



# Town of Carrboro

Town Hall  
301 W. Main St.  
Carrboro, NC 27510

## Meeting Agenda Board of Aldermen



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Tuesday, February 11, 2014

7:30 PM

Board Chambers - Room 110

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**Work Session - Public comment is generally not accepted.**

**Work Session - Please note that public comment is generally not accepted during work sessions of the Board of Aldermen.**

### 7:30-7:40

#### **A. PUBLIC HEARING**

1. [14-0040](#) A Public Hearing To Obtain Community Input On Town Needs and Budget For Upcoming FY 2014-15

PURPOSE: This is a public hearing to receive comments from the public regarding the upcoming budget for the Town beginning July 1, 2014.

Attachments: [NOTICE OF PUBLIC HEARING](#)

#### **B. OTHER MATTERS**

### 7:40-8:00

1. [14-0033](#) Solarize Carrboro Report

PURPOSE: The purpose of this agenda item is for the Board to receive a report on Solarize Carrboro from Rob Pinder with Next Climate, Inc.

Attachments: [Attachment A - Solarize Resolution](#)

### 8:00-8:20

2. [14-0027](#) Update on the Process for Developing a Parking Management Plan

PURPOSE: This agenda follows up on the Board of Aldermen's resolution on November 12, 2013, relating to developing a scope for a parking management plan.

**Attachments:**   [Attachment A - Resolution - Parking plan update - Feb 2014](#)  
[Attachment B - Parking Plan scope - Draft 2-7-14](#)  
[Attachment C - Board of Aldermen comment summary - parking plan - Nov 12 2013](#)  
[Attachment D-1-2 - 2014-01-29 - Letter to MPO - Carrboro Parking Plan - FY15 UPWP](#)  
[Attachment D-3 - Email from MPO Planning Manager](#)  
[Attachment D-4 - Email 2 from MPO Planning Manager](#)

### **8:20-8:40**

3.      [14-0028](#)      Storm Water Design Standards - future considerations

PURPOSE: The purpose of this item is to provide the Board of Aldermen an opportunity to discuss possible future changes to storm water design standards in light of recent flooding issues and concerns about climate change.

**Attachments:**   [Overview map of June 30 2013 flood reports - 8-5-13 8](#)  
[APPEND-I.pdf](#)  
[Tom's Creek Survey Summary - February 2014](#)  
[Jordan Lake Water Quality Act S515.pdf](#)

### **8:40-9:00**

4.      [14-0039](#)      Discussion on land uses associated with drive-in and drive-through windows

PURPOSE: The purpose of this item is to provide the Board of Aldermen with an opportunity to discuss regulations affecting land uses with drive-in and drive-through windows.

**Attachments:**   [Att A - Excerpts from ART-XI-drive-in windows](#)  
[Att B - ART-X of the LUO Table of Permissible Uses](#)  
[Att C - EPA Article on Extended Vehicle Idling](#)  
[Att D - US Dept of Energy Idle vs stop at drive-thru](#)  
[Att E - US Dept of Energy Idle vs stop and start paper](#)

### **9:00-9:30**

5.      [14-0022](#)      Discussion of Prohibition on Parking in Public Lots from 3 AM to 5 AM  
PURPOSE: The purpose of this agenda item is to provide an opportunity for the Board of Aldermen to discuss the late night/early morning parking prohibition for public parking lots in the downtown.

**Attachments:**   [Ordinance No 21 Amending Parking in Town Lots.pdf](#)

## **C.      MATTERS BY TOWN CLERK**

- D.      MATTERS BY TOWN MANAGER**
- E.      MATTERS BY TOWN ATTORNEY**
- F.      MATTERS BY BOARD MEMBERS**



# Town of Carrboro

Town Hall  
301 W. Main St.  
Carrboro, NC 27510

## Legislation Text

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**File #:** 14-0040, **Version:** 1

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**TITLE:**

A Public Hearing To Obtain Community Input On Town Needs and Budget For Upcoming FY 2014-15

**PURPOSE:** This is a public hearing to receive comments from the public regarding the upcoming budget for the Town beginning July 1, 2014.

**DEPARTMENT:** Town Manger

**CONTACT INFORMATION:** David Andrews, Town Manager

**INFORMATION:** Each year the Board of Aldermen must adopt an annual operating budget by July 1st. As part of its budget development process, the Board schedules a public hearing to receive comments from residents regarding Town services at the beginning of the process. These comments will be considered in developing the FY 2014-15 operating and capital budgets.

A notice of this public hearing was advertised in The Chapel Hill Herald and on the Town's website. The advertisement notifies residents of a public hearing to receive public input and invites residents to submit written comments about the budget for the upcoming year. Residents may also email their comments to the Town Clerk via the Town's website ([townofcarrboro.org](http://townofcarrboro.org)). All comments will be summarized by the Town staff and given to the Board as they are received following the public hearing. Residents will have another opportunity to speak about Town services and the Town Manager's Recommended Budget for FY 2014-15 at a public hearing planned for Tuesday, May 20, 2014.

In addition, the Board of Aldermen is requested to provide input to the Town Manager on needs or service improvements they consider important in developing the budget for FY 2014-15.

**FISCAL & STAFF IMPACT:** None

**RECOMMENDATION:** Staff recommends that the Board hold a public hearing to receive community comments on Town services and needs for the upcoming budget year and provide input to the Town Manager on needs and service improvements to consider in developing the budget for FY 2014-15

**NOTICE OF PUBLIC HEARING  
TO  
RECEIVE COMMENTS AND SUGGESTIONS ON CARRBORO COMMUNITY NEEDS AND  
PRIORITIES FOR FISCAL YEAR 2014-15 BUDGET BEGINNING JULY 1**

On February 11, 2014 the Board of Aldermen will hold a public hearing to receive comments and suggestions on Carrboro community needs and priorities for the budget beginning July 1, 2014.

The Town Manager plans to submit a Recommended Budget to the Board of Aldermen on May 6, 2014. A public hearing to receive comments on the Manager's Recommended Budget will be held on May 20, 2014. The final budget is planned for adoption on Jun 17, 2014.

The Board of Aldermen and Town Manager welcome feedback from Town residents throughout the budget process. Carrboro residents may send written suggestions and comments to the Town Clerk at 301 West Main Street, Carrboro, NC 27510; or fax them to (919) 918-4456. Residents may also email written suggestions to the Town Clerk at [Cwilson@townofcarrboro.org](mailto:Cwilson@townofcarrboro.org)



# Town of Carrboro

Town Hall  
301 W. Main St.  
Carrboro, NC 27510

## Legislation Text

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**File #:** 14-0033, **Version:** 1

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**TITLE:**

Solarize Carrboro Report

**PURPOSE:** The purpose of this agenda item is for the Board to receive a report on Solarize Carrboro from Rob Pinder with Next Climate, Inc.

**DEPARTMENT:** Planning

**CONTACT INFORMATION:** Randy Dodd, Environmental Planner (918-7326)

**INFORMATION:** Solarize Carrboro is a collaboration between Next Climate, Inc. (a Carrboro-based, 501 (c)(3) non-profit organization), the Town of Carrboro, and the NC Solar Center that seeks to inspire individuals and organizations and reduce the barriers to residential solar installations, thereby reducing emissions that contribute to climate change, improving air quality, lowering energy costs, and increasing community resilience. Central to the “Solarize” concept is leveraging local community support through outreach and aggregating sales. The aggregation of multiple residential solar PV installations within a community provides opportunities to realize economies of scale for an installer and cost savings for the customers. Next Climate, Inc. has recently issued a Request for Proposals to select an installer to perform the installations for Solarize Carrboro. The installer is expected to provide a tiered pricing structure that provides lower cost per watt installed within the project area as more people sign on, as well as free solar site assessments, financing models, applicable rebate information, and installation services. Next Climate, Inc. has also worked with Town staff to identify neighborhoods in Carrboro that have high owner occupancy rates, recent construction, and other factors that are suitable for home solar installation, and begin soliciting homeowner interest both for installations on their homes and to help get the word out about Solarize Carrboro. Next Climate, Inc. intends to support neighborhood volunteers and host free events to provide technical information, answer questions and solicit feedback. The time frame is to select an installer in February, ramp up outreach and pursue homeowner sign-up March-May, and complete installations beginning in the summer.

**FISCAL & STAFF IMPACT:** There is no fiscal impact associated with receiving this report and the Town is not providing financial support. Staff have been working with Next Climate, Inc. to support the launch of the initiative, and plan to continue to do so in coming months.

**RECOMMENDATION:** Staff recommends that the Board adopt the resolution provided in Attachment A receiving the report from Next Climate, Inc., directing staff to continue supporting Solarize Carrboro and offering any additional input. .

## **ATTACHMENT A**

### **A RESOLUTION ACCEPTING THE SOLARIZE CARRBORO REPORT AND DIRECTING STAFF TO CONTINUE TO SUPPORT SOLARIZE CARRBORO**

WHEREAS, the Town has signed on to the Mayors Climate Protection Agreement and adopted a Climate Protection Resolution in 2009;

WHEREAS, the Town participated in the Orange County Greenhouse Gas Inventory, and updated the inventory in 2011, 2012, and 2013, and has pursued emissions reductions through a variety of means; and

WHEREAS, Town staff have recommended next steps with energy and climate protection planning and implementation in an update to the Board; and

WHEREAS, Solarize Carrboro is being led by Next Climate, Inc., and Next Climate, Inc. has asked the Town to support Solarize Carrboro, and has provided a report to the Board of Aldermen.

NOW THEREFORE BE IT RESOLVED by the Carrboro Board of Aldermen that the Aldermen accept the Solarize Carrboro report and direct staff to continue supporting Solarize Carrboro.



## Legislation Text

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**File #:** 14-0027, **Version:** 1

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**TITLE:**

Update on the Process for Developing a Parking Management Plan

**PURPOSE:** This agenda follows up on the Board of Aldermen's resolution on November 12, 2013, relating to developing a scope for a parking management plan.

**DEPARTMENT:** Planning

**CONTACT INFORMATION:** Jeff Brubaker - 918-7329

**INFORMATION:** On November 12, 2013, the Board of Aldermen received a staff report on a scope, issues, potential strategies, and next steps for completing a parking plan. The Board adopted a resolution receiving the report and asking that staff consider the comments Board members provided during the discussion portion of the agenda item. The Board also adopted a resolution approving of staff communicating with the Durham-Chapel Hill-Carrboro Metropolitan Planning Organization (DCHC-MPO) regarding potential assistance and coordination on the development of a parking plan.

A draft revised scope is provided in Attachment B. The scope will eventually be incorporated into the Request for Proposals (RFP) for consulting services. This agenda item is only an update and an opportunity for the Board to provide further comments. At the time of this writing, staff are still finalizing notes from the participant feedback at the January 31 Parking Summit.

A document that summarizes Board of Aldermen comments from the November 12 meeting and provides a staff response is provided in Attachment C.

Attachment D provides correspondence between Town staff and MPO staff in regard to a request for funding for the plan. The MPO staff concur with including \$120,000 in the FY14-15 Unified Planning Work Program (UPWP) for the parking plan; the allocation will be formalized when the UPWP is adopted by the MPO Transportation Advisory Committee, usually occurring in the spring. This allocation would require a non-federal match (20%) of \$30,000, for a total allocation of \$150,000 for the plan. It also means that the process would need to adhere to federal grant and procurement guidelines.

**FISCAL & STAFF IMPACT:** No fiscal and staff impacts accrue from receiving the update. As stated above, a non-federal match of \$30,000 from Town revenues or another source would need to be provided to make use of the proposed \$120,000 in planning funds for the UPWP.

**RECOMMENDATION:** That the Board of Aldermen adopt the resolution in Attachment A receiving the update.

A RESOLUTION RECEIVING AN UPDATE ON THE PROCESS FOR DEVELOPING A  
PARKING PLAN

WHEREAS, *Carrboro Vision 2020* Objective 3.21 recommends that the Town should adopt a goal to “improve the downtown infrastructure”, including “parking facilities”; and,

WHEREAS, *Carrboro Vision 2020* Objective 3.24 states: “Frequent, accessible public transit is necessary for a thriving downtown. Multi-modal access to downtown should be provided. As traffic increases, Carrboro should consider perimeter parking lots served by shuttles to bring people downtown.”; and,

WHEREAS, both *Downtown Carrboro: New Vision (2001)* and the *Carrboro Downtown Transportation Study (2005)* offer findings and recommendations with respect to parking; and,

WHEREAS, the *Carrboro Comprehensive Bicycle Transportation Plan (2009)* makes recommendations with respect to bike parking; and,

WHEREAS, a 2008 study by UNC Department of City and Regional Planning graduate students and faculty and a 2013 study also conducted by UNC DRCP graduate students both examined parking in Carrboro; and,

WHEREAS, the Board of Aldermen has, over the past several years, discussed parking issues on numerous occasions; and,

WHEREAS, Board of Aldermen members have expressed interest in the completion of a parking plan; and,

WHEREAS, the Board of Aldermen received an update on the development of a parking plan at its November 12, 2013, meeting, and directed that its comments be incorporated into a future update;

NOW, THEREFORE, BE IT RESOLVED by the Board of Aldermen that the Board accepts the staff update on the process for developing a parking plan.

BE IT FURTHER RESOLVED that the Board offers the following feedback and direction:

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

This is the 11<sup>th</sup> day of February in the year 2014.

# Parking plan scope – DRAFT

For Board of Aldermen reference – Feb. 11, 2014

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## Summary of services contracted

The selected consulting team will be expected to perform, or otherwise assist with, tasks including, but not necessarily limited to, public and stakeholder participation; data collection; data analysis; mapping; policy analysis; one or more presentations to advisory board members, the Board of Aldermen, and-or other community organizations; and preparation of a parking plan document. For more details on the expected tasks to be performed, see the Tasks section below.

## Expected project milestones

- Consultant selection: spring/summer 2014
- Project kickoff: August 2014
- Public participation and stakeholder coordination: throughout project
- Policy analysis: fall 2014
- Data collection and analysis: fall 2014/spring 2015
- Mapping: as needed
- Board of Aldermen/advisory board presentations: September 2014, January 2015, May or June 2015
- Completion of draft plan: spring/summer 2015

## Major themes

- Supply
- Demand
- Management
- Enforcement
- User experience

## Geographic scope

A three-tiered geographic scope is proposed for the parking plan.

1. **Focus area**
  - a. Central business district
  - b. Principal trip attractor

- c. Same extent of the 2008 DCRP study area. The plan should also demarcate zones and sub-zones the same way as that study did.
  - d. Approximately two-thirds of a mile across
  - e. Most rigorous data collection and analysis
2. **Impact area**
- a. Quarter-mile spatial buffer around the focus area
  - b. Includes neighborhoods adjacent to downtown
  - c. Could be impacted by policies and projects in the focus area
  - d. Approximately one mile across
  - e. Additional data collection as needed
3. **Study area**
- a. The whole town
  - b. Proposed geographic scope of the resident survey
  - c. All residents (plus interested visitors) should feel welcome to participate in the process
  - d. Land Use Ordinance parking requirements affect all areas of town

See Appendix [\[1\]](#) for more information.

## Special emphasis areas

In addition to the three-tiered scope, special emphasis areas may be studied, including:

- Commercial areas outside of downtown
- Chapel Hill Transit park-and-ride lots
- Other areas identified during contract scoping

## Tasks

### Public participation

#### 1. Public participation plan

At the outset of the planning process, the consulting team will produce a brief memo including a plan for the approximate dates, content, and expected consultant and Town staff responsibilities in regard to the public participation activities described below. The memo will also describe how the process will reach out to traditionally underserved and non-English-speaking community members.

#### *Consultant tasks*

- Prepare public participation plan memo
- Present the memo for review at a staff meeting
- Revise if necessary based on any review comments

## 2. Kickoff meeting

A plan kickoff meeting will be held that will allow the public and stakeholders to provide input on parking and access issues downtown. Big-picture themes and goals will be discussed at this meeting.

### *Consultant tasks*

- Coordinate with Town staff in designing the agenda for the meeting
- Co-run the meeting with Town staff
- Give a presentation at the meeting
- Compile and summarize written and verbal comments and group reports

## 3. Parking and access charrette

This event will allow participants to propose solutions to particular parking management problems.

### *Consultant tasks*

- Plan the charrette agenda and review with Town staff
- Prepare maps and public comment forms for the charrette
- Attend and co-facilitate the charrette with Town staff
- Compile and summarize all comments, group reports, and proposed solutions from charrette participants
- Include summarized information in the parking plan

## 4. Stakeholder interviews

Stakeholder interviews allow those most affected by parking issues and strategies to report specific parking issues/concerns and suggest remedies.

Interviews may include representatives from the business community, nonprofit organizations, advisory boards, Chapel Hill Transit, the Carrboro Farmers' Market, Town staff, citizens, and others.

### *Consultant tasks*

- Coordinate with Town staff to recruit interviewees and schedule interviews
- Conduct interviews (in person, email, or phone)
- Compile and summarize interview notes
- Include summarized information in the parking plan

## 5. Public forum

One or more public forums will be held to educate the community on parking management strategies and best practices from other communities. This could take the form of one forum including a panel discussion, or multiple forums with individual speakers, depending on scheduling availability.

Possible forum topics include: downtown parking strategies for smaller communities; how the price of parking affects travel mode choices; parking supply needs and financial analysis; and how carsharing, ridesharing, and transit connections relate to parking.

The forum or forums should represent an array of viewpoints on effective parking management. Emphasis should be given, as much as possible, to speakers who have expertise in, or familiarity with, parking policies and strategies in communities of a similar size and economic profile as Carrboro.

### *Consultant tasks*

- Coordinate with Town staff on the scheduling of, and speakers for, the forum or forums
- Attend the forum or forums
- Write a summary of the forum or forums to be included in the parking plan

## 6. Parking scavenger hunt

A parking scavenger hunt will provide participants with the opportunity to experience accessing multiple destinations in Carrboro using different modes. Starting from various points, and using various modes, participants will visit multiple businesses and other locations in order to find a list of items. They will be asked to keep track of length of time spent searching for a parking spot (if in a car or bike), the distance and time walking from the parking space to the front door of the destination, route taken, and other important information. The results will serve as examples of the decisions residents make when they need to access destinations in Carrboro, especially downtown, and find a place to park.

### *Consultant tasks*

- Coordinate with Town staff and businesses to organize the scavenger hunt
- Compile and summarize information from participant logs
- Include information in the parking plan

## 7. Social media and tabling

A social networking page, video channel, and other social media will be considered as tools to connect people with information about the parking plan. Use of an online community engagement site may also be considered.

Tabling at events or locations with heavy foot traffic may also be considered to inform attendees/customers of the parking plan.

The extent to which both of these are included in the parking plan will be discussed further prior to contract signing. This task is expected to be primarily the responsibility of Town staff; however, Town staff will coordinate with the consultant and therefore the consultant should expect to have some role.

## **8. Surveys**

Surveys are described further in the “Data Collection” section.

## **9. Draft plan public open house**

The draft parking plan will be presented at a public open house, where interested residents and stakeholders can view plan goals and recommendations.

### *Consultant tasks*

- Print draft copies of the plan to be displayed at the open house
- Create maps and graphic boards, as appropriate, to display at the open house
- Attend the open house, providing a brief presentation and answering questions from the public
- Compile public comments into a document that can be presented along with the draft plan to the Board of Aldermen and advisory boards

## **Data collection**

### **10. Data collection plan**

The consultant will produce a brief memo that outlines a data collection plan, including a general timeline for implementing each data collection task, and specific strategic information where necessary, e.g. expected times during the day parking utilization counts will be conducted. This will be completed early in the process, and Town staff will review the plan with the consultant to ensure that there is agreement on the strategies and tasks outlined.

### *Consultant tasks*

- Produce a data collection plan

### **11. Parking space inventory**

*Tiers: focus area, impact area, special study areas such as CHT park-and-ride lots*

The consultant will work with Town staff to assemble a comprehensive GIS-based inventory of parking spaces, utilizing existing data where available and collecting new data using rudimentary on-site hand counts, viewing satellite imagery, or consulting approved site plans or other planning documents. Note that the 2008 DCRP study collected supply data for select CBD lots, and the Town has parking space supply data for all municipal lots and CHT park-and-ride lots. The inventory should classify spaces by accessibility (ADA or non-ADA), public/private, time restriction, trip purpose restriction, and potentially other attributes.

*Consultant tasks*

- Coordinate with Town staff in assembling the inventory in GIS
- Collect additional data via hand counts or satellite imagery as necessary (may also be completed by Town staff)

## 12. Parking utilization surveys

*Tiers: focus area, impact area (on-street parking), possibly special study areas*

The consulting team, working with Town staff and volunteers, will conduct parking utilization surveys of private and public lots. Town staff will request permission from private property owners for surveys on private lots. Counts will be conducted at multiple times on both weekdays and weekends. At this time, there is expected to be two count sets: one in fall 2014 and one in early 2015. Each set would involve counts on select weekdays plus weekend days. However, this could change during the contract scoping process.

*Consultant tasks*

- Coordinate with Town staff in designing and organizing the surveys
- Input the counts into a database and review the data to ensure quality, enabling the data to be used to report occupancy at various times in the day

## 13. Targeted, detailed turnover studies

*Tiers: focus area*

Detailed turnover studies will be conducted where their particular level of data may be useful. While parking utilization surveys count the raw number of cars in each lot, detailed turnover studies track individual space utilization, logging the times when motor vehicles park at and depart from each space. As noted above, the Town has conducted detailed turnover studies on E. Weaver St. The 2008 DCRP study conducted a turnover survey of public lots, although instead of logging exact times of vehicle arrival and departure, the study took counts in three-hour increments, noting during each count (using tire chalking) which vehicles from the previous count were still parked in the same space.

*Consultant tasks*

- As part of the data collection plan, the consultant will work with Town staff to identify the specific turnover study areas
- Conduct the counts
- Compile the data into a database

#### 14. Resident survey

Tiers: study area

The resident survey is important to collect residents' perceptions and attitudes to accessing destinations and parking in Carrboro. Particularly, residents and visitors who live further away from downtown and other destinations and-or have limited transit service available are more likely to rely on an automobile for access. The survey is expected to be a sample of households spread throughout town. The survey's purpose is to identify how parking and access opinions positively or negatively affect residents' travel choices within Carrboro. The type(s) of survey delivery (online, mail, phone) will be discussed with the selected consultant during contract scoping. Consulting teams may propose a range of resident survey methodologies in their proposals.

*Consultant tasks*

- Write a draft of the survey for Town staff review
- Finalize the survey
- Administer the survey
- Tabulate survey results

#### 15. Customer/visitor survey

Tiers: focus area

This survey will be an intercept survey with people visiting businesses and other destinations in downtown Carrboro. Surveyors will stand near the entrance and ask customers if they would like to participate. The survey will be in-person and ask questions about what mode the respondents used, where they parked (if car or bike), if they searched for parking, and related questions.

*Consultant tasks*

- Write a draft of the survey for Town staff review
- Finalize the survey
- Administer the survey, coordinating with Town staff and potential volunteers, who may assist with administering it
- Tabulate survey results

## 16. Business owner survey

### Tiers: focus area

A business owner survey was conducted as part of the 2008 DCRP study. A survey specifically with respect to employee parking was conducted by the Town in fall 2013. This survey would be similar to the 2008 DCRP survey, intending to provide quantitative and qualitative data which would be supplemented by the stakeholder interviews. Town staff can assist in recruiting businesses to take the survey.

### *Consultant tasks*

- Write a draft of the survey for Town staff review
- Finalize the survey
- Administer the survey
- Tabulate survey results

## 17. Cruising for parking survey

### Tiers: focus area

This could be a separate survey or combined with the customer/visitor survey, which is designed to estimate the extent to which motorists cruise for parking in the CBD. The exact design of this survey will be discussed during contract scoping. Consultants are encouraged but not required to propose specific cruising study methodologies (or strategies for incorporating cruising questions into the customer/visitor survey).

### *Consultant tasks*

- Develop the cruising survey, or survey questions, coordinating with Town staff
- Administer the survey
- Tabulate survey results

## 18. Loading zone utilization surveys

### Tiers: focus area

These surveys will determine utilization of loading zones throughout the day by delivery vehicles. Collecting loading zone utilization data could be most efficiently implemented as part of a targeted turnover study, as was the case for the Town's E. Weaver St. turnover surveys. However, it is possible that a standalone loading zone survey could be conducted.

### *Consultant tasks*

- Collect loading zone utilization data along with a detailed turnover survey, where appropriate

## Data analysis

### 19. Projection of future parking demand

*Tiers: focus area, impact area*

Using current parking supply and demand data, and future land use scenarios – including buildout under current zoning – the consultant will prepare an analysis of future parking demand in the central business district. In addition to land use scenarios, the analysis should take into account a range of factors – such as demographics (e.g. number of households without a vehicle); pricing; presence of car-sharing, transit service, and bicycle and pedestrian amenities; and transportation demand management (TDM) measures that could be implemented by tenants – that could affect demand for residential and commercial parking. The potential for spillover parking within the impact area should also be considered in this analysis. ITE parking generation data may be considered as part of the analysis but should not be the sole or primary methodology for determining parking demand. Parking occupancy data from land uses in similar contexts in other communities may be helpful in projecting demand. In summary, the analysis should be careful not to underestimate or overestimate future parking demand.

*Consultant tasks*

- Conduct the analysis
- Include the analysis in the parking plan document

### 20. Land Use Ordinance parking requirement review

*Tiers: study area*

The consultant will conduct a comprehensive review of parking requirements included in Article XVIII of the Carrboro Land Use Ordinance, with particular attention to the Table of Parking Requirements in 15-291(g). The review should make use of the data collected as described above, and recommendations should be tailored based on different land use and transportation contexts, such as CBD vs. non-CBD and whether areas are transit-accessible.

*Consultant tasks*

- Conduct the review
- Include the analysis in the parking plan document

## 21. Walkability micro-audit

### *Tiers: focus area*

Since downtown Carrboro's street network has very limited on-street parking, public parking supply substantially depends on public parking lots and the parking deck. This means that parkers will have to walk a distance to some destinations. Whether a destination is seen as walkable and comfortable from a particular parking lot is a factor in the perception of parking availability. The consulting team will therefore conduct a walkability micro-audit in the CBD that makes recommendations for improving the safety, comfort, aesthetic quality, and accessibility for persons with disabilities, of pedestrian facilities in the vicinity of parking lots and the parking deck that are on a common walking route to destinations.

### *Consultant tasks*

- Schedule and lead a field walk downtown, noting problem areas
- Complete maps of issues and recommended improvements to be included in the parking plan
- Complete a table of recommendations and accompanying text as necessary to include in the parking plan

## 22. Park-and-ride analysis

### *Tiers: special emphasis area*

The plan should include a brief analysis of park-and-ride provisions in Carrboro. This would inform the Town's and transit agencies' planning for access to transit services.

### *Consultant tasks*

- Complete a park-and-ride analysis to include in the parking plan

## 23. Bike parking recommendations

### *Tiers: focus area*

The consultant will prepare recommendations on where bike parking may need to be enhanced in the CBD. This is not expected to be a detailed analysis, but should provide recommendations for both short-term and long-term (including covered) parking.

### *Consultant tasks*

- Develop bike parking recommendations for inclusion in the plan

## **Presentations**

### **24. Carrboro Board of Aldermen presentations**

The consultant will be expected to make three (3) presentations on the parking plan to the Board of Aldermen. Timing of presentations will be determined with the selected consultant during contract scoping.

#### *Consultant tasks*

- Develop slideshows
- Make three (3) presentations at Board of Aldermen meetings

### **25. Carrboro advisory board review presentations**

The consultant will be expected to make two (2) presentations to the Town's advisory boards during joint advisory board review meetings. These meetings bring together several advisory boards in the same room to streamline review of development concept plans, applications, and planning topics. The expected timeframe is one introductory presentation near the beginning of the planning process and one that presents the draft plan for review.

#### *Consultant tasks*

- Develop slideshows
- Make three (2) presentations at joint advisory board review meetings

### **26. Presentations to other organizations**

The consultant will be expected to make two (2) presentations to other organizations who have an interest in learning about the planning process. This could include an organization such as the Chapel Hill-Carrboro Chamber of Commerce or the Chapel Hill and Orange County Visitors' Bureau. These presentations will be scheduled at appropriate times during the planning process.

