodplain and land area within 3-feet above floodplain elevation. The Town of Chapel Hill adopted a Land Use Management Ordinance (LUMO, effective January, 2003) establishing riparian buffer requirements from the RCD. All perennial streams shall have a 50-foot Stream Side Zone, 50-foot Management Use Zone, and a 50-foot Upland Zone for a total of 150-foot riparian buffer from the top of bank. All intermittent streams and pond features shall have a 50-foot Stream Side Zone to serve as a riparian buffer from the top of bank. These varying stream buffers are depicted on the Wetlands and Streams Exhibit.

Allowable Uses

The Town of Chapel Hill has established a table of uses allowed within each zone of the stream buffers (see Appendix 1, Table 3.6.3-2: Permitted Uses within Resource Conservation District). For both intermittent and perennial streams, the 50-foot Stream Side Zone restricts most uses except for the following: a) public utilities and storm drainage facilities, b) trails and sidewalks, and c) streets and bridges. The 50-foot Management Use Zone associated with perennial streams allows the uses permitted in the Stream Side Zone with the following additional uses: a) play areas, pastures, plant nurseries, gardens, and other similar uses that do not require the use of fertilizers and pesticides, b) archery ranges, picnic structures, and playground equipment, and c) detention/retention basins and associated infrastructure. The 50-foot Upland Zone associated with perennial streams allows the uses permitted in the Stream Side Zone and Management Use Zone with the following additional uses: a) lawns and golf course fairways, play fields, and other areas that may require the use of pesticides.

Steep Slope Regulations

In accordance with the Chapel Hill LUMO, all developments shall comply with the provisions of applicable soil erosion and sedimentation control regulations located within Section 5.3. As part of this, there are Steep Slope regulations requiring special construction techniques in steeply sloped areas in order to protect water quality and water integrity, protect plant and animal habitat, and preserve natural beauty. Construction activities on slopes greater than 10% require site preparation techniques which minimize grading and site disturbance. Building and site preparation may occur upon demonstration of specialized site design techniques for slopes greater than 15%. Land disturbance
shall not exceed 25% of the area containing 25% or greater slopes unless a variance is granted by the Board of Adjustment.

Carrboro

Resource Buffers

The Town of Carrboro has also established riparian buffer rules within their Land Use Ordinance (Section 15-269, amended 11/19/02) The buffer rules area applicable to intermittent streams, perennial streams, and floodplains for a region known as the “Northern Transition Area”, as depicted on Carrboro’s Northern Transition Area Stream Buffer Map (NTA). Buffers on major streams and floodplains, as defined on the NTA map, are calculated by adding 100 ft plus (4 x slope x 100). The buffer is measured from the 100-year floodplain, or if no floodplain exists, it is taken from the stream bank. Bolin Creek and the perennial streams flowing into Bolin Creek are considered major streams within the NTA. Intermittent Streams flowing into Bolin Creek and its perennial tributaries require a 60 ft buffer from their stream bank. Minor intermittent streams within the NTA require a 30 ft buffer from their stream bank. Stream classifications and buffers distances/areas are normally submitted to the Town of Carrboro’s consultant for final verification.

Allowable Uses

In accordance with the NTA buffer ordinance, existing natural vegetation in a buffer area shall not be disturbed unless it is permitted by the Town of Carrboro as one of the allowable uses. These allowable uses are limited to linear transportation and utility crossings.

Conservation Areas / Steep Slope Regulations

The Town of Carrboro has established restrictions for development impacts within conservation areas, to include steep slopes as defined in Article XIII. Recreational Facilities and Open Space in the Town of Carrboro’s Land Development Ordinance. “Primary conservation areas” are defined as areas containing slopes greater than 25%, hardwood areas identified on the “Carrboro Natural Constraints Map”, wetlands, floodplains, stream buffers, lakes and ponds, and some road buffers. Secondary conservation areas are defined as slopes between 15 and 25%, wooded areas, other than hardwood areas, identified on the “Carrboro Natural Constraints Map”, vistas along entrance ways to the town, rock formations, and historical, archaeological, or
unique areas. Development is restricted within these areas and limited to roadway crossings, utility crossings, and passive recreational purposes.

