

On May 22, 2014, Council voted to receive the report for review and to forward the recommendations to Town staff for review, feedback, and implementation as needed.

# Executive summary:

## Shale Gas Development (SGD) Subcommittee Authority and Limitations

Following the work of the Town of Cary Shale Gas Development Task Force, the Environmental Advisory Board (EAB) of the Town of Cary formed a six-member Shale Gas Development (SGD) Subcommittee. The EAB tasked the subcommittee with the following work plan:

- Monitor and update the EAB about potential legislation
- Review, understand and report to the EAB potential risks to the Town
- Review, understand and report to the EAB potential risks to homeowners
- Make recommendations to the EAB about educating and communicating risks to the Town Council
- Make recommendations to the EAB about what the EAB can do to ensure shale gas development does not result in negative impacts to Cary's quality of life, health and economy
- Make recommendations to the EAB about what the EAB can do to advise the Town Council and staff about potential approaches to address adverse consequences

## Background on Shale Gas Development

In the late 1940s, a process was developed to increase the yields of oil and gas wells by increasing the porosity of the area around the well. This process, "hydraulic fracturing" or "fracking," involves pumping fluids at high pressure into the oil- or gas-bearing rock to create fractures, and flushing the oil/gas out to the surface. It has become quite widespread in the recent years, especially due to technological advances in hydraulic fracturing and horizontal drilling. Shale gas development activities are now occurring in 32 states, with the largest shale gas production in Texas, Louisiana, Arkansas and Oklahoma. Production in the Midwestern and Northeastern states is growing rapidly, as well. By 2011, shale gas production contributed 30% of the total natural gas production in the country with its contribution increasing rapidly.

## Shale Gas Development and Production: A Multistage Process

Shale gas development is a multistage process, involving vertical drilling, as well as horizontal drilling and hydraulic fracturing. Vertical drilling occurs first, continuing until the drilled hole reaches below the deepest layer of fresh water. Cement is then pumped into a well casing which is smaller than the bore hole, so that cement flows out of the bottom of the casing and up between the casing and hole. When it hardens, the cement acts as a barrier between the wellbore and the aquifer. Vertical drilling then continues until a depth is reached that is up to 500 feet above the planned horizontal drilling section. At this point, the drill pipe and bit are pulled out of the hole. A different downward drilling motor is lowered to enable horizontal drilling. The curved drilling occurs over approximately one-quarter of a mile. When the lateral target distance is reached, the drill and pipe are removed for the final time. Production casing is inserted into the full length of the wellbore. Cement is pumped into the casing, out of the end, and back between the casing and the walls of the hole. This secures the wellbore permanently to prevent hydrocarbons from seeping out. The drilling rig is no longer needed and is removed. A temporary wellhead is installed. The well is then perforated, or "perfed." This is accomplished by lowering a "gun" to shoot small holes through the horizontal well casing and cement. A high-pressure mixture of water, sand and chemicals is then pumped into the well, causing fractures in the rocks adjacent to the perforated holes. The fractures provide a path for the shale gas. On completion, a permanent wellhead is installed at the surface.

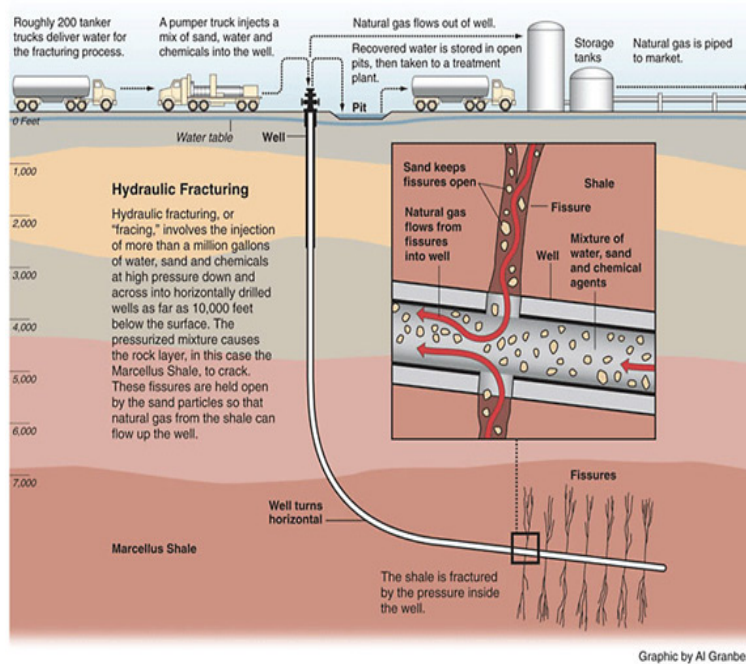


Figure 2.2: The hydraulic fracturing process. Source: Shale Stuff. (n.d.). Process of Fracking. Retrieved September 17, 2013, from <http://shalestuff.com/education/fracking/fracking>

## Shale Gas in North Carolina

While shale gas is not currently produced in North Carolina, the State has four subsurface regions (called “basins”) that may be capable of producing shale gas. The four basins are Deep River basin, Dan River basin, Davie basin and Ellerbe basin. The Deep River Basin has the most promising shale gas potential in North Carolina. It is especially relevant to the Town of Cary as it lies under parts of the Town and is beneath large areas to the west and north of the Town, as shown in the Figure ES.1.