#### *Consultant tasks*

- Develop slideshows
- Make three (2) presentations to organizations

## **Plan development**

### **27. Writing of the plan**

The consultant will compile the information collected from the public, data collected as described above, and aforementioned analysis into a comprehensive, well-organized, and clear parking planning document that describes parking and access issues and opportunities and provides recommendations to inform future parking strategies in Carrboro. Goals developed early in the process should be included.

*Consultant tasks*

- Develop a draft version of the parking plan for staff review
- Develop a revised draft version for presentation to the public, advisory boards, and Board of Aldermen
- Revise the plan into a final draft to be considered for adoption

***Topics and strategies that should be analyzed for potential inclusion in the plan***

- Comprehensive, coordinated management of public parking spaces
- Enforcement of public parking space restrictions
- Employee parking
- Joint use
- Unbundling
- Car sharing
- Transportation demand management
- Pricing
- Enhancing supply of parking
- Bike parking
- Signage and marketing
- Parking ambassadors

**28. (Optional) Parking demand model**

It is in the Town's interest to have use of a model to estimate the demand of parking given changes in certain variables, such as land use and density, pricing, presence of carsharing, use of TDM strategies, presence of transit service and bicycle and pedestrian infrastructure, and other variables. Consultants' proposals should include a description of how the consultant could provide, develop, or assist in the development of a parking demand model to be given or licensed to the Town for future use. Further communication on this component should occur with the selected consultant during contract scoping.

**Staff meetings, coordination, and contract management**

**29. Bi-weekly plan update calls**

It is expected that, bi-weekly, the consultant and Town staff will have conference calls to check in on the progress of the plan, address issues that arise, and plan for upcoming tasks. A meeting could be in-person if that would be the most effective or convenient. Call/meeting frequency could increase or decrease depending on the number of issues to address or upcoming tasks for which to plan.

*Consultant tasks*

- Participate in bi-weekly (on average) check-in calls (or in-person meetings)
- Email a summary and list of action items after each call/meeting

**30. General coordination and contract management**

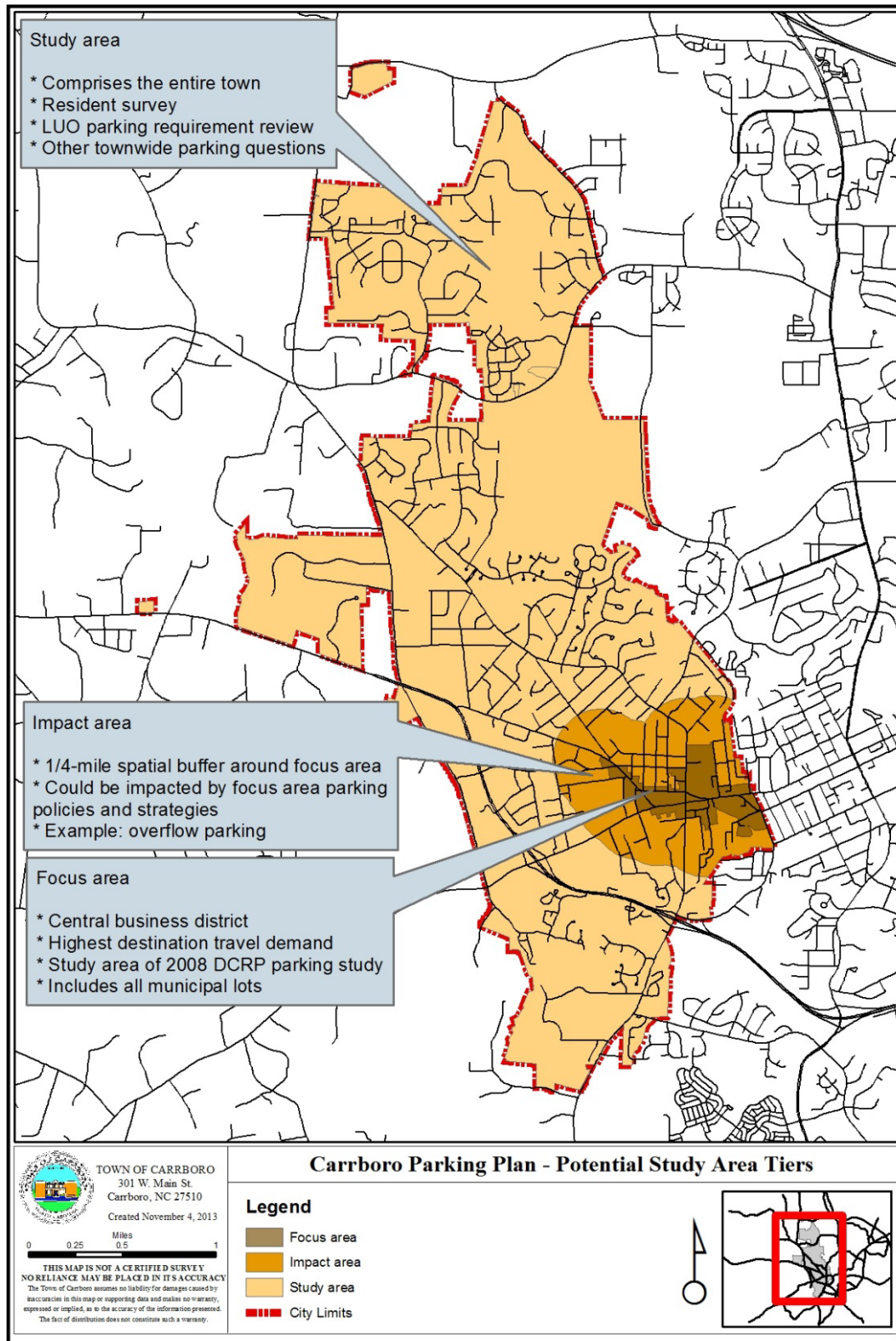
The consultant will maintain a project schedule, to be coordinated with Town staff. In addition to the aforementioned check-in calls, it is expected the consultant and Town staff will occasionally need to have additional phone and email conversations as the need arises.

The consultant will be responsible for submitting timely invoices with a list of items completed for the invoicing period. The consultant will also be required to submit, along with each invoice, documentation required for federal grants.

*Consultant tasks*

- Generate a project schedule
- Communicate with Town staff as needed
- Submit timely invoices along with a list of tasks completed during the invoicing period and any necessary accompanying documentation

## Appendix [ ]. Proposed parking plan scope and tiers



DRAFT

**Summary of, and staff response to, Board of Aldermen comments on the November 12, 2013, agenda item, Update on the Process for Developing a Town Parking Plan**

Comments (paraphrased)

*There needs to be an unbiased consultant and public forum.*

- Staff response: The goal of including speakers from a range of perspectives in a public forum can be included in the RFP and discussed with the selected consultant in conjunction with the development of the proposed public involvement plan. The RFP submitting teams can be assessed in part on their experience with towns similar to Carrboro and their approach to developing recommendations given the analysis.

*Prefer a consulting firm that has worked with towns of similar sizes and transit options as Carrboro.*

- Staff response: See above.

*Consultant should be able to integrate parking planning with bicycle planning.*

- Staff response: This point can be discussed with the contracted consulting team. The proposed scope includes the development of bike parking recommendations as necessary.

*Parking plan should include residents who would like to visit downtown and ride a bike to destinations after they arrive downtown.*

- Staff response: Parking plan scope proposes a survey of a sample of residents representing all areas of town. Invitations to public events will be made publicly available. The desire to park downtown and ride a bike to various destinations may be best addressed by a bike sharing or bike rental program, were one to be started.

*Take into account need to ensure northern neighborhoods' access to downtown with sufficient parking while also considering strategies to reduce car use.*

- Staff response: Specific parking-related goals are expected to be developed as part of the parking planning process, taking into account feedback from the public.

*Not interested in valet parking.*

- Staff response: Valet parking could be removed as a possible option to be explored by the parking planning process, although some businesses may be interested in it.

*One of the issues is the cost of the plan; the Board will need to have a discussion about this.*

- Staff response: Town staff have made a request for the MPO to consider allocating planning-related funding to cover some of the cost of the plan. MPO staff support the request in concept; however, funding would likely be confirmed via the development of the FY15 Unified Planning Work Program, which provides opportunities for MPO member jurisdictions to request funds,

over and above routine planning allocations, for special projects, provided they identify the non-federal match.

*Would like to confirm that an analysis of parking requirements in the Land Use Ordinance will take place as part of the plan.*

- Staff response: This is expected to be included in the scope of the contract.

*Note that the number of households without a vehicle in Carrboro has gone up.*

- Staff response: Data on household vehicle ownership can be presented as background data in the RFP.

*Would like to see projections for parking needs and supply over the next year or two.*

- Staff response: Parking need projections are common elements of parking plans, and this can be included in the RFP.

*Would like to see different models of shared parking in municipalities of different sizes.*

- Staff response: This can be included in the RFP.

*The Town should highlight the businesses who are sharing parking.*

- Staff response: More detail would be needed on how this should be done. The January 31, 2014, Parking Summit provided an opportunity for businesses to discuss shared parking.

*Discussion of the Town's goals with respect to parking, and when it is most appropriate to set goals on parking.*

- Staff response: It is expected that goal-setting will take place during the planning process.

**TOWN OF CARRBORO**

NORTH CAROLINA

WWW.TOWNOFCARRBORO.ORG

January 29, 2014

Mr. Felix Nwoko, PhD  
Transportation Planning Manager  
DCHC-MPO  
101 City Hall Plaza, 4th Floor  
Durham, NC 27701

Dear ~~Mr. Nwoko~~ <sup>Felix</sup>:

Based on a Board of Aldermen resolution on November 12, 2013, I am writing to request that the DCHC-MPO consider allocating planning funds to the Town of Carrboro as part of the FY14-15 Unified Planning Work Program for the development of a parking plan for Carrboro.

The Town is laying the groundwork for the parking plan, including preliminary discussions by the Board of Aldermen and interaction with businesses. The need for a parking plan stems from recent disagreements between business owners regarding the potential for shared parking spaces; differing points of view within the community about supply, demand, price, and effect on transportation mode choices and traffic in Carrboro's central business district; discussions about how best to enhance customer access to businesses and support a thriving downtown; the likelihood of changes in perimeter park-and-ride lot prices causing spillover in Carrboro municipal parking lots; and other factors.

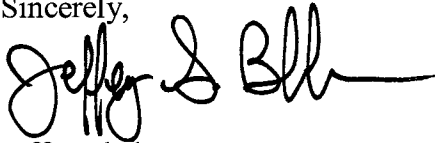
A parking plan would help address Goal 5 of the 2040 Metropolitan Transportation Plan, Integration of Land Use and Transportation, specifically Objectives 5c and 5e. It will help the Town identify implementation strategies that can lead to a more efficient transportation system.

Town staff recognize that, as this is a planning activity specifically benefitting the Town of Carrboro, the Town will likely need to identify the non-federal (20%) match in the

event the federal funds are available. The expected schedule for the parking plan development overlaps substantially with the FY14-15 UPWP period.

Thank you for any further assistance you could provide, and let me know if you need more information.

Sincerely,

A handwritten signature in black ink, appearing to read "Jeff Brubaker", with a long horizontal flourish extending to the right.

Jeff Brubaker  
Transportation Planner  
Town of Carrboro

cc: Christina Moon, Planning Administrator  
Patricia McGuire, Planning Director  
David Andrews, Town Manager  
Arche McAdoo, Finance Director  
Annette Stone, Community and Economic Development Director

**Jeff Brubaker**

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**From:** Nwoko, Felix <Felix.Nwoko@durhamnc.gov>  
**Sent:** Wednesday, January 29, 2014 12:59 PM  
**To:** Jeff Brubaker  
**Cc:** Christina Moon; Patricia J. McGuire; David Andrews; Arche McAdoo; Annette Stone  
**Subject:** RE: Letter regarding a Carrboro Parking Plan

Jeff,

I support this request in concept. It fits in the MPO 2040 MTP and will improve the regional model. But I have bring this request to the LPA Oversight Committee for their consideration and hopefully concurrence.

Felix Nwoko, PhD  
Transportation Manager, City of Durham, DOT  
Administrator DCHC MPO  
919-560-4366

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**From:** Jeff Brubaker [<mailto:JBrubaker@townofcarrboro.org>]  
**Sent:** Wednesday, January 29, 2014 12:52 PM  
**To:** Nwoko, Felix  
**Cc:** Christina Moon; Patricia J. McGuire; David Andrews; Arche McAdoo; Annette Stone  
**Subject:** Letter regarding a Carrboro Parking Plan

Felix,

Please see attached.

Thanks,

Jeff

Jeff Brubaker, AICP  
Transportation Planner  
Town of Carrboro

**Jeff Brubaker**

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**From:** Nwoko, Felix <Felix.Nwoko@durhamnc.gov>  
**Sent:** Sunday, February 02, 2014 8:04 AM  
**To:** Jeff Brubaker  
**Subject:** FY 2015 UPWP Followup

Hi Jeff,

The LPA Oversight Committee approved the Town's request for parking plan funding in concept. They wanted to see the estimates. Please, note that we are using the STP-DA for routine and special planning. So use your FY 2015 PL allocation as your target for FY 2015 routine planning. Your tasks breakdown should be captured under the STP-DA columns AND NOT the Section 104(f) PL columns.

In your FY 2015 UPWP request, delineate what is routine and what is special (for example, the parking plan request will be special planning).

When in doubt, email me. Hope you are feeling better.

Felix Nwoko, PhD  
Transportation Manager, City of Durham, DOT  
Administrator DCHC MPO  
919-560-4366



## Legislation Text

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**File #:** 14-0028, **Version:** 1

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**TITLE:**

Storm Water Design Standards - future considerations

**PURPOSE:** The purpose of this item is to provide the Board of Aldermen an opportunity to discuss possible future changes to storm water design standards in light of recent flooding issues and concerns about climate change.

**DEPARTMENT:** Public Works Department and Planning Department

**CONTACT INFORMATION:** George Seiz, Director of Public Works, 918-7427; Patricia McGuire, Planning Director, 918-7227; Randy Dodd, Environmental Planner, 919-7426; Henry Wells, P.E., Town Engineer, 919/859-2243

**INFORMATION:**

Last fall the Board of Aldermen expressed an interest in having a discussion about possible future changes to storm water design standards. The interest in this subject stemmed from a significant rainfall event (June 30, 2013) and also from concerns about climate change. In order to help facilitate a discussion on this matter Town staff is providing the following information:

1. Recent flooding concerns (Map)
2. Basis for Carrboro Storm Water Design Standards
3. FEMA Repetitive loss
4. Update on various storm water problem areas

**1. Recent Flooding concerns**

On Sunday, June 30, 2013, the Town experienced a significant rainfall event which created flooding at several locations within the Town and surrounding communities. Approximately five (5) inches of rain fell over a twelve hour period, but more importantly a little over 3 inches of rain fell in just two hour towards the end of the event. Important to note is that rainfall was relatively consistent throughout the area based on the similar recorded amounts in rain gauges at Public Works (south part of Town), a rain gage on Oak Ave. (central), and at the Horace Williams airport (E of Town).

Emergency services personnel responded to many calls about street flooding and water coming out of stream banks. Several homes in the town experienced flooding including a few homes along Tom's Creek and unfortunately the Rocky Brook trailer court also received significant flood damage. Other examples of reported damage were a washed out section of Board Street and water over topping the road along Old Pittsboro Rd.

Public Works staff documented many of the locations where flooding was reported or observed during and after

the rain event and is shown on the attached map. Yellow shaded text indicates locations where storm water entered structures. Gray shaded text indicates locations where there was damage to town infrastructure. A general statement can be made that most of the flooding calls are within areas that were developed before the Town's storm water regulations were put in place (1995). This could be an indicator that perhaps the current regulations being used for new development are adequate.

## **2. Basis for Carrboro Storm water Design**

Over the past twenty years the Carrboro LUO has been amended and expanded to include regulations to abate existing flooding problems and to prevent new ones. These amendments included new storm water standards promulgated by FEMA and NCDENR, but more importantly, the town responded proactively to adopt a Storm Drainage Design Manual to set minimum standards that address previously unregulated flooding. In the early 1990's the State of North Carolina enacted the NPDES Storm water Rules regulating surface water discharges of stormwater into streams. In the wake of Hurricane Floyd in 1999 the State of North Carolina established the North Carolina Floodplain Mapping Program. The purpose of the program was to establish a state agency to enforce FEMA regulations regarding Special Flood Hazard Areas. In August, 2009 the State enacted the Jordan Lake Rules which would eventually require each municipality to enforce buffer requirements for streams within their jurisdiction. The Town of Carrboro again proactively incorporated each of these required programs into their overall Stormwater Program to augment the requirements for storm water design guidelines. Of these mandatory and self-imposed programs the FEMA Floodplain regulations and the Carrboro Storm Drainage Design Manual are essential to the prevention of flooding.

Adoption of the FEMA Flood Hazard Program by the local governing jurisdiction allows owners of structures subject to flooding by the 100-year storm to obtain federally funded flood insurance. FEMA provides Flood Insurance Rate Maps (FIRM) and Flood Profiles on larger streams showing the areas of flooding as well as the elevation of the flood. FEMA uses the best available technical data to create the FIRM's including statistical information for stormwater discharges, hydrologic and hydraulic modeling, rainfall data and topographic surveys. The updated and current FEMA Study for Orange County was released in May 2008 and replaced the previous study of August 1979. Discharges for the study were based on existing development within the watershed and were estimated using the US Department of Interior publication The National Flood-Frequency Program - Methods for Estimating Flood magnitude and Frequency in rural and Urban Areas In North Carolina, 2001. The equations for establishing peak discharge are based on one of the three separate Hydrologic Regions in North Carolina and are calibrated where applicable, using historical high-water marks obtained from interviews of residents and associated surveys. The equations were developed using historical USGS gage data from over 360 sites statewide. The HEC RAS model (Version 3.1.2) used as the Hydraulic Model to predict the elevations of the 100-year storm was released as an update of the original HEC RAS model in June 2004. The latest update of the FEMA study for Orange County is currently under review by the community. The new study will incorporate updates to both the USGS Hydrologic analysis as well as to the HEC RAS model (Version 4.1, Jan 2010)

The Carrboro Storm Drainage Design Manual was adopted around 1995 and has been updated to keep abreast of new developments in storm water regulations. The manual outlines design requirements for storm drainage for streets and local development sites outside the FEMA areas. The purpose of these requirements is to

provide adequate conveyance of storm water without causing flooding of proposed streets, houses or buildings, or up or downstream properties. The manual was developed based on experience gained in dealing with the existing flooding problems in Carrboro, reference material from NCDOT and other local storm water programs and applicable state and federal storm water legislation. The current design standards include conveyance of the 10-year storm for storm drainage systems and conveyance of the 25-year storm for culverts crossing under roads. In addition no increase in the flood levels expected from the 100-year storm event are allowed to occur on upstream properties due to development on lower properties. The peak discharges associated with these events for smaller watersheds are generally computed using the Rational Method. In the Carrboro area the 10-year storm discharge is based on a rainfall event of approximately 6.0 inches/hour (based on National Oceanic and Atmospheric Administration statistical data) for the Rational Method. The 25-year storm is based on a rainfall event of approximately 7.0 inches/hour. For most areas monthly rainfall data gathered by NOAA has been accumulated for the past 100-years in order to arrive at these numbers. As a base of reference, the highest hourly reading during the storm which occurred on June 30, 2013 was 2.09 inches in one hour.

As previously mentioned most hydrologic analyses are based on studies of statistical data produced either by NOAA or the USGS and these procedures are based on historical rainfall data that is derived from the record of actual climatic events. If weather patterns were to change in response to whatever naturally evolving or human inspired conditions these shifts or trends would be revealed and appropriate revisions in the base data would be made. Both of these agency's procedures have been updated as additional data continues to be gathered over time and is revised and improved as weather patterns and climate change. The Engineering community constantly monitors changes in computational methodologies that will enable us more accurately predict peak discharges of storm events so as to continue to safeguard life, health, and property and to promote the public welfare.

### **3. Flood Mitigation Assistance (FMA) grant - response to flooding along Tom's Creek**

In late July 2013, staff learned that the Federal Emergency Management Agency had released a notice of funds available for the Flood Mitigation program (FMA). An initial letter of interest was submitted, pertaining to four properties in the Plantation Acres neighborhood based on historical and recent flooding, as communicated to staff in meetings held in the neighborhood that summer. After further communication with property owners, four properties were discussed with the Board of Aldermen on October 15<sup>th</sup>. The Board of Aldermen authorized the submittal of two grant applications, one for acquisition of two properties and one for elevation of two properties. The total cost estimate for projects is \$746, 857. A 25 percent local match, which can be met through in-kind contributions and cash match from the owners, is required. If approved, grant funds are expected to be available early in federal fiscal year 2015.

### **4. Update on various storm water problem areas**

The following is a status update on various locations where Town staff is working to address storm water drainage concerns:

- *Tom's Creek* - Following the suggestion of one of the neighbors along Tom's Creek, Town staff set up a series of meetings to go door to door and ask homeowners what problems they have and here about

concerns and suggestions. There were 5 neighborhood meetings held from mid-July to early August and 16 out of 39 property owners came to the meetings and helped to answer questions on survey sheets. A summary of the surveys is attached. More evaluation is needed.

- *105 Morningside Drive - yard flooding, water overtops the road, request to enlarge culvert.* Staff has visited with the adjacent resident and discussed possible options. Preliminary analysis indicates that enlarging the culvert under Morningside will likely cause negative impacts downstream. Replacing sections of curb and/or installing some storm inlets may help mitigate the problem.
- *400 Block of Broad St. - water overtopped road on June 30<sup>th</sup>, public road damage and private property damage. petition received, request to enlarge culvert.* An emergency repair was made at this location costing about \$10,000. Preliminary review indicates the culvert would need to be enlarged from an 18" to 48" to meet current standards. Potential downstream impacts need to be reviewed as well as other possible options. Cost estimates for options need to be determined and programming in the CIP considered.
- *Old Pittsboro Road - concerns expressed about storm water run-off, sewage in the drainage ditch, sitting water.* Staff is still in the early stages of evaluating the storm water run-off issues. Ideas suggested such as widening the drainage ditch or piping the storm water could possibly be considered. OWASA made a repair last summer to address sewage backing into a storm junction box. As a follow up to that repair OWASA also did some public education outreach to citizens and businesses about the detriments of putting fats, oils and grease in sanitary sewers as requested by the BOA.
- *Tributary to Morgan Creek adjacent to Public Works -* While clearing scrub trees this winter adjacent to the culvert pipes under Public Works Drive, Public Works staff has discovered significant erosion of the stream bank adjacent to the Public Works property. Appears to be a result from June 30, 2013 storm event. Location is still being evaluated to determine extent of repair work needed. Cost estimate for repair needs to be determined and programming in the CIP considered. A temporary more immediate repair may be necessary.
- *Wilson Park Multi-Use Path - Erosion along edge of path due to storm system overloading.* An emergency repair was made by the Public Works Department. Repair work seems to be holding and will continue to monitor location.
- *Existing Capital Improvements Planning and Relationship to Flooding -* To date, the management practices identified for making progress under the existing development provisions of the Jordan Lake Rules have not in general been located in areas experiencing higher impacts from flooding. It is possible that some retrofit opportunities identified could have a small flood (peak flow) mitigation result, although additional analyses will be necessary to quantify the potential to mitigate flooding. The retrofits identified will reduce total stormwater volume, and in doing so, protect stream channels from erosion and provide groundwater recharge benefits.
- For several years, Town staff have been identifying retrofit opportunities to comply with the existing development provisions of the Jordan Lake Rules which are based on reducing nitrogen and phosphorus in runoff. As was noted in the recent review of the CIP for FY 2014-15 to so19-20, modifications to the state law (SL 2013-295), delay the previously mandated implementation by three years. Planning has continued, to so as: 1) not to lose sight of the federal\* and state requirement which may result in a significantly larger obligation in years ahead; 2) advance commitments to improving water quality in Bolin Creek and Morgan Creek; and 3) respond due to uncertainty about the interrelationship of to

responsibilities under the Town's NPDES permit. The design storm used for designing BMPs under the Jordan Lake rules is the 1" rain event; flow beyond 1" as in flood events generally bypasses the BMP and is not retained or detained. So for a 5" rain and flood event, 4" will bypass a stormwater device designed to reduce nitrogen and phosphorus.

- \*The past year has resulted in State legislation which has delayed implementation. It is noteworthy that Jordan Lake is considered to be impaired by EPA, and is under a federal "TMDL". Current or future changes in State level implementation could be challenged at the federal level.

**FISCAL & STAFF IMPACT:** No fiscal impact with the accepting this report. There may be significant fiscal impacts in the future depending on solutions determined to adequately address some of the problem areas.

**RECOMMENDATION:** It is recommended the BOA review and discuss the information provided, and further direct the Town staff on this matter.

## Sunday June 30, 2013—flooding reports

Locations where stormwater entered structures

Damage to town infrastructure

Estes Dr. and Estes Park Apts.  
Water damage to lower level apartments.  
Stormwater covered apartment entrance drive and east side of Estes Dr. at railroad tracks.

Wilson Park Multi—Use Path—damage to east path edge between tennis courts and bottom of hill.  
Stormwater overflowed from park storm system by southwest corner of tennis courts and cascaded down path.

107 Hillview St. - Dianna Griffin  
Heat pump unit partially submerged and stormwater accumulated along west side of house.  
Stormwater flooded over emergency access drive at culvert crossing.

103 Sudbury Lane—Thor  
Stormwater overflowed from upland raised yard inlet and flowed downhill toward residence. No structural damage. Displaced yard items.  
Sudbury Lane roadway flooded as a result of overland flow.

123 Pine St.—stormwater overflowed roadway and flowed over sidewalk side of street onto 123 Pine St. Displaced yard items. No structural damage to residence or roadway.

612 Hillsborough Rd.—Vacherson—roadway storm system backed up on east side of street. Stormwater backed up and entered converted garage living space by a depth of @ 6".

103 Dove—roadway culvert overflowed onto property  
101 Dove—flooding across property  
200 Rainbow—property flooding/ Rainbow Dr. flooded over roadway including Dove intersection where culvert overflowed

118-116 Carol St.—stormwater almost ran over roadway. Significant damage to lower living level of 116 Carol St. Stormwater entered crawl space for 118 Carol and partially submerged heat pump.

400 Lorraine—Farrell—stormwater entered crawl space/damage to insulation and vapor barrier/ displaced yard items/inundated entire yard

100 Phipps St.—stormwater overflowed from street onto property/ water damage to lower level of split level residence

206-204 James—stormwater crossed from west to east like a "river" and flowed between the two properties. Existing 30" culvert could not accommodate stormwater flow.

403 Lorraine St.—Vanfleet—stormwater 36" depth in garage

100 James St.—stormwater entered lower level to a depth of 30"

302-304 W. Poplar Ave.—Jason West—stormwater inundated roadway/ stormwater backed up on north side of roadway/ once level with south side curb began to overflow curb. No damage to residence/ displaced some landscaping.

Gary Rd. at Oleander—stormwater over washed roadway and continued down to Liac Dr. Washed driveway at 100 Oleander and left debris within roadway.

206 Lynn Dr.; 109 and 111 Keith St.—all three experienced varying depth of water into lower living spaces. Damage to drywall, flooring and items stored on floor. Displaced items in yard areas. Overflow from Lynn inlet washed driveway stone down driveway to rear yard area.

Upland man made ditch overflowed. 30" culvert at NC 54 overwhelmed/ backwatered onto properties

N. Greensboro at Estes Dr. intersection  
Stormwater covered intersection. Roadway closed. Stranded cars.

Broad St. extension (un-paved portion)  
Roadway overflowed from west to east. Significantly eroded east shoulder between 408-410 Broad St. Overflow eroded portion of 410 Broad driveway soils. Clean up of downstream areas to remove stone and debris. Damage to property landscaping.

S. Greensboro at Rand Rd.—street closed due to roadway flooding. Triem property flooded. Rocky Brook Trailer Park significantly impacted. Evacuated residents. Damage to mobile homes.

Public Works Facility—entrance flooded over and portion of lower yard. PW staff relocated vehicles from lower to higher yard areas.