**Stormwater Management Requirements:**

**Stormwater Management: NC Division of Water Quality Standards**

The DWQ Stormwater Management Program protects waters by restricting impervious surface development, maintaining vegetative buffers, and prescribing vegetative conveyances to transport runoff. DWQ has assigned the section of Bolin Creek located a stream index number of 16-41-1-15-1-(0.5) and a stream classification of Class C and Nutrient Sensitive Waters (NSW). DWQ has assigned the Crow Branch a stream index number of 16-41-1-13-2-2 and a stream classification of Class B and NSW. Class C waters are protected for secondary recreation, fishing, wildlife, fish and aquatic life propagation and survival, agriculture and other uses. There are no restrictions on watershed development or types of discharges. Class B Waters are used for primary recreation and other uses and there are no restrictions on watershed development or types of discharges. In general, management strategies are site-specific for NSW waters and require control of pollutants for water quality benefits. Water quality certification from DWQ to disturb these streams, and associated tributaries, is required. A typical requirement of the water quality certification is the review and approval from DWQ for a stormwater management system designed to achieve 85% total suspended solids (TSS) removal. Additionally, DWQ mandates the use of one of the three following methods for achieving this requirement: 1) Wet Detention Ponds followed by a forested filter strip, 2) Extended Detention Stormwater Wetlands, or 3) Bioretention Areas. Special permission from the DWQ will be required to use below ground stormwater management facilities to meet the requirements of a water quality certification.

**Stormwater Management: Town of Chapel Hill Standards**

The Town of Chapel Hill enforces strict stormwater management requirements for new developments. The following are the performance standards for site stormwater management plans, as is stated within the Land Use Management Ordinance, Section 5.4.6:

- Stormwater treatment must be designed to achieve an average annual TSS removal efficiency of 85%. This removal standard applies to the volume of runoff that is generated by the first inch of rainfall.
The stormwater runoff volume leaving the site in the post-development condition cannot exceed the volume leaving the site in the pre-development condition for the two-year, 24-hour storm event. The reduction in volume may be attained by hydrologic abstraction, recycling and/or re-use, or any other acceptable scientific method.

The stormwater runoff rate leaving the site in the post-development condition cannot exceed the rate leaving the site in the pre-development condition for the one-, two-, and 25-year, 24-hour storm events.

Land disturbance within the stream channel of any ephemeral stream shall be minimized and prohibited unless explicitly authorized by issuance of a Zoning Compliance Permit after demonstration of the necessity for the disturbance. Ephemeral streams are designated as such by Town staff upon site inspection. The true definition of an ephemeral stream is a channel that carries flow only in direct response to a rainfall event and in all cases is elevated above the groundwater table in the area.

This subject property is not located within a water-supply watershed protected area, and it is not currently located within a designated river basin requiring specific State mandated nutrient and/or runoff rate controls. However, it is expected that on or about the summer of 2007, regulations will be enacted on a State level that will require this development to comply with nutrient and peak flow rate reduction and control strategies. It is not yet known when these regulations may apply at a local level. These requirements are part of draft regulations intended to protect the water quality of Jordan Lake. Per the current draft regulations being considered, the following would apply to development on the subject property:

- Riparian buffers of fifty feet from the top of bank of all intermittent and perennial streams as denoted on the most recent versions of the 1:24000 USGS topographic map or the Orange County Soil Survey Maps, unless the State Division of Water Quality concurs that the features shown on the maps do not exist in the field.

- Nutrient controls for stormwater runoff leaving the site limiting both nitrogen and phosphorus export.

- One year storm peak runoff rate controls (overlapping with the Town’s runoff rate control requirements).
Stormwater Management: Town of Carrboro Standards

The Town of Carrboro also has stormwater management requirements for new developments. The following are the performance standards for stormwater management plans, as is stated within the Land Use Management Ordinance, Section 15-263.

1) All developments shall be constructed and maintained so that they do not cause stormwater-related damage to upstream or downstream properties as provided in the remaining provisions of this section. Compliance with this standard shall be determined in reference to storm events up to the 100-year storm for upstream properties and up to the twenty-five year storm for downstream properties. Effects on downstream drainage facilities within street rights-of-way shall also be evaluated for storm events up to the twenty-five year storm.

2) Developers shall design and construct all storm water drainage facilities in accordance with the guidelines set forth in the Town of Carrboro Storm Drainage Design Manual. However, the permit issuing authority may establish different requirements if it concludes, based upon the development proposal, recommendations of the Public Works Director, or the Town Engineer, that such deviations from the guidelines are necessary to satisfy the standards set forth in this section, or that the standards can still be met with such deviations and the deviations are otherwise warranted.