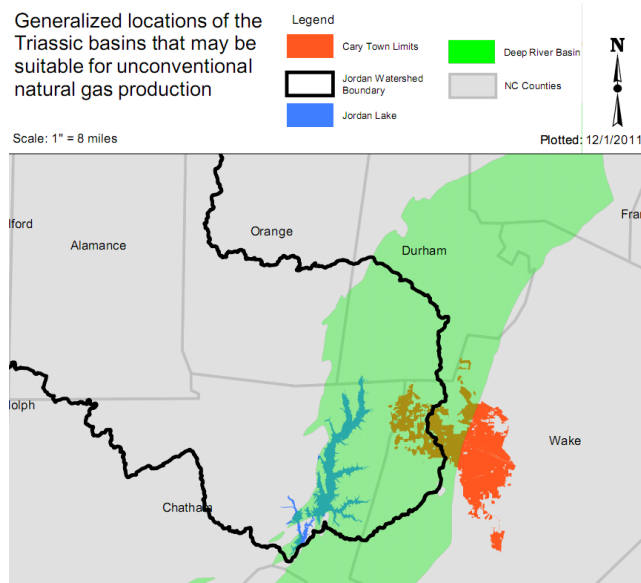


Figure ES.1 Location of the Deep River basin and the Town of Cary: Source: Town of Cary Staff Report PWUT12-16, Report on Activities of the Shale Gas Development Task force, March 13, 2012

## Laws and Regulations Affecting Shale Gas Development

### Federal laws and regulations

Shale gas development and production are subject to a number of Federal environmental regulations and laws. Many of these laws and regulations apply to any heavy industry; some are specific to oil and gas; and some specific to shale gas development. Notably, EPA recently promulgated rules requiring “green completion” of new shale gas wells starting in 2015. Green completion recovers emissions that would otherwise be vented. This requirement is expected to reduce emissions of volatile organic compounds (VOCs) by 95%. This group of chemicals includes most of the hazardous air pollutants (HAPs) associated with shale gas development. Until 2015, new shale gas wells are required to treat emissions by flaring, a process that removes VOCs and HAPs, but produces combustion-related emissions.

In some cases, specific activities and wastes from oil and gas production are exempted from Federal laws. Notable among these are (a) an exemption from storm water discharge permitting requirements, (b) an exemption from the Toxic Release Inventory (TRI) reporting program, and (c) an exemption from EPA’s hazardous waste rules for most wastes produced in oil and gas exploration and production. The reasons for these exemptions are varied, but often include a judgment by EPA that the activities or wastes in question are best dealt with by the State. A remaining question is how or whether the environmental risks posed by these and other gaps in Federal legislation and regulations will be filled by State rules.

### State laws and regulations

In July 2012, North Carolina Senate Bill 820 became S.L. 2012-143, which legalized hydraulic fracturing. The “Clean Energy and Economic Security Act,” authorized natural gas horizontal drilling and hydraulic fracturing, but prohibits issuing permits until new rules are developed, reviewed and approved by the State Legislature. The law approved the formation of the Mining and Energy Commission (MEC) to develop rules and regulations for gas drilling and adopt the rules by October 1, 2014. Ultimately, the North Carolina Division of Environment and Natural Resources (NCDENR), Division of Energy, Mineral and Land Resources (DEMLR) will enforce the rules. S.L. 2012-143 contains instructions on environmental and other risks to be addressed in the rules. Abbreviated requirements include:

- “(1) Regulation of pre-drilling exploration activities...
- (2) Regulation of drilling, operation, casing, plugging, completion, and abandonment of wells.
- (3) Prevention of pollution of water supplies...
- (4) Protection of the quality of the water, air, soil, or any other environmental resource...
- (5) Regulation of horizontal drilling and hydraulic fracturing treatments for the purpose of oil and gas exploration. Such rules shall, at a minimum, include standards or requirements related to...[baseline environmental data, construction and siting standards, limits on water use, prohibition on the use of certain chemicals, chemical disclosure requirements with exceptions for trade secrets, safety equipment and protocols, measures to mitigate impacts on infrastructure, and proper well closure, site remediation, post closure monitoring and financial assurance]
- (6) To require surveys upon application of any owner who has reason to believe that a well has been unlawfully drilled...
- (7) To require the making of reports showing the location of oil and gas wells and the filing of logs and drilling records.
- (8) To prevent blowouts, caving, and seepage, as...generally understood in the oil and gas industry.

- (9) To identify the ownership of all oil or gas wells, producing leases, refineries, tanks, plants, structures, and all storage and transportation equipment and facilities.
- (10) To regulate the "shooting," perforating, and chemical treatment of wells.
- (11) To regulate secondary recovery methods,...
- (12) To regulate the spacing of wells and to establish drilling units.
- (13) To regulate and, if necessary...prohibit...wells in the interest of protecting the quality of the water, air, soil, or any other environmental resource against injury, damage, or impairment.
- (14) Any other matter the Commission deems necessary for implementation of a modern regulatory program for the management of oil and gas exploration and development in the State and the use of horizontal drilling and hydraulic fracturing for that purpose.”

The law places additional requirements on the Environmental Management Commission, including adopting rules, after considering recommendations from MEC, for all of the following:

- (1) Stormwater control on sites with oil and gas exploration and development activities.
- (2) Regulation of toxic air emissions from drilling operations...assess emissions...in order to (i) determine the adequacy of the State's current air toxics program to protect landowners who lease their property to drilling operations and (ii) determine the impact on ozone levels in the area in order to determine measures needed to maintain compliance with federal ozone standards.”

Both MEC and the Environmental Management Commission have progressed with these tasks. MEC made a presentation on October 1, 2013 to the Joint Legislative Commission on Energy Policy identifying target dates for providing rules to the NC General Assembly. The schedule calls for MEC to complete internal rule writing by early September 2014 and have the rules considered by the Rules Review Commission (RRC) by December 15, 2014. At the same meeting, the Environmental Management Commission also identified a number of rules needing revision, including certain Water Quality, Stormwater, and Land Application Rules. The schedules for developing the needed revisions, with revisions to be complete by mid-October 2014. The Division of Air Quality, after reviewing existing Federal and State regulations, concluded additional air pollution regulations were not needed.

### **The relationship between State and Local authority**

North Carolina is one of 39 states that operate under “Dillon’s Rule”, under which local government’s authority is generally limited to areas specifically granted by state law. More specific to the environmental concerns about shale gas development, the North Carolina Regulatory Reform Act of 2013 temporarily restricted local government from adopting new ordinances regulating a field that is also regulated by a state or federal environmental agency unless approved by a unanimous vote of the city or county board members present and voting. This legislation contains a sunset date of Oct. 1, 2014. The Environmental Review Commission has been charged with studying the circumstances which local governments should be allowed to regulate matters already regulated by state or federal environmental agencies and reporting these findings to the legislature by May 2014.