S. Greensboro St. at NC 54 westbound on-ramp—closed ramp and portion of street due to roadway flooding from Rocky Brook Trailer park which flowed within roadway south to Public Works entrance drive

## LEGEND

|                                   |        |
|-----------------------------------|--------|
| STATE MAINTAINED ROADS            |        |
| CARRBORO STREETS - UNPAVED        | 1.70   |
| CARRBORO STREETS - PAVED          | 42.52  |
| CARRBORO STREETS - PRIVATE        |        |
| TOTAL MILEAGE :                   | 44.22* |
| TOWN OF CARRBORO CORPORATE LIMITS |        |

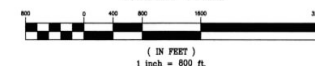
\* MILEAGE OF TOWN MAINTAINED ROADS

MILEAGE \*

IN

## NOTE:

This Powell Bill Map was prepared by Stantec Consulting Services Inc. from information furnished by the Town of Carrboro, not a field survey.



GRAPHIC SCALE

( IN FEET )

1 inch = 800 ft.

PREPARED FOR THE  
TOWN OF  
CARRBORO  
NORTH CAROLINA



Stantec  
5660 CENTERVIEW DR.  
DURHAM, NC 27713  
(919) 851-1919 FAX (919) 851-1917  
LICENSE # F-4872

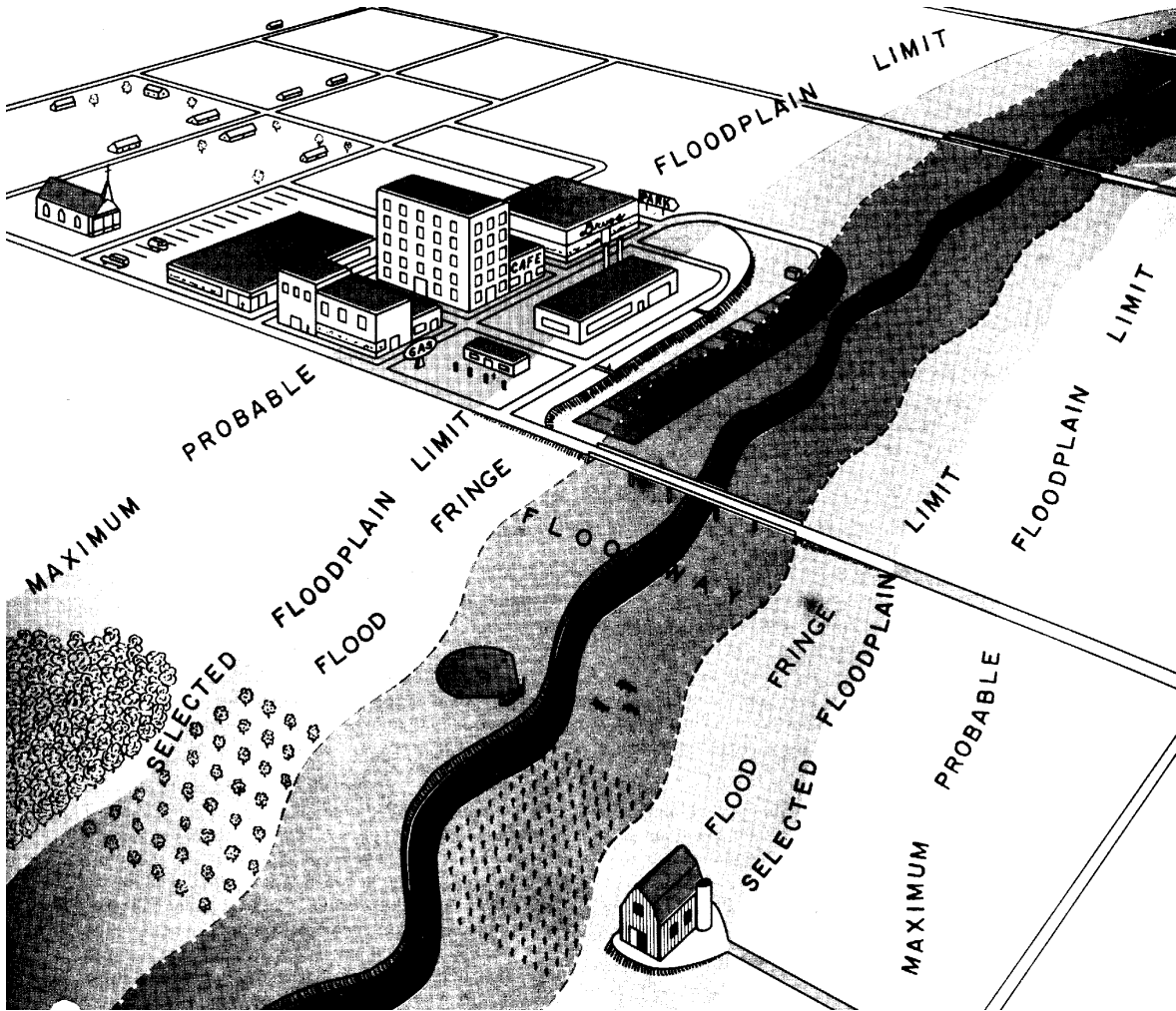
TOWN OF  
CARRBORO  
ORANGE CO. NORTH CAROLINA  
POWELL BILL MAP - 2013

2023000104  
JOB NO. SCALE  
CPR DESIGN  
CPR DRAWN  
1 OF 1  
RDL CHECKED SHEET  
16/JULY/2013  
DATE FILE NO.

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## Appendix I

# TOWN OF CARRBORO



## STORM DRAINAGE DESIGN MANUAL

by:

SUNGATE DESIGN GROUP, P.A.

# **GENERAL DESIGN STANDARDS AND POLICIES**

## **1. STREET AND LOCAL DRAINAGE**

Discharge estimates for specified design storms shall be calculated assuming full development of the contributing watershed based on current zoning or on existing development whichever is greater. Routing of discharges through lakes, ponds, or other impoundments is not acceptable unless the impoundment is publicly owned and operated as a permanent discharge control structure. Diversions of stormwater flow are not acceptable. The Town Engineer must approve any diversion of stormwater, which cannot be avoided.

For review, copies of topographic maps or the equivalent, clearly showing the limits of the site, shall be submitted with the plans. These maps shall extend a minimum of 1000 feet beyond the site boundaries. All off-site drainage areas shall be shown on the topographic maps. All calculations used to compute runoff and storm drainage systems, culvert and detention designs shall be submitted for review.

## **2. STORM DRAINAGE SYSTEM**

All street and local drainage systems, which collect and transport stormwater runoff from the street to an outlet should be designed to pass the 10-year design storm unless more stringent requirements apply. Catch basins in streets shall be designed for spread using the 2-year storm provided a 5-minute time of concentration is used and the remainder of the system is designed for the 10-year storm. For computation of spread, a 4-inch per hour intensity (as allowed by NCDOT) may be used in lieu of the 2-year storm with minimum 5-minute intensity. Inlet capacity at sags shall allow for potential debris blockage by providing twice the required computed opening.

All storm drainage systems shall be analyzed to establish the hydraulic grade line. The hydraulic grade line shall be at least 0.5' below the top of the inlet grate. Each storm drainage structure shall also be checked for inlet control. The recommended HW/D ratio is 1.5 or less. The occurrence of pressure flow in storm drainage systems is not recommended. If pressure flow in the system is proposed, a thorough analysis of pressure flow in the system will be required. In addition the joints in the system will be constructed to withstand the projected pressure without leaking.

No more than 3 cubic feet per second (cfs) shall be discharged over the curb and into the street at any one point and spread shall be checked at that point.

No concentrated flow shall be discharged across walkways. Provisions are to be made to pipe the flow under the walkway.

No pipe shall be longer than 400 feet without some type structure providing access.

All structures shall allow for access to the storm drainage system with a grate, manhole ring and cover, or lid capable of being removed without mechanical equipment. No “blind boxes” are permitted.

Curb inlets in the roadway should be placed in such a way that the spread of water in the 2-year storm does not exceed one half of a lane width. When the typical section includes a full shoulder or parking lane, no spread encroachment into the travel lane will be allowed.

Inlets should be provided at sags, up-grade of intersections, up-grade of super-elevation crossovers, and where driveways would discharge more than 3 cfs into a street.

A minimum gutter gradient of 0.3 percent shall be utilized. When lesser gutter slopes are encountered (such as at sags), the gutter shall be warped to provide the minimum slope.

NCDOT type E, F, and G (bicycle) grate inlets are allowed in streets. Grates shall be oriented to capture flow.

When development of an area changes the flow regime from sheet flow to concentrated flow, the drainage system should be designed to minimize impacts of the concentrated flow on adjacent properties by tying into existing systems, providing detention, using multiple outlets through agreements with adjacent owners, or other appropriate means.

Minimum drops in inlets, junction boxes and other structures shall be designed and constructed to NCDOT standards.

Where storm drainage lines cross or parallel other utility lines, appropriate clearances shall be provided as required by the appropriate utility or local, state or federal agencies.

A manhole, inlet junction box or other structure allowing for access shall be required at all changes in grade or direction or at any pipe junction. Details shall be provided on the plans for all such structures.

### **3. CULVERTS**

All culverts (conduits which convey flow through the roadway embankment) shall be designed to pass the 25-year storm with HW/D less than or equal to 1.2. Effects of the 100-year storm shall also be analyzed to ensure that:

- 1) No flooding will occur on upstream off-site properties due to backwater from the culvert.
- 2) The stability of the roadway embankment will not be compromised due to overtopping.
- 3) Proposed or existing structures and utilities will not be inundated due to backup of stormwater created by installation of a culvert or other drainage structure.
- 4) No structures will be constructed on lots within the 100-year flood limits created by backup of stormwater from culverts or other stormwater structures.

Storm drainage pipes in the public or private right-of-way shall be reinforced concrete with a minimum diameter of 15 inches. Pipes utilizing other materials with a service life equal to or greater than reinforced concrete (as determined by an independent testing agent) may be approved by the Town Engineer.

Headwalls plus an appropriate velocity dissipater will be required at the end of all culvert systems (excluding driveway pipes) based on the following table;

| <b>END TREATMENT FOR CULVERTS</b> |                                 |
|-----------------------------------|---------------------------------|
| <b>18" - 30"</b>                  | <b>NO END TREATMENT.</b>        |
| <b>&gt;36"</b>                    | <b>HEADWALL ON UPSTREAM END</b> |

Headwalls are also required if the skew of the pipe is less than 75 degrees or greater than 105 degrees. Skew is defined as the angle from the centerline road line ahead of the end of the pipe on the right-hand side of the road.

All reinforced concrete pipe shall be Class III or higher.

The maximum fill height for Class III RCP with standard bedding is 23 feet. Loading conditions should be evaluated where deep fills or other high loads are expected and the appropriate combination of pipe material, class of pipe, and bedding selected.

Minimum slopes for pipes and open ditches is 0.5%.

Maximum slopes for concrete pipes are 10.0%.

Minimum cover for reinforced concrete culverts is one foot to top of sub grade. Pipes of materials other than reinforced concrete shall have minimum cover conforming to manufacturer's recommendation.

For cross drainage serving 10 acres or more, the maximum depth of the water impounded during the 100-year flood shall not exceed fifteen (15) feet as measured from the upstream invert of the culvert beneath the roadway section to the water surface elevation unless appropriate engineering calculations are submitted verifying the stability of the embankment against slope failure and seepage effects. Any detention facility designed and construction in compliance with the North Carolina Dam Safety Regulations shall be acceptable to the city.

Roads, which cross or parallel creeks serving more than 25 acres of drainage area must have at least 2 feet of freeboard in the 10-year storm and 6 inches in the 100-year storm. If this is impractical, the street may be designed to flood in the 100-year event provided the flooding depth does not exceed 1 foot and substantial erosion protection is provided on the downstream side of the roadway. In "regulated discharge floodplain areas", streets shall be constructed at or above the 100-year flood elevation.

No public roads are to be constructed on dams.

#### **4. OPEN CHANNELS**

For open channels, gradual changes in alignment, not to exceed a minimum radius of 4 times the top width of channel is recommend. Where no other options are available, sharper changes in alignment may be allowed under the following conditions.

|                                |                                                                                                                                                                                                         |
|--------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>20 - 45 DEGREES</b>         | <b>Bank stabilization must be provided according to tractive force analysis.</b>                                                                                                                        |
| <b>GREATER THAN 45 DEGREES</b> | <b>Same as for above but in addition, freeboard equal to or greater than 1/2 of the Q10 depth of flow must be provided utilizing berms or other appropriate means to increase depth of the channel.</b> |

Side slopes for vegetated open channels in residential areas should be no greater than 3 to 1 for stability, safety, and ease of maintenance. Where the channel width must be limited, side slope may be increased if suitable structural stabilization techniques are employed according to following the table and safety measures are utilized. A tractive

force analysis of the channel is also required. Aesthetics and ease of maintenance should also be considered in the design.

| MAXIMUM SLOPES FOR COMMON STABILIZATION TECHNIQUES |          |
|----------------------------------------------------|----------|
| STONE                                              | 1.5:1    |
| GRID PAVERS                                        | 2:1      |
| PAVING *                                           | 1:1      |
| GABIONS                                            | VERTICAL |
| RETAINING WALLS                                    | VERTICAL |

\* Note: asphalt channel linings are not allowed.

## **5. EASEMENTS**

Private drainage easements shall be provided outside of the public right-of-way:

- \* for all culverts; except private driveway pipes,
- \* for all new or existing open channels or watercourses,
- \* below all new or existing pipes and other points of concentrated flow;
- \* for primary and emergency dam spillways; or
- \* at other locations deemed appropriate by the Town engineer.

Normally, the easements shall be centered, but offset easements may be permitted by the Town Engineer.

Easements widths may differ from the nominal width below if an engineering study is performed, to the satisfaction of the Town Engineer, which demonstrates that the pipe or channel can be excavated and maintained, meeting all OSHA sloping and other safety regulations, within a different easement width.

Combined easements, with widths as approved by the Town Engineer, are permitted with other utilities.

Private drainage easements containing only storm drainage facilities shall be of sufficient width to provide for access and maintenance and shall be centered over the culvert or watercourse with recommended widths based on the following table

| FOR CULVERTS        |                                       |
|---------------------|---------------------------------------|
| 0 TO 35 INCHES      | 20 FEET                               |
| 36 TO 72 INCHES     | 40 FEET                               |
| 72 INCHES AND ABOVE | THE DIAMETER OR WIDTH PLUS 40 FEET    |
| MULTIPLE CULVERTS   | THE SUM OF THE DIAMETERS PLUS 40 FEET |

| FOR OPEN CHANNELS |                            |
|-------------------|----------------------------|
| 0 TO 25 ACRES     | 15 FEET ON EACH SIDE       |
| 25 TO 100 ACRES   | 25 FEET ON EACH SIDE       |
| = 100 ACRES       | DETERMINE FLOOD BOUNDARIES |

Widths shall be determined from the top of the bank or centerline if no banks are discernible

All drainage easements shall be recorded based on field surveys, following construction, to insure that the drainage structure or watercourse is centered within the easement.

All drainage easements shall be designed to tie into existing easements, existing watercourses, or to other appropriate locations when possible.

## **6. DETENTION**

Detention of stormwater shall be provided in each development so that the peak flow up to and including the post development 25-year storm leaving the site does not exceed up to and including the pre-development 25-year storm peak. This requirement may be varied by the Town Engineer based on existing conditions downstream and the impact, which increased flow in the receiving watercourse, could have on flooding levels. It is recommended that a pre-design meeting with the Town Engineer and the Town Planning Director be held to discuss detention requirements.



G. Seiz

2/1/14

The water's edge for typical flooding and the water's edge for the worst flooding were noted on a map. Photos also taken or provided.

## Tom's Creek Survey Summary

| Mtg. Date | Address        | Year | Typical damage during flooding                                                                            | Worst damage and when                                                                     | Factors you feel contribute to flooding                                      | Suggestions for correcting                                                       | Flood Insur. | Comments                                                          |
|-----------|----------------|------|-----------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|----------------------------------------------------------------------------------|--------------|-------------------------------------------------------------------|
| 7/16/13   | 100 James St.  | 1993 | Yard under water and remains soggy for days<br>Low areas pond water for days, does not get in house.      | 30 " water in lower level of home<br>Lost fridge/dryer/stove - 6-30-13                    | OWASA filled easement higher than yard<br>Creek narrows just before culvert  | Straighten/enlarge stream near culvert                                           | Y            | Owner backfilled property 1995 to raise level of backyard         |
| 7/16/13   | 102 James St.  | 1992 | About 3 times per year water in storage shed                                                              | 6-30-13 shed floated up into yard                                                         | Building that has occurred. Concern about future development.                | Change elevation so this side of creek is higher.                                | ?            | No water in house since she has owned it starting in 1982,        |
| 7/16/13   | 104 James      | 1984 | 4-5 times per year flooding in rear yard up to shed                                                       | Fran 1996 and 6-30-13 water came with 4 -6 ft of residence.                               | Debris build up/meandering channel                                           | Redefine street/widen and deepen.                                                | N            | Hope town finds a solution.                                       |
| 7/22/13   | 107 Melba Cir. | 1973 | Typical damage is erosion. She had creek cleaned in 1980s and Added rip-rap. Seems to be holding.         | 6-30-13 Block retaining wall washed out.<br>Damage to red fence over years.               | Debris in creek. Seems to be more flow since Cates Farm dev.                 | Dig out creek and straighten. Keep it clean.                                     | N            |                                                                   |
| 7/22/13   | 115 Carol St.  | 1981 | 1-3 times per year. Flooding of rear yard area.<br>Some trees undermined and need to be removed.          | Fran 1996 and 6-30-13 water came with 4 -6 ft 6" depth of water in downstairs living area | Upstream development - McDougal and Post Office.                             | Need closer scrutiny of development.                                             | N            |                                                                   |
| 7/22/13   | 400 Lorraine   | 1973 | 2-3 times per year. Loss of vegetation and landscape timbers.                                             | 6-30-13 - Water entered crawl space.<br>HVAC unit, hot water heater both damaged          | Building of new homes, new construction,                                     | Feels creek should be clean out                                                  | Y            |                                                                   |
| 7/22/13   | 208 James St.  | 1993 | 6 times per year. Flood of yard. No structure or plantings damaged.                                       | 6-30-13 - water within 16' of storage shed.<br>Water did not get to residence.            | Creek not deep enough, too much debris.                                      | Redefine creek channel. Clean up debris twice per year.                          | N            | Water came over James St. from west and ran down into their yard. |
| 7/30/13   | 116 Carol St.  | 2012 | 3-4 x in May Comes up quickly and goes down quickly.<br>One large tree has fallen due to roots softening. | 6-30-13 About 24 " of water in lower level.<br>Electronic business equipment damaged.     | Water can't get thru culvert.<br>Debris on May 20th may cause blockage.      | Pd. for Eng. Report that indicates culverts should be enlarged to meet Town Std. | Y            | Perhaps remove culverts entirely.                                 |
| 7/30/13   | 214 James St.  | 2002 | About twice per year flooding of non-maintained area.<br>Leaves and stick debris remain after event.      | Not from creek but water coming into crawl space from water coming over James St.         | Did not record any comments                                                  | Did not record any comments.                                                     | N            |                                                                   |
| 7/30/13   | 302 Simpson    | 2005 | About once per year water comes out of banks.<br>No yard damage or structure damage                       | 6-30-13 - lower TV dish near creek went partway under water losing reception.             | Did not record any comments                                                  | Did not record any comments.                                                     | N            | Experienced overland flooding from up-hill. Washed across yard.   |
| 7/30/13   | 118 Carol St.  | 1999 | 4 x bwt. Aug. 1999 and Sept 2012 extends about 10 from bank leaving debris. x bwt. Sept. 2012 and 6-30-13 | 6-30-13 worst. Water entered crawl space.<br>Damage to insulation, heat pump, vapor Bar.  | Undersized culvert, increase run-off from upstream dev..                     | Enlarge roadway culvert or lower roadway.                                        | Y            | Should culv. under Carol comply with current standards? Cost?     |
| 7/30/13   | 300 James St.  | 1984 | Typically not out of banks. No damage with typical flood.                                                 | 6-30-13 seemed to be worse than Fran (1996)<br>No damage.                                 | Development in watershed                                                     | None suggested.                                                                  | N            |                                                                   |
| 7/30/13   | 201 Rainbow    | 2002 | No damage with typical flooding                                                                           | Flood waters got to basement door but not in basement. Damage to ancillary struct.        | McDougal School. Other Development in watershed.                             | Anything that will benefit all that were flooded.                                | Y            |                                                                   |
| 8/7/13    | 103 Dove St.   | 2010 | No impact to residence structure. Displaced driveway stone and landscaping.                               | More extensive than typical event.<br>No impact to residence.                             | Private property is lower than back slope of roadway ditch at culvert.       | Increase driveway culvert size or evaluate elevation of ditch.                   | N            | None                                                              |
| 8/7/13    | 200 Rainbow    | 1987 | No property damage during typical flooding aside from some vegetation damage and washing of gravel.       | 6-30-13 - worst flooding experience. Water 2 ft. high on heat pumps, Crawl space flooded  | Notice higher water since McDougal built.<br>Water ran across rainbow drive. | Increase culvert size under Rainbow Dr. may push water downstream and impact ?   |              | Concerns about future dev. Lloyd Sq & MLK Park.                   |
| 8/7/13    | 101 Rainbow    |      |                                                                                                           |                                                                                           |                                                                              |                                                                                  |              |                                                                   |
|           |                |      |                                                                                                           |                                                                                           |                                                                              |                                                                                  |              |                                                                   |

**GENERAL ASSEMBLY OF NORTH CAROLINA  
SESSION 2013**

**SESSION LAW 2013-395  
SENATE BILL 515**

**AN ACT TO DELAY ADDITIONAL IMPLEMENTATION OF THE JORDAN LAKE  
RULES AND JORDAN LAKE SESSION LAWS AND PROVIDE FOR ALTERNATIVE  
IMPLEMENTATION OF THE PROTECTION OF EXISTING BUFFERS RULE.**

Whereas, the United States Congress authorized the United States Army Corps of Engineers (USACE) to create what is now the B. Everett Jordan Lake in 1963; and

Whereas, the USACE submitted a Final Environmental Impact Statement (EIS) in November 1971 that stated, "Of primary concern is the eutrophic tendency of the lake. Eutrophication is a term used to describe the natural change in productivity of a lake during aging. It is usually a long-term phenomenon, which may be measured in geologic time .... Studies have shown that, assuming that all other elements necessary are available, the amounts of nitrogen and phosphorus presently found in the influent are adequate to produce algae blooms in the lake."; and

Whereas, the USACE stated in the EIS, "Several studies have indicated that the major water quality problem will be associated with anticipated nuisance algal growths resulting from excess nutrients from upstream sources."; and

Whereas, the United States Environmental Protection Agency (EPA) commented in the EIS, "Nutrient concentration in both the Haw River and New Hope River are high, and nuisance algal growth detrimental to water supply and recreation are a virtual certainty .... Impoundment should not take place until there is a strong technical basis for the prediction that nuisance algal growths will not occur."; and

Whereas, the USACE, in responding to the EPA's comments in the EIS, stated, "... it is doubtful whether a strong technical basis exists for the prediction that nuisance algal growths will not occur on most existing reservoirs ...."; and

Whereas, the United States Department of the Interior Bureau of Sport Fisheries and Wildlife commented in the EIS that, "High nutrient concentrations will intensify and extend water quality problems into the upper surface layers. Therefore, impoundment will create a pollution problem to the detriment of the ecosystem."; and

Whereas, the EIS contained a summary of complaints from pending litigation that included, "Even in the absence of nutrients from wastes, the shallowness ... would ensure abnormally heavy algae growths that could not be controlled .... Probably the most serious deficiency of defendants' environmental statement is its de-emphasis on the certainty that the water ... will be of exceptionally bad quality."; and

Whereas, despite the many inherent challenges of managing the water quality of Jordan Lake, the General Assembly remains committed to addressing issues that affect the water quality of the Lake; and

Whereas, it is the intent of the General Assembly to continue implementation of current measures to address water quality issues in Jordan Lake; and

Whereas, it is the intent of the General Assembly to temporarily delay additional implementation of measures to address water quality issues in Jordan Lake in order to allow for further evaluation of those measures and further exploration of other measures and technologies to improve the water quality of the Lake; Now, therefore,

The General Assembly of North Carolina enacts:

**PART I. DELAY ADDITIONAL IMPLEMENTATION OF THE JORDAN LAKE  
RULES AND THE JORDAN LAKE SESSION LAWS**



\* S 5 1 5 - V - 6 \*

**SECTION 1.(a)** For purposes of this act, the following definitions apply:

- (1) "Jordan Lake Rules" means all of the following rules:
  - a. 15A NCAC 02B .0262 (Jordan Water Supply Nutrient Strategy: Purpose and Scope)
  - b. 15A NCAC 02B .0263 (Jordan Water Supply Nutrient Strategy: Definitions)
  - c. 15A NCAC 02B .0264 (Jordan Water Supply Nutrient Strategy: Agriculture)
  - d. 15A NCAC 02B .0265 (Jordan Water Supply Nutrient Strategy: Stormwater Management for New Development)
  - e. 15A NCAC 02B .0266 (Jordan Water Supply Nutrient Strategy: Stormwater Management for Existing Development)
  - f. 15A NCAC 02B .0267 (Jordan Water Supply Nutrient Strategy: Protection of Existing Riparian Buffers)
  - g. 15A NCAC 02B .0270 (Jordan Water Supply Nutrient Strategy: Wastewater Discharge Requirements)
  - h. 15A NCAC 02B .0271 (Jordan Water Supply Nutrient Strategy: Stormwater Requirements for State and Federal Entities)
  - i. 15A NCAC 02B .0272 (Jordan Water Supply Nutrient Strategy: Fertilizer Management)
  - j. 15A NCAC 02B .0311 (Cape Fear River Basin)
- (2) "Jordan Lake Session Laws" means all of the following Session Laws or portions of Session Laws:
  - a. S.L. 2009-216.
  - b. Part II of S.L. 2009-484.
  - c. Section 14 of S.L. 2011-394.
  - d. Section 12.1 of S.L. 2012-187.
  - e. Subsections 9(c) through 9(g) of S.L. 2012-200.
  - f. Subsections 11(a) through 11(e) of S.L. 2012-201.

**SECTION 1.(b)** The implementation dates of the Jordan Lake Rules and Jordan Lake Session Laws that begin July 1, 2013, or later shall be delayed for a period of three years.

**PART II. IMPLEMENTATION OF RULE FOR PROTECTION OF EXISTING BUFFERS**

**SECTION 2.(a)** The definitions set out in G.S. 143-212 and 15A NCAC 02B .0267 (Jordan Water Supply Nutrient Strategy: Protection of Existing Riparian Buffers) apply to this section. For purposes of this section, "Protection of Existing Riparian Buffers Rule" means 15A NCAC 02B .0267 (Jordan Water Supply Nutrient Strategy: Protection of Existing Riparian Buffers).

**SECTION 2.(b)** Protection of Existing Riparian Buffers Rule. – Until the effective date of the revised permanent rule that the Commission is required to adopt pursuant to Section 2(d) of this act, the Commission and the Department shall implement the Protection of Existing Riparian Buffers Rule as provided in Section 2(c) of this act.

**SECTION 2.(c)** Implementation. – The Protection of Existing Riparian Buffers Rule shall be implemented as follows:

- (1) Notwithstanding the Table of Uses set out in subdivision (9) of the Protection of Existing Riparian Buffers Rule, utility, nonelectric, other than perpendicular crossings that have impacts only in Zone Two shall be categorized as exempt.
- (2) Notwithstanding the Table of Uses set out in subdivision (9) of the Protection of Existing Riparian Buffers Rule, the piping of a stream allowed under a permit issued by the United States Army Corps of Engineers shall be categorized as an allowable use.
- (3) Notwithstanding the definition of "Airport Facilities" set out in sub-subdivision (b) of subdivision (2) of the Protection of Existing Riparian Buffers Rule, "Airport Facilities" shall include any aeronautic industrial facilities that require direct access to the airfield.

**SECTION 2.(d)** Additional Rule-Making Authority. – The Environmental Management Commission shall adopt a rule to amend 15A NCAC 02B .0267 (Jordan Water

Supply Nutrient Strategy: Protection of Existing Riparian Buffers) consistent with Section 2(c) of this act. Notwithstanding G.S. 150B-19(4), the rule adopted by the Commission pursuant to this section shall be substantively identical to the provisions of Section 2(c) of this act. Rules adopted pursuant to this section are not subject to Part 3 of Article 2A of Chapter 150B of the General Statutes. Rules adopted pursuant to this section shall become effective as provided in G.S. 150B-21.3(b1) as though 10 or more written objections had been received as provided by G.S. 150B-21.3(b2).