Cultural and Historic Resources:

The John R. McAdams Company reviewed maps and records located at the North Carolina State Preservation and Historic Office (SHPO) on August 3, 2006 for documented occurrences of cultural and historic resources sites on the subject property and within the vicinity. The locations of cultural and historic resources sites were noted and files were reviewed for each of the noted sites. Table 2, below, provides a summary of the NCSHPO review. The attached Wetlands and Streams Exhibit depicts the approximate location of cultural and historic resources sites located on the subject property boundary. The attached USGS with SHPO Exhibit depicts the approximate location of cultural and historic resources sites that lie outside the subject property boundary.
<table>
<thead>
<tr>
<th>Item Number</th>
<th>Record</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>31OR42</td>
<td>Un-assessed; Middle &amp; Late Archaic; projectile point, debitage</td>
</tr>
<tr>
<td>2</td>
<td>31OR272</td>
<td>Not Eligible; recorded during widening survey; historic period (former house site)</td>
</tr>
<tr>
<td>3</td>
<td>31OR19</td>
<td>Not eligible; site destroyed by construction of church ball field revisited in 1992 in connection with road widening; Middle Archaic, Middle Woodland</td>
</tr>
<tr>
<td>4</td>
<td>A</td>
<td>Archaeology reviewed areas; however, there was not a significant finding</td>
</tr>
<tr>
<td>5</td>
<td>ER-87-8426</td>
<td>Not found to be significant</td>
</tr>
<tr>
<td>6</td>
<td>ER-85-7596</td>
<td>Not found to be significant</td>
</tr>
<tr>
<td>7</td>
<td>31-OR-272(SL)(DOE)</td>
<td>State List &amp; State Register, Determined Eligible; Weaver House; 116 Walters Road</td>
</tr>
<tr>
<td>8</td>
<td>31-OR-562(SL)</td>
<td>State List &amp; State Register; Hudson-Merritt-McDade House; 133 W. Franklin Street</td>
</tr>
<tr>
<td>9</td>
<td>31-OR-1260(LD)</td>
<td>Local Landmark; Franklin Rosemary Historic District, Icl.; E Franklin Street, Pritchard Avenue, McDade and Lindsay Streets</td>
</tr>
<tr>
<td>10</td>
<td>31-OR-1449(SL)</td>
<td>State List &amp; State Register; Old Tavern Building; 419 block Hillsborough Street</td>
</tr>
<tr>
<td>11(a)</td>
<td>31-OR-327(NR)</td>
<td>National Register; Chapel Hill Town Hall; NW corner Franklin and Rosemary Streets; 11(a) is the former Town Hall location</td>
</tr>
<tr>
<td>12</td>
<td>31-OR-506(SL)</td>
<td>State List &amp; State Register; Lustron House; 109 Stephens Street; noted site</td>
</tr>
<tr>
<td>13</td>
<td>31-OR-445</td>
<td>Thomas Hogan Farm; E si Old NC 86, 0.2 mi S of jet w/ SR 1777</td>
</tr>
<tr>
<td>14</td>
<td>31-OR-446</td>
<td>Brodie Lloyd Farm; E si NC 86, 0.3 mi S of jet w/ SR 1777; noted site</td>
</tr>
</tbody>
</table>
Mr. Kevin Nunnery  
November 22, 2006  
UNC-06010  
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<table>
<thead>
<tr>
<th>15</th>
<th>31-OR-448</th>
<th>Hogan Dairy, Clay Hogan, Dairy Farm Road; N si SR 1777, 0.4 mi E of jet w/ Old NC 86; noted site</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>B</td>
<td>Church # 605 Church Street; noted site</td>
</tr>
<tr>
<td>17</td>
<td>C</td>
<td>Hargraves Center; noted site</td>
</tr>
<tr>
<td>18</td>
<td>D</td>
<td>House 405 Lindsay Drive; noted site</td>
</tr>
<tr>
<td>19</td>
<td>E</td>
<td>House 7 Mt. Bolus Road; noted site</td>
</tr>
<tr>
<td>20</td>
<td>F</td>
<td>House 5 Mt. Bolus Road; noted site</td>
</tr>
<tr>
<td>21</td>
<td>G</td>
<td>Johnson Williams house; noted site</td>
</tr>
<tr>
<td>22</td>
<td>H</td>
<td>Maddry house; moved 4/97; noted site</td>
</tr>
<tr>
<td>23</td>
<td>I</td>
<td>Hogan house; noted site</td>
</tr>
<tr>
<td>24</td>
<td>J</td>
<td>House (Airport Road); demolished; noted site</td>
</tr>
<tr>
<td>25</td>
<td>31-OR-449</td>
<td>Hogan - William D. Hogan House; N si SR 1777, 1 mi W of jet w/ SR 1729; noted site</td>
</tr>
<tr>
<td>26</td>
<td>31-OR-450</td>
<td>Hogan - Hogan House; S si SR 177, 0.9 mi W of jet w/ SR 1729; noted site</td>
</tr>
<tr>
<td>27</td>
<td>K</td>
<td>Old Hogan Mill near here; noted site</td>
</tr>
<tr>
<td>28</td>
<td>L</td>
<td>2 old chimneys; noted site</td>
</tr>
<tr>
<td>29</td>
<td>M</td>
<td>1 story front gable; noted site</td>
</tr>
<tr>
<td>30</td>
<td>N</td>
<td>1 story side gable; noted site</td>
</tr>
<tr>
<td>31</td>
<td>O</td>
<td>1 story side gable; noted site</td>
</tr>
</tbody>
</table>

