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W o r l d
C l a s s
R e g i o n

Draft Memorandum

To: Chris Dreps, Upper Neuse River Basin Association
From: John Hodges-Copple, Triangle J Council of Governments
Date: March 30, 2007
Re: Memorandum describing the process and results of the current and future land use analyses performed for the Lick Creek Watershed Restoration Plan

This memorandum describes the process used to develop a land use analysis to be used in the Lick Creek Watershed Restoration Plan. The products are detailed land use attributes for both current and build-out conditions for each of Lick Creek's 11 subwatersheds. The resulting data will be used for identifying target areas for field work and for prioritization of potential projects for implementation. Specifically, the UNRBA and partners will use the current and future land use data in the Center for Watershed Protection's Watershed Treatment Model.

1. Background

Land Categorizations from several sources were compared, most notably Durham County's and Wake County's cadastral (parcel) databases of land use and building type and use codes, the Durham Comprehensive Plan, and land uses/land covers used in the Center for Watershed Protection's model. The final categories were derived from existing parcel data supplied by Durham and Wake Counties. Calculations for roads were obtained from design standards supplied by the Durham Transportation Division.

Future land use by parcel for a "build out scenario" version of CWP's Watershed Treatment Model was derived from the same sources.

Current and build-out land use information and model loading estimates will be important information sources for the Little Lick Creek Local Watershed Planning Group as it prioritizes subwatersheds and specific watershed management projects.

2. Process

Two timeframes are examined: existing and buildout. Buildout is not specifically defined as any particular year, but assumes the complete development of the watershed based on the future land use in the respective Durham and Wake County parcel databases. Similarly, the existing condition is not a specific date, but is based on the information from the most recent data sources; the principal one being the attribute for existing land use in the 2006 Durham parcel-level database and the land class and building type and use code in the 2006 Wake County parcel database. Other layers available to further clarify land use include 1999 satellite imagery, 2005 aerial photography, and 2006 street centerlines which were obtained from the City of Durham and Wake County.

Layers of information

The following were the main Geographic Information System layers used in the analysis:

1. parcels and the following attributes associated with the parcels:
 - existing land use
 - building assessed value
 - land assessed value
2. street centerlines (located within the “negative space” of road rights-of-way not covered by parcels).
3. Durham Comprehensive Plan future land use
4. Long Range Transportation Plan facilities
5. aerial photographs
6. satellite imagery with land cover categorization
7. plannimetrics (impervious surface coverage, mostly within city limits; includes building rooftops, driveways, sidewalks, parking lots, and some other impervious surfaces such as tennis courts, but does not include other surfaces such as decks)

Land Categorization

In the Geographic Information System for the Lick Creek watershed, land is divided into two basic geographies: land in parcels and land located within the “negative space” of road rights-of-way not covered by parcels. Each geography is handled differently.

Land in Parcels

There are 68 different Existing Land Use Codes assigned to parcels in the Lick Creek Watershed in the Durham parcel database. The Durham Comprehensive Plan contains the following 16 land uses on its future land use map, 9 of which are in the Lick Creek Watershed, as shown in Table 1.

Table 1. Durham Land Use Plan Designations

Land Use Categories from the Durham Comprehensive Plan	Description of the Land Use in the Plan	Land Use Category in Lick Creek Watershed
agriculture	property identified as prime farmland by the Farmland Preservation Board and that is purchased by a Governing Body (either fee simple or easement)	no
rural residential	0.5 DUs per acre or less (current UDO proposal is 3 acre lot minimum in rural tier)	yes
very low density residential	2 DUs per acre or less	yes
low density residential	4 DUs per acre or less	yes
low-medium density residential	4-8 DUs per acre	yes
medium density residential	6-16 DUs per acre	no
medium-high density residential	8-20 DUs per acre	no
high density residential	12-60 DUs per acre	no
very high density residential	12-150 DUs per acre	no
central business district	major commercial downtown center.	no
commercial	facilities for the buying and selling of commodities and services; principally a retail classification	yes
office	business, medical and professional offices and administrative units of industrial uses.	yes
institutional	mostly schools; also hospitals, museums, churches and other non-profit activities (minimum size of 4 acres)	yes
industrial	manufacture, production and processing of goods (divided into warehousing [light] and factories/quarries/construction yards [heavy])	yes
research/research applications	not defined; confined to Research Triangle Park and Treyburn	no
recreation/open space	Page 7-7 specifies recreation and open space areas on the land use map; including ACOE land, public parks, 100-year floodplains, historic sites, unused railroads, local land trust lands.	yes

The Center for Watershed Protection (CWP) recommends the following land use categories for application of event mean concentrations (EMCs) of pollutants:

1. Residential, further categorized by density (see below)
2. Commercial – office and retail
3. Industrial – light manufacturing, distribution, storage
4. Institutional – churches, schools, hospitals and other public facilities
5. Agricultural, further categorized by row crop or pasture
6. Forested
7. Open urban land – developed park land and recreational areas, golf courses, cemeteries
8. Natural Areas – protected natural areas
9. Highways

Highways are not parcel-based and will be addressed in the section of this report on road rights-of-way. The residential densities the CWP used in its study of Impervious Cover and Land Use in the Chesapeake Bay Watershed (January 2001) are shown in Table 2.

Table 2. Center for Watershed Protection Residential Density Ranges

Category	Density range in study
Residential – 2 acre lot	1.7 to 2.3 acres
Residential – 1 acre lot	0.75 to 1.25 acres
Residential – ½ acre lot	0.4 to 0.5 acres
Residential – ¼ acre lot	0.2 to 0.3 acres
Residential – 1/8 acre lot	0.10 to 0.16 acres, including duplexes
Residential – townhouse	5 to 10 units per acre
Residential – multifamily	10 to 20 units per acre

The CWP study did not specifically address rural residential areas (lots of three to ten acres) or farmsteads on parcels larger than 10 acres.

Reconciling the Durham Comprehensive Plan and Center for Watershed Protection categories, 26 land uses were derived; 21 of these land uses currently exist in the Lick Creek Watershed and form the most detailed level of land use description, as shown in Table 3.

Table 3. Lick Creek Land Use Categorization.