### **MEC Study Group Recommendations regarding Local Government Regulations**

Municipalities are granted Zoning and Development Regulation Powers and those powers have been discussed specifically by the MEC Local Government Regulation Study Group. “The study group researched whether or not a local government could or should apply its zoning ordinances to the oil and gas industry and developed these recommendations:

- a. Local zoning ordinances should only apply to surface land use, not to subsurface use;
- b. Local governments should retain their existing zoning and land use authorities and be able to apply these ordinances to the oil and gas industry;
- c. Local governments should not be allowed to apply zoning ordinances to exclusively prohibit oil or gas operations;
- d. Local governments could implement special use permitting for specific properties, such as forestry districts, agricultural areas, and family farms, while also allowing other land uses, such as development of resources (e.g. shale gas)...;
- e. A special use permit could include a provision for oil and gas operations, so that these operations could still occur within designated special use permitted lands;
- f. Local governments implementing a special use permitting program should be aware of the potential for land-owner abuse of a “present use value” designation to avoid taxation on the production of subsurface resources;
- g. Appeals to zoning decisions should be adjudicated through existing local and judicial processes.”

Additionally, the Study Group addressed several other mechanisms, including:

- a. “Setbacks for oil and gas development and hydraulic fracturing need to be detailed for well head, well lateral lines, gathering lines and transmission lines. Setbacks should be used only for environmental, health and safety purposes...local governments cannot implement setbacks to exclusively prevent oil and gas development and exploration.”
- b. “The study group recommends that the Commission adopt state setback rules.”
- c. “The study group recommends that local governments continue addressing odor, noise, and light-related issues under their current police power authority.”
- d. “Groundwater and surface water monitoring activities will continue to be performed by local health departments, DWR, DWM, and eventually by DEMLR. Additionally, a “baseline” sampling and testing rule set has been developed...which will require oil and gas companies to sample and test private drinking water wells in the vicinity of operations [and]...follow-up testing after operations have been completed. The study group has no recommendations for water testing beyond current sampling programs and implementing the new baseline sampling rule set.”
- e. “DENR Division of Air Quality plans to continue its program of collecting sampling data using its current ambient air monitoring network [and]...plans to install a new monitoring network near an area where initial shale gas operations are expected...”
- f. “The study group also researched waste generation from oil and gas operations and recommends that any wastewater that is discharged to a municipal wastewater collection system for treatment must meet local standards for industrial pretreatment.”

The report noted that local officials are responsible for the health, safety, and welfare of their citizens. “They must balance a property owners’ right to quiet enjoyment of their property versus the other owners’ right to extract natural gas from their property.” Local concerns include compatible land uses, water supply contamination, side effects of industrial operations, and the ability to follow federal rules. Areas of traditional local control over heavy industry include:

- 1) Zoning: separation of uses, setbacks, allowable uses
- 2) Industrial Impacts
  - a. Health/Safety/welfare: noise/light/odors

- b. Streets: weight limits on city-owned roads, placement of infrastructure in municipal right-of-way, truck routes and timing of truck operations
- 3) Federal/state environmental laws
  - a. Federal: Floodplain management, stormwater, hazardous waste, air quality
  - b. State: sedimentation/erosion control, Water Supply Watershed”

Additionally, the Funding Levels and Potential Funding Sources Study Group specified that local government will experience increased costs associated with:

- 1) Transportation infrastructure upgrades & repair
- 2) Waste handling
- 3) Hazmat training
- 4) Emergency response
- 5) Training of local government staff – tax assessors, register of deeds, inspectors/code compliance officers, public safety officers
- 6) Increase in local government personnel or overtime needed
- 7) Drinking water well testing

### **Local Zoning Authority and Subsurface Oil and Gas Rights in Cary**

Cities, Towns (and Counties) are granted Zoning and Development Regulation Powers by the State. In Cary, zoning and development regulations are consolidated into the Town’s Land Development Ordinance (LDO). Currently, Shale Gas Development is an “Unlisted Use.” An applicant would go through a process to get it classified according to the nearest definition, likely to be Resource Extraction, which occurs by Special Use Permit in Industrial Zones. When applying for a Special Use Permit, a State Mining Permit is first required. Various other requirements, including 300’ setbacks, are also outlined.

The Town has three locations currently zoned industrial, which are partially or entirely located within the Deep River Basin (with potential for shale gas extraction). Two additional Industrial locations are outside but close to the Deep River Basin. At this time, it is not known if these areas are likely candidates for shale gas development. Any future rezoning would occur through the standard Town process.

Additionally, if the State accepts the MEC study group recommendations, zoning will only apply to surface land, not subsurface area. Therefore, if the mining company has oil and gas rights and utilizes horizontal drilling techniques, extraction may be allowed by the state (regardless of local zoning) beneath lands within other zones. Additional work would be necessary to identify the owners and to determine whether subsurface mineral rights have been severed (on areas in Cary, Cary’s ETJ, Morrisville and other areas adjacent to Cary) as they have on several hundred lots in Wake, Durham and Chatham counties.

### **Shale Gas Extraction Moratoriums and Bans in North Carolina Municipalities**

Within North Carolina, two municipalities and one county have enacted policy to prohibit or temporarily prohibit Shale Gas extraction. This includes the City of Raleigh, the City of Creedmoor and Anson County. Anson County adopted a “Moratorium, which temporarily prohibits natural gas development activities, including hydraulic fracturing and horizontal drilling, from occurring within Anson County while ordinances are developed, enacted and implemented....” These bans and moratoriums have not been challenged in courts so it is not known whether they exceed local authorities under State law.