**SECTION 2.(e)** Sunset. – Section 2(c) of this act expires on the date that rules adopted pursuant to Section 2(d) of this act become effective.

### **PART III. EFFECTIVE DATE**

**SECTION 3.** This act is effective when it becomes law.

In the General Assembly read three times and ratified this the 26<sup>th</sup> day of July, 2013.

s/ Philip E. Berger  
President Pro Tempore of the Senate

s/ Thom Tillis  
Speaker of the House of Representatives

s/ Pat McCrory  
Governor

Approved 10:47 a.m. this 23<sup>rd</sup> day of August, 2013



## Legislation Text

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**File #:** 14-0039, **Version:** 1

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**TITLE:**

Discussion on land uses associated with drive-in and drive-through windows

**PURPOSE:** The purpose of this item is to provide the Board of Aldermen with an opportunity to discuss regulations affecting land uses with drive-in and drive-through windows.

**DEPARTMENT:** Planning

**CONTACT INFORMATION:** Christina Moon - 919-918-7325; Patricia McGuire - 919-918-7327

**INFORMATION:** In June and September of 2013, the Board of Aldermen considered a request for a conditional use permit (CUP) modification for the Bank of America branch located on East Main Street regarding its drive-through teller station. Shortly thereafter, the Board received a request for text amendment to allow additional uses in M-1 zoning district subject to a CUP, including banks with drive-in windows and freestanding ATMs. These recent requests have brought to the surface questions relating to the appropriateness of drive-in and drive-through windows in the downtown and elsewhere in the Town's jurisdiction.

The Board discussed the topic of drive-in and drive-through windows at length during several meetings in 1997 and 1998 and subsequently adopted amendments to the Land Use Ordinance (LUO) following a public hearing on June 9, 1998. Agenda materials from the public hearing may be found at:

[http://www.townofcarrboro.org/BoA/Agendas/1998/06\\_09\\_1998.pdf](http://www.townofcarrboro.org/BoA/Agendas/1998/06_09_1998.pdf). The LUO distinguishes drive-in uses from drive-through uses in the Table of Permissible Uses (Section 15-146). The descriptions for use category 8.000 restaurants (including food delivery services), bars, night clubs, includes the following subsections:

- 8.300 Drive-in -- (service to and consumption in vehicle on premises)
- 8.400 Drive-through windows - (service directly to vehicles primarily for off-premise consumption)

These uses are not to be confused with 8.500 carry out service (food picked up inside for off-premises consumption) or 8.600 food delivery, or 8.700 mobile prepared food vendors.

The 1998 discussion focused on the use of drive-in/drive-through windows in the downtown, mainly in the B-1 (c) and B-1(g) zoning districts. Staff included an analysis of existing businesses with drive-through windows as part of the work session materials for March 24, 1998. Information from that meeting can be found at the following link: [http://www.townofcarrboro.org/BoA/Agendas/1998/03\\_24\\_1998.pdf](http://www.townofcarrboro.org/BoA/Agendas/1998/03_24_1998.pdf)

Also part of that analysis, staff identified six existing businesses with drive-in/drive-through uses in or near the downtown; five businesses are still in operation in those locations: Bank of America, Wendy's, PNC Bank, Central Carolina Bank, and Burger King. Of those, three-Bank of America, Wendy's and PNC Bank are within the downtown and still appear to be compatible with the needs of the community for those who may have limited mobility and for those who do not and prefer to walk. (Two other businesses are currently located in Carrboro Plaza, the State Employees Credit Union and Arby's.) Staff presented three alternatives for the Board's consideration in 1998.

1. Adopt an ordinance prohibiting drive-in and drive-through uses in all zoning districts.
2. Provide direction to staff concerning those uses and locations where drive-in/through uses may be allowed to continue and where they should be prohibited entirely.
3. Leave the present use classifications and regulatory measures as they are.

The Board moved forward with option #2. Advisory board comments, during the public hearing process, provided further refinement to the amendment in an effort to address safety concerns such as the potential for drive-through patrons to interact with patrons leaving the building on foot. The Board of Aldermen subsequently adopted text amendments which included the performance standards for businesses with drive-in windows found in Section 15-176.1 of the LUO, Supplementary Use Regulations (Attachment A). To reiterate the difference between drive-through and drive-in windows, a drive-through window allows customers to purchase products or conduct business without leaving their vehicle. Cars typically stack and move in one direction within a designated lane. Drive-in uses typically provide a place for customers to park their cars while food is brought to them or while they watch a movie. The adopted amendment included provisions for a handrail barrier to prevent pedestrians from walking directly into the path of the drive-through lane.

The general discussion regarding the topic of drive-in and drive-through windows, in the late 1990s and in the present, tends to target four main areas which when in balance support a vibrant and successful community.

- 1) Addressing environmental concerns linked to idling
- 2) Creating and promoting a walkable community, one that encourages residents to get out of their cars for all of the associated benefits
- 3) Promoting economic development by allowing land uses with a strong economic return to occur in key areas
- 4) Ensuring equal access to services for all citizens including those with special needs such as the elderly, those with disabilities and perhaps even parents with young children.

Research on the negative effects of extended idling have focused more on large diesel truck use than on individual cars. Findings from environmental studies comparing the impact of car idling while using drive-through windows as opposed to parking and going inside the building have not conclusively supported either option as significantly less detrimental (Attachments C through E). Information regarding the other three elements has also proved somewhat inconclusive in that there are a number of elements that impact walkability in a downtown and the ability of special needs population to have access to services. For example, some patrons may find a drive-through lane or window difficult to maneuver while others may find the services virtually unavailable to them without a drive-through option. Similarly, the practical impact of prohibiting certain uses such as banks with drive-in windows in zoning districts that are outside of the downtown may in effect serve as a determination that such uses will not be allowed in those districts.

The following two tables are designed to facilitate further discussion by providing a comparison of the existing land use classifications that include a drive-in/drive-through service with the four areas identified as elements that contribute to a vibrant and successful community.

Table 1. Use Classification and Description

| Use Classification | Description                               | Discussion Topics – elements that create a more vibrant and successful community |             |                      |              |
|--------------------|-------------------------------------------|----------------------------------------------------------------------------------|-------------|----------------------|--------------|
|                    |                                           | Environmental Protection                                                         | Walkability | Economic Development | Equal Access |
| 2.140              | Retail/No Outside Display/Drive-In Window | +/-                                                                              | -           | +                    | +/-          |
| 2.240              | Retail/Outside Display/Drive-In Window    | +/-                                                                              | -           | +                    | +/-          |
| 3.230              | Bank with Drive-In Window                 | +/-                                                                              | +           | -                    | +/-          |
| 3.250              | Freestanding ATM                          | NA                                                                               | +           | +                    | +            |
| 6.260              | Drive-In Movie Theaters                   | NA                                                                               | NA          | +                    | +            |
| 8.300              | Drive-In Restaurant                       | NA                                                                               | NA          | +                    | +/-          |
| 8.400              | Drive-Through Restaurant                  | +/-                                                                              | NA          | +                    | +/-          |
| 16.100             | Dry Cleaners with Drive-In Window         | +/-                                                                              | NA          | +                    | +/-          |

Table 2. Use Classification and Potential Location by Zoning District

| Zone   | 2.140 | 2.240 | 3.230 | 3.250 | 6.260 | 8.300 | 8.400 | 16.100 | Discussion Topics – elements that create a more vibrant and successful community |      |      |        |
|--------|-------|-------|-------|-------|-------|-------|-------|--------|----------------------------------------------------------------------------------|------|------|--------|
|        |       |       |       |       |       |       |       |        | Environ                                                                          | Walk | Econ | Access |
| B-1(c) |       |       |       | C     |       |       |       |        | -                                                                                | -    | +    | +/-    |
| B-1(g) |       |       |       | C     |       |       |       |        | -                                                                                | -    | +    | +/-    |
| B-3    | C     | C     | C     | C     |       |       |       | C      | -                                                                                | NA   | +    | +/-    |
| B-3T   | C     | C     | C     |       |       |       |       | C      | -                                                                                | NA   | +    | +/-    |
| B-4    | C     |       | C     | C     | C     | C     | C     | C      | +/-                                                                              | NA   | +    | +/-    |
| B-5*   |       |       |       |       |       |       |       |        | NA                                                                               | NA   | NA   | NA     |
| M-1    | C     | C     |       |       |       |       |       | C      | -                                                                                | -    | +    | +/-    |
| M-2    |       |       | C     |       |       |       |       |        | -                                                                                | NA   | +    | +/-    |
| CT     |       |       |       | C     |       |       |       |        | -                                                                                | -    | +    | +/-    |
| O      |       |       |       | C     |       |       |       |        | -                                                                                | NA   | +    | +/-    |
| O/A    |       |       |       | C     |       |       |       | C      | -                                                                                | NA   | +    | +/-    |

\*Some drive-in/drive-through uses were allowed in the B-5 zoning classification during the 1990s. The subsequent amendments adopted in 1998, removed all of those uses from this district.

**FISCAL & STAFF IMPACT:** There is no fiscal impact related to the discussion of this item. Costs are associated with public hearings and staff time should the Board wish to pursue text amendments to the Land Use Ordinance.

**RECOMMENDATION:** Staff recommends that the Board of Aldermen discuss land use regulations affecting drive-in windows and provide input relating to possible next steps, which may include text amendments to the Land Use Ordinance.

## **ARTICLE XI**

### **SUPPLEMENTARY USE REGULATIONS**

#### **PART II. MISCELLANEOUS SUPPLEMENTARY USE PROVISIONS**

##### **Section 15-176.1 Businesses with Drive-In Windows (AMENDED 06/09/98)**

In addition to other applicable provisions of this chapter, use classifications 2.140, 2.240, 3.230, 3.250, 8.300, 8.400, and 16.100 shall be subject to the following requirements:

- (1) The entrance/exit doors of such uses shall be located in such a manner that a person entering/exiting such business is not required immediately to cross a drive-in window exit lane.
- (2) Drive-in windows shall be located in such a fashion that vehicles using or waiting to use such drive-in or drive-through facilities do not interfere with vehicles seeking to enter or leave parking areas.
- (3) Where it is necessary for patrons wishing to park and enter such businesses to cross a drive-in window lane, crosswalks leading from parking areas to building entrances shall be clearly marked.
- (4) The vehicular entrances or exits of such uses shall not be located within 300 feet of the intersection of the centerlines of intersecting streets.
- (5) A building housing an 8.400 classification use may not be located closer than 1,000 feet to the nearest point of another building housing an 8.400 classification.
- (6) A Type B screen shall be erected, on the exterior border, from the service window to the entrance of the stacking lane.

## **Article X**

### **PERMISSIBLE USES**

#### **Section 15-146      Table of Permissible Uses.<sup>1</sup>**

The following Table of Permissible Uses should be read in close conjunction with the definitions of terms set forth in Section 15-15 and the other interpretative provisions set forth in this article.

<sup>1</sup>The Table of Permissible Uses was amended 05/12/81 to add the R-SIR-2 and W categories.

The Table of Permissible Uses was amended 12/07/83 to delete the W category and to add the C, R-40, R-80, B-5, and WM-3 categories.

The Table of Permissible Uses was amended 02/04/86 to add the R-2, B-1(c), B-1(g), and CT categories; 04/05/88 the B-3T; and 04/16/91 the O and OA zones.

The Table of Permissible Uses of the Carrboro Land Use Ordinance was amended 6/22/04 to modify the permit requirements for the 8.000 uses.

The Table of Permissible Uses was amended 5/24/2005 modifying the use classification 15.800.

The Table of Permissible Uses is further amended 5/24/2005 by adding a new classification 17.400 Underground Utility Lines.

The Table of Permissible Uses is amended 3/7/06 by adding the letter “S” opposite use classifications 3.110, 3.120, and 3.130 under the B-3 district column to indicate that these uses are permissible with the special use permit in that district.

The Table of Permissible Uses is further amended 3/7/06 by replacing the designation “ZC” opposite use classification 3.150 under the B-3 district column with the designation “S” to indicate that this use is permissible in this district with a special use permit.

The Table of Permissible Uses is amended 6/26/07 by modifying the use classification 21.000 Cemetery and Crematorium by creating two new subcategories for this use so that the permit requirements now read as follows: 21.200 All other cemeteries; and 21.300 Crematorium.

The Table of Permissible Uses is amended by deleting the entries for 1.510 Hotels and Motels and 1.530 Bed and Breakfast, renumbering the remaining Temporary Residential use classification that is remaining, 1.520 Tourist Homes and other Temporary Residences Renting Rooms for Relatively Short Periods of Time, from 1.520 to 1.510; and a new use classification 34.000 Temporary Lodging with associated permit requirements.

*Art. X PERMISSIBLE USES (con't)*

The Table of Permissible Uses is amended 6/26/07 by changing adding the letter “S” opposite use classification 22.100 under the B-1-C district column to indicate that this use is permissible with a Special Use Permit in that district. The Table of Permissible Uses is further amended by adding the letter “Z” opposite use classification 22.200 under the B-1-C district column to indicate that this use is permissible in this district with a Zoning Permit.

The Table of Permissible Uses is amended 6/26/07 by changing the letter “S” to letter “Z” opposite the classification 22.200 under the B-2, B-4, and CT district column to indicate that this use is now permissible with a Zoning Permit in these districts.

The Table of Permissible Uses is amended 6/26/07 by relabeling use 22.300 as Senior Citizens Day Care, Class A and by changing the letter “S” to letter “Z” opposite the classification 22.300 under the B-2, B-4, and CT district column to indicate that this use is now permissible with a Zoning Permit in these districts.

The Table of Permissible Uses is amended 6/26/07 by adding a new use classification, 22.400, Senior Citizens Day Care, Class B and adding the letter “S” opposite this use classification under the columns for the R-2, R-3 R-7.5, R-10, R-15, R-20, RR B-2, B-4, and CT zoning districts, by adding a “Z” under the columns for the B-1(G), B-1(C), B-3, M-1, O, and O/A zoning districts.

The Table of Permissible Uses is amended 11/27/07 by adding the letter “C” opposite use classifications 2.112, 2.120, 2.150, 3.120, and 3.220 under the WM-3 district column to indicate that these uses are permissible with a Conditional Use Permit in that district.

The Table of Permissible Uses is amended 6/24/08 by adding a new use classification 8.700 entitled “Mobile prepared food vendors” and by adding the letter “z” opposite this use classification under the B-1(C), B-1(G) and M-1 zoning district columns to indicate that this use is permissible in those districts with a zoning permit.

The Table of Permissible Uses is amended 10/28/08 by adding the letter “C” opposite use classifications 2.210, 2.220, 2.230 under the WM-3 district column to indicate that these uses are permissible with a Conditional Use Permit in that district.

The Table of Permissible Uses is amended 11/24/09 by the addition of a “Z(l)” opposite the 5.110 use classification in the column for the B-4 zoning district to indicate that these uses are permissible with a zoning permit in that district, subject to the limitations provided in Section 15-147(m).

The Table of Permissible Uses is hereby amended 6/22/10 to include “electronic gaming operations” as use # 6.150 and to add the electronic gaming definition. Electronic gaming operations shall be permitted with a special use permit in the B-4 zoning district, and the Table of Permissible Uses is amended accordingly.

*Art. X PERMISSIBLE USES (con't)*

The Table of Permissible is hereby amended on 4/23/13 is amended by changing the permit designation “ZS” to “ZC” wherever the former designation appears in the table under the zoning district columns applicable to the commercial and manufacturing districts. No change shall be made with respect to use classification 26.100 (major subdivisions).

<sup>2</sup>Use classifications amendment/repeal dates are as follows:

|                                   |                               |
|-----------------------------------|-------------------------------|
| 1.112—Amended 10/01/85            | 8.600—Amended 06/22/04        |
| 1.120—Amended 10/01/85            | 9.100—Amended 6/25/02         |
| 1.420—Amended 05/10/83; 06/22/04  | 15.147—Amended 06/22/04       |
| 1.480-- Amended 04/19/05          | 15.800—Amended 05/24/05       |
| 1.640—Amended 10/22/85            | 17.400—Amended 05/24/05       |
| 1.700—{Repealed}                  | 18.200---Amended 11/12/85     |
| 1.800                             | 19.100---Amended 05/12/81     |
| 2.110                             | 19.200---Amended 05/12/81     |
| 2.120                             | 21.000—Amended 06/20/06       |
| 2.111--Amended 04/15/81; 12/14/82 | 21.100—Amended 06/20/06       |
| 2.210—Amended 05/28/02 ; 10/28/08 | 21.200—Amended 06/20/06       |
| 2.220—Amended 10/28/08            | 21.300—Amended 06/20/06       |
| 2.230—Amended 5/28/02; 10/28/08   | 22.100—Amended 06/26/07       |
| 3.110—Amended 03/7/06             | 22.200—Amended 06/26/07       |
| 3.120—Amended 03/7/06             | 22.300—Amended 06/26/07       |
| 3.130---Amended 03/7/06           | 2.120—Amended 11/27/07        |
| 3.140---Amended 12/07/83          | 2.150—Amended 11/27/07        |
| 3.150—Amended 03/7/06             | 3.120—Amended 11/27/07        |
| 7.200---Amended 05/10/83          | 3.220—Amended 11/27/07        |
| 8.100—Amended 06/22/04            | 8.700—Amended 06/24/08        |
| 8.200—Amended 06/22/04            | 2.210---Amended 10/28/08      |
| 8.500—Amended 6/22/04             | 2.220---Amended 10/28/08      |
| 22.400--Amended 6/26/07           | 2.230---Amended 10/28/08      |
| 34.000--Amended 11/28/06          | 5.110---Amended 11/24/09      |
| 34.100--Amended 11/28/06          | 6.150---Amended 06/22/10      |
| 34.200--Amended 11/28/06          | ZS to ZC --- Amended 04/23/13 |
| 2.112—Amended 11/27/07            |                               |

# TABLE OF PERMISSIBLE USES

Last Amended: 4/23/13

| DESCRIPTION                                                                                           | R-2 | R-3 | R-7.5 | R-SIR, SIR2, 10 | R-15 | R-20 | RR | B-1 (C) | B-1 (G) | B-2 | B-3 | B-3-T | B-4 | M-1 | M-2 | CT | C | W-R | B-5 | WM-3 | O  | O/A |
|-------------------------------------------------------------------------------------------------------|-----|-----|-------|-----------------|------|------|----|---------|---------|-----|-----|-------|-----|-----|-----|----|---|-----|-----|------|----|-----|
| <b>1.000 Residential</b>                                                                              |     |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |    |     |
| 1.100 Single Family Residences                                                                        |     |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |    |     |
| 1.110 Single Family Detached One Dwelling Unit Per Lot                                                |     |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |    |     |
| 1.111 Site Built/Modular                                                                              | Z   | Z   | Z     | Z               | Z    | Z    | Z  |         | Z       | Z   | Z   | Z     |     |     |     | Z  |   | Z   |     |      | Z  | Z   |
| 1.112 Class A Mobile Home                                                                             |     |     | Z     | Z               | Z    | Z    | Z  |         |         |     |     |       |     |     |     |    |   | Z   |     |      |    |     |
| 1.113 Class B Mobile Home                                                                             |     |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |    |     |
| 1.120 Single Family Detached More Than One Dwelling Unit Per Lot                                      |     |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |    |     |
| 1.121 Site Built/Modular                                                                              | *   | *   | *     | *               | *    | *    | *  |         | *       | *   | *   | *     |     |     |     | *  |   |     |     |      | *  | *   |
| 1.122 Class A Mobile Home                                                                             |     |     | *     | *               | *    | *    | *  |         |         |     |     |       |     |     |     |    |   |     |     |      |    |     |
| 1.123 Class B Mobile Home                                                                             |     |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |    |     |
| 1.200 Two-Family Residences                                                                           |     |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |    |     |
| 1.210 Two-Family Conversion                                                                           | *   | *   | *     | *               | *    | *    | *  | *       | *       | *   | *   | *     |     |     |     | *  |   |     |     |      | *  | *   |
| 1.220 Primary Residence with Accessory Apartment                                                      | *   | *   | *     | *               | *    | *    | *  | *       | *       | *   | *   | *     |     |     |     | *  |   |     |     |      | *  | *   |
| 1.230 Duplex                                                                                          | *   | *   | *     | *               | *    | *    | *  | *       | *       | *   | *   | *     |     |     |     | *  |   |     |     |      | *  | *   |
| 1.231 Maximum 20% units > 3 bedrms/du                                                                 | *   | *   | *     | *               | *    | *    | *  | *       | *       | *   | *   | *     |     |     |     | *  |   |     |     |      | *  | *   |
| 1.232 No bedroom limit                                                                                | *   | *   |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |    |     |
| 1.240 Two Family Apartment                                                                            | *   | *   | *     | *               | *    | *    | *  | *       | *       | *   | *   | *     |     |     |     | *  |   |     |     |      | *  | *   |
| 1.241 Maximum 20% units > 3 bedrms/du                                                                 | *   | *   | *     | *               | *    | *    | *  | *       | *       | *   | *   | *     |     |     |     | *  |   |     |     |      | *  | *   |
| 1.242 No bedroom limit                                                                                | *   | *   |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |    |     |
| 1.300 Multi-Family Residences                                                                         |     |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |    |     |
| 1.310 Multi-Family Conversion                                                                         | SC  | SC  | SC    | SC              | SC   | SC   | SC | SC      | SC      | SC  | SC  | SC    |     |     |     | SC |   |     |     |      | SC | SC  |
| 1.320 Multi-Family Townhomes                                                                          | SC  | SC  | SC    | SC              | SC   | SC   | SC | SC      | SC      | SC  | SC  | SC    |     |     |     | SC |   |     |     |      | SC | SC  |
| 1.321 Maximum 20% units > 3 bedrms/du                                                                 | SC  | SC  | SC    | SC              | SC   | SC   | SC | SC      | SC      | SC  | SC  | SC    |     |     |     | SC |   |     |     |      | SC | SC  |
| 1.322 No bedroom limit                                                                                | SC  | SC  |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |    |     |
| 1.330 Multi-Family Apartments                                                                         | SC  | SC  | SC    | SC              | SC   | SC   | SC | SC      | SC      | SC  | SC  | SC    |     |     |     | SC |   |     |     |      | SC | SC  |
| 1.331 Maximum 20% units > 3 bedrms/du                                                                 | SC  | SC  | SC    | SC              | SC   | SC   | SC | SC      | SC      | SC  | SC  | SC    |     |     |     | SC |   |     |     |      | SC | SC  |
| 1.332 No bedroom limit                                                                                | SC  | SC  |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |    |     |
| 1.340 Single-Room Occupancy                                                                           | SC  |     |       |                 |      |      |    | SC      | SC      | SC  | SC  |       |     |     |     | SC |   |     |     |      |    |     |
| 1.400 Group Homes                                                                                     |     |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |    |     |
| 1.410 Fraternities, Sororities, Dormitories and Similar Housing                                       | C   | C   | C     | C               | C    | C    | C  |         | C       | C   |     |       |     |     |     | C  |   |     |     |      |    |     |
| 1.420 Boarding Houses, Rooming Houses                                                                 | S   | S   | S     | S               | S    | S    | S  |         | C       | S   |     |       |     |     |     | C  |   | C   |     |      |    |     |
| 1.430 Adult Care Home, Class A                                                                        | Z   | Z   | Z     | Z               | Z    | Z    | Z  |         | Z       | Z   | Z   | Z     |     |     |     | Z  |   | Z   |     |      | Z  | Z   |
| 1.440 Adult Care Home, Class B                                                                        | S   | S   | S     | S               | S    | S    | S  |         | Z       | Z   |     |       |     |     |     | Z  |   | S   |     |      |    |     |
| 1.450 Child Care Home, Class A                                                                        | Z   | Z   | Z     | Z               | Z    | Z    | Z  |         | Z       | Z   | Z   | Z     |     |     |     | Z  |   | Z   |     |      | Z  | Z   |
| 1.460 Child Care Home, Class B                                                                        | S   | S   | S     | S               | S    | S    | S  |         | Z       | Z   |     |       |     |     |     | Z  |   | S   |     |      |    |     |
| 1.470 Maternity Home                                                                                  | Z   | Z   | Z     | Z               | Z    | Z    | Z  |         | Z       | Z   | Z   | Z     |     |     |     | Z  |   | Z   |     |      | Z  | Z   |
| 1.480 Nursing Care Home                                                                               | Z   | Z   | Z     | Z               | Z    | Z    | Z  |         | Z       | Z   | Z   | Z     |     |     |     | Z  |   | Z   |     |      | Z  | Z   |
| 1.500 Temporary Residences                                                                            |     |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |    |     |
| 1.510 Tourist Homes and other Temporary Residences Renting Rooms for Relatively Short Periods of Time | S   | S   | S     | S               |      |      |    |         |         | S   |     |       |     |     |     |    |   |     | C   |      |    |     |
| 1.600 Homes Emphasizing Services, Treatment or Supervision                                            |     |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |    |     |
| 1.610 Temporary Homes for the Homeless                                                                |     | S   | S     |                 |      |      | S  | S       |         | S   | S   | S     |     |     |     |    |   |     |     |      |    |     |
| 1.620 Overnight Shelters for Homeless                                                                 |     |     |       |                 |      |      |    | S       |         | S   | S   | S     |     |     |     |    |   |     |     |      |    |     |
| 1.630 Senior Citizen Residential Complex                                                              |     |     |       | C               | C    |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |    |     |
| 1.700                                                                                                 |     |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |    |     |
| 1.800                                                                                                 |     |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |    |     |
| 1.900 Home Occupation                                                                                 | Z   | Z   | Z     | Z               | Z    | Z    | Z  |         |         | S   | S   | S     |     |     |     | S  |   | Z   |     |      | Z  | Z   |

# TABLE OF PERMISSIBLE USES

Last Amended: 4/23/13

| DESCRIPTION                                                                                                                                                                                                                        | R-2 | R-3 | R-7.5 | R-SIR, SIR2, 10 | R-15 | R-20 | RR | B-1 (C) | B-1 (G) | B-2 | B-3 | B-3-T | B-4 | M-1 | M-2 | CT | C | W-R | B-5 | WM-3 | O  | O/A |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-------|-----------------|------|------|----|---------|---------|-----|-----|-------|-----|-----|-----|----|---|-----|-----|------|----|-----|
| <b>2.000 Sales and Rental of Goods, Merchandise and Equipment</b>                                                                                                                                                                  |     |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |    |     |
| 2.100 No Storage or Display of Goods Outside Fully Enclosed Building                                                                                                                                                               |     |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |    |     |
| 2.110 High-Volume Traffic Generation                                                                                                                                                                                               |     |     |       |                 |      |      |    | ZC      | ZC      |     | ZC  | ZC    | ZC  | ZC  | ZC  | C  |   |     | C   |      |    | ZC  |
| 2.111 ABC Stores                                                                                                                                                                                                                   |     |     |       |                 |      |      |    | ZC      | ZC      |     | C   | C     | C   |     |     | C  |   |     |     |      |    |     |
| 2.112 Specialty High Volume Retail                                                                                                                                                                                                 |     |     |       |                 |      |      |    |         |         | ZC  |     |       |     |     |     |    |   |     |     | C    |    |     |
| 2.120 Low-Volume Traffic Generation                                                                                                                                                                                                |     |     |       |                 |      |      |    | ZC      | ZC      | ZC  | ZC  | ZC    | ZC  | ZC  | ZC  | C  |   |     | C   | C    |    | ZC  |
| 2.130 Wholesale Sales                                                                                                                                                                                                              |     |     |       |                 |      |      |    |         | ZC      |     |     | ZC    | ZC  | ZC  | ZC  | C  |   |     | C   | C    |    | ZC  |
| 2.140 Drive-In Windows                                                                                                                                                                                                             |     |     |       |                 |      |      |    |         |         |     | C   | C     | C   | C   |     |    |   |     |     |      |    |     |
| 2.150 Retail Sales with Subordinate Manufacturing and Processing                                                                                                                                                                   |     |     |       |                 |      |      |    | ZC      |         |     |     |       |     |     |     |    |   |     |     | C    |    |     |
| 2.200 Display of Goods Outside Fully Enclosed Building                                                                                                                                                                             |     |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |    |     |
| 2.210 High-Volume Traffic Generation                                                                                                                                                                                               |     |     |       |                 |      |      |    | ZC      | ZC      |     |     |       |     | ZC  | ZC  | ZC |   |     | C   | C    |    | ZC  |
| 2.220 Low-Volume Traffic Generation                                                                                                                                                                                                |     |     |       |                 |      |      |    | ZC      | ZC      |     |     |       |     | ZC  | ZC  | ZC |   |     | C   | C    |    | ZC  |
| 2.230 Wholesale Sales                                                                                                                                                                                                              |     |     |       |                 |      |      |    |         | C       |     |     |       |     | ZC  | ZC  | ZC |   |     | C   | C    |    | ZC  |
| 2.240 Drive-In Windows                                                                                                                                                                                                             |     |     |       |                 |      |      |    |         |         |     | C   | C     |     | C   |     |    |   |     |     |      |    |     |
| 2.300 Storage of goods outside fully enclosed building                                                                                                                                                                             |     |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |    |     |
| 2.310 High-volume traffic generation                                                                                                                                                                                               |     |     |       |                 |      |      |    |         |         |     |     |       |     | ZC  |     |    |   |     |     |      |    |     |
| 2.320 Low-volume traffic                                                                                                                                                                                                           |     |     |       |                 |      |      |    |         |         |     |     |       |     | ZC  |     |    |   |     |     |      |    |     |
| 2.330 Wholesale Sales                                                                                                                                                                                                              |     |     |       |                 |      |      |    |         |         |     |     |       |     | ZC  |     |    |   |     |     |      |    |     |
| 2.340 Drive-in Windows                                                                                                                                                                                                             |     |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |    |     |
| <b>3.000 Office, Clerical, Research and Services Not Primarily Related to Goods or Merchandise</b>                                                                                                                                 |     |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |    |     |
| 3.100 All operations conducted entirely Within Fully Enclosed Building                                                                                                                                                             |     |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |    |     |
| 3.110 Operations designed to attract and serve customers or clients on the premises, such as the office of attorneys, physicians, other professions, insurance and stock brokers, travel agents, government office buildings, etc. |     |     |       |                 |      |      |    | ZC      | ZC      | ZC  | S   |       | ZC  | ZC  | ZC  | C  |   |     | C   |      | ZC | ZC  |
| 3.120 Operations designed to attract little or no customer or client traffic other than employees of the entity operating the principal use                                                                                        |     |     |       |                 |      |      |    | ZC      | ZC      | ZC  | S   |       | ZC  | ZC  | ZC  | C  |   |     | C   | C    | Z  | ZC  |
| 3.130 Office or clinics of physicians or dentists with not more than 10,000 square feet of gross floor area                                                                                                                        |     |     |       |                 |      |      |    | ZC      | ZC      | ZC  | S   |       | ZC  | ZC  |     | ZC |   |     | C   |      | ZC | ZC  |
| 3.140 Watershed research                                                                                                                                                                                                           |     |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    | C |     |     |      |    |     |
| 3.150 Copy Centers/Printing Operations                                                                                                                                                                                             |     |     |       |                 |      |      |    | ZC      | ZC      | ZC  | S   | ZC    | ZC  | ZC  | ZC  | ZC |   |     | ZC  |      | ZC |     |