**Threatened and Endangered Species:**

**NHP Review**

The John R. McAdams Company reviewed databases, maps, and records located at the North Carolina Natural Heritage Program (NHP) office on August 3, 2006 for documented occurrences of uncommon species and unique habitats on the subject property and within the vicinity. The locations of uncommon species and unique habitats were noted and files were reviewed for each. Table 3, below, provides a summary of the NHP review. The
attached Wetlands and Streams Exhibit depicts the approximate location of uncommon species and unique habitats located on the subject property boundary. The attached USGS Natural Heritage Program Database Review Exhibit with SHPO Exhibit depicts the approximate location of uncommon species and unique habitats that lie outside the subject property boundary.

Table 3. NHP Records Review

<table>
<thead>
<tr>
<th>Item Number</th>
<th>Record</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7</td>
<td>Bolin Creek; significant Natural Heritage Area</td>
</tr>
<tr>
<td>2</td>
<td>9</td>
<td><em>Hemidactylum scutatum</em>; Rare Animal</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>University Lake marsh; Natural Community</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>On map; No data; Not in data base</td>
</tr>
<tr>
<td>5</td>
<td>32</td>
<td>On map; No data; Not in data base</td>
</tr>
<tr>
<td>6</td>
<td>23</td>
<td>University Lake Aquatic Habitat; Natural Community</td>
</tr>
<tr>
<td>7</td>
<td>27</td>
<td><em>Pycanthemum torrei</em>; Rare Animal</td>
</tr>
</tbody>
</table>

Threatened and Endangered Species Field Inspections

Information concerning the occurrence of federally protected species within Orange County was obtained from the USFWS list of protected and candidate species (April, 2006 listings). A series of on-site inspections were initiated from August 8th through August 22nd, 2006 to determine the presence of threatened and endangered species on the subject property. The principal Federally listed species surveyed for include the following: bald eagle (*Haliaeetus leucocephalus* – Threatened [proposed delisting]), red-cockaded woodpecker (*Picoides borealis* – Endangered), Michaux’s sumac (*Rhus michauxii* – Endangered), and smooth coneflower (*Echinacea laevigata* – Endangered). The USFWS also lists the dwarf wedgemussel (*Alasmidonta heterodon* – Endangered) as occurring within Orange County; however, this species was not surveyed for. In addition, surveys were not conducted for Federal Species of Concern (FSC). Based on the field surveys, no individual species were observed; however, potential habitat for the bald eagle, red-cockaded woodpecker, Michaux’s sumac, and smooth coneflower was observed on the subject property.
Mr. Kevin Nunnery  
November 22, 2006  
UNC-06010  
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The John R. McAdams Company appreciates the opportunity to provide our services for the referenced project. If you should have any questions, please do not hesitate to contact us at (919)361-5000. 
Sincerely, 

THE JOHN R. McADAMS COMPANY, INC.