## **Environmental/Health/Economic Impacts**

This report assesses potential direct impacts on the Town of Cary. Broader issues, such as national energy policy and the impacts on societal greenhouse gas emissions are not addressed. In addition, the discussion of the potential economic impacts (positive or negative) on Cary is extremely limited as these impacts fall outside of the mission of the Environmental Resources Board. Impacts include:

### **Water availability**

Two to four million gallons of water or more is required to hydraulically fracture a single shale gas well. While this water requirement is episodic, being related primarily to well development, the cumulative requirements associated with a large number of wells could be significant. In addition, waste water treatment plant capacity and inter-basin transfers of water may also become important issues. The ability of Jordan Lake to supply additional water for shale gas development has not been assessed.

### **Water and Soil Contamination**

Under current national regulations, natural gas operations cannot discharge wastewaters directly to surface waters. Given the current ban on deep well injection in North Carolina, this leaves two primary options for managing wastewaters from shale gas production; evaporation in holding ponds or transferring to a publically owned treatment works (POTW) from which the wastewater can be discharged to surface waters. Experience in Pennsylvania suggests the potential for “interference and passthrough” in POTWs treating shale gas wastewaters. Constituents of particular concern in shale gas wastewaters with respect to the potential for interference and passthrough include dissolved solids and naturally occurring radioactive materials (NORM). A range of chemical additives are required to drill and fracture wells to produce shale gas. These vary in toxicity from benign to potentially toxic, with the risks generally being highest in cases of spills and other accidental releases. Disclosure requirements for chemicals used in shale gas development vary among jurisdictions, especially for chemicals considered trade secrets. Surface waters in the vicinity of shale gas operation can be impacted by runoff during storm events. This can be especially significant during construction activities. Groundwater drinking supplies near shale gas wells have at times been contaminated. There is a growing consensus that groundwater contamination is due to inadequacies in the construction of the vertical portion of the well or to surface spills.

### **Air Quality**

Shale gas drilling can impact air quality. Some of these potential impacts are common to all industrial operations while others are primarily associated with natural gas drilling and well operation. Diesel equipment used in the drilling operations emits PM 2.5 and PM 10 particulate matter and other pollutants. Trucks emit nitrogen oxides, carbon monoxide, particulate matter, and hydrocarbons. Moreover, the use of dirt roads impacts air quality and fugitive dust. Methane, VOCs and hazardous air pollutants (HAPs), as defined under the Clean Air Act, are also released during drilling operations. The HAPs most often associated with shale gas development (and fossil fuel production in general) are benzene, ethylbenzene, toluene, xylene, sometimes collectively called BETX. Other HAPs that have been associated with shale gas development are hexane and 2,2,4-trimethylpentane (also known as isooctane), which are commonly found in gasoline and other fossil fuels, and formaldehyde (formed in combustion of natural gas).

### **Parks, Open Space and Forest Fragmentation**

Large scale development of shale gas resources can have a significant impact on the land surface due to well pad and gas pipeline infrastructure. This can have aesthetic as well as ecological impacts.



## **Infrastructure**

Shale gas often develops without adequate infrastructure to accommodate it. The risks to transportation infrastructure primarily occur with the increased truck traffic associated with site preparation, equipment delivery, materials, and water supply. Major roadway segments, interchanges, and intersections will experience an increase in average annual daily traffic (AADT) with potential impacts on the level of service. Local roads and minor collectors within Town limits may experience congestion during certain times of the day or during at heavily traveled intersections/interchanges. Rail traffic may also increase.

## **Energy and greenhouse gas impacts to the Town Operations**

The Town has conducted a greenhouse gas inventory that clearly shows the energy and greenhouse gas impacts associated with treating the Town's wastewater. Additional wastewater could cause the Town's energy consumption and greenhouse gas emissions to increase.

## **Noise**

Drilling operations typically continues 24 hours a day until completion resulting in noise during nighttime hours. Noise associated with the drilling activities is temporary and ends once drilling operations cease. After the drilling process ends, specialized site equipment and vehicles, water trucks, tractor trailers, and delivery and employee vehicles will frequently use the site. Noise impacts can be expected in the immediate vicinity of the site as well as along truck routes.

## **Earthquakes**

There have been reports of small earthquakes in the vicinity of shale gas operations involving hydraulic fracturing. Although the causes for these are still debated, the likely causes appear to be deep well injection of wastewater from the shale gas operations (currently banned in North Carolina), although one recent study has also connected small earthquakes to hydraulic fracturing in shale gas wells. The reported earthquakes, whether associated with wastewater injection or shale gas wells, have been magnitude 3 to 4 or less. The SGD Sub-Committee has not attempted to determine the significance of disturbances of this magnitude to local infrastructure (e.g. highway overpasses, pipelines, dams, nuclear power plants).

## **Property Values**

A key concern of property owners in areas where shale gas will be developed is the impact on property values. While it is difficult to generalize due to property valuations being so site-specific, some studies have attempted to assess these impacts. In one case, it was determined that the increased property values attributable to the drilling activity (e.g. lease payments or improved economic conditions) were fully offset by loss of property value in places where there were concerns about the impact of nearby shale gas operations. Impacts on property values are not unique to shale gas development. Effects on property values are observed for other types of industrial operations, such as power plants, for instance.

## **Community Health impacts**

There are few studies in the peer reviewed literature estimating the potential risk levels for populations in the vicinity of shale gas operations. Furthermore, the peer reviewed studies currently available were largely performed in the vicinity of shale gas operations that do not meet recently issued requirements for new shale gas facilities. At least one study of releases from older-generation operations suggests that exposures to these releases could result in elevated non-cancer risks and slightly elevated risks of cancer for individuals living close to the operations. It is difficult to know how relevant such studies are in addressing concerns about potential exposures from new operations, as the releases would be far lower.

## Monitoring the effects of shale gas development

A number of efforts are in place to monitoring potential effects of shale gas development, including:

The Triangle Area Water Supply Monitoring Project has collected and analyzed water-quality samples from reservoirs (including Jordan Lake) and streams and collected continuous discharge record from streams in the study area for more than 20 years.