# TABLE OF PERMISSIBLE USES

Last Amended: 4/23/13

| DESCRIPTION                                                                                                                                                                                             | R-2 | R-3 | R-7.5 | R-SIR, SIR2, 10 | R-15 | R-20 | RR | B-1 (C) | B-1 (G) | B-2 | B-3 | B-3-T | B-4  | M-1 | M-2 | CT | C | W-R | B-5 | WM-3 | O  | O/A |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-------|-----------------|------|------|----|---------|---------|-----|-----|-------|------|-----|-----|----|---|-----|-----|------|----|-----|
| 3.200 Operations conducted within or outside fully enclosed buildings                                                                                                                                   |     |     |       |                 |      |      |    |         |         |     |     |       |      |     |     |    |   |     |     |      |    |     |
| 3.210 Operations designed to affect and serve customers or clients on the premises                                                                                                                      |     |     |       |                 |      |      |    |         |         |     |     |       |      | ZC  | ZC  |    |   |     | C   |      |    | ZC  |
| 3.220 Operations designed to attract little or no customer or client traffic other than employees of the entity operating the principal use                                                             |     |     |       |                 |      |      |    |         |         |     |     |       |      | ZC  | ZC  | C  |   |     | C   | C    |    | ZC  |
| 3.230 Banks with drive-in window                                                                                                                                                                        |     |     |       |                 |      |      |    |         |         |     | C   | C     | C    |     | C   |    |   |     |     |      |    |     |
| 3.240 Watershed research                                                                                                                                                                                |     |     |       |                 |      |      |    |         |         |     |     |       |      |     |     |    | C |     |     |      |    |     |
| 3.250 Automatic Teller Machine, Freestanding                                                                                                                                                            |     |     |       |                 |      |      |    | C       | C       |     | C   |       | C    |     |     | C  |   |     |     |      | C  | C   |
| <b>4.000 Manufacturing, Processing, Creating, Repairing, Renovating, Painting, Cleaning, Assembling of Goods, Merchandise and Equipment</b>                                                             |     |     |       |                 |      |      |    |         |         |     |     |       |      |     |     |    |   |     |     |      |    |     |
| 4.100 All operations conducted entirely within fully enclosed buildings                                                                                                                                 |     |     |       |                 |      |      |    |         | ZC      |     |     |       |      | ZC  | ZC  | C  |   |     |     | C    |    | C   |
| 4.200 Operations conducted within or outside fully enclosed buildings                                                                                                                                   |     |     |       |                 |      |      |    |         |         |     |     |       |      |     | ZC  |    |   |     |     |      |    |     |
| <b>5.000 Educational, Cultural, Religious, Philanthropic, Social, Fraternal Uses</b>                                                                                                                    |     |     |       |                 |      |      |    |         |         |     |     |       |      |     |     |    |   |     |     |      |    |     |
| 5.100 Schools                                                                                                                                                                                           |     |     |       |                 |      |      |    |         |         |     |     |       |      |     |     |    |   |     |     |      |    |     |
| 5.110 Elementary and secondary (including associated grounds and athletic and other facilities)                                                                                                         | C   | C   | C     | C               | C    | C    | C  | C       | C       |     |     |       | Z(1) |     |     |    |   | Z   | C   |      |    |     |
| 5.120 Trade or vocational school                                                                                                                                                                        |     |     |       |                 |      |      |    | Z       | ZC      |     |     |       | C    | ZC  | C   | C  |   |     | C   |      |    |     |
| 5.130 Colleges, universities, community colleges (including associated facilities such as dormitories, office buildings, athletic fields, etc)                                                          |     |     |       |                 |      |      | C  | Z       | ZC      |     |     |       | C    | C   |     | C  |   |     |     |      |    |     |
| 5.200 Churches, synagogues and temples (including associated residential structures for religious personnel and associated buildings but not including elementary school buildings) school or secondary | ZS  | ZS  | ZS    | ZS              | ZS   | ZS   | ZS | Z       | ZC      | ZC  | ZC  | ZC    | ZC   | ZC  |     | ZC |   | C   | C   |      | ZS | ZS  |
| 5.300 Libraries, museums, art galleries, art centers and similar uses (including associated educational and instructional activities)                                                                   |     |     |       |                 |      |      |    |         |         |     |     |       |      |     |     |    |   |     |     |      |    |     |
| 5.310 Located within a building designed and previously occupied as a residence or within a building having a gross floor area not in excess of 3,500 square feet                                       | S   | S   | S     | S               | S    | S    | S  | ZC      | Z       | Z   | Z   | Z     | S    | ZC  |     | ZC |   |     | C   |      | Z  | ZS  |
| 5.320 Located within any permissible structures                                                                                                                                                         |     |     |       |                 |      |      |    | ZC      | ZC      | ZC  |     |       | S    | ZC  |     | ZC |   |     | C   |      | C  | ZS  |
| 5.400 Social, fraternal clubs and lodges, union halls, and similar uses                                                                                                                                 |     |     |       |                 |      |      |    | ZC      | ZC      | ZC  |     |       | S    | S   |     | ZC |   |     | C   |      |    |     |
| <b>6.000 Recreation, Amusement, Entertainment</b>                                                                                                                                                       |     |     |       |                 |      |      |    |         |         |     |     |       |      |     |     |    |   |     |     |      |    |     |
| 6.100 Activity conducted entirely within building or substantial structure                                                                                                                              |     |     |       |                 |      |      |    |         |         |     |     |       |      |     |     |    |   |     |     |      |    |     |
| 6.110 Bowling alley, skating rinks, indoor tennis and squash courts, billiards and pool halls, indoor athletic and exercise facilities and similar uses.                                                |     |     |       |                 |      |      |    | ZC      | ZC      |     | ZC  | ZC    | ZC   | ZC  |     | ZC |   |     | C   |      |    |     |

# TABLE OF PERMISSIBLE USES

Last Amended: 4/23/13

| DESCRIPTION                                                                                                                                                                                                                                                                                               | R-2 | R-3 | R-7.5 | R-SIR, SIR2, 10 | R-15 | R-20 | RR | B-1 (C) | B-1 (G) | B-2 | B-3 | B-3-T | B-4 | M-1 | M-2 | CT | C | W-R | B-5 | WM-3 | O | O/A |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-------|-----------------|------|------|----|---------|---------|-----|-----|-------|-----|-----|-----|----|---|-----|-----|------|---|-----|
| 6.120 Movie Theaters                                                                                                                                                                                                                                                                                      |     |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |   |     |
| 6.121 Seating capacity of not more than 300                                                                                                                                                                                                                                                               |     |     |       |                 |      |      |    | ZC      | ZC      |     |     |       | ZC  | S   |     | ZC |   |     |     |      |   | S   |
| 6.122 Unlimited Seating Capacity                                                                                                                                                                                                                                                                          |     |     |       |                 |      |      |    | S       | ZC      |     |     |       | ZC  | S   |     | ZC |   |     |     |      |   |     |
| 6.130 Coliseums, stadiums, and all other facilities listed in the 6.100 classification designed to seat or accommodate simultaneously more than 1000 people                                                                                                                                               |     |     |       |                 |      |      |    | C       | C       |     |     |       | C   | C   |     | C  |   |     |     |      |   |     |
| 6.140 Community Center--a Town sponsored, non-profit indoor facility providing for one or several of various type of recreational uses. Facilities in a Community Center may include, but are not limited to gymnasia, swimming pools, indoor court areas, meeting/activity rooms, and other similar uses | Z   | Z   | Z     | Z               | Z    | Z    | Z  | Z       | Z       | Z   | Z   | Z     | Z   | Z   | Z   | Z  | Z |     | Z   | Z    |   | Z   |
| 6.150 Electronic Gaming Operations                                                                                                                                                                                                                                                                        |     |     |       |                 |      |      |    |         |         |     |     |       | S   |     |     |    |   |     |     |      |   |     |
| 6.200 Activity conducted primarily outside enclosed buildings or structures.                                                                                                                                                                                                                              |     |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |   |     |
| 6.210 Outdoor recreational facilities developed on private lands, without Town sponsorship or investment, such as golf and country clubs, swimming or tennis clubs, etc. and not constructed pursuant to a permit authorizing the construction of a residential development.                              | S   | S   | S     | S               | S    | S    | S  |         | C       |     |     |       |     |     |     | C  | C | C   | C   |      |   |     |
| 6.220 Outdoor recreational facilities developed on public lands, or on private lands with swimming pools, parks, etc., not constructed pursuant to a permit authorizing the construction of another use such as a school                                                                                  |     |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |   |     |
| 6.221 Town of Carrboro owned and operated facilities.                                                                                                                                                                                                                                                     | Z   | Z   | Z     | Z               | Z    | Z    | Z  | Z       | Z       |     |     |       | Z   | Z   |     | Z  | Z | Z   | Z   | Z    |   |     |
| 6.222 Facilities owned and operated by public entities other than the Town of Carrboro                                                                                                                                                                                                                    | C   | C   | C     | C               | C    | C    | C  | C       | C       |     |     |       | C   | C   |     | C  | C | C   | C   | C    |   |     |
| 6.230 Golf driving ranges not accessory to golf course, par 3 golf courses, miniature golf course, skateboard parks, water slides, and similar uses.                                                                                                                                                      |     |     |       |                 |      |      |    |         |         |     |     |       |     | ZC  |     |    |   |     | C   |      |   |     |
| 6.240 Horseback riding stables (not constructed pursuant to permit authorizing residential development)                                                                                                                                                                                                   |     |     |       |                 |      |      | S  |         |         |     |     |       |     | S   |     |    | Z | C   | C   |      |   |     |
| 6.250 Automobile and motorcycle racing tracks                                                                                                                                                                                                                                                             |     |     |       |                 |      |      |    |         |         |     |     |       |     |     | S   |    |   |     |     |      |   |     |
| 6.260 Drive-in Movie Theaters                                                                                                                                                                                                                                                                             |     |     |       |                 |      |      |    |         |         |     |     |       |     | C   |     |    |   |     |     |      |   |     |
| <b>7.000 Institutional Residence or Care of Confinement Facilities</b>                                                                                                                                                                                                                                    |     |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |   |     |
| 7.100 Hospitals, clinics, other medical (including mental health) treatment facilities in excess of 10,000 square feet of floor area                                                                                                                                                                      |     |     |       |                 |      |      |    |         | C       |     |     |       |     |     |     | C  |   |     |     |      |   |     |

# TABLE OF PERMISSIBLE USES

Last Amended: 4/23/13

| DESCRIPTION                                                                                                                                                                                                                                                                     | R-2 | R-3 | R-7.5 | R-SIR, SIR2, 10 | R-15 | R-20 | RR | B-1 (C) | B-1 (G) | B-2 | B-3 | B-3-T | B-4 | M-1 | M-2 | CT | C | W-R | B-5 | WM-3 | O | O/A |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-------|-----------------|------|------|----|---------|---------|-----|-----|-------|-----|-----|-----|----|---|-----|-----|------|---|-----|
| 7.200 Nursing care institutions, intermediate care institutions, handicapped, aged or infirm institutions, child care institutions                                                                                                                                              | C   | C   |       |                 |      |      | C  |         | C       |     |     |       |     |     |     | C  |   |     | C   |      |   |     |
| 7.300 Institutions (other than halfway houses) where mentally ill persons are confined                                                                                                                                                                                          |     |     |       |                 |      |      |    |         | C       |     |     |       |     |     |     | C  |   |     |     |      |   |     |
| 7.400 Penal and Correctional Facilities                                                                                                                                                                                                                                         |     |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |   |     |
| <b>8.000 Restaurants (including food delivery services), Bars, Night Clubs</b>                                                                                                                                                                                                  |     |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |   |     |
| 8.100 Restaurant with none of the features listed in use classification below as its primary activity                                                                                                                                                                           |     |     |       |                 |      |      |    | ZC      | ZC(l)   | C   |     |       | Z   |     |     |    |   |     | C   |      |   | ZC  |
| 8.200 Outside Service or Consumption                                                                                                                                                                                                                                            |     |     |       |                 |      |      |    | ZC      | ZC(l)   | C   |     |       | S   |     |     |    |   |     | C   |      |   | ZC  |
| 8.300 Drive-in (service to and consumption in vehicle on premises)                                                                                                                                                                                                              |     |     |       |                 |      |      |    |         |         |     |     |       | C   |     |     |    |   |     |     |      |   |     |
| 8.400 Drive Through Windows (service directly to vehicles primarily for off-premises consumption)                                                                                                                                                                               |     |     |       |                 |      |      |    |         |         |     |     |       | C   |     |     |    |   |     |     |      |   |     |
| 8.500 Carry Out Service (food picked up inside of off-premises consumption)                                                                                                                                                                                                     |     |     |       |                 |      |      |    | ZC      | ZC(l)   |     |     |       | Z   |     |     |    |   |     | C   |      |   |     |
| 8.600 Food Delivery                                                                                                                                                                                                                                                             |     |     |       |                 |      |      |    | ZC      | ZC(l)   |     |     |       | Z   |     |     |    |   |     | C   |      |   |     |
| 8.700 Mobile prepared food vendors                                                                                                                                                                                                                                              |     |     |       |                 |      |      |    | Z       | Z       |     |     |       |     | Z   |     |    |   |     |     |      |   |     |
| <b>9.000 Motor Vehicle-Related Sales and Service Operations</b>                                                                                                                                                                                                                 |     |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |   |     |
| 9.100 Motor vehicle sales or rental of sales and service                                                                                                                                                                                                                        |     |     |       |                 |      |      |    |         | C       |     |     |       |     | ZC  | ZC  |    |   |     |     |      |   |     |
| 9.200 Automobile service stations                                                                                                                                                                                                                                               |     |     |       |                 |      |      |    |         |         |     |     |       | S   | C   | Z   |    |   |     |     |      |   |     |
| 9.300 Gas sales operations                                                                                                                                                                                                                                                      |     |     |       |                 |      |      |    |         |         |     | S   | S     | S   | C   | Z   |    |   |     |     |      |   |     |
| 9.400 Automobile repair shop or body shop                                                                                                                                                                                                                                       |     |     |       |                 |      |      |    |         | C       |     |     | S     | S   | C   | Z   |    |   |     |     |      |   |     |
| 9.500 Car wash                                                                                                                                                                                                                                                                  |     |     |       |                 |      |      |    |         |         |     |     |       |     | C   | Z   |    |   |     |     |      |   |     |
| <b>10.000 Storage and Parking</b>                                                                                                                                                                                                                                               |     |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |   |     |
| 10.100 Independent automobile parking lots or garages                                                                                                                                                                                                                           |     |     |       |                 |      |      |    | ZC      | Z       |     |     |       | Z   | Z   | Z   | C  |   |     |     |      |   |     |
| 10.200 Storage of goods not related to sale or uses of those goods on the same lot where they are stored                                                                                                                                                                        |     |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |   |     |
| 10.210 All storage within completely enclosed structures                                                                                                                                                                                                                        |     |     |       |                 |      |      |    |         |         |     |     |       |     | Z   | Z   |    |   |     |     |      |   | C   |
| 10.220 Storage inside or outside completely enclosed structures                                                                                                                                                                                                                 |     |     |       |                 |      |      |    |         |         |     |     |       |     | C   | Z   |    |   |     |     |      |   | ZC  |
| 10.300 Parking of vehicles or storage of equipment outside enclosed structures where: (i) vehicles or equipment are owned and used by the person making use of the lot, and (ii) parking or storage is more than a minor and incidental part of the overall use made of the lot |     |     |       |                 |      |      |    |         |         |     |     |       |     | S   | S   |    |   |     |     |      |   |     |
| <b>11.000 Scrap Materials Salvage Yards, Junkyards, Automobile Graveyards</b>                                                                                                                                                                                                   |     |     |       |                 |      |      |    |         |         |     |     |       |     |     | S   |    |   |     |     |      |   |     |
| <b>12.000 Services and Enterprises Related to Animals</b>                                                                                                                                                                                                                       |     |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |   |     |
| 12.100 Veterinarian                                                                                                                                                                                                                                                             |     |     |       |                 |      |      | S  |         | ZC      |     |     |       | S   | S   | S   |    |   |     |     |      |   |     |
| 12.200 Kennel                                                                                                                                                                                                                                                                   |     |     |       |                 |      |      | S  |         |         |     |     |       |     | S   | S   |    |   |     |     |      |   |     |
| <b>13.000 Emergency Services</b>                                                                                                                                                                                                                                                |     |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |   |     |
| 13.100 Police Stations                                                                                                                                                                                                                                                          | Z   | Z   | Z     | Z               | Z    | Z    | Z  | Z       | Z       | Z   | Z   | Z     | Z   | Z   | Z   | Z  | Z | Z   | Z   | Z    | Z | Z   |
| 13.200 Fire Stations                                                                                                                                                                                                                                                            | Z   | Z   | Z     | Z               | Z    | Z    | Z  |         | Z       | Z   | Z   | Z     | Z   | Z   | Z   | Z  | Z | Z   | Z   | Z    | Z | Z   |
| 13.300 Rescue Squad, Ambulance Service                                                                                                                                                                                                                                          | S   | S   | S     | S               | S    | S    | Z  |         | S       | S   | S   | S     | S   | S   | Z   | S  | C | C   | C   | C    | S | S   |
| 13.400 Civil Defense Operation                                                                                                                                                                                                                                                  | S   | S   | S     | S               | S    | S    | Z  |         | S       | S   | S   | S     | S   | S   | Z   | S  | C | C   | C   | C    | S | S   |
| <b>14.000 Agricultural, Silvicultural, Mining, Quarrying Operations</b>                                                                                                                                                                                                         |     |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |   |     |
| 14.100 Agricultural operations, farming                                                                                                                                                                                                                                         |     |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |   |     |
| 14.110 Excluding livestock                                                                                                                                                                                                                                                      |     | Z   | Z     | Z               | Z    | Z    | Z  |         |         |     |     |       |     |     | Z   |    | Z | Z   | Z   |      |   |     |
| 14.120 Including livestock                                                                                                                                                                                                                                                      |     |     |       |                 |      |      | Z  |         |         |     |     |       |     |     |     |    | Z | Z   | Z   |      |   |     |
| 14.200 Silvicultural operations                                                                                                                                                                                                                                                 |     | Z   | Z     | Z               | Z    | Z    | Z  |         |         |     |     |       |     |     | Z   |    |   |     |     |      |   |     |

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Last Amended: 4/23/13

| DESCRIPTION                                                                                                                                               | R-2 | R-3 | R-7.5 | R-SIR, SIR2, 10 | R-15 | R-20 | RR | B-1 (C) | B-1 (G) | B-2 | B-3 | B-3-T | B-4 | M-1 | M-2 | CT | C | W-R | B-5 | WM-3 | O | O/A |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-------|-----------------|------|------|----|---------|---------|-----|-----|-------|-----|-----|-----|----|---|-----|-----|------|---|-----|
| 14.300 Mining or quarrying operations, including on-site sales of products                                                                                |     |     |       |                 |      |      |    |         |         |     |     |       |     |     | S   |    |   |     |     |      |   |     |
| 14.400 Reclamation landfill                                                                                                                               |     | Z   | Z     | Z               | Z    | Z    | Z  |         |         |     |     |       | Z   | Z   | Z   |    |   |     |     |      |   |     |
| <b>15.000 Miscellaneous Public and Semi-Public Facilities</b>                                                                                             |     |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |   |     |
| 15.100 Post Office                                                                                                                                        |     |     |       |                 |      |      |    | C       | C       |     | C   | C     | C   | C   | C   | C  |   |     |     |      |   |     |
| 15.200 Airport                                                                                                                                            |     |     |       |                 |      |      | C  |         | S       |     |     |       | S   | S   |     |    |   |     |     |      |   | C   |
| 15.300 Sanitary landfill                                                                                                                                  |     |     |       |                 |      |      | C  |         |         |     |     |       |     | C   |     |    |   |     |     |      |   |     |
| 15.400 Military reserve, National Guard centers                                                                                                           |     |     |       |                 |      |      |    |         |         |     |     |       |     | Z   |     |    |   |     |     |      |   |     |
| 15.500 Recycling materials collection operations                                                                                                          |     |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |   |     |
| 15.510 Using collection facilities other than motor vehicles                                                                                              |     |     |       |                 |      |      |    |         | Z       |     |     |       | Z   | Z   | Z   |    |   |     |     |      |   |     |
| 15.520 Aluminum recycling using motor vehicles                                                                                                            |     |     |       |                 |      |      |    |         | S       |     |     |       | S   | S   | S   |    |   |     |     |      |   |     |
| 15.600 Public utility service complex                                                                                                                     |     |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     | C   |      |   |     |
| 15.700 Cable Television Signal Distribution Center                                                                                                        |     |     |       |                 |      |      |    | S       | S       | S   | S   |       | S   | S   | S   | S  |   |     |     |      | S | S   |
| <b>15.800 Town-owned and/or Operated Facilities and Services</b>                                                                                          |     |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |   |     |
| 15.810 Town-owned and/or Operated Public Parking Lot                                                                                                      |     |     |       |                 |      |      |    | Z       | Z       | Z   | Z   | Z     | Z   | Z   | Z   | Z  |   |     |     | Z    |   | Z   |
| 15.820 All other town-owned and/or operated facilities and services                                                                                       | Z   | Z   | Z     | Z               | Z    | Z    | Z  |         | Z       |     | Z   | Z     |     | Z   | Z   | Z  | Z | Z   | Z   | Z    | Z | Z   |
| <b>16.000 Dry Cleaner, Laundromat</b>                                                                                                                     |     |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |   |     |
| 16.100 With drive-in windows                                                                                                                              |     |     |       |                 |      |      |    |         |         |     | C   | C     | C   | C   |     |    |   |     |     |      |   | C   |
| 16.200 Without drive-in windows                                                                                                                           |     |     |       |                 |      |      |    |         | Z       |     | S   | S     | Z   | S   |     | Z  |   |     | C   |      |   | S   |
| <b>17.000 Utility Facilities</b>                                                                                                                          |     |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |   |     |
| 17.100 Neighborhood                                                                                                                                       | S   | S   | S     | S               | S    | S    | S  |         | S       | S   | S   | S     | S   | S   | S   | S  | C | C   | C   |      |   | S   |
| 17.200 Community or regional                                                                                                                              |     |     |       |                 |      |      |    |         |         |     |     |       |     | S   | S   |    | C |     | C   |      |   | S   |
| 17.300 Cable Television Satellite Station                                                                                                                 |     |     |       |                 |      |      | S  |         |         |     | S   | S     | S   | S   | S   | S  |   |     |     |      | S | S   |
| 17.400 Underground Utility Lines                                                                                                                          | Z   | Z   | Z     | Z               | Z    | Z    | Z  | Z       | Z       | Z   | Z   | Z     | Z   | Z   | Z   | Z  | C | C   | Z   | C    | Z | Z   |
| <b>18.000 Towers and Related Structures</b>                                                                                                               |     |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |   |     |
| 18.100 Towers and antennas fifty feet tall or less                                                                                                        | Z   | Z   | Z     | Z               | Z    | Z    | Z  | Z       | Z       |     | Z   | Z     | Z   | Z   | Z   | Z  | Z | C   | Z   |      |   | Z   |
| 18.200 Towers and antennas attached thereto that exceed 50 feet in height, and that are not regarded as accessory to residential users under 15-150(c)(5) |     |     |       |                 |      | C    | C  |         |         |     | C   | C     | C   | C   | C   | C  |   |     | C   | C    | C | C   |
| 18.300 Antennas exceeding 50 feet in height attached to structures other than towers, [other than accessory uses under 15-150(c)(5)]                      | S   | S   | S     | S               | S    | S    | S  | S       | S       | S   | S   | S     | S   | S   | S   | S  | S | S   | S   | S    | S | S   |
| 18.400 Publicly-owned towers and antennas of all sizes that are used in the provision of public safety services                                           |     |     |       |                 |      |      |    |         | ZC      |     |     |       |     |     |     |    |   |     |     |      |   |     |
| <b>19.000 Open Air Markets and Horticultural Sales</b>                                                                                                    |     |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |   |     |
| 19.100 Open air markets (farm and craft markets, flea markets, produce markets)                                                                           |     |     |       |                 |      |      |    | ZC      | ZC      | ZC  | S   | S     |     | S   |     | S  |   |     |     |      | S | S   |
| 19.200 Horticultural sales with outdoor display                                                                                                           |     |     |       |                 |      |      |    |         | ZC      | ZC  | S   | S     |     | S   |     | S  |   |     |     |      | S | S   |
| 19.300 Seasonal Christmas or pumpkin sales                                                                                                                |     |     |       |                 |      |      |    | Z       | Z       | Z   | Z   | Z     | Z   | Z   | Z   |    |   |     |     |      | Z | Z   |
| <b>20.000 Funeral Homes</b>                                                                                                                               |     |     |       |                 |      |      |    |         |         |     |     |       | Z   | Z   |     |    |   |     |     |      |   |     |
| <b>21.000 Cemetery and Crematorium</b>                                                                                                                    |     |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |   |     |
| 21.100 Town-owned cemetery                                                                                                                                | Z   | Z   | Z     | Z               | Z    | Z    | Z  | Z       | Z       | Z   | Z   | Z     | Z   | Z   | Z   | Z  | Z | Z   | Z   | Z    | Z | Z   |
| 21.200 All other cemeteries                                                                                                                               |     |     |       |                 |      |      | S  |         |         |     |     |       |     | Z   | Z   |    | C | C   | C   |      |   |     |
| 21.300 Crematorium                                                                                                                                        |     |     |       |                 |      |      |    |         |         |     |     |       |     | Z   | Z   |    |   |     |     |      |   |     |
| <b>22.000 Day Care</b>                                                                                                                                    |     |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |   |     |
| 22.100 Child Day Care Home                                                                                                                                | ZZ  | Z   | Z     | Z               | Z    | Z    | Z  | S       | S       | Z   | S   | S     |     |     |     | Z  |   | Z   |     |      | S | S   |
| 22.200 Child Day Care Facility                                                                                                                            | S   | S   | S     | S               | S    | S    | S  | Z       | Z       | Z   | Z   | Z     | Z   | Z   |     | Z  |   | C   | C   |      | Z | Z   |
| 22.300 Senior Citizens Day Care, Class A                                                                                                                  | S   | S   | S     | S               | S    | S    | S  |         | Z       | Z   | Z   | Z     | Z   | Z   |     | Z  |   | C   | C   |      | Z | Z   |
| 22.400 Senior Citizens Day Care, Class B                                                                                                                  | S   | S   | S     | S               | S    | S    | S  | Z       | Z       | S   | Z   | Z     | S   | Z   |     | S  |   |     |     |      | Z | Z   |