	Land Use Category (Detailed Level)	Description	In Lick Creek Watershed?
1	Industrial	Industrial from the Durham Comprehensive Plan (excluding resource extraction, e.g. quarries)	yes
2	Institutional	schools, churches, libraries, museums, fire/police stations	yes
3	Commercial Retail	Commercial from the Durham Comprehensive Plan	yes
4	Commercial Office	Office from the Durham Comprehensive Plan	yes
5	Central Business District	Central Business District from the Durham Comprehensive Plan	no
6	Research Applications	Research Triangle Park and Treyburn Corporate Park	no
7	Very High Density Residential	VHDR from the Durham Comprehensive Plan (12-150 units per acre)	no
8	High Density Residential	HDR from the Durham Comprehensive Plan (12-60 units per acre)	no
9	High-Medium Density Residential	HMDR from the Durham Comprehensive Plan (8-20 units per acre)	no
10	Medium Density Residential	lots less than 0.125 acres with a residence, all developed multi-family (8-16 units per acre)	yes
11	Low-Medium Density Residential	0.125-0.25 acre lots with a residence (4-8 units/acre)	yes
12	Low Density Residential	0.25 to 0.5 acre lots with a residence (2-4 units/acre)	yes
13	Very Low Density Residential	0.5 to 2 acre lots with a residence	yes
14	Semi-Rural Residential	2 to 3 acre lots with a residence	yes
15	Rural Residential	3 to 10 acre lots with a residence	yes
16	Agricultural-Row Crops	lots greater than 10 acres, with or without residence	yes
17	Agricultural-Pasture	lots greater than 10 acres, with or without residence	yes
18	Unmanaged Rural Lands	Vacant, Undeveloped, or Residential Parcels > 10 Acres	yes
19	Undeveloped Lands	Vacant Land < 10 Acres	yes
20	Urban Green Space	developed parks, golf courses, cemeteries, land set aside as a condition of development approval, lots of 2 acres or less with no building	yes
21	Protected Natural Area	mostly undeveloped parks and protected natural areas, 100 year floodplains on undeveloped parcels	yes
22	Other Forested Land	vacant private land in a forested condition	yes
23	Water Surface	lakes	yes
24	Major Roads	roads with 4 or more travel lanes	yes
25	Local Roads	all other roads	yes
26	Special (2 types)	Marina, Well Site	yes

These land uses track the Durham Comprehensive Plan land uses with the following modifications:

Institutional. The Durham Comprehensive Plan limits institutional designations to sites greater than 4 acres so, for example, most churches are shown as a land use that matches adjacent parcels, typically residential. In the Lick Creek scheme, institutional uses are defined as schools, churches, libraries, museums, and fire/police/sheriff stations and are developed independently; the method used is explained in more detail later in this report. *[note: CWP defines cemeteries as urban open space]*

Semi-Rural Residential and Rural Residential. The Durham Comprehensive Plan has a single rural residential category for development on lots greater than 2 acres. In the Lick Creek scheme, semi-rural residential is classified as lots of 2 to 3 acres and rural residential on lots greater than 3 acres.

Medium Density Residential. The Durham Comprehensive Plan uses overlapping density ranges to define residential categories. The Lick Creek scheme uses exclusive density ranges that do not overlap for those residential densities located within the watershed (medium density residential and less dense), so that existing residential patterns from the parcel data base can be assigned to a unique classification. Medium Density Residential is defined in the Durham Comprehensive Plan as 6-20 units per acre (overlapping the Low-Medium Density Residential category of 4-8 units per acre); in the Lick Creek scheme, it is adjusted to 8-20 units per acre.

Agricultural and Forested. The Durham Comprehensive Plan narrowly defines agricultural land use, restricting it to property identified as prime farmland by the Farmland Preservation Board and that is purchased by a Governing Body (either fee simple or easement). Forested land is not a land use category in the Comprehensive Plan. These categories are only partly used in the existing land use code, because they represent a land cover spread across several land uses. The existing land use coding variously assigns a "vacant," "present use agriculture," "agriculture/1-family," or "rural residential with acreage" designation to agricultural and forested lands. The Lick Creek scheme develops its own agricultural (stratified by crops or pasture) and forested designations, which are explained in more detail later in this report. However, "Agricultural/ 1-Family" and "Rural Residential with Acreage" designated lots with acreages that fall into the Rural, Semi-Rural, Very Low, Low, Low-Medium, and Medium density ranges are assigned the appropriate category.

Urban Green Space, Water Surface, and Protected Natural Areas. The Durham Comprehensive Plan includes a single Recreation/Open Space category that includes 16 types of lands, of which the following are designated or could be designated in the future within the watershed:

- 100-year floodplains (currently in the watershed) -- independent of parcel lines and underlying parcel designations
- US Army Corps of Engineers land (currently in the watershed)
- County Parks
- City Parks (currently in the watershed)
- Privately owned conservation lands held by local land trusts
- Culturally or historically significant cemeteries
- State-owned historic sites

The comprehensive plan does not include golf courses or other cemeteries or private lands set aside as a condition of development approval as open space land uses. The Lick Creek scheme develops its own Urban Green Space and Protected Natural Areas designations, which are explained in more detail later in this report.

Roads. The Durham Comprehensive Plan does not include road rights-of-way as a distinct use; roads are assigned the land use of adjoining parcels.

Special. Two special uses are identified in the this study: a Marina and Well Sites.

These detailed land uses can be collapsed into a summary level of 12 land uses within the Lick Creek Watershed, as shown in Table 4.

Table 4. Summary Level Lick Creek Land Use Categories.

	Land Use Category (Summary Level)	Description
1	Industrial	Industrial from the Durham Comprehensive Plan (excluding resource extraction, e.g. quarries)
2	Institutional	schools, churches, libraries, museums, fire/police stations
3	Commercial Retail	Commercial from the Durham Comprehensive Plan
4	Commercial Office	Office from the Durham Comprehensive Plan
5	Medium Density Residential	lots 0.125 acres or less with a residence and all developed multi-family, including mobile home parks (8+ units per acre)
6	Lower Density Residential (by 5 density subcategories)	Single Family Residential development ranging from 8 units per acre down to 1 unit per 10 acres.
7	Urban Green Space	developed parks, golf courses and cemeteries, land set aside as a condition of development approval, residential lots of 2 acres or less with no building
8	Protected Natural Area	mostly undeveloped parks and protected natural areas, excluding lake surface areas.
9	Agriculture, Forest, Rural and Undeveloped Land	Other privately owned land that is undeveloped or rural.
10	Water Surface	Lakes
11	Roads (by 2 subcategories)	All road rights-of-way: major and minor
12	Special	Marina, Well Sites

Land Use Category Summary. Table 5 summarizes what land use categories exist and are planned in the Lick Creek Watershed and how categories compare to one another in the Durham Comprehensive Plan, the Lick Creek Detailed Level Land Use and the Lick Creek Summary Level Land Use.