The North Carolina Air Quality Monitoring Plan involves 65 air quality monitoring sites for criteria pollutants. The monitors are located in 45 counties and operated by DENR’s Division of Air Quality (DAQ), local air programs, and EPA. The monitor in Chatham County is sampling for ozone and sulfur dioxide. The monitors in Wake County have various functions, but collectively are sampling for ozone, particulates, carbon monoxide, reactive oxides of nitrogen. One monitor is sampling unspecified “toxics.”

The N.C. Division of Air Quality has developed a plan to characterize baseline air quality in the Sanford sub-basin located in Lee County to address the potential effects of shale gas production. This project plan recommends establishing a multi-pollutant air monitoring site in Lee County that will employ identical monitoring methods and equipment as is used at all other monitoring sites.

The U.S. Geological Survey (USGS) North Carolina Water Science Center is conducting an inventory of well records and baseline groundwater-quality sampling in Lee and Chatham Counties, just west of Sanford. The objective is “to better delineate areas of groundwater use and groundwater-quality characteristics prior to potential shale gas exploration in the Triassic Basins...”

## Prioritizing environmental risks

With a large number of potential concerns, it is important to know whether there is consensus on which risks warrant the most attention. Resources for the Future conducted a survey of 215 experts from academia, government, industry and nongovernmental organizations (NGOs) to determine whether such a consensus exists. Results of the survey “...stand in sharp contrast to the rhetoric of much of the public debate. For example, a key finding is the high degree of consensus among experts about the specific risks to mitigate. Survey respondents from all four expert groups most frequently identified the following “consensus risks,” and pathways leading to the risks, as needing further regulatory or voluntary action:

Surface water risks	<ul style="list-style-type: none"> <li>• Site preparation → Stormwater flows</li> <li>• Fracturing and completion → Freshwater withdrawals</li> <li>• Storage of wastewaters (fracturing fluids, flowback, produced water) → Losses to surface water</li> <li>• Treatment of wastewaters → Impacts to treatment and surface waters</li> </ul>
Groundwater risks	<ul style="list-style-type: none"> <li>• Fracturing and completion → Groundwater withdrawals</li> <li>• Storage of wastewaters (fracturing fluids, flowback, produced water) → Losses to groundwater</li> <li>• Drilling → Improper casing and cementing → Methane in groundwater</li> <li>• Drilling → Accidents involving casing and cementing → Groundwater contamination</li> </ul>
Air quality risks	<ul style="list-style-type: none"> <li>• Drilling → Venting of methane</li> <li>• Fracturing and completion → Venting of methane</li> </ul>
Habitat disruption	<ul style="list-style-type: none"> <li>• Site and infrastructure preparation → Land clearing</li> </ul>

Table ES.1 Consensus risks identified by academia, government, industry and nongovernmental experts

Source: Krupnick, A., Gordon, H. & Olmstead, S. Pathways to Dialogue. February 2013

# Recommendations Table

## 5.1 Short-term actions, 0-1 Year Timeframe

<b>5.1.1 Recommendations Influencing state laws &amp; regulations</b>	
Ensure that State law not infringe on the Town’s right to adapt and apply its zoning and land use authorities to the oil and gas industry to protect Cary’s environment and health/welfare of citizens.	
Examine experience elsewhere in the U.S. where shale gas development has infringed on populated areas.	
Ensure that State law and regulations require full disclosure to local governments and the public of chemicals used in shale gas operations and the amounts stored on site.	
Ensure that State law and regulations require green completion methods be applied immediately (to reduce VOC, HAP and PM 2.5 and criteria pollutants, avoiding combustion-related emissions), instead of being delayed until required by federal regulations in 2015.	
Ensure that State law and regulations set applicability thresholds for New Source and Prevention of Significant Deterioration (PSD) reviews at levels that will capture shale gas operations.	
Ensure that the state examines the potential impacts of shale gas development on forest fragmentation and on the public’s use and enjoyment of public lands in and near Cary.	
Examine the issue of "compulsory pooling" to determining whether the Town should attempt to influence State law on this question.	
<b>5.1.2 Recommendations regarding town ordinances and plans</b>	
Place a moratorium on shale gas development in the Town of Cary until requirements of State law and implementing regulations on are final and Town staff informs Town Council that (a) the impacts of these on the Town’s legal authorities and activities are known, and (b) changes have been made to Town ordinances and activities needed to reflect the requirements of State law and regulations.	
<b>5.1.3 Recommendations related to interaction with regional partners</b>	
Leverage the authority given to Wake County and Chatham County under state law in affecting the development of law and regulations on shale gas development.	
Request that Triangle J Council of Government establish a committee, with representation from each affected county and municipality, to ensure coordination of efforts among the counties and municipalities to mitigate the impacts of shale gas development.	
Determine Army Corp. of Engineer policies and plans regarding shale gas development in the Jordan Lake water supply watershed.	
Work with the Triangle J Council of Government to require the use of best management practices for storm water and stream buffers for all shale gas operations within the Jordan Lake watershed.	
<b>5.1.4 Recommendations regarding monitoring</b>	
Advocate for DNER to develop a network of monitoring stations to establish improved baselines for surface water, groundwater and air quality and to allow ongoing monitoring of the effects of shale gas operations.	
Examine the State’s air quality monitoring network to ensure that the ambient air quality monitoring program, after it is expanded to include Lee County, is adequate to address concerns about the impact of shale gas development in, or upwind of, the Town of Cary.	
Establish an EAB subcommittee to examine issues related to Jordan Lake watershed, including: (a) adequacy of water quality monitoring in Jordan Lake watershed to detect impacts on water quality related to shale gas development (including impacts on cumulative loadings, non-point inputs, and water treatment operations), and (b) impacts of water withdrawals for shale gas development on short- and long-term availability of water for the Town of Cary.	