TABLE OF PERMISSIBLE USES

Last Amended: 4/23/13

| DESCRIPTION                                                                                                                                   | R-2                                                                                                                             | R-3 | R-7.5 | R-SIR, SIR2, 10 | R-15 | R-20 | RR | B-1 (C) | B-1 (G) | B-2 | B-3 | B-3-T | B-4 | M-1 | M-2 | CT | C | W-R | B-5 | WM-3 | O  | O/A |
|-----------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|-----|-------|-----------------|------|------|----|---------|---------|-----|-----|-------|-----|-----|-----|----|---|-----|-----|------|----|-----|
| 23.000 Temporary structure or parking lots used in connection with the construction of a permanent building or for some non-recurring purpose |                                                                                                                                 |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |    |     |
| 23.100 Temporary structures located on same lot as activity generating need for structure                                                     | Z                                                                                                                               | Z   | Z     | Z               | Z    | Z    | Z  | Z       | Z       | Z   | Z   | Z     | Z   | Z   | Z   | Z  | C | C   | C   | C    | Z  | Z   |
| 23.200 Temporary parking facilities located on or off-site of activity generating need for parking                                            | Z                                                                                                                               |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |    |     |
| 24.000 Bus Station                                                                                                                            |                                                                                                                                 |     |       |                 |      |      |    |         | ZC      |     |     |       | S   | S   |     | S  |   |     |     |      |    |     |
| 25.000 Commercial Greenhouse Operations                                                                                                       |                                                                                                                                 |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |    |     |
| 25.100 No on-premises sales                                                                                                                   |                                                                                                                                 |     |       |                 |      | S    | S  |         |         |     |     |       |     | Z   |     |    |   |     |     |      |    |     |
| 25.200 On-premises sales permitted                                                                                                            |                                                                                                                                 |     |       |                 |      |      | S  |         |         |     |     |       |     | Z   |     |    |   |     |     |      |    |     |
| 26.000 Subdivisions                                                                                                                           |                                                                                                                                 |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |    |     |
| 26.100 Major                                                                                                                                  | SC                                                                                                                              | SC  | SC    | SC              | SC   | SC   | SC | SC      | SC      | SC  | SC  | SC    | SC  | SC  | SC  | SC | C | C   | C   | C    | SC | SC  |
| 26.200 Minor                                                                                                                                  | Z                                                                                                                               | Z   | Z     | Z               | Z    | Z    | Z  | Z       | Z       | Z   | Z   | Z     | Z   | Z   | Z   | Z  | C | C   | C   | C    | Z  | Z   |
| 27.000 Combination Uses                                                                                                                       | *                                                                                                                               | *   | *     | *               | *    | *    | *  | *       | *       | *   | *   | *     | *   | *   | *   | *  | * | C   | *   | *    | *  | *   |
| 28.000 Planned Unit Developments                                                                                                              | Permissible only in Planned Unit Development Districts (See Section 15-139) pursuant to a conditional use permit).              |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |    |     |
| 29.000 Special Events                                                                                                                         | C                                                                                                                               | C   | C     | C               | C    | C    | C  | ZC      | ZC      | ZC  | C   | C     | C   | C   | C   | C  | C | C   |     |      | C  | C   |
| 30.000 Planned Industrial Development                                                                                                         | Permissible only in Planned Industrial Development Districts [See Subsection 15-137(c)] pursuant to a conditional use permit    |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |    |     |
| 31.000 Off-Premises Signs                                                                                                                     |                                                                                                                                 |     |       |                 |      |      |    |         |         |     |     |       |     |     | Z   |    |   |     |     |      |    |     |
| 32.000 Village Mixed Use Development                                                                                                          | Permissible only in Village Mixed Use Districts (See Section 15-141.2 pursuant to a conditional use permit).                    |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |    |     |
| 33.000 Office/Assembly Planned Development                                                                                                    | Permissible only in Office/Assembly Conditional Use Districts [see Subsection 15-136(11) pursuant to a conditional use permit]. |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |    |     |
| 34.000 Temporary Lodging                                                                                                                      |                                                                                                                                 |     |       |                 |      |      |    |         |         |     |     |       |     |     |     |    |   |     |     |      |    |     |
| 34.100 Hotels and Motels                                                                                                                      | C                                                                                                                               |     |       |                 |      |      |    | C       | C       |     |     |       | C   |     |     | C  |   |     |     |      |    | C   |
| 34.200 Bed and Breakfast                                                                                                                      | S                                                                                                                               | S   | S     | S               | S    | S    | S  |         |         | S   |     |       |     |     |     | S  |   | C   | S   |      |    |     |

*Art. X PERMISSIBLE USES (con't)***Section 15-147 Use of the Designations Z,S,C in Table of Permissible Uses (AMENDED 11/18/03; 6/22/04; 10/25/05; 11/22/05; 6/26/07; 11/27/07; 10/28/08, 11/24/09. REWRITTEN 4/23/09)**

(a) Subject to Section 15-148, and subsection (h) of this section, when used in connection with a particular use in the Table of Permissible Uses (Section 15-146), the letter “Z” means that the use is permissible in the indicated zone with a zoning permit issued by the administrator (except that, in connection with use classification 26.200, minor subdivisions, the letter “Z” means that final plat approval shall be granted by the Planning Director). The letter “S” means a special use permit must be obtained from the board of adjustment, and the letter “C” means a conditional use permit must be obtained from the Board of Aldermen. **(AMENDED 1/22/85; 11/18/03)**

(b) When used in connection with single-family, two-family and multi-family residences (use classifications 1.100, 1.200 and 1.300) outside the watershed districts, the designation “ZSC” or “SC” means that tracts developed with four dwelling units or less require a zoning permit, tracts developed with between five and twelve dwelling units require a special use permit, and tracts developed with more than twelve dwelling units require a conditional use permit. When used in connection with single-family, two-family, and multi-family residences in the watershed districts, the designation “ZC” means that tracts developed with one dwelling unit shall require a zoning permit and tracts developed with two or more dwelling units shall require a conditional use permit. **(AMENDED 1/22/85; 2/24/87; 12/15/87)**

(c) When used in connection with major subdivisions (use classification 26.100) outside the watershed districts, the designation “SC” means that subdivisions containing between five and twelve lots shall require a special use permit, and subdivisions containing thirteen or more lots shall require a conditional use permit. **(AMENDED 7/21/87; 12/15/87)**

(d) Subject to Section 15-148, use of the designation “ZC” (which designation appears only under the zoning district columns applicable to the commercial and manufacturing districts) means that a conditional use permit must be obtained if the development involves the construction of more than 3,000 square feet of new building gross floor area *or* the development is located on a lot of more than one acre, and a zoning permit must be obtained if the development involves the construction of 3,000 square feet or less of new building gross floor area *and* the development is located on a lot of one acre or less. **(AMENDED 11/14/88) (REWRITTEN 4/23/13)**

(e) Subject to Section 15-148, use of the designation “Z,S” means that a zoning permit must be obtained if the development is located on a lot of two acres or less while a special use permit must be obtained for developments in excess of two acres.

(f) Use of the designation Z,S,C, for combination uses is explained in Section 15-154.

(g) When used in connection with use classification 18.400 (publicly-owned towers and antennas of all sizes that are used in the provisions of public safety services), the designation “ZC” means that the development of such towers that are fifty feet tall or less

*Art. X PERMISSIBLE USES (con't)*

shall require a zoning permit, and the development of such towers that are more than fifty feet tall shall require a conditional use permit. **(AMENDED 10/04/88, 02/18/97)**

- (h) Whenever any 1.000 classification use is proposed for a lot in the R-2, R-3, R-7.5, and R-10 zoning districts and such use would otherwise require the issuance of a zoning permit under the provisions of this section, a special use permit shall nevertheless be required if:
  - (1) The use involves (i) construction of an addition to an existing dwelling, or (ii) construction of an additional dwelling on a lot where at least one dwelling already exists, or (iii) construction of a dwelling on a lot from which a previously existing dwelling has been removed within a period of three years prior to the application for a permit under this chapter, and
  - (2) The gross floor area of any one dwelling unit exceeds 3,500 square feet, or the gross floor area of all dwellings covered by the proposed permit exceeds 5,500 square feet.
  - (3) This requirement shall not apply if at least one of the dwelling units is an affordable housing unit as defined in Section 15-182.4(a).
  - (4) This requirement shall not apply with respect to a proposed one-time addition to a dwelling that has been in existence for a period of at least twenty years if such one-time addition results in less than a 25 percent increase in the gross floor area of such dwelling and less than a 15 percent increase in the gross floor area of all dwellings covered by the proposed permit.
- (i) When used in connection with 8.100, 8.200, 8.500 and 8.600 uses, the designation "ZC(l)" means that a zoning permit must be obtained if the total area within a development to be used for this purpose does not exceed 1,500 square feet and the use is to take place in a building in existence on the effective date of this subsection while a conditional use permit must be obtained whenever the total area to be used for this purpose is equal to or exceeds 1,500 square feet.
- (j) Notwithstanding the other provisions of this section, whenever a building of more than two stories or 35 feet in height is proposed within the B-1(g), B-1(c), B-2, CT or M-1 zoning districts, a conditional use permit must be obtained from the Board of Aldermen. **(AMENDED 10/25/05)**
- (k) Notwithstanding the foregoing, Uses 22.200 Child Day Care Facilities serving nine to fifteen children, and 22.300 Senior Citizen Day Care, Class A, serving four to sixteen seniors, that are located on collector or arterial streets are permissible with a Zoning Permit issued by the

*Art. X PERMISSIBLE USES (con't)*

Administrator. For the purposes of this section, collector streets are those streets whose function and design meet the current town standards for classification as collector streets; and arterial streets are those listed in subsection 15-210.

l) Notwithstanding the foregoing, if a use within use classifications 2.112, 2.120, 2.150, 2.220, 2.230, 3.120, or 3.220 is proposed for an existing building within the WM-3 zoning district, and no other changes to the site are proposed that would require the issuance of a new permit under Section 15-46, then such use shall be permissible with a zoning permit. **(Amended 10/28/08)**

m) Notwithstanding the foregoing, 5.110 uses may be permitted within the B-4 zoning district only when proposed within an existing building and when no other changes to the site are proposed that would require the issuance of a new permit under Section 15-46. **(AMENDED 11/24/09)**

**Section 15-148 Board of Adjustment Jurisdiction Over Uses Otherwise Permissible With a Zoning Permit.**

(a) Notwithstanding any other provisions of this article, whenever the Table of Permissible Uses (interpreted in the light of Section 15-147 and the other provisions of this article) provides that a use is permissible with a zoning permit, (i) a conditional use permit shall nevertheless be required if the administrator finds that the proposed use is located within the University Lake Watershed (i.e., the C, B-5, and WM-3 districts) and would have a substantial impact on neighboring properties or the general public, and (ii) a conditional use permit shall nevertheless be required if the administrator finds that the proposed use is located in the B-1(c), B-1(g), B-2, or CT zoning districts, the use is shown as permissible in those districts with a "ZC" designation in the Table of Permissible Uses, and the proposed use would have a substantial impact on neighboring properties or the general public; (iii) otherwise, a special use permit shall nevertheless be required if the administrator finds that the proposed use would have a substantial impact on neighboring properties or the general public. **(AMENDED 01/22/85; 12/15/87; 02/25/92)**

(b) A special use permit shall be required for any use that is otherwise permissible with a zoning permit if the administrator concludes that, given the impact of the proposed use on neighboring properties, the vested right conferred upon the permit recipient pursuant to Section 15-128.2 should not be conferred without an opportunity for public input. A conditional use permit shall be required for any use that is otherwise permissible with a zoning permit if the administrator concludes that, given the impact of the proposed use on the general public, the vested right conferred upon the permit recipient pursuant to Section 15-128.2 should not be conferred without an opportunity for public input. However, if the zoning administrator makes this determination, the permit applicant may require that the application be returned to the zoning permit process by submitting to the administrator a written waiver of the vested right normally acquired under Section 15-128.2 upon the issuance of a zoning permit. **(AMENDED 10/01/91; 02/25/92)**

**Section 15-149 Permissible Uses and Specific Exclusions** **(AMENDED 6/24/08)**

*Art. X PERMISSIBLE USES (con't)*

(a) The presumption established by this chapter is that all legitimate uses of land are permissible within at least one zoning district in the town's planning jurisdiction. Therefore, because the list of permissible uses set forth in Section 15-146 (Table of Permissible Uses) cannot be all-inclusive, those uses that are listed shall be interpreted liberally to include other uses that have similar impacts to the listed uses.

(b) Notwithstanding subsection (a), all uses that are not listed in Section 15-146 (Table of Permissible Uses), even given the liberal interpretation mandated by subsection (a), are prohibited. Nor shall Section 15-146 (Table of Permissible Uses) be interpreted to allow a use in one zoning district when the use in question is more closely related to another specified use that is permissible in other zoning districts.

(c) Without limiting the generality of the foregoing provisions, the following uses are specifically prohibited in all districts:

- (1) Any use that involves the manufacture, handling, sale, distribution, or storage of any highly combustible or explosive materials in violation of the fire prevention code adopted by reference in Section 12-11 of the Town Code.
- (2) Stockyards, slaughterhouses, rendering plants.
- (3) Use of a travel trailer as a residence, temporary or permanent.
- (4) The use of any motor vehicle (as defined in Section 6-1 of the Town Code), parked on a lot, as a structure in which, out of which, or from which any goods are sold or stored, any services performed, or other businesses conducted (as defined in Section 8-1 of the Town Code), except that the following shall not be prohibited by this subdivision: (i) retail sales of goods and food products manufactured, created or produced by the seller, (ii) the sale of food products on town property by persons authorized or acting on behalf of the town; (iii) the sale of prepared food by mobile prepared food vendors to the extent authorized in the Table of Permissible Uses and Section 15-176.5; and (iv) use of a motor vehicle in connection with an aluminum recycling operation to the extent authorized in the Table of Permissible Uses and other provisions of this chapter. Notwithstanding any other provision of this chapter, situations that exist on the effective date of this provision that are in violation thereof shall not be regarded as lawful, nonconforming situations thirty days after the effective date of this subdivision.  
**(AMENDED 11/10/81; 6/22/82; 6/28/83; 6/24/08)**

*Art. X PERMISSIBLE USES (con't)*

- (5) Construction by the developer of a major residential subdivision of an opaque fence, wall, or berm more than three feet in height around any portion of the periphery of such subdivision, except where such fence, wall or berm is designed to shield the residents of such subdivision from the adverse effects of any adjoining nonresidential use other than a street. Notwithstanding the foregoing, a berm of more than three but less than four feet in height shall be allowed under the foregoing circumstances where (i) the side slopes of the berm are constructed at a steepness ratio of 4:1 to 6:1 and (ii) the average height of the berm does not exceed three feet. For purposes of this subsection, the term “developer” includes any entity that is under the control of the developer, including a homeowners association that is under the developer’s control. **(AMENDED 05/19/98, 08/24/99)**
- (6) Construction of gates that prevent access to private roads serving five or more lots or dwelling units. **(AMENDED 05/25/99)**

**Section 15-150 Accessory Uses.**

(a) The Table of Permissible Uses (Section 15-146) classifies different principal uses according to their different impacts. Whenever an activity (which may or may not be separately listed as a principal use in this table) is conducted in conjunction with another principal use and the former use (i) constitutes only an incidental or insubstantial part of the total activity that takes place on a lot, or (ii) is commonly associated with the principal use and integrally related to it, then the former use may be regarded as accessory to the principal use and may be carried on underneath the umbrella of the permit issued for the principal use. For example, a service station (use classification 9.200) is permissible in a B-3 district; car washes (9.500) are not. However, many service stations have facilities for washing cars. If such car washing activities are incidental to the principal use, then they may be regarded as accessory to the principal use and a service station with such facilities would be permissible in a B-3 district. However, if the car washing operations are substantial (e.g., if separate from the main building or if there are two or more bays used principally or solely for car washing), then the total operation would be considered a combination use consisting of a service station principal use and a car wash principal use. This combination use would not be permitted within a B-3 district. As another example, a swimming pool/tennis court complex is customarily associated with and integrally related to a residential subdivision or multi-family development and would be regarded as accessory to such principal uses, even though such facilities, if developed (as use classification 6.210 or 6.220) apart from a residential development, would require a special use permit or conditional use permit. **(AMENDED 02/02/88)**

(b) For purposes of interpreting subsection (a):

- (1) A use may be regarded as incidental or insubstantial if it is incidental or insubstantial in and of itself or in relation to the principal use;

*Art. X PERMISSIBLE USES (con't)*

- (2) To be “commonly associated” with a principal use it is not necessary for an accessory use to be connected with such principal use more times than not, but only that the association of such accessory use with such principal use takes place with sufficient frequency that there is common acceptance of their relatedness.

(c) Without limiting the generality of subsections (a) and (b), the following activities are specifically regarded as accessory to residential principal uses so long as they satisfy the general criteria set forth above:

- (1) Offices or studios within an enclosed building and used by an occupant of a residence located on the same lot as such building to carry on administrative or artistic activities of a commercial nature, so long as such activities do not fall within the definition of a home occupation.
- (2) Hobbies or recreational activities of a noncommercial nature.
- (3) The renting out of one or two rooms within a single-family residence (which one or two rooms do not themselves constitute a separate dwelling unit) to not more than two persons who are not part of the family that resides in the single-family dwelling.
- (4) Yard sales or garage sales, so long as such sales are not conducted on the same lot for more than three days (whether consecutive or not) during any 90-day period.  
**(AMENDED 4/27/82)**
- (5) Towers and antennas constructed on residential property, as long as:
  - a. Such towers are intended for the personal and noncommercial use of the residents of the property where located; and
  - b. Such towers and antennas comply with the setback requirements of Subsection 15-176(2) and are installed only in rear or side yards; and
  - c. No more than one such tower or antenna may be regarded as an accessory use on a single lot; and
  - d. The owner must be able to demonstrate compliance with Federal Communications Commission regulations, 47 C.F.R. Part 97, Subpart 97.15, Sections (a) through (e), inclusive; and  
**(REPEALED & AMENDED 02/18/97)**

*Art. X PERMISSIBLE USES (con't)*

- (6) Child day care arrangements for one or two children who do not reside with the provider. **(AMENDED 02/04/97; 6/26/07)**

(d) Without listing the generality of subsections (a) and (b), the following activities shall not be regarded as accessory to a residential principal use and are prohibited in residential districts:

- (1) Parking outside a substantially enclosed structure of more than four motor vehicles between the front building line of the principal building and the street on any lot used for purposes that fall within the following principal use classifications: 1.100, 1.200, 1.420, or 1.430.

(e) Satellite dishes shall be regarded as accessory uses to any residential or non-residential principal use. However, as set forth in the Table of Permissible Uses, Cable Television Satellite stations shall be regarded as a separate principal use (use classification 17.300). **(AMENDED 02/18/97)**

**Section 15-151 Permissible Uses Not Requiring Permits (AMENDED 06/06/89)**

(a) Notwithstanding any other provisions of this chapter, no zoning, special use, or conditional use permit is necessary for the following uses:

- (1) Electric power, telephone, telegraph, cable television, gas, water and sewer lines, wires or pipes, together with supporting poles or structures, located within a public right-of-way.
- (2) Neighborhood utility facilities located within a public right-of-way with the permission of the owner (state or town) of the right-of-way, so long as such facilities do not exceed five feet in height, five feet in width, or five feet in depth. **(AMENDED 05/26/81)**
- (3) Bus shelters erected by or under the direction of the town. **(AMENDED 01/22/85)**
- (4) Space occupied by the Town of Carrboro police department within pre-existing buildings for purposes of allowing police officers to spend time periodically within such buildings or portions thereof conducting official business, including without limitation the completion of paperwork or meeting with neighborhood residents. Such uses shall be permitted in all zoning districts, and no additional parking or screening shall be required when property is used in this fashion. **(AMENDED 04/18/95)**

(b) As described in Section 15-84(b), construction plans for new electric power, telephone, telegraph, cable television, gas, water, and sewer lines, wires or pipes, together with supporting poles or structures, located within a public right-of-way shall be submitted to and approved by the public works director before construction of such facilities may commence. **(AMENDED 06/06/89)**

*Art. X PERMISSIBLE USES (con't)*

**Section 15-152 Change in Use.**

(a) A substantial change in use of property occurs whenever the essential character or nature of the activity conducted on a lot changes. This occurs whenever:

- (1) The change involves a change from one principal use category to another.
- (2) If the original use is a combination use (27.000) or planned unit development (28.000), the relative proportion of space devoted to the individual principal uses that comprise the combination use or planned unit development use changes to such an extent that the parking requirements for the overall use are altered.
- (3) If the original use is a combination use or planned unit development use, the mixture of types of individual principal uses that comprise the combination use or planned unit development use changes.
- (4) **(DELETED 10/22/91)**

(b) A mere change in the status of property from unoccupied to occupied or vice-versa does not constitute a change in use. Whether a change in use occurs shall be determined by comparing the two active uses of the property without regard to any intervening period during which the property may have been unoccupied, unless the property has remained unoccupied for more than twelve consecutive months. **(AMENDED 06/18/91)**

(c) A mere change in ownership of a business or enterprise shall not be regarded as a change in use.

**Section 15-153 Developments in the B-3 Zoning District.**

The 2.000, 3.000, and 4.000 classifications in the Table of Permissible Uses are written in very broad terms. However, it is the intention of this chapter that uses described in those classifications are permissible in an area zoned B-3 only when the particular use is in accordance with the objectives of the B-3 zoning district set forth in Section 15-136. **(AMENDED 5/26/81)**

**Section 15-154 Combination Uses.**

(a) When a combination use comprises two or more principal uses that require different types of permits (zoning, special use, or conditional use), then the permit authorizing the combination use shall be:

*Art. X PERMISSIBLE USES (con't)*

- (1) A conditional use permit if any of the principal uses combined requires a conditional use permit.
- (2) A special use permit if any of the principal uses combined requires a special use permit but none requires a conditional use permit.
- (3) A zoning permit in all other cases.

This is indicated in the Table of Permissible Uses by the designation “Z,S,C” in each of the columns adjacent to the 27.000 classification.

(b) Subject to subsection (c), when a combination use consists of a residential subdivision and a multi-family development the total density permissible on the developer’s tract shall be determined by having the developer indicate on the plans the portion of the total tract that will be developed for each purpose and calculating the density for each portion as if it were a separate lot. **(AMENDED 11/26/85)**

(c) Notwithstanding Subsection 15-182(b), whenever (i) a combination use consists of a standard residential subdivision and a multi-family development and (ii) the subdivided portion of the tract contains lots that exceed the minimum lot size requirements set forth in Section 15-181, but that do not exceed an average of 30,000 square feet, then the density of the portion of the tract developed for multi-family purposes may be increased beyond the permissible density calculated in accordance with subsection (b). The increase in density shall be determined as follows: **(AMENDED 11/26/85)**

- (1) The minimum lot size requirement for the applicable zoning district shall be subtracted from each lot that exceeds the minimum lot size, and the remainders totaled.
- (2) The sum derived from the calculation in subdivision (1) shall be divided by the minimum lot size requirements. Fractions shall be rounded to the nearest whole number.
- (3) The result of the calculation in subdivision (2) shall yield the number of additional multi-family dwelling units that may be located within the portion of the tract developed for multi-family purposes.

(d) When a residential use is combined with a non-residential use in a business district, the lot must have at least the minimum square footage required for the residential use alone. For example, in a B-1 zone, if two dwelling units are combined with a retail store in one building, the lot must have at least 6,000 square feet.

*Art. X PERMISSIBLE USES (con't)*

(e) When two principal uses are combined, the total amount of parking required for the combination use shall be determined by cumulating the amount of parking required for each individual principal use according to the relative amount of space occupied by that use.

**Section 15-155 Planned Unit Developments.**

(a) In a planned unit development the developer may make use of the land for any purpose authorized in the particular PUD zoning district in which the land is located, subject to the provisions of this chapter. Section 15-139 describes the various types of PUD zoning districts.

(b) Within any lot developed as a planned unit development, not more than ten percent of the total lot area may be developed for purposes that are permissible only in a B-1(g), B-2, or B-3 zoning district (whichever corresponds to the PUD zoning district in question), and not more than five percent of the total lot area may be developed for uses permissible only in the M-1 zoning district (assuming the PUD zoning district allows such uses at all).

(c) The plans for the proposed planned unit development shall indicate the particular portions of the lot that the developer intends to develop for purposes permissible in a residential district (as applicable), purposes permissible in a business district (as applicable), and purposes permissible only in an M-1 district (as applicable). For purposes of determining the substantive regulations that apply to the planned unit development, each portion of the lot so designated shall then be treated as if it were a separate district, zoned to permit, respectively, residential, business or M-1 uses. However, only one permit--a planned unit development permit--shall be issued for the entire development.

(d) The nonresidential portions of any planned unit development may not be occupied until all of the residential portions of the development are completed or their completion is assured by any of the mechanisms provided in Article IV to guarantee completion. The purpose and intent of this provision is to ensure that the planned unit development procedure is not used, intentionally or unintentionally, to create nonresidential uses in areas generally zoned for residential uses except as part of an integrated and well-planned, primarily residential, development.

**Section 15-156 More Specific Use Controls.**

Whenever a development could fall within more than one use classification in the Table of Permissible Uses (Section 15-146), the classification that most closely and most specifically describes the development controls. For example, a small doctor's office or clinic clearly falls within the 3.110 classification (office and service operations conducted entirely indoors and designed to attract customers or clients to the premises). However, classification 3.130 "Physicians and dentists offices and clinics occupying not more than 10,000 square feet of gross floor area" more specifically covers this use and therefore is controlling.

*Art. X PERMISSIBLE USES (con't)***Section 15-157 Residential Uses in Conservation Districts.**

The Table of Permissible uses indicates that single family residences are permissible in the conservation district. However, this shall be true only if and to the extent a residence is used in conjunction with another permitted use, e.g., a caretaker's house. **(AMENDED 12/7/83)**

**Section 15-158 Hazardous Substances in B-5 and WM-3 Districts** **(AMENDED 12/7/83)**

(a) Subject to subsection (b), no use involving the possession, storage, maintenance, or use of any quantity of hazardous substance shall be permissible on any lot within the B- 5 or WM-3 zoning districts. **(AMENDED 06/21/88)**

(b) Subsection (a) shall not apply to commercial or industrial enterprises which:

- (1) use, possess, store, or maintain gasoline, kerosene, diesel fuel, and other petroleum products where such products are held solely for the purpose of on-premises sales to retail customers; however, storage tanks for such products must be emptied within sixty days after sale of the products stored is discontinued;
- (2) use, possess, store, or maintain hazardous substances contained in consumer products packaged and held for retail sale to the general public;
- (3) use, possess, store, or maintain hazardous substances contained in commercial products used for janitorial or maintenance purposes on the premises where stored.
- (4) are in possession, on June 21, 1988 of a Hazardous Substances Authorization Certificate issued under the prior subsection (c) of this section; to the extent that such enterprises use, possession, storage, or maintenance of hazardous chemicals is substantially the same as was the case on the date of issuance of such Certificate. This exemption is transferable with the transfer of the enterprise in question only to the extent that the new enterprise will operate substantially the same operation at the same location as that for which the Certificate was issued. **(AMENDED 06/21/88)**

(c) Notwithstanding the provision of Article VIII of this chapter, situations that exist on the effective date of this section that are made non-conforming by this section shall not be allowed to continue beyond sixty days after the effective date of this section.