George Buchholz, REM, PWS  
Environmental/Wetland Scientist  
Stormwater and Environmental Department

Kevin Yates  
Senior Environmental/Wetland Scientist  
Stormwater and Environmental Department
APPENDIX 3

Inventory Maps
Ecological Inventory

Soil Groups

- Chewacla Loam - Ch
- Congaree Fine Sandy Loam - Cp
- Lion Loam, 0% - 3% slopes - Lg
- Lion Loam, 3% - 12% slopes - GeB
- Georgeville Silt Loam, 2% - 6% slopes - GeB
- Georgeville Silt Loam, 4% - 10% slopes - GeC
- Goldston Silt Loam, 0% - 5% slopes - GeB
- Goldston Silt Loam, 5% - 15% slopes - GeC
- Huffman Silt Loam, 2% - 6% slopes - HrB
- Huffman Silt Loam, 6% - 12% slopes - HrC
- Hiawassee Clay Loam, 2% - 6% slopes - HwB
- Iredell Gravelly Loam, 1% - 4% slopes - IrB
- Iredell - Urban Land Complex, 1% - 6% slopes - IuB
- Lignum Silt Loam, 0% - 3% slopes - Lg
- Tatum Silt Loam, 8% - 15% slopes - TaD
- Wilkes Gravelly Loam, 15% - 45% slopes - WxF

Legend

- Carolina North Property Boundaries
- Carolina/Chapel Hill Boundary
- Roads
- Streams
- Ponds/Lakes

Soil Groups

August 2007

Data Sources:
- Soils data
  - Natural Resources Conservation Service (NRCS)
  - UNC GIS Department

$
Ecological Inventory
Approximate Tree Stand Age

Legend
- Carolina North Property Boundaries
- Carolina/Chapel Hill Boundary
- Roads
- Streams
- Ponds/Lakes

Approximate Tree Stand Age
- 1 - 27 yrs
- 28 - 45 yrs
- 46 - 74 yrs
- 75 - 99 yrs
- 100 - 110 yrs

Data Sources:
- Stand Age Data - UNC GIS Department
- Biohabitats, Inc.

August 2007
Data Sources:
- Ecological Inventory

Legend:
- Carolina North Property Bounds
- Carolina North/Chapel Hill Boundary
- Roads
- Surface Water
  - Ephemeral Streams
  - Ancestral Streams
  - Perennial Streams
  - Unidentified Streams
  - Ferticakes
- Buffers (Perennial Streams)
  - 30m Riparian Conservation Buffer
  - 15m Riparian Conservation Buffer
- Forest:
  - 100m Edge Forest
  - 50m Transition Forest
  - Interior Forest

Landscape Ecology - Biohabitat, Inc.

August 2007
### Federally Protected Species in Orange County

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
<th>State Status</th>
<th>Federal Status</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Bald Eagle</em></td>
<td>-</td>
<td>Threatened</td>
<td>Threatened</td>
</tr>
<tr>
<td><em>American Eel</em></td>
<td>-</td>
<td>None</td>
<td>-</td>
</tr>
<tr>
<td><em>Roanoke Bass</em></td>
<td>-</td>
<td>None</td>
<td>Threatened</td>
</tr>
<tr>
<td><em>Atlantic Pigtoe</em></td>
<td>-</td>
<td>None</td>
<td>Endangered</td>
</tr>
<tr>
<td><em>Brock Floater</em></td>
<td>-</td>
<td>None</td>
<td>Endangered</td>
</tr>
<tr>
<td><em>Green Floater</em></td>
<td>-</td>
<td>None</td>
<td>Endangered</td>
</tr>
<tr>
<td><em>Savannah Killiput</em></td>
<td>-</td>
<td>None</td>
<td>Endangered</td>
</tr>
<tr>
<td><em>Yellow Lampmussel</em></td>
<td>-</td>
<td>None</td>
<td>Endangered</td>
</tr>
<tr>
<td><em>Creamy Trefoil</em></td>
<td>-</td>
<td>None</td>
<td>Significantly Rare</td>
</tr>
<tr>
<td><em>Sweet Pinesap</em></td>
<td>-</td>
<td>Significantly Rare</td>
<td>-</td>
</tr>
<tr>
<td><em>Torrey's Mountain-mint</em></td>
<td>-</td>
<td>Significantly Rare</td>
<td>-</td>
</tr>
</tbody>
</table>

*It should be noted that no federally protected species are known to be present on the Carolina North site.*

### Data Sources:
- North Carolina Natural Heritage Program
- Biohabitats, Inc.

### State and Local Government Natural Area Designations
- Carolina North Property Boundaries
- Carolina North Boundary
- Roads
- Streams
- Pond/Lakes
- Conservation Areas
- Carolina North Natural Heritage Area
- Friends of Bolin Creek Proposed Preserve Revised

### University Lake
- Main Campus
- Mason Farm

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**Legend**
- Carolina North Property Boundaries
- Carolina North Boundary
- Roads
- Streams
- Pond/Lakes
- Conservation Areas
- Carolina North Natural Heritage Area
- Friends of Bolin Creek Proposed Preserve Revised