# Recommendations Table

## 5.2 Longer-term actions, 1-3 Year Timeframe

<b>5.2.1 Recommendations regarding town ordinances and plans</b>
Examine current rules under the Town's police power authority to ensure that they are adequate to address odor, noise and light issues associated with shale gas operations and activities.
Begin the process of identifying protocols and limitations that should apply to the acceptance of shale gas wastewaters, including provisions related to dissolved solids and the presence of naturally occurring radioactive materials.
Consistent with existing permitting requirements covering similar activities, permits should be issued by the Town requiring the use of best management practices for storm water and stream buffers for shale gas operations within the Town.
Develop the ability to control and monitor spills and illegal discharges to the Town's POTW from shale gas operations and ancillary activities, if it is found that current approaches are inadequate.
Surface spraying of shale gas wastewaters should not be allowed in the Town of Cary or its ETJ.
Revise the Town's secondary and cumulative impacts master mitigation plan to include potential impacts of shale gas development.
Examine existing emergency response plans (e.g. Town of Cary Operations Plan) and related equipment and infrastructure to ensure they are adequate to address emergencies at shale gas operations and related activities. These plans should be coordinated to ensure effective response, as well as rapid communication, of emergencies to affected citizens (perhaps similar to the "Amber Alert" system).
Examine, within the context of the Water Resources Plan, the potential impact of shale gas development on Cary's future water supply.
The process of issuing special use permits for oil and gas development should include an assessment of the proximity of potentially exposed populations.
<b>5.2.2 Recommendations regarding studies and monitoring</b>
Work with other affected entities to examine the effects of shale gas-related withdrawals from Jordan Lake on the Town's current and future water supplies.
To better understand the magnitude of potential direct environmental exposures to parcels and populations within one kilometer of shale gas development, the Town should analyze locations, which have potential for shale gas development, such as large undeveloped parcels or large developed but under utilized parcels in or near Cary.
<b>5.2.3 Recommendations regarding interaction with regional partners</b>
Work to ensure that surface spraying of shale gas wastewaters is not allowed in jurisdictions adjacent to Cary or in the Jordan Lake water supply watershed.
Coordinate with adjacent jurisdictions and groups (e.g. Wake County Local Emergency Planning Committee) to examine the collective adequacy of existing emergency response plans and related equipment and infrastructure.
To limit potential exposure of Cary residents to releases to the environment from shale gas operations, jurisdictions adjacent to the Town of Cary should include an assessment of the proximity of potentially exposed populations when issuing permits to shale gas operations.

## Recommendations Table

### 5.3 Additional considerations regarding education, awareness and fiscal impacts that may require attention by other Town Boards, Commissions,

<p>Examine State law to determine whether current provisions regarding disclosure of conveyance of mineral rights are adequate. The Town may want to examine ways to ensure that current and prospective landowners understand the implications of separating subsurface mineral rights from surface rights on the ability to obtain mortgage funding. As a part of this, the Town may want to consider informing its citizens of the process for (a) discovering whether the land owner also owns the subsurface mineral rights and (b) how to obtain those rights. The Town may want to consider undertaking an analysis to identify those properties within the town limits where the subsurface mineral rights are not owned by the property owner and then alert the affected property owners</p>
<p>Consider a requirement that zoning/rezoning cases involving shale gas development include notification of all property owners within one kilometer (0.6 miles).</p>
<p>Consider a separate zoning/rezoning process within the LDO and comprehensive public engagement process for shale gas development activities similar to that for mixed use developments.</p>
<p>Fully understand the implications of an issue raised by the MEC Local Government Regulation Study Group: Local governments implementing a special use permitting program should be aware of the potential for land owner abuse of a “present use value” designation to avoid taxation on the production of subsurface resources.</p>
<p>Due to likelihood of increased truck and rail traffic, the Town’s transportation planners and engineers should consider a traffic impact analysis to identify needed transportation infrastructure improvements, including changes to height and weight limitations.</p>
<p>Conduct a study to determine the potential costs arising from the following activities involving the shale gas industry including options for recovering costs:</p> <ul style="list-style-type: none"><li>Transportation infrastructure upgrades &amp; repair</li><li>Waste handling</li><li>Hazmat training</li><li>Emergency response</li><li>Training of staff – inspectors/code compliance, public safety</li><li>Increase in local government personnel or overtime needed</li><li>Drinking water well testing</li></ul>

**Shale Gas Development (SGD)**  
**Subcommittee Report**  
*to the*  
Town of Cary  
Environmental Advisory Board (EAB)

*January 8, 2014*

**Shale Gas Development Subcommittee**

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# Chapter 1: Background on the Shale Gas Development (SGD) Subcommittee

## 1.0 Shale Gas Development (SGD) Subcommittee Authority and Limitations

In March 2012, The Cary Town Council directed staff to assemble a Shale Gas Development Task Force and directed that Task Force to “investigate and report back to Council the pros and cons and suggested actions the Town may take regarding shale gas development within the Cary town limits and/or extra-territorial jurisdiction (ETJ); and to include requests for recommendations from the Environmental Advisory Board (EAB) and the Economic Development Commission (EDC).” In August 2012, the Task Force submitted its final report to Town Council. The Task Force report included a recommendation that Town staff “*monitor legislative and rulemaking processes..., providing input to the various processes as appropriate, to protect the Town of Cary’s environmental, natural resource, town-provided services, and planning and zoning interests. The Town of Cary should also participate in regional study and work groups as needed to stay informed on shale gas activities, in coordination with neighboring communities, to remain aware of other potential impacts to Cary*”<sup>1</sup>

Recognizing the need to remain engaged in this issue, in February 2013, the Environmental Advisory Board (EAB) of the Town of Cary formed a six-member Shale Gas Development (SGD) Subcommittee. Ultimately, the SGD Subcommittee completed its work with four members, two of whom had also served on the earlier Task Force. The EAB tasked the subcommittee with the following work plan:

- Monitor and update the EAB about potential legislation
- Review, understand and report to the EAB potential risks to the Town
- Review, understand and report to the EAB potential risks to homeowners
- Make recommendations to the EAB about educating and communicating risks to the Town Council
- Make recommendations to the EAB about what the EAB can do to ensure shale gas development does not result in negative impacts to Cary’s quality of life, health and economy
- Make recommendations to the EAB about what the EAB can do to advise the Town Council and staff about potential approaches to address adverse consequences

In this report we, the members of the SGD Subcommittee, attempt to summarize information on the background, regulation and potential impacts of shale gas development, with an emphasis on the potential impacts on the Town of Cary. The report does not address a range of issues of broader societal importance not directly related to the Town of Cary. Such broader issues include, for instance, energy security issues and the impacts of shale gas on societal emissions of greenhouse gases. Nor does the

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<sup>1</sup> Town of Cary, August 2012, Shale Gas Development Task Force Final Report, available online at <http://www.townofcary.org/Assets/Council+Minutes/councilmin12/Shale+Gas+Development+Task+Force+-+7.30.12.pdf>

report attempt to address the economic benefits or costs to the Town, as this lies outside of the mandate of the EAB.