*Art. X PERMISSIBLE USES (con't)***Section 15-159 Mobile Home Type Structures Prohibited In Business Districts (AMENDED 10/1/85)**

Notwithstanding any other provision of this ordinance, no building that (i) is composed of one or more components, each of which was substantially assembled in a manufacturing plant and designed to be transported on its own chassis, and (ii) is not constructed in accordance with the standards set forth in the North Carolina State Building Code, may be located in any of the commercial districts established in Section 15-136.

**Section 15-160 Outside Display of Goods in B-1(c) and B-1(g), and WM-3 Districts (AMENDED 2/4/86; 10/28/08)**

(a) As indicated in the Table of Permissible Uses, outside display of goods for sale or rent, but not outside storage, is permitted in the B-1(c), B-1(g) and WM-3 zoning districts. However, such outside display shall only be allowed if and to the extent that:

- (1) Such display is conducted in furtherance of a business operated on such the lot where the display is located, by the person operating such business; and
- (2) Such display is conducted on a lot on which is located a principal building that houses the businesses referenced in subdivision (1); and
- (3) For lots located within the B-1(c) and B-1(g) districts, the area of such display does not exceed 25% of the gross floor area of the principal building referenced as subdivision (2) that is occupied by the business referenced in subdivision (1). For lots located within the WM-3 district the total area of such display does not exceed 5% of the gross floor area of the principal building, the display must be located outside of all required setbacks and areas landscaped to meet screening and shading requirements, and the display must be removed or adequately secured when the business operating on the lot is closed.

(b) For purposes of this section, the term “lot” shall include all contiguous land as well as land immediately on the opposite side of a bisecting street that is in the possession or under the control of the person operating the business referenced in subdivision (a)(1).  
**(AMENDED 10/28/08)**

**Section 15-160.1 Residential Uses in B-1(c) Districts (AMENDED 2/4/86)**

Residential uses are not allowed on the ground floor of property within a B-1(c) district.

*Art. X PERMISSIBLE USES (con't)*

**Section 15-160.2 Permissible Uses in the Historic District (HD) (AMENDED 11/21/95)**

Notwithstanding the provisions of 15-146 (Table of Permissible Uses), only single-family residences (uses classification 1.100) are permitted in the Historic District (HD) on properties with the following underlying zoning district designations: R-20, R-15, R-10, R-7.5, R-3, R-2, R-R, R-40, R-SIR, and R-SIR-2.

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# **Extended Vehicle Idling**

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# Extended Vehicle Idling

## ■ Introduction

Item (xi) of Section 108 (f) of the 1990 amended Clean Air Act defines "programs to control extended idling of vehicles" as a candidate transportation control measure. The idea is that vehicular emissions can be reduced by eliminating vehicle idling, either by turning the engine off while the vehicle is stopped or by limiting the periods of time in which a vehicle must be stopped and idling. One method of reducing vehicle idle time is through the use of traffic flow improvement techniques, and these are discussed in the corresponding chapter of these information documents. This chapter addresses two other sources of extended idling of vehicles:

- Passenger vehicles using drive-through facilities, such as those existing at banks and fast food restaurants, where the vehicle is kept idling during the service period.
- Heavy-duty vehicles that are not in use and are kept idling rather than being shut off, such as buses that are kept idling at layover points or trucks that are left to idle while being loaded or unloaded.

The tradeoff between idling emissions and hot start emissions by vehicles of a particular type depends on a number of factors including the age of the vehicle, the type of control equipment used, the type of fuel used, the pollutant of interest, and the ambient temperature. For example, catalytic controls work well in the idle mode, so that idle emissions from newer vehicles are far less of a problem than from older, non-catalyst equipped automobiles. It is difficult, therefore, to develop a single transferable number that represents the maximum desired idling time. The following is an analysis for one urban area which indicates the factors which should be considered.

In preparing the 1982 Revised Air Quality Management Plan (AQMP) for the South Coast Air Basin, a strategy for reducing idling emissions by restriction or elimination of drive-through facilities was considered (3). An emissions analysis of drive-through facilities was done by comparing the emissions from idling with those from a hot start/hot soak cycle, which would represent a person parking, carrying out a business transaction within an hour, restarting the car, and leaving. The results are summarized in Table 1.

According to this analysis, for CO a car could idle for 6 minutes before it would generate the same emissions as when it was restarted. The equivalent idling times are even greater for HC and NO<sub>x</sub>. Based on this analysis, it was concluded that the banning of drive-through facilities would be counter-productive.

**Table 1. Vehicle Idle vs. Hot Start/Soak Emissions**

| Year | Pollutant | Hot Start Emissions (gm/start) | Hot Soak Emissions (gm/soak) | Idling Emissions (gm/min) | Idling Time Equivalent to Start/Stop Cycle Emissions |
|------|-----------|--------------------------------|------------------------------|---------------------------|------------------------------------------------------|
| 1987 | THC       | 4.16                           | 1.67                         | .2217                     | 26                                                   |
|      | NOx       | .71                            |                              | .0551                     | 13                                                   |
|      | CO        | 13.18                          |                              | 2.3541                    | 6                                                    |
| 2000 | THC       | 4.06                           | .67                          | .1743                     | 27                                                   |
|      | NOx       | .41                            |                              | .0386                     | 11                                                   |
|      | CO        | 10.93                          |                              | 1.8164                    | 6                                                    |

Source: (3)

Heavy-duty vehicle idling represents a different problem. Trucks are often left idling while their drivers await access to facilities to make pickups or deliveries. Older trucks often required longer amounts of time to warm up and cool down, and some operating habits have carried over in the use of modern vehicles. Modern vehicles, however, require less than five minutes to reach an operating temperature that assures proper engine lubrication under load.

Not all engine idling is at the discretion of the driver. Many facilities are operated in such a manner that idling is required. For example, at some facilities, trucks are required to be in a slowly moving queue to make pickups or deliveries; trucks are required to move at a moment's notice, and are therefore kept idling to be ready to move.

Public transit vehicles such as diesel buses and diesel locomotives also may be left idling for long periods of time. Examples include the period between runs, midday layovers, or even overnight. Transit authorities increasingly are instituting operations policies to limit this idling as a means of controlling fuel costs and minimizing community complaints over excessive emissions and noise.

### **Description of Measures**

The following types of measures have been considered to control extended vehicle idling:

- Controls on drive-through facilities;
- Laws or operating policies that limit idling of heavy-duty vehicles; and
- Mechanical modifications to the vehicle that restrict the amount of time that it can idle.

Possible controls on drive-through facilities include:

- Limitations on the construction of new drive-through facilities,
- Removal of existing facilities, and
- Specification of design standards applicable to the development and operation of new drive-through facilities.

The removal of existing facilities would affect the largest market, but also would involve a retroactive control or reversal of previous development decisions. Proposals to eliminate existing drive-through facilities have resulted in considerable opposition and been abandoned as being politically infeasible. More realistic approaches are to manage the way in which new drive-through facilities are developed and operated. For example, a fast food window configuration could be required where there are three stops – one to

place the order, one to pay, and one to receive the food. Such an approach could shorten the total length of time a vehicle is in queue, and thereby lead to both reduced idling time and fewer acceleration/deceleration cycles. As described in the following section, this kind of management approach is receiving current interest as a means of controlling both congestion and emissions.

Interest also is increasing in more carefully managing the emissions of heavy-duty vehicles while operating in the idle mode. For example, a law to restrict heavy-duty vehicle idling has been considered by the California legislature. As an example of the third type of control, Volkswagen is working on an engine that may increase fuel efficiency by as much as 90 per cent, using measures such as computer control that shut off the engine during idling and storing energy in a flywheel to provide an instant restart.

## ■ Case Study Examples

### **Proposed California Legislation to Limit Heavy Truck Idling**

The South Coast Air Quality Management District (SCAQMD) has worked with the California state legislature to develop legislation that would restrict truck idling. The proposed law was developed by the California AB 2595 Technical Advisory Group with the cooperation of the trucking industry (2). The trucking industry cooperated because they believed that it would be better to have a single, consistent statewide law on heavy duty vehicle idling than to have a number of possibly different regional or local regulations.

The proposed law has two significant provisions:

- No person shall cause, allow, or permit the engine of a heavy-duty motor vehicle to idle for more than five consecutive minutes if the vehicle is not performing useful work.
- No person responsible for the shipping or receiving of goods by a heavy-duty motor vehicle shall operate a facility in such a manner that causes, allows, or permits, a heavy-duty motor vehicle to idle for more than five consecutive minutes when the vehicle is not performing useful work.

The proposed bill contains exceptions for buses picking up passengers, motor vehicles stopped in the line of traffic, snow removal equipment, and emergency vehicles. It also provides for the following exceptions that pertain especially to trucks:

- Motor vehicles whose primary power source is utilized in whole or part for necessary and definitively prescribed mechanical operation other than propulsion, passenger compartment heating, or air conditioning (e.g., refrigerated trailers that require an idling engine to receive power).
- Motor vehicles manufactured with a sleeper berth while the sleeper berth is being used, in a non-residential area, by the vehicle operator for sleeping or resting, provided that the vehicle is not in a queue, and provided that the operation of the vehicle does not create a public nuisance.
- Motor vehicles used under adverse weather conditions, including rain, snow, temperatures below freezing, and temperatures in excess of 100 degrees Fahrenheit.
- Motor vehicles when the driver compartment is in direct sunlight and the temperature is in excess of 80 degrees Fahrenheit, provided that the engine idling is required to operate an air conditioning system.

The Technical Advisory Committee also determined that a truck operator education program would be a cost-effective measure in conjunction with the proposed law.

### **Limitations on Drive-Up Windows**

In the Sacramento metropolitan area, the 1982 AQMP programs for the County of Placer and the Cities of Lincoln, Rocklin, and Roseville included drive-up window limitations (3). The measures are intended to limit the number and design of new drive-up window facilities to reduce idling time and congestion.

The County of Sacramento regulates drive-up facilities by a use permit. The code is intended to ensure that the design and location of a drive-up facility will not contribute to increased congestion on public or private streets adjacent to the facility. The code requires that:

- Design and location will not impede access to or exit from the parking lot serving the facility, nor impair normal circulation in the parking lot;
- No drive-up lane shall extend closer than 25 feet to the access driveway;
- Advance ordering stations be located a minimum of 120 to 180 feet from the window;
- The window cannot be used to justify fewer parking spaces; and
- The use permit is revocable if congestion due to the window regularly occurs.

## ■ Estimated Impacts

The regional emission reductions associated with reducing the number of new drive-through facilities are expected to be minimal, primarily because of the small amount of travel impacted relative to the total highway vehicle mobile source inventory. At best, such measures may be effective in reducing localized CO hotspots.

Controls on extended vehicle idling of heavy duty vehicles may have a larger emissions reduction impact in commercial urban areas than will the limitations of drive-through facilities. This is because of the higher unit emissions of heavy duty vehicles compared to light duty automobiles.

## Program Costs and Other Considerations

The proposed California law on heavy duty truck idling would require funding for public awareness, facility inspection, law enforcement, and truck operator education. It could also incur additional cost to truck operators by shortening starter life, but would also reduce the costs of fuel consumption and engine wear.

Elimination of existing drive-through facilities would require compensation of the affected businesses and physical modifications to the facilities. The affected market segments would be shopping and personal business trips that use these facilities, primarily in suburban areas.

The costs associated with efforts to influence the design or limit the number of new drive-through facilities would largely be limited to small administrative costs to manage the new development code. Costs to building owners and operators could be mixed, with lower construction costs and higher operating costs if buildings must be kept open for longer periods of time.

## Implementation Considerations

Because most heavy-duty vehicles operate across jurisdictional boundaries, laws to restrict heavy-duty vehicle idling should be implemented statewide rather than locally so as to ease enforcement. In the case of California, the proposed law would be enforced by air pollution control districts through routine inspections of facilities with heavy-duty truck activity and through response to public complaints. The California Highway Patrol and local law enforcement agencies would have discretionary enforcement authority. The Technical Advisory Committee suggested that current resource constraints on enforcement of traffic safety regulations might make it necessary to develop new funding or cost sharing mechanisms between law enforcement and air pollution control agencies in order to enforce the proposed restrictions (2).

Affecting the development of drive-through facilities currently is controlled through the zoning process and limitation of conditional use permits, which is exclusively under the control of cities and counties. Hence, this type of control measure may be difficult to implement on a regional, statewide, or national basis.

Equity considerations are an issue that has arisen in past public policy debates over the possible limitation of drive-through facilities. Is it fair to remove existing, already approved and operating drive-up facilities? Conversely, is it fair to ban or even limit new drive-up facilities and allow existing services to continue to operate?

The following implementation guidelines can be summarized:

- Controls on vehicle operations are probably most effectively implemented at the state level.
- Controls on development are the province of local jurisdictions. In this case, regional and state agencies can play a valuable technical assistance role.
- Controls on drive-through facilities generally are most effective as limitations rather than outright bans.
- Design standards represent an appropriate implementation mechanism, based on congestion as well as emission considerations.
- Data should be collected prior to enactment of any measure so as to establish the magnitude of existing idling emissions that would be impacted.
- Controls on extended idling of vehicles will impact existing businesses as well as the public. It is important that representatives of both groups be actively involved in the planning, analysis, and development of any such controls. As evidenced by the history of the proposed California legislation on heavy-duty vehicle idling, implementation prospects can be enhanced by actively involving potentially impacted business interests in the development of proposed control measures.

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# Which Is Greener: Idle, or Stop and Restart?

## Comparing Fuel Use and Emissions for Short Passenger-Car Stops

L. Gaines, E. Rask, and G. Keller, Argonne National Laboratory

### Overview

The argument against parking and going into a business, rather than using a drive-through window, has been that the emissions and fuel use associated with restarting your car are greater than those incurred by idling for that time. Argonne National Laboratory undertook a series of measurements to determine whether this was true, by comparing actual idling fuel use and emissions with those for restarting. This work seeks to answer the question: Considering both fuel use and emissions, how long can you idle in a queue before impacts from idling are greater than they are for restarting? Fuel use and carbon dioxide emissions are always greater for idling over 10 seconds; the crossover times are found to vary by pollutant.

### Background

The bulk of idling research to date has focused on the effects of heavy- and medium-duty diesel vehicle idling. But most research has ignored passenger car idling—even at schools—as a source of emissions and wasted fuel.

While idling in traffic is necessary for safety, vehicles can be turned off while waiting for passengers or for freight trains to pass. Consumers can choose to park and enter a fast-food restaurant, rather than idle in a drive-through line (Figure 1). If each car in the United States idles just 6 minutes per day, about 3 billion gallons of fuel are wasted annually, costing drivers over \$10 billion or more. And they haven't gotten anywhere!

The U.S. Department of Energy Clean Cities Program uses its national network of almost 100 local coalitions to reduce transportation dependence on petroleum through the use of alternative fuels and efficiency measures, including idling reduction. The program therefore funded Argonne to measure idling fuel use by and emissions from light-duty vehicles and to compare these to start-up emissions to enable data-based decision making.



**Figure 1.** Americans love their drive-throughs, but are they more fuel-efficient and environmentally friendly than parking and going into the restaurant?

### Testing



**Figure 2.** Ford Fusion Test Vehicle

Argonne National Laboratory used a 2011 Ford Fusion mid-sized sedan with a 2.5-L, 4-cylinder engine (175 HP) and 6-speed automatic transmission (Figure 2). Its EPA fuel-efficiency label shows 23 mpg city/33 mpg highway and 26 mpg combined. We equipped the vehicle to measure numerous engine parameters and temperatures, including catalyst inlet and brick temperatures and oil and coolant temperatures. We collected data in one of Argonne's test cells at the Advanced Powertrain Research Facility (APRF), using a SemtechD emissions analyzer for emissions and a direct fuel flow meter for fuel measurement. The vehicle was prepared and run by using approximate Federal Test Procedure (FTP) standard ambient temperature testing criteria. The emissions of interest in this study include total hydrocarbons (THC), nitrogen oxides (NO<sub>x</sub>), carbon monoxide (CO), and carbon dioxide (CO<sub>2</sub>).

**Table 1. Idling Emissions and Fuel Use per Second**

| NO <sub>x</sub> (mg) | THC (mg) | CO (mg) | CO <sub>2</sub> (mg) | Fuel (cc) |
|----------------------|----------|---------|----------------------|-----------|
| 0.0097               | 0.266    | 0.108   | 0.887                | 0.279     |

- Criteria pollutant emissions were low for idling following catalyst activation.

**Table 2. Comparison of Emissions from Cold Start, Restart, and Idling**

| Emission             | Tier 2-Bin 5 (g) <sup>a</sup> | Cold Start | Restart | Idle 30 s | Cold Start ÷ Restart |
|----------------------|-------------------------------|------------|---------|-----------|----------------------|
| THC (mg)             | 878                           | 191        | 16–40   | 0.8       | 4.4–12               |
| NO <sub>x</sub> (mg) | 552                           | 228        | 1.3–1.6 | 0.3       | 140–175              |

<sup>a</sup> Tier 2-Bin 5 g/mi converted to FTP-75 mg

- Emissions from restarting were larger, but at least an order of magnitude lower than those from starting a cold engine.
- The catalyst cooled down slowly, so that restarts after times equivalent to a short transaction at a bank or restaurant are unlikely to allow the temperature to drop below light-off and incur large cold-start emissions.

### Research Limitations

Data presented here are based on one vehicle at one temperature, with a small number of runs. Therefore, although several conclusions are suggested by this work, generalizations are unwarranted without additional work to confirm the extent to which the results apply, for the following reasons:

- Hot and cold ambient conditions are likely to affect results, as are the loads required to supply passenger comfort at those temperatures.
- Older vehicles and diesels are both likely to behave differently.
- More research is required to explain differences in THC emissions between the runs, as well as to make more generalizations regarding the emissions impacts of different restart/soak times. Additional research to fill in all these gaps would enable more conclusive statements concerning the differences in emissions between idling and restarts.

### Conclusions

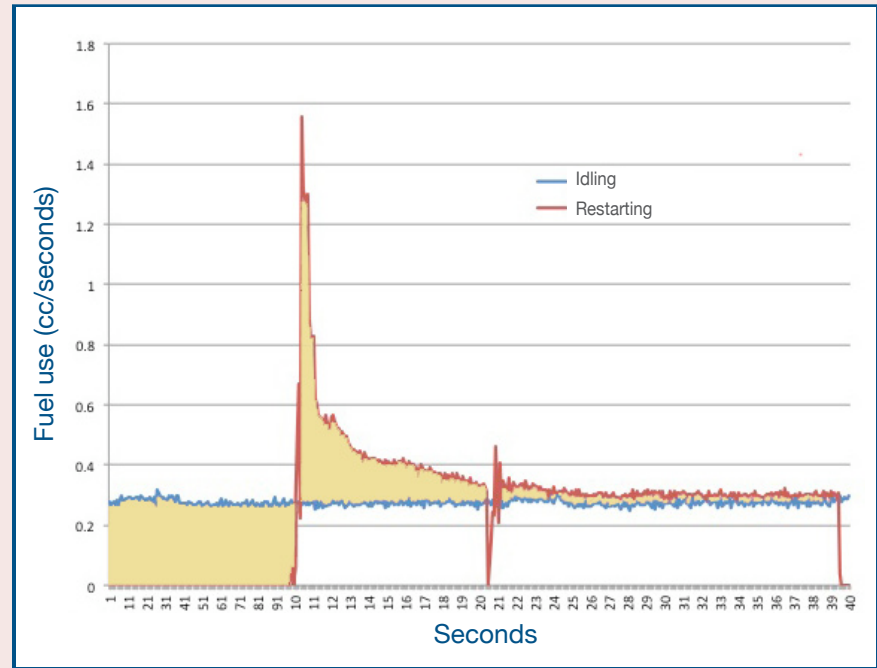
Testing at 21°C ambient conditions on a late-model mid-sized American car shows that:

- Idling for more than 10 seconds uses more fuel (Figure 3) and emits more CO<sub>2</sub> than engine restarting.
- Idling fuel usage varies from 0.2 to 0.5 gal/h for passenger vehicles across a range of sizes, and increased with idling speed.
- The vehicle warms up faster when driving than it does when idling.
- NO<sub>x</sub> and THC emissions from restarting are larger, but at least an order of magnitude lower than those from starting a cold engine (Table 2).
- For short stops, it makes sense to turn the vehicle off in order to minimize fuel use and CO<sub>2</sub> emissions. At least for the conditions evaluated in this work, the penalty in terms of criteria pollutant emissions is very small compared to cold-start emissions.

### Acknowledgments

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Testing at 21°C ambient conditions on a late-model mid-sized American car shows that idling for more than 10 seconds uses more fuel (Figure 3) and emits more CO<sub>2</sub> (Table 1) than engine restarting.



**Figure 3.** The shaded area under the blue line (idling fuel rate) and the red line (restart) before the engine is restarted (at 10.1 s) represents the quantity of fuel that the engine would have burned if it were idling instead of being off, and the area between the red and blue lines after the engine is restarted represents the excess on restart.

# **Which Is Greener: Idle, or Stop and Restart? Comparing Fuel Use and Emissions for Short Passenger-Car Stops**

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by

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## Which Is Greener: Idle, or Stop and Restart? Comparing Fuel Use and Emissions for Short Passenger-Car Stops

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### ABSTRACT

Most advice to the public about idle-reduction lacks scientific basis. And the information in the literature is often inconsistent. Argonne National Laboratory performed some simple experiments to provide a preliminary factual basis for recommendations on when to keep the engine on, and when to turn it off, for the minimum environmental impact.

Our previous work demonstrated that idling is a very inefficient way to warm up your car (your diesel might never warm up if it is very cold [1]), and that the catalytic converter cools slowly enough that it will still be working when you return to your car after a short stop. The argument against parking and going into a business, rather than using a drive-through window, has been that the emissions and fuel use associated with restarting your car are greater than those incurred by idling for that time. Argonne undertook a series of measurements to determine whether this was true by comparing actual idling fuel use and emissions with those for restarting. This work seeks to answer the question: Considering both fuel use and emissions, how long can you idle in a queue before impacts from idling are greater than they are for restarting? We determined that fuel use and carbon dioxide emissions are greater for idling over 10 seconds. Other emissions from idling were found to be low, so that much longer idling times were preferable before they exceeded restart emissions; these crossover times were found to vary by pollutant. The restart emissions were found to be much smaller than those from cold starts. Note, however, that these results are very limited and more research is necessary.

### BACKGROUND

Idling reduction efforts have focused on heavy-duty diesel vehicles because they are typically idled for extended periods. Long-haul trucks often idle overnight to keep the driver comfortable; our previous work has identified and compared lower-impact alternatives (2, 3). We have also identified workday idling by all classes of vehicles as a significant waste of petroleum and source of excess emissions (4). And the EPA's large and visible program to reduce emissions from school buses includes a component on idling reduction (5). But many people ignore passenger car idling—even at schools—as a source of emissions and wasted fuel. While idling in traffic is necessary for safety, drivers can turn off their vehicles while waiting for passengers or for freight trains to pass. And remote start, although now a popular option, is still idling, and in some jurisdictions, idling an unattended vehicle is illegal. If each of the 250 million cars in the United States idles just 6 minutes per day at 0.3 gal/h, almost 3 billion gallons of fuel are wasted annually, costing drivers \$10 billion or more, with no vehicle miles traveled.

Major vehicle manufacturers and suppliers hold the view that idling modern engines is not only unnecessary but undesirable (6). Owner's manuals often advise against idling and encourage "ecodriving" as a way to increase fuel economy and reduce emissions. In addition, the U.S. Department of Energy (DOE), U.S. Department of Transportation (DOT), and the U.S. Environmental Protection Agency (EPA) discourage unnecessarily idling, and the Department of Defense (DOD) attempts to reduce idling to limit fuel costs and engine wear (7, 8, 9, 10).

We found inconsistent and conflicting recommendations, with minimal scientific data to support them, in anti-idling literature distributed across North America. One fast-food chain claimed that it was "greener" (from an emissions perspective) to use the drive-through than to park and go into the restaurant. The study it cited used actual drive-through vehicle statistics but relied on

modeled emission data that are several orders of magnitude higher than what we report here (11). One technical paper (12) did report hydrocarbon and NO<sub>x</sub> emissions from several model-year 2004 passenger vehicles, but it did not measure fuel use or CO<sub>2</sub> emissions.

The U.S. Department of Energy Clean Cities Program uses its national network of almost 100 local coalitions to reduce transportation dependence on petroleum through the use of alternative fuels and efficiency measures, including idling reduction. The program therefore funded Argonne to measure idling fuel use by and emissions from light-duty vehicles and to compare these to start-up emissions to enable data-based decision-making.

## EXPERIMENT DESCRIPTION

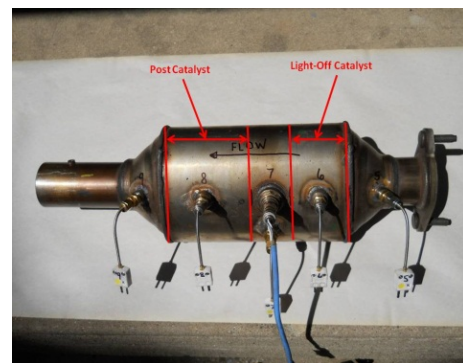
### Vehicle Set-Up

A model year 2011 Ford Fusion was used for the majority of the analysis for this work (Figure 1). This vehicle is a 4-door mid-size sedan with a 2.5-L 4-cylinder engine (175 HP) and 6-speed automatic transmission. Its EPA fuel-efficiency label shows 23 mpg city/33 mpg highway and 26 mpg combined. It was instrumented with equipment to measure numerous engine parameters and temperatures, including catalyst inlet and brick temperatures (see Figure 2) and oil and coolant temperatures. The vehicle was installed in one of Argonne's test cells at the Advanced Powertrain Research Facility (APRF), utilizing a Semtech emissions analyzer for emissions and a direct fuel flow meter for fuel measurement. The APRF has a two-wheel-drive (2WD) chassis dynamometer that is used for simulating road load, monitoring tractive effort, and performing coast-down testing; it is also used for the calibration of 2WD vehicles of up to 12,000 lb. The restart emissions and the idle emissions were measured in real time at a no-load stationary position; one exception is noted below. The vehicle was prepared and run by using approximate Federal Test Procedure (FTP) standard ambient temperature testing criteria.

The vehicle was connected to a PEMS SemtechD at the tailpipe, which allowed emissions data to be gathered for each species with respect to time. The emissions of interest in this study include total hydrocarbons (THC), nitrogen oxides (NO<sub>x</sub>), carbon monoxide (CO), and carbon dioxide (CO<sub>2</sub>). The SemtechD is equipped with a heated sample line to minimize the loss of hydrocarbons before they are in range of the sensors. It measures the hydrocarbon emissions by using a Flame Ionization Detector (FID), while the NO<sub>x</sub> species are measured by using a Non-Dispersive Ultra Violet (NDUV) method. It measures CO and CO<sub>2</sub> via a Non-Dispersive InfraRed Analyzer (NDIR).



**FIGURE 1 Ford Fusion Test Vehicle.**



**FIGURE 2 Catalyst Temperature Measurement Sites.**

The SemtechD analyzer also accounts for the ambient humidity in the calculation of the emissions. It has been verified to be accurate when testing for these emission species (7, 8). The specifications for the analyzer are listed in Table 1. Additionally, the fuel consumption rate was measured directly. For this study, the emission concentrations were measured every 0.1 s, and concentrations were converted to actual masses by using measured air-flow volume. The exhaust measurement was accomplished by using an AVL North America DVE-150 direct vehicle exhaust (DVE) measurement device. This device, when coupled to the SemtechD analyzer, allows the collection and analysis of exhaust mass emissions, particularly in ultra-low- and super ultra-low-emitting vehicles. Flow meter specifications are shown in Table 2.

**TABLE 1 PEMS SemtechD Emissions Analyzer Specifications (1)**

| Parameter               | NO            | NO <sub>2</sub> | THC           | CO      | CO <sub>2</sub> |
|-------------------------|---------------|-----------------|---------------|---------|-----------------|
| Measurement Range       | 0–2,500 (ppm) | 0–500 (ppm)     | 0–1,000 (ppm) | 0–4 (%) | 0–20 (%)        |
| Accuracy (% of Reading) | ±3            | ±3              | ±2            | ±3      | ±3              |
| Resolution              | 1 ppm         | 1 ppm           | 1 ppm C       | 10 ppm  | 0.01%           |
| Response Time (T90) (s) | ≤2            | ≤2              | ≤2            | ≤3      | ≤2              |

**TABLE 2 AVL DVE-150 Flow Meter Specifications (1)**

|                          |                           |
|--------------------------|---------------------------|
| Exhaust Flow Measurement | 8–350 scfm FS             |
| Accuracy (% of Reading)  | ±1% FS                    |
| Resolution               | 0.1 scfm                  |
| Tailpipe Backpressure    | ±1.5 in. H <sub>2</sub> O |

## Procedure

The intent was to simulate a vehicle idling in queue for the drive-through window at a bank or fast-food restaurant. Fuel use and emissions from an idling hot engine were measured, as were those from a case in which the vehicle was keyed off for 5 minutes following roughly 8 minutes of urban-style driving and then restarted every minute. These cases simulate both a 5-minute visit into the business and turning the vehicle off and on in a queue.