Table 5. Land Use Category Comparison

	Lick Creek Land Use Category (Detailed Level)	units per acre	In Lick Creek Watershed Today?	In Lick Creek Watershed at Buildout?	Lick Creek Land Use Summary Level	Durham Comprehensive Plan
1	Industrial	N/A	●	●	●	●
2	Institutional	N/A	●	●	●	●
3	Commercial Retail	N/A	●	●	●	●
4	Commercial Office	N/A	●	●	●	●
5	Central Business District	N/A				●
6	Research Applications	N/A				●
7	Very High Density Residential	12-150				●
8	High Density Residential	12-60				●
9	High-Medium Density Residential	8-20				●
10	Medium Density Residential	8-16	●	●	●	●*
11	Low-Medium Density Residential	4-8	●	●	●	●*
12	Low Density Residential	2-4	●	●	●	●*
13	Very Low Density Residential	0.5-2	●	●	●	●*
14	Semi-Rural Residential	0.33-0.5	●	●	●	included in rural residential
15	Rural Residential	0.1-0.33	●	●	●	●
16	Agricultural-Crops	N/A	●		AFRU	protected only
17	Agricultural-Pasture	N/A	●		AFRU	protected only
18	Unmanaged Rural Lands	N/A	●		AFRU	in other categories
19	Undeveloped Lands	N/A	●		AFRU	in other categories
20	Urban Green Space	N/A	●	●	●	in other categories
21	Protected Natural Area	N/A	●	●	●	●*
22	Other Forested Land	N/A	●		AFRU	protected only
23	Water Surface	N/A	●	●	●	included in Protected Nat. Area
24	Major Roads	N/A	●	●	Roads	adjoining land
25	Local Roads	N/A	●	●	Roads	adjoining land
26	Special**	N/A	●	●	●	in other categories

AFRU: Agriculture, Forest, Rural and Undeveloped lands

* indicates definition slightly different from Lick Creek definition; see text.

** in Lick Creek watershed, it is a Marina and Well Sites.

Protected only: Comprehensive Plan includes only land identified as prime farmland by the Farmland Preservation Board and purchased by a Governing Body (either fee simple or easement); other farm and forest land would be in a rural residential or other residential category.

In Comprehensive Plan, roads have same land use as adjoining land, with the road centerline serving as the dividing line.

Process for Determining Existing Land Use

A two-stage process was used to develop existing land use at both a summary level for early reporting and a more finely-grained detailed level. The detailed level includes both further disaggregation of land uses, and additional analysis to ensure that land is assigned to the most appropriate category. Existing land use was addressed in the following order and manner; notes are provided where the Detailed Level involves subsequent analysis:

Protected Natural Area - public and water surface. Protected Natural Areas in this portion of the category are protected by public or non-profit ownership or easement and largely restricted to remaining in a natural state. In the Lick Creek watershed, Natural Areas consist of land around Falls Lake.

1. Select all parcels in public ownership around Falls Lake and assign to this category.
2. Overlay the Falls Lake surface and calculate the amount of this portion of the category that is water area; assign it to the Water Surface category. The remainder is assigned to the Protected Natural Area category

[If more detail is desired, satellite imagery can be used to assign a land cover category.]

Protected Natural Area - private set-aside. Protected Natural Areas in this portion of the category are permanently set aside as a condition of development approval, and identified as such in the existing land use database.

1. Select all Durham County parcels that have an existing land use code of vacant residential/homeowners association (code #317). For Wake County, no homeowner association lands appear (LAND_CLASS code I).

[If more detail is desired, satellite imagery or aerial photography can be used to assign a land cover category.]

Urban Green Space. Urban green space consists of developed parks, golf courses and cemeteries, lands protected as a condition of development approval and lots of 2 acres or less with no building.

- a. Select all Durham County parcels that have an existing land use code of recreation/golf course (code #552). Verify that Falls Village Golf Course parcels have been selected. No golf course parcels exist in in the Wake County portion of Lick Creek Watershed.
- b. Select all Durham County parcels that have an existing land use code of commercial services/cemeteries (code #695). For Wake County parcels, this is tax exempt burial property (LAND_CLASS code E, EXEMPTDESC “burial property”)
- c. Select all Durham County parcels that have existing land use codes of residential/homeowners association improvement (code #119) and residential/leasehold improvement (code #130). No equivalent code appears in Wake County parcels. For the Detailed Level, review these on aerial photos and assign to urban green space or a more appropriate category depending on the characteristics.
- d. Select all Durham County residential (100-level) parcels not already selected that are 2.0 acres or less and that have a building value of \$0. There are no “residential” parcels in the Wake County portion of the Lick Creek watershed that have a building value of \$0. This is because residential parcels as defined by Wake County only include parcels with an existing residential building on them. Wake county assigns a classification of “vacant” to any parcel that has no building value, with no other indicator for the type of vacant parcel. The “undeveloped” category was created for these vacant parcels.

- e. Select Durham County parcels with an existing land use code of vacant residential/lots-small tracts (code #311) that are 2.0 acres or less.

[note: these latter two categories are probably collections of different land covers. Most are scattered vacant infill lots which may be either lawn or wooded. Some are subdivided land that has not been developed and would most likely be forested. If more detail is desired, partners can discuss whether to assign these to this category or to a forested category; theoretically, these could be included with the larger vacant parcels that can be analyzed by overlaying satellite imagery, but the assumption is that it would not be efficient to do so. It is assumed that non-residential lots with a building value of \$0 that are not specifically identified as “vacant” in the existing land use code are part of a larger commercial or industrial site.]

Protected Floodplain (additional 100-year floodplain). (Detailed Level only) Protected Natural Areas in this portion of the category are in an undeveloped condition within the floodplain and not already accounted for in the previous portions of this category or the urban green space category. At the summary level, these lands would be included in other categories, the majority would appear to be in the Agriculture/Forest/Rural/Undeveloped Land summary level category.

Institutional. Institutional uses are defined as schools, churches, libraries, museums, and fire/police/sheriff stations.

1. Select all Durham County parcels that have an existing land use code of community services (code #600), community services/school (code #612), community services/church (code #621), and community services/church parking lot (code #624). For Wake County, select tax exempt church parcels (LAND_CLASS code E, TYPE_USE code “66”)

For the Detailed Level, review these on aerial photos and assign to institutional or a more appropriate category depending on the characteristics. Document what categories they are assigned to.

Industrial.

1. Select all Durham County parcels that have an existing land use code of commercial/warehouse-storage (code #440), and industrial/manufacturing-processing (code #710), public service (code #800), public service/telephone (code #831), and public service/sewer and water (code #853). At the detailed level, the following codes may need to be reviewed over aerial photos and assigned to the appropriate categories based on their characteristics and discussion with project partners: public service (code #800), public service/telephone (code #831), and public service/sewer and water (code #853). For Wake County, identify Industrial parcels (LAND_CLASS code D) and commercial/warehouse parcels, (LAND_CLASS code C, TYPE_USE code “82”)

Commercial Retail.