We have undertaken this task as volunteer citizens of the Town of Cary having an interest in, but lacking expert knowledge of, shale gas development. Given this and the limited time available to volunteers for such an activity, we recognize that this report is not comprehensive. Nonetheless, within these constraints, we have attempted to assemble and summarize information from credible and authoritative sources in a way that we hope will be useful to those wanting an understanding of this topic.

As a Subcommittee of the Environmental Advisory Board, we have developed a series of recommendations for consideration by that Board. We anticipate that these will be discussed by the EAB and a decision will be made as to which, if any, will become recommendations from the EAB to the Town Council.

In the course of this review, we have also identified a number of issues that fall outside of the purview of the EAB but may warrant attention by other Town Boards, Commissions and Committees and by Town Staff. These issues, however, are not the subject of our recommendations.

# Chapter 2: Background on Shale Gas Development

## 2.1 Shale Gas Development and Production: A Multistage Process

In the late 1940s, a process was developed to increase the yields of oil and gas wells by increasing the porosity of the area around the well. This process, “hydraulic fracturing” or “fracking,” involved pumping fluids at high pressure into the oil- or gas-bearing rock to create fractures, and flush the oil/gas out to the surface. It has become quite widespread in the recent years, especially due to technological advances made in both horizontal drilling as well as hydraulic fracturing. It is important to note that hydraulic fracturing and horizontal drilling are not the same processes, although both are usually used in shale gas development.

Shale gas development is a multistage process. It involves vertical drilling as well as horizontal drilling and hydraulic fracturing. The Michigan Oil & Gas Producers Education Foundation explains the process as follows.<sup>2</sup>

### Step 1: Vertical drilling

Following selection of a drilling location, a drill bit is mounted at the end of a drill pipe and drilling is begun vertically downwards. Cut pieces of rock from the drilling are continuously flushed to the surface by pumping cold mud into the drilling pipe. This helps keep the drilling path clear. Drilling continues until the drilled hole reaches just below the deepest layer of fresh water. The drill pipe and bit are then removed and surface casing is inserted into the hole to keep it separated from the fresh water aquifer. Cement is pumped in the casing, causing it to go down and out of the bottom end of the casing and then be forced up between the casing and the hole. When it hardens, the cement acts as a barrier between the wellbore and the aquifer. The drill pipe and bit are then lowered in the hole to continue drilling up to 500 feet above the planned horizontal drilling section. This depth, where the curve begins in order to be able to do horizontal drilling, is called “kick off” point.

### Step 2: Horizontal drilling

The drill pipe and the bit are pulled out of the hole. A different downward drilling motor is lowered to enable horizontal drilling. The curved drilling occurs over approximately one-quarter of a mile. The 90 degree curve allows horizontally drilling along the length of the seam. When the lateral target distance is reached, the drill and pipe are removed for the final time. Production casing is inserted into the full length of the wellbore. Cement is pumped into the casing, out of the end, and back between the casing and the walls of the hole. This secures the wellbore permanently to prevent any hydrocarbons from seeping out. The drilling rig is no longer needed and is removed. A temporary wellhead is installed on the well.

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<sup>2</sup> This material is from the Michigan Oil & Gas Producers Education Foundation website, <http://www.mogpef.org/>. A video on the website provides an animated description of the process.

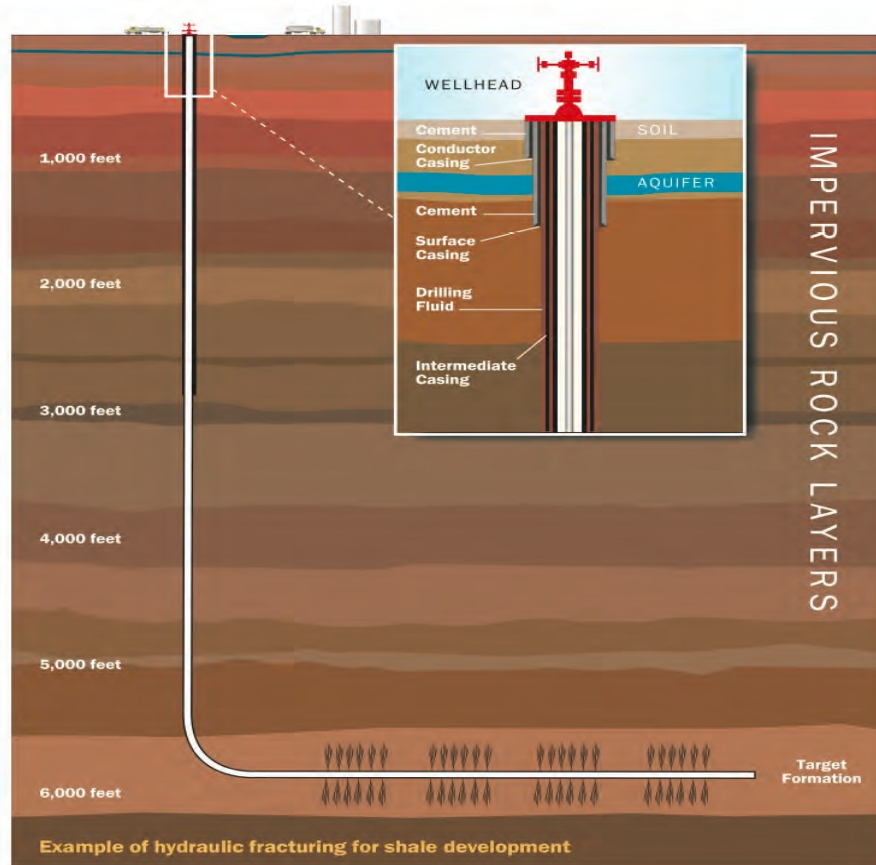


Fig 2.1: Diagrammatic representation of Steps 1 and 2 of Shale Gas Development<sup>3</sup>