There were two dynamometer runs with the instrumented 2011 Ford Fusion in which emissions were measured as described above and a third without emission measurements. All data were taken at roughly 21°C ambient conditions. Limited funding precluded investigation of additional vehicles or temperatures. To summarize:

1. *20-min idle run:* Turn the cold engine on, idle the vehicle at steady state until the engine temperatures are stabilized. Allow the vehicle to idle in “Drive” with the brake applied. Begin timing 20-min interval and collect emissions data during a 20-min idling interval (initially at higher rpm but then at constant ~750 rpm). Turn the engine off for 30 s, then restart for 30 s, off for 30 s, on for 30 s, and off. No loads are applied.
2. *505 UDDS run + idle:* Turn on the already-warm engine, “drive” for 5 min on the UDDS cycle, turn off the car (soak) for 5 min, then restart 7 times, with 30 s in between. The first five restarts were with no load, 30 s on, and off. The last two on periods are longer (60 s, 90 s) with a load to simulate 3-mph creep or heavy traffic.
3. *50-mph steady speed:* Turn on the cold engine and drive at a steady 50 mph for about 10 minutes.

## EXPERIMENTAL RESULTS

### Idling

The first run enabled estimation of long-duration idling emissions and fuel use, from 700 s in the flat part of the 20-min run at 750 RPM (after an initial period of higher RPM). For each parameter of interest, cumulative readings were calculated, and the difference between the total at the selected end-point (1200 s) and the start point selected during stable 750-RPM idling (500 s) was obtained. This difference represents the emissions during 700 s of stable idling and was used to estimate the emission and fuel use rates for idling at 750 RPM. Table 3 summarizes the calculation and the results. Emissions of criteria pollutants are extremely low.

**TABLE 3 Calculation of Idling Emissions and Fuel Use**

| Time (s)   | NO <sub>x</sub> (mg) | THC (mg) | CO (mg) | CO <sub>2</sub> (g) | Fuel (cc) |
|------------|----------------------|----------|---------|---------------------|-----------|
| 500.1      | 70.27                | 159.2    | 549.5   | 430.0               | 135.22    |
| 1200.1     | 77.04                | 177.8    | 625.3   | 1053.0              | 331.15    |
| Difference | 6.77                 | 18.64    | 75.8    | 623.0               | 195.93    |
| Per hour   | 34.8                 | 95.9     | 389.8   | 3204.2              | 1007.6    |
| Per second | 0.0097 <sup>a</sup>  | 0.266    | 0.108   | 0.588               | 0.279     |

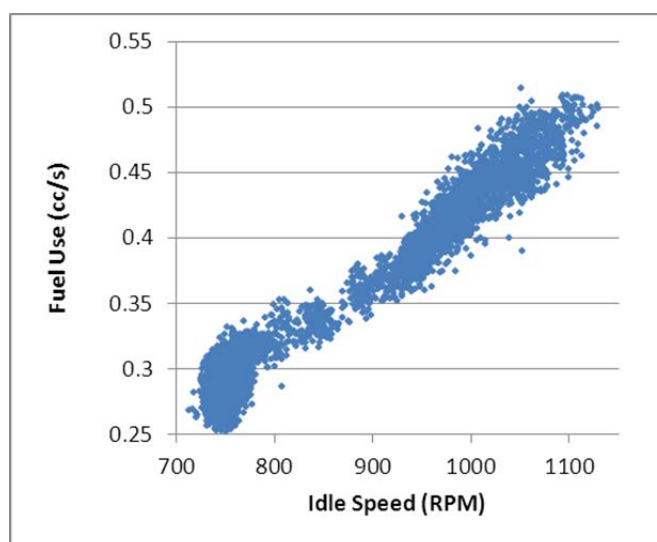
<sup>a</sup> Emissions are nominally zero

The fuel consumption can be converted to a rate of 0.265 gal/h (1 gal = 3785.41 cc). Fuel consumption at idle varies with engine size; other ongoing work on similarly instrumented vehicles at Argonne has estimated fuel consumption at idle of about 0.2 gal/h for a 2004 Ford Focus (2.0-L I4) and 0.5 gal/h for a late-model Crown Victoria Police Cruiser (4.6-L V8).

Fuel consumption at idle also depends on engine speed. The higher RPM period at the start of the long idling period allowed us to verify that fuel use increases with idling speed (see Figure 3).

### Restarts

As can be seen in Figure 4, when the engine was restarted, there was an initial sharp rise in fuel use. There were also peaks of THC and sometimes NO<sub>x</sub> and/or CO (Figure 5). The fuel use settled back close to the idling rate within about 15 s, but the THC and CO declined more slowly after the spike, remaining elevated for the entire 30-s restart period. Both test scenarios showed emissions spikes during the subsequent engine starts — NO<sub>x</sub> spikes appear sporadically, and THC and CO spikes occur consistently, but are variable in size. Both effects are worth additional investigation.



**FIGURE 3 Increase of Fuel Use with Idling Speed.**

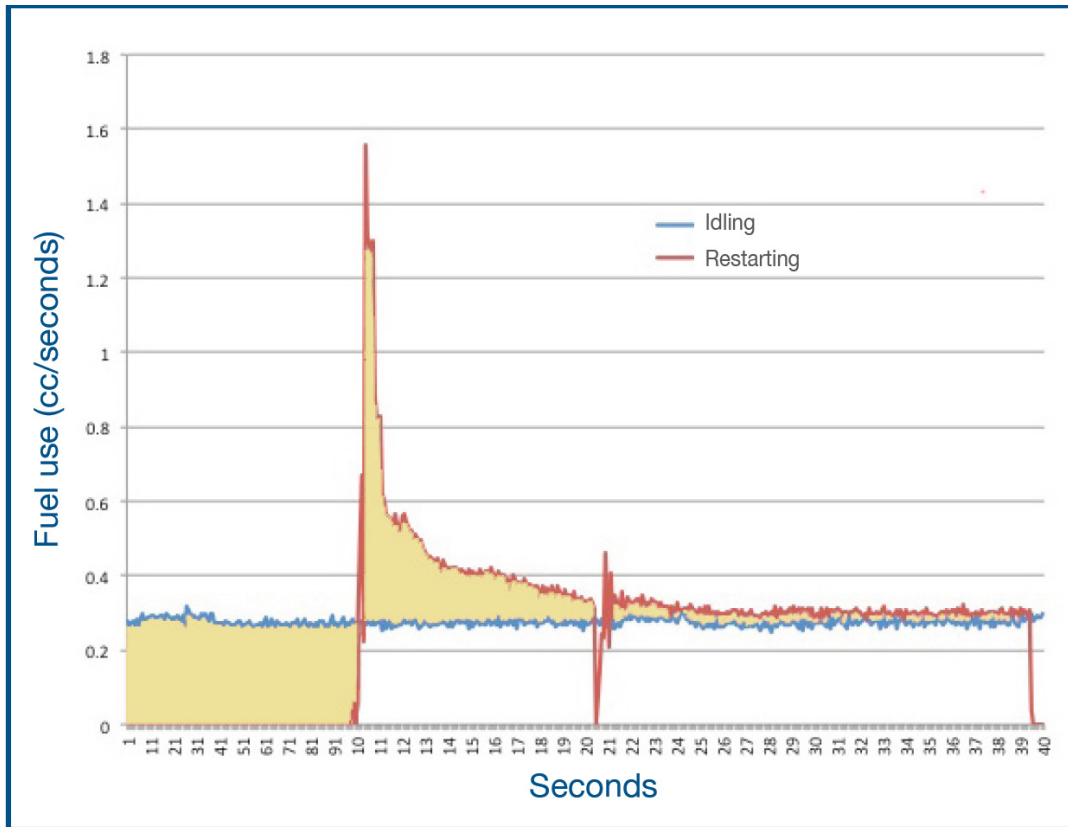


FIGURE 4 Fuel Use for Idling and Restarting.

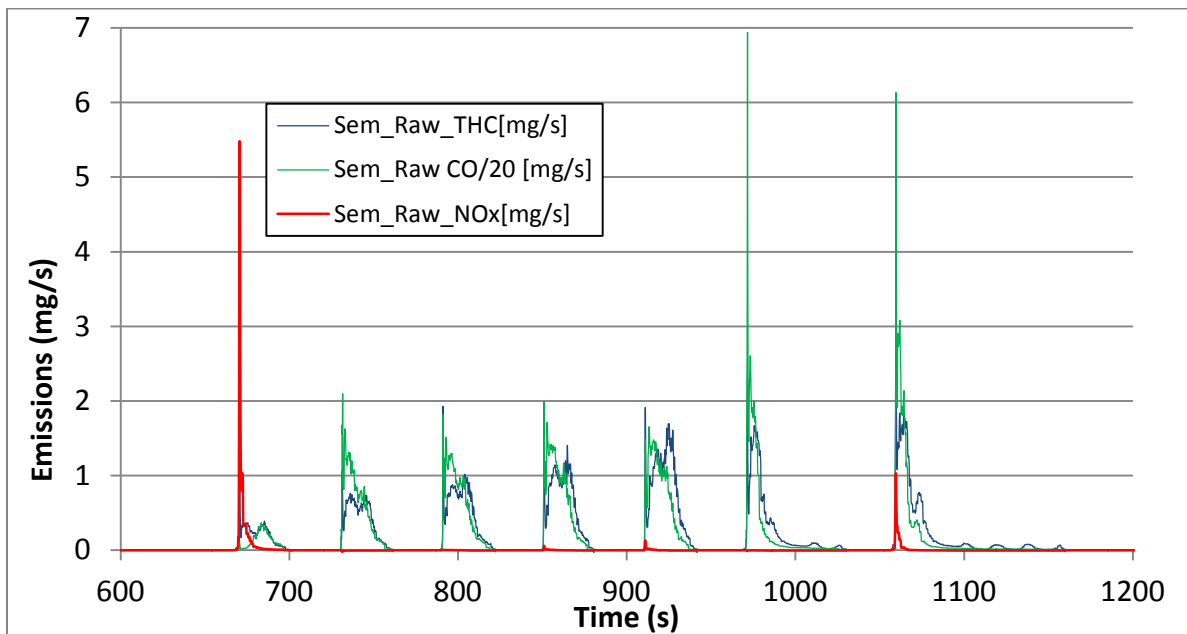


FIGURE 5 Emissions for 7 Restarts.

NO<sub>x</sub> emissions were essentially zero, actually at the limit of instrument resolution. The two longer restarts in the run with seven restarts included a dynamometer load to simulate 3-mph

creeping. In those two cases, the THC dropped quickly back to near the idling levels after about 30 s. Therefore, the 30-s starts captured most of the excess (compared to idling) THC emissions from restart. Emissions of CO on restart were similar to those during vehicle operation and over two orders of magnitude larger than those during idling. For both CO and THC, emissions during restart were over a factor of 2 larger during the restarts after a long idling period than after a 5-min soak. This difference has not been explained and will likely be investigated in future work. Emissions during restarts while the catalyst is still hot are likely due primarily to engine start calibrations for consistent engine start, as well as additional issues related to stopping/starting the engine.

To estimate additional impacts caused by the restarts, we compared the fuel use and emissions from the restarts with those from an equivalent period (30 s) of idling at 750 RPM. Figure 4 includes a graphical representation for this comparison. In the graph, the shaded area under the blue line (idling fuel rate) and the red line (restart) before the engine is restarted (at 10.1 s) represents the quantity of fuel that the engine would have burned if it were idling instead of being off, and the area between the red and blue lines after the engine is restarted represents the excess on restart. All of the impacts and calculated excesses (over idling levels) for the restarts are shown in Table 4, along with equivalent idling times for that excess impact. *Our key conclusion: To minimize fuel use (and CO<sub>2</sub> emissions) under nominal test conditions (25°C ambient temperature), the engine should be turned off if idling is to be over 10 s in duration.* The appropriate “crossover” (maximum idling duration) is longer if the objective is to minimize criteria pollutant emissions, and that duration depends on the pollutant. The maximum idling duration is for CO, which is emitted in significant quantities during restarts.

**TABLE 4 Emissions and Fuel Use for Restarts and Equivalent Idling Times**

| Parameter                  | Average<br>(per second) | Average<br>per start | Equivalent<br>idling time |
|----------------------------|-------------------------|----------------------|---------------------------|
| NO <sub>x</sub> after soak | 0.043 mg                | 1.3 mg               | 1.7 min                   |
| NO <sub>x</sub> after idle | 0.050 mg                | 1.6 mg               | 2.3 min                   |
| THC after soak             | 0.53 mg                 | 16.0 mg              | 10 min                    |
| THC after idle             | 1.34 mg                 | 40.4 mg              | 25 min                    |
| CO after soak              | 10.5 mg                 | 315 mg               | 48 min                    |
| CO after idle              | 35.0 mg                 | 1050 mg              | 2.7 h                     |
| Fuel after soak            | 0.34 cc                 | 10.2 cc              | 6 s                       |
| Fuel after idle            | 0.38 cc                 | 11.3 cc              | 10 s                      |

Thus, we can see that, on the basis of fuel use, idling should be minimized. In terms of criteria pollutant emissions, frequent restarts do have some negative impacts. However, to put these into perspective, it is necessary to compare them to emissions from cold-starting the vehicle.

### Comparison to Cold Start

While the criteria emissions related to vehicle restarting with a hot catalyst are, on a percentage basis, relatively large compared to the extremely low emissions during warm vehicle idling, it is important to understand these emissions in the context of overall allowable vehicle emissions. Although this work did not include measurements of cold start, data were available from other experiments performed with the same instrumented 2011 Ford Fusion. Emissions from restarts and idling are compared with those from initial engine cold-start and with regulated emission levels for the vehicle class in Table 5. For comparison with the collected data, the Tier 2-Bin 5 CO criteria emissions limit is 3.4 g/mi for the first 50,000 mi (14). So even with the higher restart emissions described above, the

engine must be restarted three times to equal the emissions from just one mile of driving, and so CO emissions from restarts are a less-serious concern.

**TABLE 5 Comparison of Emissions from Initial Engine Start and Restart**

|                            | <b>Tier 2-Bin 5 (15)<sup>a</sup></b> | <b>Initial Engine Start</b> | <b>Engine Restart</b> |
|----------------------------|--------------------------------------|-----------------------------|-----------------------|
| <b>THC (mg)</b>            | 878                                  | 191                         | 44                    |
| <b>NO<sub>x</sub> (mg)</b> | 552                                  | 228                         | 6                     |
| <b>CO (mg)</b>             | 31290                                | 2970                        | 1253                  |

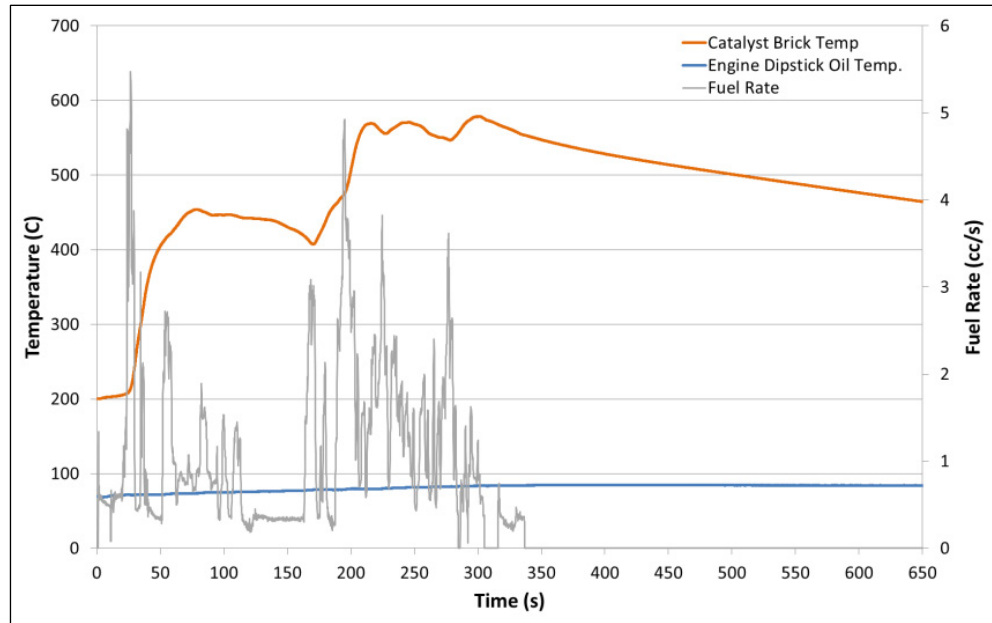
<sup>a</sup> Tier 2-Bin 5 g/mi converted to FTP-75 mg

These results clearly imply that emissions from starting an engine cold are by far the largest environmental risk. Therefore, we also considered how quickly the catalyst cooled when the vehicle was turned off.

### **Rate of Catalyst Cooling**

The catalyst brick temperature was monitored for both runs and can be seen in Figure 6. In the long-idle run, the catalyst temperature remained stable around 375°C after the initial warm-up. In the other run, the catalyst temperature reached over 550°C during the period in which a “driving” load was applied and cooled down slowly, falling to about 460°C after 5 min with the engine off and stabilizing around 350°C (above the catalyst activation temperature) after three restarts. The engine dipstick oil temperature was also measured, and it did not decrease significantly during the 5-min soak (see Figure 7). This cooldown was slow because the vehicle was not moving and therefore experienced little airflow and resultant heat transfer.

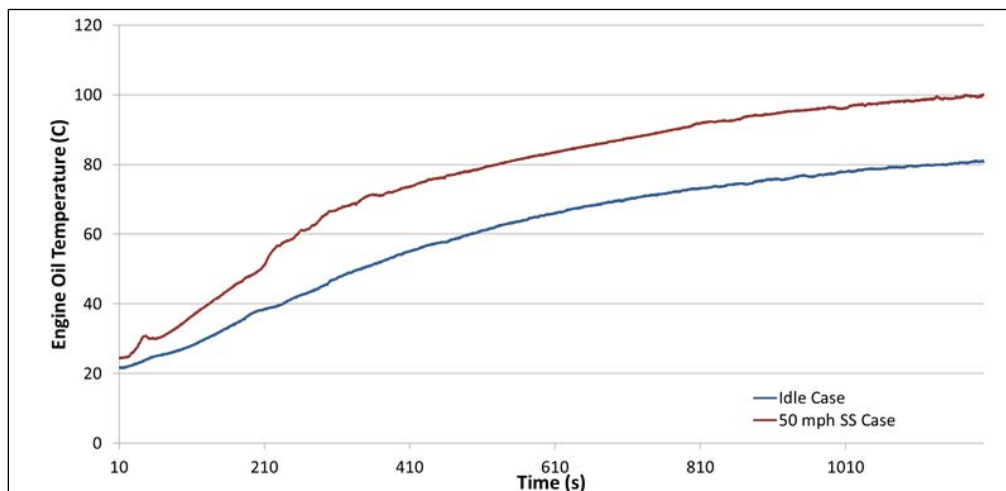
We estimate from the cooling results that the catalyst remained above the light-off temperature for at least 5 min after the engine was turned off, at 21°C. The catalyst would not cool any faster at higher (4) temperatures, but it would certainly cool faster at lower ambient temperatures. Funding constraints prevented us from repeating these experiments at lower temperatures. However, other work done at Argonne confirmed this (1). Measurements during a Chicago winter of the external temperature of the catalytic converter of a 2009 Volkswagen Jetta after the vehicle was shut down showed that the time it took to cool down decreased slowly, from about 3 min to just under 2 min when the temperature dropped from 1°C to -17°C.



**FIGURE 6 Catalyst and Dipstick Temperature Behavior when Engine Is Shut Off (at ~340 s).**

### Engine Warm-Up

The conventional wisdom has always been that it is necessary to idle for some period to warm up the engine before driving the car. This strategy might actually be appropriate in some circumstances, such as in extremely cold temperatures. Hard acceleration is also not recommended with a cold engine and catalyst. However, under normal conditions, the engine warms up much faster when driven than when idled. Figure 7 compares engine oil temperature for the case where the engine is started and then idled for 20 min with the case when the engine was started and then run at a constant 50 mph (and then restarted several times). As a point of comparison, note that the engine oil reaches 60°C (a nominal comparison point) roughly 4 min faster when driving versus at idle. There is no need to consume fuel in idle if the intent is to warm the engine.



**FIGURE 7 Coolant Temperature for 50-mph Drive on Start-Up vs. Idle on Start.**

## EXPERIMENT LIMITATIONS

Data presented here are extremely limited, based on one vehicle at one temperature, with a small number of runs. Therefore, although several conclusions are appropriate as a result of this work, generalizations are unwarranted without additional work to confirm the extent to which the results apply. Hot and cold ambient conditions are likely to impact results, as are the loads required to supply passenger comfort at those temperatures. Older vehicles and diesels are both likely to behave differently. And no simulation of driving away immediately on restart was done, and so this work does not compare warming up the vehicle during idling with warming up the vehicle as it is being driven. In addition, more research would be required to explain differences in THC emissions between the runs, as well as to make more generalizations regarding the impacts of different restart/soak times on emissions. Additional research to fill in all these gaps would enable more conclusive statements concerning the differences in emissions between idling and restarts.

## CONCLUSIONS

Argonne testing at 21°C ambient conditions on a late-model mid-sized American car (2011 Ford Fusion) shows that idling for more than 10 s uses more fuel and emits more CO<sub>2</sub> than restarting the engine. Idling fuel usage was shown to vary from 0.2 to 0.5 gal/h for passenger vehicles across a range of sizes. Criteria pollutant emissions were determined to be relatively low for idling following catalyst activation. Emissions from restarting were larger, but at least an order of magnitude lower than those from starting a cold engine, as shown in Table 5. The catalyst was found to cool down slowly so that restarts after times equivalent to a short transaction at a bank or restaurant are unlikely to allow the temperature to drop below light-off and result in high cold-start emissions. Therefore, for short stops, it makes sense to turn the vehicle off in order to minimize fuel use and CO<sub>2</sub> emissions.

Unpublished results of recent tests at Argonne that involve auto-stopping/starting a vehicle are similar to those of Fusion testing conducted here; clearly, stop/start decreases fuel consumption, but engine re-starts result in increased emissions (16). The degree of increased emissions has differed among vehicles, as well as between engine technologies (diesel versus gasoline).

At least for the conditions evaluated in this work, a penalty in terms of criteria pollutant emissions is very small compared to cold-start emissions. Idling was also shown to be a very slow way to warm up your car.

## ACKNOWLEDGMENTS

This work was sponsored primarily by the Clean Cities Program U.S. Department of Energy's Office of Vehicle Technologies, to which we offer our thanks. We also thank Steven McConnell, Christopher Saricks, Michael Duoba, and Terry Levinson of the Center for Transportation Research for extremely helpful discussions and insights.

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## Legislation Text

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**File #:** 14-0022, **Version:** 1

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**TITLE:**

Discussion of Prohibition on Parking in Public Lots from 3 AM to 5 AM

**PURPOSE:** The purpose of this agenda item is to provide an opportunity for the Board of Aldermen to discuss the late night/early morning parking prohibition for public parking lots in the downtown.

**DEPARTMENT:** Planning

**CONTACT INFORMATION:** Patricia McGuire - 919-918-7327 - [pmcguire@townofcarrboro.org](mailto:pmcguire@townofcarrboro.org)

**INFORMATION:** The late-night/early morning prohibition on parking in downtown public lots was established on June 26, 2013 in conjunction with a review of towing and parking provisions in the Town Code. Signs indicating the limitation were installed thereafter.

The parking prohibition was included in changes presented in June in response to a request for staff to explore ways to minimize the overflow to downtown public parking lots of parking generated by nearby residential properties. In recent years, renovations of two downtown properties adjacent to public parking areas have resulted in an increase in the number of vehicles parking overnight in nearby public lots. In December, Board of Aldermen members expressed an interest in revisiting the prohibition on parking in the wee hours of the morning. One concern that has been expressed is that, fearing a parking ticket, drivers who have frequented one of Carrboro's entertainment venues will choose to get behind the wheel when it is unsafe or illegal for them to do so. In addition, since the signage does not indicate the mechanism for enforcement, some drivers might anticipate that their vehicles would be towed if found in violation.

Since the June 2013 action, work has been progressing on several fronts related to parking and towing: staff has presented a framework for completing a study and plan for downtown parking; outreach associated with anticipated enforcement has gotten underway and; some businesses have requested that the Town step up enforcement and others have requested that the Town establish a mechanism for granting permission for longer-term parking; and, public meetings where staff will seek to identify 'matches' between parking supply and demand - as an interim step to the longer-term parking management strategy that will result from a planning effort - were held in early February. Vehicles have been observed parking in some downtown lots during the wee hours in recent weeks; a systematic data collection effort has not been undertaken.

Possible action options are as follows:

- Direct staff to prepare an ordinance removing the 3 am to 5 am parking prohibition from downtown public lots.
- Direct staff to prepare an ordinance modifying the Town Code related to the late night/early morning parking prohibition.
- Leave the existing regulations as they are. Direct staff to communicate with the community regarding enforcement (e.g. tickets, rather than towing). Revisit following data collection associated with the

parking plan.

**FISCAL & STAFF IMPACT:** Impacts vary in relation to next steps identified by the Board of Aldermen.

**RECOMMENDATION:** Staff recommends that the Board of Aldermen discuss the parking prohibition and direct staff regarding any alternative approaches.

Motion was made by Alderman Seils, seconded by Alderman Johnson, to approve the following ordinance:

AN ORDINANCE AMENDING THE CARRBORO TOWN CODE PROVISIONS DEALING  
WITH PARKING  
Ordinance No. 21/2012-13

THE BOARD OF ALDERMEN OF THE TOWN OF CARRBORO ORDAINS:

Section 1. Subsection 6-19(b)(4) of the Carrboro Town Code (parking for not more than two hours between 7:00 p.m. and 5:30 a.m.) is amended by adding a new subdivision (f) and (g) as follows:

(f) Within the municipal parking lot located on Laurel Avenue.

(g) Within the leased parking spaces at the 300 East Main Street Development

Section 2. Subsection 6-19(b) of the Carrboro Town Code (parking prohibited in certain locations at certain times) is amended by adding a new subsection (10) as follows:

(11) No Parking from 3:00 a.m. to 5:00 a.m.

All town parking lots

Section 3. Subsection 6-41(c) of the Carrboro Town Code is amended by raising the \$25.00 civil penalty for parking offenses to \$35.00 for the first offense, \$50.00 for the second offense, and \$100.00 for the third offense within a 365 day period. The amended subsection reads as follows:

(c) Any violation of the following sections shall subject the offender to a civil penalty as indicated. If the offender fails to pay this penalty within 10 days after being cited for a violation and notified of the penalty, the Town may seek to collect it in a civil action in nature of debt:

| Section                                                                     | Civil Penalty                                                                                                                           |
|-----------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| 6-14.1, 6-24, 6-26, 6-28, 6-28.1,<br>6-28.2, 6-29, 6-35, 6-37, 6-38, 6-40.1 | \$25.00                                                                                                                                 |
| 6-18 (except 6-18(a)(13), 6-19, 6-20, 6-21, 6-22                            | \$35.00 for the first offense,<br>\$50.00 for the second<br>offense, \$100.00 for each<br>subsequent offense within a<br>365 day period |
| 6-18(a)(13)                                                                 | \$50.00                                                                                                                                 |
| 6-28.3                                                                      | \$250.00                                                                                                                                |

Section 4. All provisions of any town ordinance in conflict with this ordinance are repealed.

Section 5. This ordinance shall become effective upon adoption.

This the 25<sup>th</sup> of June 2013.

**The motion carried by the following vote:**

**Aye:** Mayor Chilton, Alderman Gist, Alderman Haven-O'Donnell, Alderman Johnson, Alderman Lavelle, Alderman Slade and Alderman Seils