1. Select all Durham County parcels that have an existing land use code of commercial (code #400) and the following subsets in the commercial category: restaurants (code #421), night clubs (code #424), fast food (code #426), motor vehicle services (code #430), service and gas station (code #432), auto body-tire (code #433), self-service car wash (code #436), Parking Lot (code #438), gas-fuel-oil stations (code #441), retail services (code #450), area shopping centers (code #452), convenience store with gas (code #456), convenience store without gas (code #457) and funeral home (code #471), vet clinic (code #472), mini-warehouses (code #474), and commercial/multi-purpose (code #480). For the Detailed Level, review by aerial

photo the category commercial/multi-purpose (code #480) and assign either to the commercial retail or commercial office category depending on characteristics. Document what category it is assigned to. No commercial retail land use appears in the Wake County portion of the Lick Creek Watershed

Commercial Office.

1. Select all Durham County parcels that have an existing land use code of commercial/banks and offices (code #460), commercial/office building (code #464), commercial/converted residence (code #483), and commercial/1-story single occupant (code #484). No commercial office land use appears in the Wake County portion of the Lick Creek Watershed

Agriculture, Forest, Rural and Undeveloped Land (Summary Level).

1. Select all Durham County parcels with an existing land use of Present-Use/Agricultural (code #99010) and Present-Use/Forestry (code #99020). For Wake County, select parcels with land classes agri-farm (LAND_CLASS code F) and forestry (LAND_CLASS code Y).
2. Select all Durham County parcels not already assigned with an existing land use code of “vacant:” all 300-level codes except those already selected (#311-greater than 2 acres, #317, #347, #349). For Wake County parcels, select all vacant land (LAND_CLASS code V)
3. Select all Durham County parcels with a land use code of wild/ county parks (code #934).
4. Select all Durham County parcels not already assigned with a residential (100-level) code (excluding #119 and #130) with a building value of \$0 that are 2.0 acres or greater.
5. Select all other Durham County parcels not already assigned with a residential (100-level) code (excluding #119 and #130) that are 10.0 acres or greater, regardless of building value. For Wake County parcels, select all parcels that are 10 acres or greater that are not already assigned a land use.

Agricultural-Crops. (Detailed Level) Agricultural-Crops, Agricultural-Pasture (the following category) and a portion of the category Other Forested Land (a subsequent category) would be developed in concert, using satellite imagery.

Agricultural-Pasture. (Detailed Level) Agricultural-Crops (the previous category), Agricultural-Pasture and a portion of the category Other Forested Land (a subsequent category) are developed in concert. See Agricultural-Crops (above) for the methodology employed.

Other Forested Land. (Detailed Level) In Durham County, land designated Present Use/ Forestry is assigned to this category. In Wake County, land with LAND_CLASS = Y is assigned this category.

Unmanaged Rural Lands. (Detailed Level) Vacant, Undeveloped, or Residential parcels > 10 acres are assigned this category.

Undeveloped Land. (Detailed Level). Vacant parcels < 10 acres are assigned to this category.

Medium Density Residential. Medium Density Residential is 8.0 or more units per acre.

1. Select all Durham county parcels that have a building value greater than \$0 and an existing land use code of commercial/apartment-garden (code #411) and commercial/mobile home park (code #416).
2. Select all other Durham County parcels not already assigned that have a building value greater than \$0 and with a residential (100-level) code that are 0.125 acres (1/8 acre) or smaller.
3. Select all other Durham County parcels not already assigned that have a building value greater than \$0 and with a land use code of agriculture/1-Family (code #211) that are 0.125 acres (1/8 acre) or smaller.
4. There are no medium density residential parcels in the Wake County portion of the Lick Creek Watershed.

Low-Medium Density Residential. Select all other Durham County parcels not already assigned that have a building value greater than \$0 and with a residential (100-level) code or a land use code of agriculture/1-Family (code #211) that are greater than 0.125 acres but less than 0.25 acres. There are no low-medium density residential parcels in the Wake County portion of the Lick Creek Watershed.

Low Density Residential. Select all other Durham County parcels not already assigned that have a building value greater than \$0 and with a residential (100-level) code or a land use code of agriculture/1-Family (code #211) that are greater than 0.25 acres but less than 0.50 acres. For Wake county, select parcels with a single-family (TYPE_USE code “01”), residential (LAND_CLASS code R) land use that are greater than 0.25 acres but less than 0.50 acres.

Very Low Density Residential. Select all other Durham County parcels not already assigned that have a building value greater than \$0 and with a residential (100-level) code or a land use code of agriculture/1-Family (code #211) that are greater than 0.50 acres but less than 2.0 acres. For Wake county, select parcels with a single-family (TYPE_USE code “01”) or mobile home (TYPE_USE code “72”), residential (LAND_CLASS code R) land use OR a manufactured home (LAND_CLASS code M) land use that are greater than 0.50 acres but less than 2.0 acres.

Semi-Rural Residential. Select all other Durham County parcels not already assigned that have a building value greater than \$0 and with a residential (100-level) code or a land use code of agriculture/1-Family (code #211) that are greater than 2.0 acres but less than 3.0 acres. For Wake county, select parcels with a single-family (TYPE_USE code “01”), residential (LAND_CLASS code R) land use OR with a Wake County land class A (A parcel with a building on the property that is not a main structure) that are greater than 2.0 acres but less than 3.0 acres.

Rural Residential.

1. Select all other Durham County parcels not already assigned that have a building value greater than \$0 and with a residential (100-level) or a land use code of agriculture/1-Family (code #211) code that are greater than 3.0 acres but less than 10.0 acres. For Wake county, select parcels with a single-family (TYPE_USE code “01”), residential (LAND_CLASS code R) land use OR with a Wake County land class A (A parcel with a building on the property that is not a main structure) that are greater than 3.0 acres but less than 10.0 acres.
2. Select the parcel with an existing land use code of Agriculture/Multiple dwellings (code #280).

[Quality Check]. At this point, a quality check was made to ensure that all parcels had been assigned to a category.

Roads (Summary Level). All land not in parcels is assigned to the Roads Category.

Major Roads. (Detailed Level) Create parcels for the following major roads from the Rights-of-Way: US 70 and NC 98. Parcel boundaries should be subwatershed boundaries and major intersections.

Local Roads. (Detailed Level) The remainder of the acreage in each subwatershed should equal the land in local roads rights-of-way (ROW) and should be assigned to this category.

Once these existing land uses have been determined, assign the acreages to each subwatershed.

Corrections to Existing Land Use

Application of the procedure described above resulted in some parcels being allocated to incorrect categories. The following manual changes were made:

1. The site of a Marina on Falls Lake & the outfall of Lick Creek was changed from “Protected natural area to “Special: marina”
2. Sites in Wake County with a Water/Wastewater land use (LAND_CLASS code “W”) where divided into two categories. Parcels described as “well sites” (PROPDESC with “WELL” in the description) were reclassified as “Special Use: Well Site”. Parcels described as “septic sites” (PROPDESC with “SEPTIC” in the description) were reclassified as “Industrial.” [Note: for purposes of run-off analysis, this assignment can be reviewed and modified if needed]

Process for Determining Build-Out Land Use

Future land use involves assigning new land use categories to land that is either not currently developed but expected to develop, or land that is expected to be redeveloped based on the Durham Comprehensive Plan and related infrastructure plans. These future land uses are classified in the same categories as the existing land uses. The following steps were followed to generate future land use:

1. Major Roads.

Major roads are defined as existing and planned roads of 4 lanes or more. These include US 70 (existing, with planned changes), NC 98 (existing), and the Northern Durham Parkway (planned). Street centerlines were defined for the new major road (Northern Durham Parkway), then new major road parcels were created by creating a buffer on each side of the centerline for the Parkway.

The Durham-Chapel Hill-Carrboro MPO 2030 draft Long Range Transportation Plan also includes some new two-lane road projects in the Lick Creek watershed. Since these roads would also serve as local access to adjoining development, their rights-of-way are assumed to be captured in the local street right-of-way calculations described later in this section.

2. Unchanged Designations.

The following parcels were assumed to remain unchanged from the existing to the future land use (except as impacted by major roads) regardless of the designation in the Comprehensive Plan:

- Special
 - Protected Natural Area
 - Institutional – churches, schools, hospitals and other public facilities.
 - Urban Green Space –
 - a. Select all parcels that have an existing use code of wild/city parks and recreation (code #934).
 - b. Select all parcels that have an existing land use code of recreation/golf course (code #552).
 - c. Select all parcels that have an existing use code of commercial services/cemeteries (code #695).
 - d. Select all parcels that have existing land use codes of residential/homeowners association improvement (code #119), residential/leasehold improvement (code #130), vacant commercial/condo association (code #347) and vacant commercial/with leasehold (code #349). If more detail is desired, review these on aerial photos and assign to urban green space or a more appropriate category depending on the characteristics.
3. Industrial. Select all parcels not already selected that are designated industrial in the Durham Comprehensive Plan
4. Commercial Retail. Select all parcels not already selected that are designated commercial in the Durham Comprehensive Plan
5. Commercial Office. Select all parcels not already selected that are designated office in the Durham Comprehensive Plan

Remaining Land On The Rural Side Of The Durham Urban Growth Boundary (not already assigned)

6. Low-Medium Density Residential. Select all other parcels not already assigned that are greater than 0.125 acres but less than 0.25 acres.
7. Low Density Residential. Select all other parcels not already assigned that are greater than 0.25 acres but less than 0.50 acres.
8. Very Low Density Residential. Select all other parcels not already assigned that are greater than 0.50 acres but less than 2.0 acres.
9. Semi-Rural Residential. Select all other parcels not already assigned that are greater than 2.0 acres but less than 3.0 acres.
10. Rural Residential (existing lots). Select all other parcels not already assigned that are greater than 3.0 acres but less than 6.0 acres. This analysis uses 6-acre lots – double the 3-acre rural lot size – as the assumed threshold below which parcels would not be further sub-divided at buildout.
11. Rural Residential (new subdivisions). All remaining unassigned parcels should be greater than 6.0 acres. These are assumed to build out in rural residential lots of 3.0 acres or more served by new rural access roads and with rural open space. As large lots are subdivided and developed, land will need to be provided for open space, local roads, and potentially other public facilities such as schools, libraries and fire stations. A new library and fire station have opened on the south side of NC 98

between Nichols Farm and Robbins Roads. For this analysis, it is assumed that these facilities can serve the library and fire service needs of the Lick Creek watershed. Similarly, it is assumed that both Southern High School and Neal Middle School can adequately serve the Lick Creek watershed. At build-out, additional elementary school capacity may be needed to serve homes within the watershed. For the purposes of this study, it is assumed that any additional capacity would be provided on the site of an existing school and/or within the urban growth boundary but outside the Lick Creek watershed, with one exception: There will be an elementary school site somewhere in the Brightleaf development, but an exact location for the school would need to be assumed in order for it to be considered in the future land use analysis; presently, it is not considered).

The Durham Comprehensive Plan calls for open space reservations for new development as shown in Table 6.

Table 6. Durham Open Space Requirements.

Location	Residential Development	Non-Residential Development
Rural Tier (outside urban growth boundary)	40%	N/A
Suburban Tier (inside urban growth boundary)	15%	10%

An analysis of road rights-of-way within the developed portion of three large subdivisions in the watershed indicates that approximately 15% of the non-open space portion of a development will be in road rights of way. So for future residential development on large parcels, the percentages shown in Table 7 are used.

Table 7. Distribution of land in future residential subdivisions.

Location	Land in open space	Land in roads	Land in parcels
Rural Tier (outside urban growth boundary)	40%	9%	51%
Suburban Tier (inside urban growth boundary)	15%	13%	72%

So for all remaining parcels not previously assigned, assign 40% of the total acreage to protected natural area (open space), 9% of the total acreage to local road rights of way and 51% of the total acreage to the rural residential category. [note: on the map, display all the land in the rural residential category].

[Quality Check]. At this point, a quality check was made to ensure that all parcels in the rural part of the watershed had been assigned to a category.

Remaining Land On The Urban Side Of The Urban Growth Boundary (not already assigned)

12. Medium Density Residential (part 1). Medium Density Residential is 8.0 or more units per acre.
 - a. Select all parcels designated Medium Density Residential for the existing land use map.
 - b. Select all other parcels not already assigned that are 0.125 acres (1/8 acre) or smaller.

13. Low-Medium Density Residential (existing lots). Select all other parcels not already assigned that are greater than 0.125 acres but less than 0.25 acres.
14. Low Density Residential. Select all other parcels not already assigned that are greater than 0.25 acres but less than 0.50 acres.
15. Medium Density Residential (part 2). Medium Density Residential is 8.0 or more units per acre.
 - a. Select all other parcels not already assigned that are designated Medium Density Residential on the Durham Comp Plan and assign the following acreages: 15% of the total acreage to protected natural area (open space), 13% of the total acreage to local road rights of way and 72% of the total acreage to the medium density residential category.
16. Very Low Density Residential. Select all other parcels not already assigned that are greater than 0.50 acres but less than 2.0 acres.
17. Low-Medium Density Residential (new subdivisions). All remaining unassigned parcels should be greater than 2.0 acres. These are assumed to build out in residential lots of 0.125 acres or more served by new local access roads and with open space. Based on recently platted lots in the area, it is assumed that the most likely parcel size will be in the Low-Medium Density Residential range of between 0.125 and 0.25 acres. Assign the following acreages: 15% of the total acreage to protected natural area (open space), 13% of the total acreage to local road rights of way and 72% of the total acreage to the low-medium density residential category.

[Quality Check]. At this point, all parcels within the watershed should be assigned to a category. A check was made to see if there are any parcels not already assigned.

3. Results

Table 8 lists the resultant land use acreages for the Lick Creek watershed under current and build-out conditions. Table 9 shows the breakdown for current conditions by subwatershed. Figure 1 maps the current land uses. Table 10 shows the breakdown for build-out conditions by subwatershed. Figure 2 maps the build-out land uses.

Table 8. Lick Creek Watershed Current and Build-out Land Use Analysis Summary Table

Category	Current		Build-Out	
	Area (Acre)	Percentage of Watershed	Area (Acre)	Percentage of Watershed
1 Water Surface	362.56	2.58	362.56	2.58
2 Protected Natural Area	1,424.97	10.14	3,591.93	25.55
3 Urban Green Space	396.06	2.82	158.99	1.13
4 Institutional	42.90	0.31	60.78	0.43

5 Industrial	30.29	0.22	234.50	1.67
6 Commercial Retail	160.00	1.14	259.95	1.85
7 Commercial Office	9.15	0.07	22.33	0.16
8 Forest	2993.56	21.29	0.00	0.00
9 Agricultural - Row Crop	382.13	2.72	0.00	0.00
10 Agricultural - Pasture	517.50	3.68	0.00	0.00
11 Medium Density Residential	35.86	0.26	33.29	0.24
12 Low-Medium Density Residential (0.125-0.25 Acre)	21.63	0.15	5,274.59	37.52
13 Low-Density Residential (0.25-0.5 Acre)	47.02	0.33	113.23	0.81
14 Very Low Density Residential (0.5-2 Acre)	454.09	3.23	623.88	4.44
15 Semi-Rural Residential (2-3 Acres)	193.25	1.37	55.46	0.39
16 Rural Residential (3-10 Acres)	673.25	4.79	1,531.74	10.90
17 Unmanaged Rural Lands (Vacant, Undeveloped, or Residential Parcels >10 Acres)	5153.18	36.65	0	0
18 Undeveloped Land (Vacant Land < 10 Acres)	623.45	4.43	0	0
19 Special Use: Marina	70.94	0.50	70.94	0.50
20 Special Use: Well Sites	10.46	0.07	10.46	0.07
21 Major Roads (ROW) (US 70 & NC 98)	124.91	0.89	142.86	1.02
22 Local Roads (ROW)	329.46	2.43	1,511.62	10.75
Total Land Use Area Excluding Road Rights-of-Way (ROW)	13,586.59	96.64	13,586.59	96.64
Total Watershed Area	14,059.10		14,059.10	

Table 9. Lick Creek Current Land Use Analysis by Subwatershed (areas shown in acres)

Category	Subwatershed #											
	1	2	3	4	5	6	7	8	9	10	11	All
1 Water Surface	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	169.21	32.47	160.88	362.56
2 Protected Natural Area	54.19	0.45	16.40	0.00	0.00	109.92	24.55	0.00	571.89	177.14	470.35	1,424.89
3 Urban Green Space	103.43	16.44	79.49	5.75	3.57	152.20	2.22	23.44	8.73	0.75	0.00	396.02
4 Institutional	7.96	0.82	18.96	0.00	14.31	0.58	0.00	0.00	0.17	0.10	0.00	42.90
5 Industrial	6.96	13.60	0.00	0.00	0.00	5.14	0.06	0.19	0.06	5.69	1.07	32.77
6 Commercial Retail	13.43	137.94	7.54	0.00	0.00	0.00	0.00	0.00	1.09	0.00	0.00	160.00
7 Commercial Office	2.13	7.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.15
8 Forest	61.98	174.14	48.21	107.64	781.85	340.90	332.93	297.49	360.28	361.60	126.53	2,993.55
9 Agricultural - Row Crop	62.96	2.80	91.77	71.63	96.58	0.00	0.00	56.39	0.00	0.00	0.00	382.13
10 Agricultural - Pasture	13.46	19.92	59.39	12.34	0.00	118.78	142.73	122.39	0.00	27.44	1.06	517.51
11 Medium Density Residential	2.86	32.69	0.00	0.00	0.00	0.00	0.00	0.31	0.00	0.00	0.00	35.86
12 Low-Medium Density Residential (0.125-0.25 Acre)	2.35	0.00	18.97	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	21.60
13 Low-Density Residential (0.25-0.5 Acre)	8.39	2.20	31.83	0.68	0.77	0.00	1.00	0.32	0.96	0.86	0.00	47.01
14 Very Low Density Residential (0.5-2 Acre)	14.90	48.82	45.17	7.94	15.70	23.93	18.42	115.75	22.73	113.71	27.02	454.09
15 Semi-Rural Residential (2-3 Acres)	2.07	8.03	28.17	14.42	17.92	15.91	14.68	34.55	17.38	38.13	2.02	193.28
16 Rural Residential (3-10 Acres)	33.81	43.97	34.36	29.61	116.87	76.03	65.97	61.70	97.89	101.66	11.39	673.26
17 Unmanaged Rural Lands (Vacant, Undeveloped, or Residential Parcels >10 Acres)	531.66	678.56	195.08	410.05	464.41	579.67	857.61	487.46	580.87	367.79	0.00	5,153.16
18 Undeveloped Land (Vacant Land < 10 Acres)	75.96	73.02	32.59	25.49	56.49	40.48	51.69	56.93	61.00	145.86	3.91	623.42
19 Special Use: Marina	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	70.94	70.94
20 Special Use: Well Sites	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.58	2.88	10.46
21 Major Roads (ROW) (US 70 & NC 98)	17.29	25.63	6.53	0.00	0.00	18.15	0.00	0.00	31.59	25.72	0.00	124.91
22 Local Roads (ROW)	63.09	23.67	42.65	12.80	31.32	18.89	38.88	37.28	35.42	23.07	2.56	329.63
Total Land Use Area Excluding Road Rights-of-Way (ROW)	998.50	1,260.42	707.93	685.55	1,568.47	1,463.54	1,511.86	1,257.20	1,892.26	1,380.78	878.05	13,604.56
Total Watershed Area	1,078.88	1,309.72	757.11	698.35	1,599.79	1,500.58	1,550.74	1,294.48	1,959.27	1,429.57	880.61	14,059.10

Figure 1. Lick Creek Current Land Use

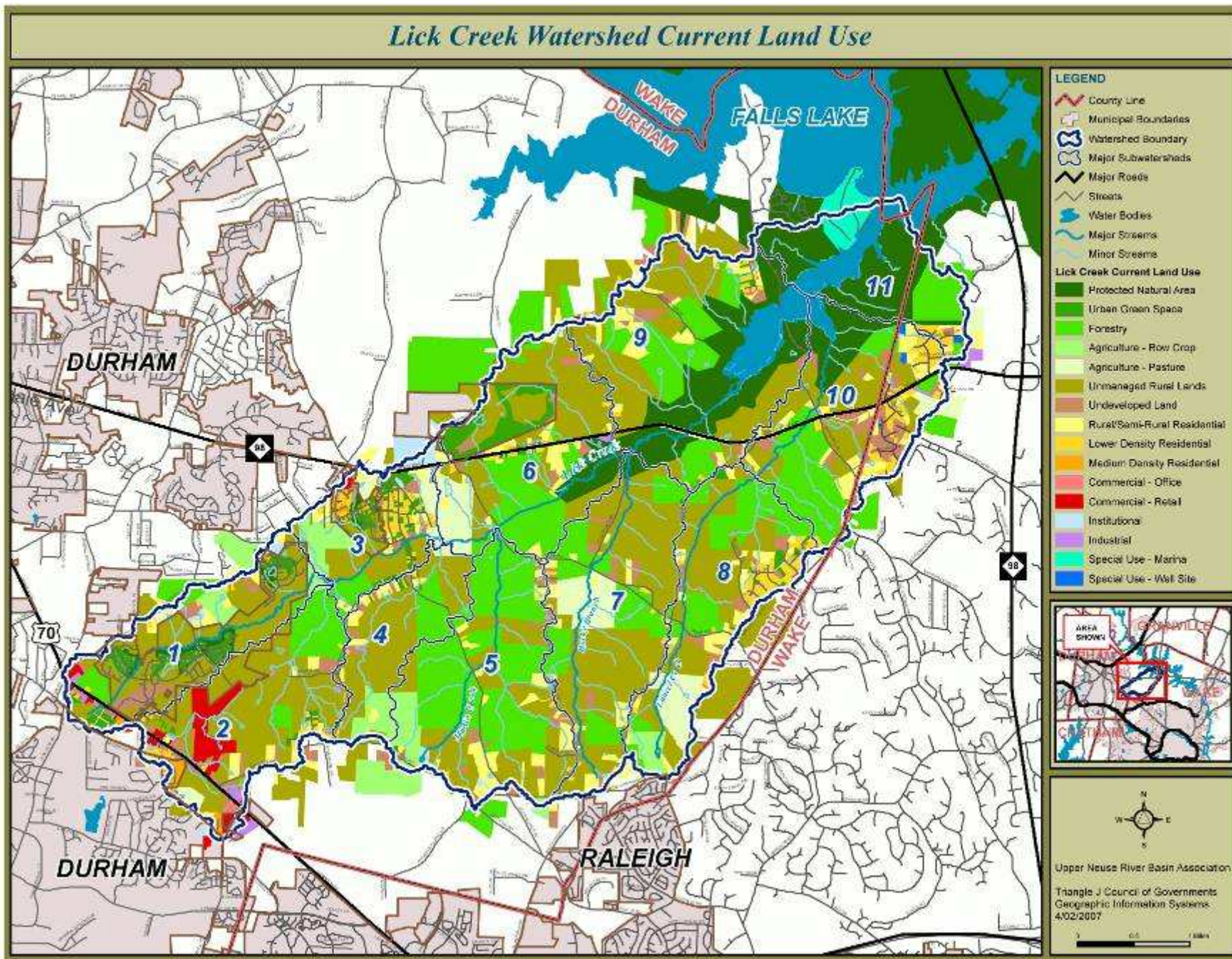
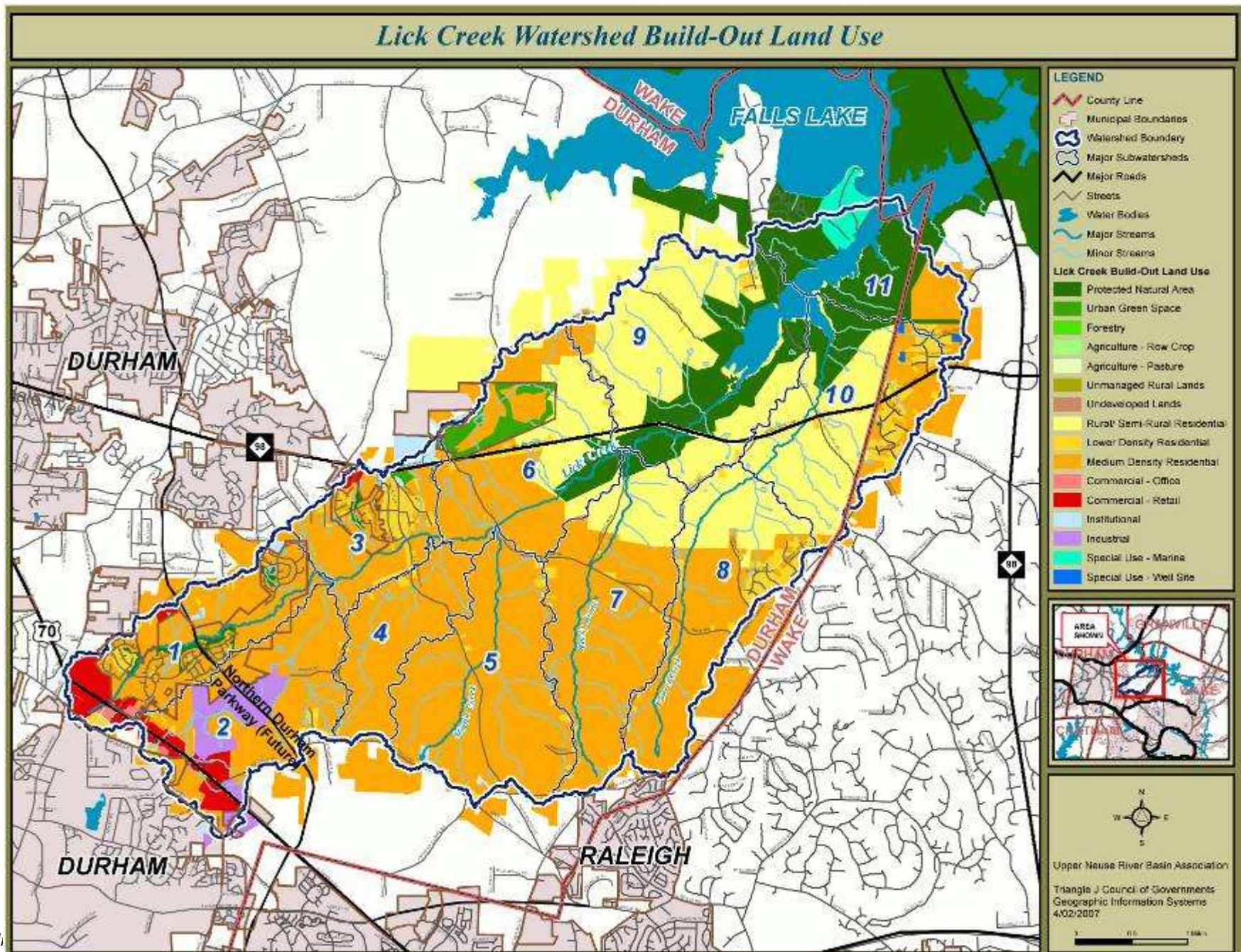


Table 10. Lick Creek Build-out Land Use Analysis by Subwatershed (areas shown in acres)

Category	Subwatershed #											
	1	2	3	4	5	6	7	8	9	10	11	All
1 Water Surface	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	169.21	32.47	160.88	362.56
2 Protected Natural Area	154.26	121.96	86.52	100.68	227.95	365.71	311.96	259.06	985.19	486.39	492.25	3,591.93
3 Urban Green Space	0.00	0.20	12.25	0.00	0.00	145.71	0.23	0.04	0.38	0.18	0.00	158.99
4 Institutional	13.28	0.82	31.52	0.00	14.31	0.58	0.00	0.00	0.17	0.10	0.00	60.78
5 Industrial	0.02	232.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.46	0.00	234.50
6 Commercial Retail	130.91	114.98	14.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	259.95
7 Commercial Office	16.61	5.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	22.33
8 Forest	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9 Agricultural - Row Crop	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10 Agricultural - Pasture	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11 Medium Density Residential	0.11	32.69	0.00	0.00	0.00	0.12	0.06	0.31	0.00	0.00	0.00	33.29
12 Low-Medium Density Residential (0.125-0.25 Acre)	532.57	575.96	371.76	483.25	1,094.15	559.22	841.50	529.06	26.61	155.40	105.11	5,274.59
13 Low Density Residential (0.25-0.5 Acre)	36.99	5.01	60.37	1.06	0.77	0.00	1.98	2.30	1.81	2.94	0.00	113.23
14 Very Low Density Residential (0.5-2 Acre)	22.30	52.51	70.68	13.31	33.74	33.04	31.09	140.43	35.31	164.45	27.02	623.88
15 Semi-Rural Residential (2-3 Acres)	0.00	0.00	0.00	0.00	0.00	9.66	0.58	2.12	24.98	18.12	0.00	55.46
16 Rural Residential (3-10 Acres)	0.00	0.00	0.00	0.00	0.00	217.19	147.30	194.87	552.05	420.34	0.00	1,531.74
17 Unmanaged Rural Lands (Vacant, Undeveloped, or Residential Parcels >10 Acres)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18 Undeveloped Land (Vacant Land < 10 Acres)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17 Special Use: Marina	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	70.94	70.94
18 Special Use: Well Sites	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.58	2.88	10.46
19 Major Roads (ROW) (US 70 & NC 98)	22.00	38.87	6.53	0.00	0.00	18.15	0.00	0.00	31.59	25.72	0.00	142.86
20 Local Roads (ROW)	149.83	128.98	103.42	100.05	228.87	151.20	216.04	166.29	131.97	113.43	21.54	1,511.62
Total Land Use Area Excluding Road Rights-of-Way (ROW)	993.77	1,247.18	707.93	685.55	1,568.47	1,463.54	1,511.86	1,257.20	1,892.26	1,380.78	878.05	13,586.59
Total Watershed Area	1,078.88	1,309.72	757.11	698.35	1,599.79	1,500.58	1,550.74	1,294.48	1,959.27	1,429.57	880.61	14,059.10

Figure 2. Lick Creek Build-out Land Use



Land Use and the Site Evaluation Tool (SET)

The SET doesn't use land use categories, per se, since it is based on calculating the actual impervious surface of a particular site (or group of sites), then applying event mean concentrations (EMCs) of pollutants to up to six different portions of a site or group of sites:

- o the impervious portion;
- o the pervious portion that is landscaped (i.e., lawns, gardens, etc.)
- o any forest cover
- o any meadow
- o any pasture (which is essentially meadow with farm animals)
- o any row crops.

For most urban and suburban sites, only the first two of these are actually used. Land use only comes into play in that sites must be identified as either "high traffic" areas – typically industrial and commercial retail sites – where pollutant loads would be higher, and "normal traffic" areas – everything else such as residential, office parks, etc. – where loads would be relatively lower; different EMCs are applied depending on the "high" or "normal" classification.

So for the purposes of the Little Lick Creek project, any land use classification can be used that can yield an estimate of the six areas described above and for which each category can be assigned the "high" or "normal" distinction. The table below assigns a "high" or "normal" value to the developed land uses.

	Lick Creek Land Use	Description	SET High or Normal
1	Industrial	Industrial from the Durham Comprehensive Plan	High
2	Institutional	schools, churches, libraries, museums, fire/police stations	Normal
3	Commercial Retail	Commercial from the Durham Comprehensive Plan	High
4	Commercial Office	Office from the Durham Comprehensive Plan	Normal
5	Medium Density Residential	lots less than 0.125 acres with a residence, all developed multi-family (8-16 units per acre)	Normal
6	Low-Medium Density Residential	0.125-0.25 acre lots with a residence (4-8 units/acre)	Normal
7	Low Density Residential	0.25 to 0.5 acre lots with a residence (2-4 units/acre)	Normal
8	Very Low Density Residential	0.5 to 2 acre lots with a residence	Normal
9	Semi-Rural Residential	2 to 3 acre lots with a residence	Normal
10	Rural Residential	3 to 10 acre lots with a residence	Normal
11	Agricultural-Crops	lots greater than 10 acres, with or without residence	N/A
12	Agricultural-Pasture	lots greater than 10 acres, with or without residence	N/A
13	Unmanaged Rural Lands	Vacant, undeveloped or residential parcels > 10 acres	N/A
14	Undeveloped Lands	Vacant land < 10 acres	N/A
15	Urban Green Space	developed parks, golf courses and cemeteries, residential lots of 1 acre or less with no residence	N/A
16	Protected Natural Area	mostly undeveloped parks and protected natural areas, 100 year floodplains on undeveloped parcels	N/A
17	Other Forested Land	vacant private land in a forested condition	N/A
18	Water Surface	lakes	N/A
19	Major Roads	roads with 4 or more travel lanes	High
20	Local Roads	all other roads	high