### Step 3: Perforating and Fracking

Perforating the well, or “perforating” is a process wherein a gun is lowered into the horizontal portion of the well to shoot small holes through the well casing and the cement. It is then pulled out of the well. Hydraulic fracturing is the next step. A mixture of water, sand and chemicals is pumped at a very high pressure into the well. This fractures the rocks in the area surrounding the wellbore at points where holes had been perforated earlier on. Because water is used, the process is called hydraulic fracturing. The fractures provide a path for the shale gas to flow to the wellbore. Areas are temporarily plugged while other sections are similarly perforated, fractured and plugged. The process continues along the entire length of the horizontally bored well. On completion, plugs from all sections are drilled out and the gas is able to flow and travel up to the surface of the well. A permanent wellhead is then installed at the surface. A pipeline transports the gas to its destination. Figure 2.2 diagrammatically represents step 3.

<sup>3</sup> American Petroleum Institute. (n.d.). Example of horizontal wells, as cited in USGS. (2012). Map of Assessed Shale Gas in the United States, 2012. Retrieved September 10, 2013 from [http://pubs.usgs.gov/dds/dds-069/dds-069-z/DDS-69-Z\\_pamphlet.pdf](http://pubs.usgs.gov/dds/dds-069/dds-069-z/DDS-69-Z_pamphlet.pdf)

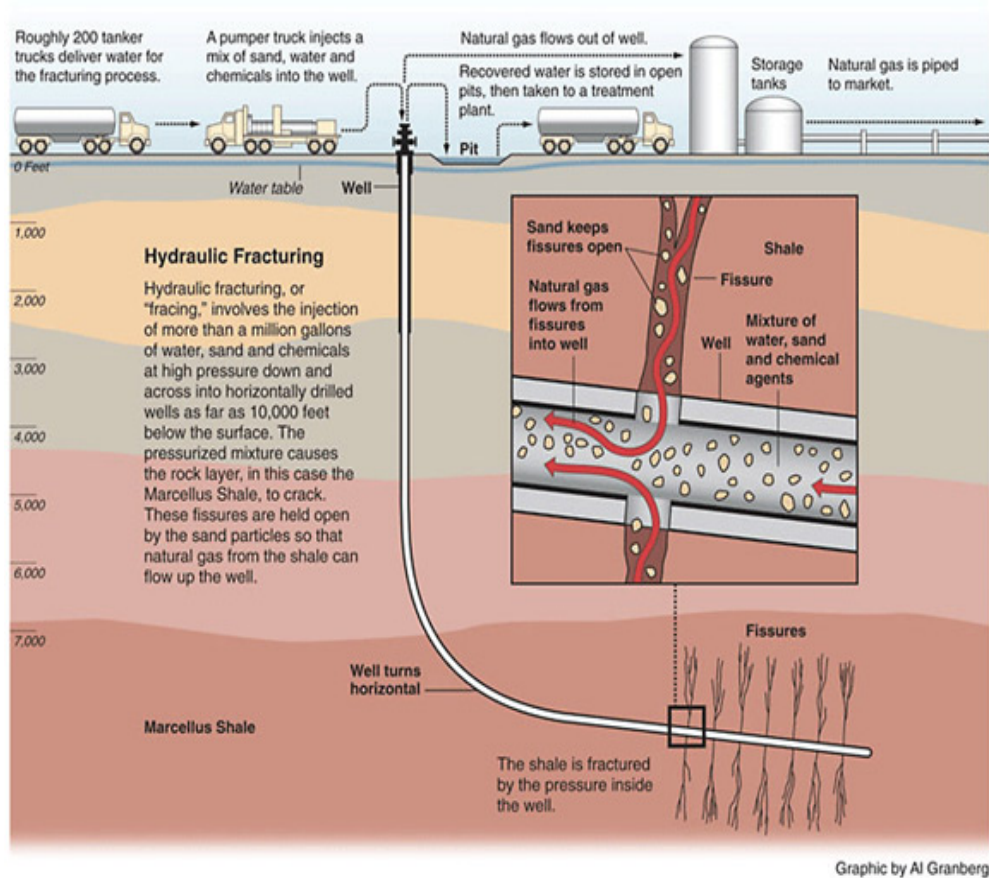


Figure 2.2: The fracking process<sup>4</sup>

## 2.2 Shale gas in the national context

Due to the technological advances in the past few years, shale gas development activities are now occurring in 32 states.<sup>5</sup> There are approximately 35,000 wells fractured in a given year with a total population of about 1 million wells. Over 50,000 well sites are registered with the *FracFocus*, the chemical disclosure registry.<sup>6</sup> In 2010, the states with the largest shale gas production were Texas, Louisiana, Arkansas and Oklahoma (Figure 2.3) and production in the Midwestern and Northeastern states was growing rapidly.

<sup>4</sup> Shale Stuff. (n.d.). Process of Fracking. Retrieved September 17, 2013, from <http://shalestuff.com/education/fracking/fracking>

<sup>5</sup> U.S. Energy Information Administration. (2011). Natural Gas Marketed Production, 2011 (million cu ft). Retrieved Sept 20, 2013, from <http://www.eia.gov/state/state-energy-rankings.cfm?keyid=29&orderid=1>

<sup>6</sup> GWPC and IOGCC (Ground Water Protection Council and Interstate Oil and Gas Compact Commission), (2013). A Historic Perspective. Retrieved Sept 20, 2013 from <http://fracfocus.org/hydraulic-fracturing-how-it-works/history-hydraulic-fracturing>

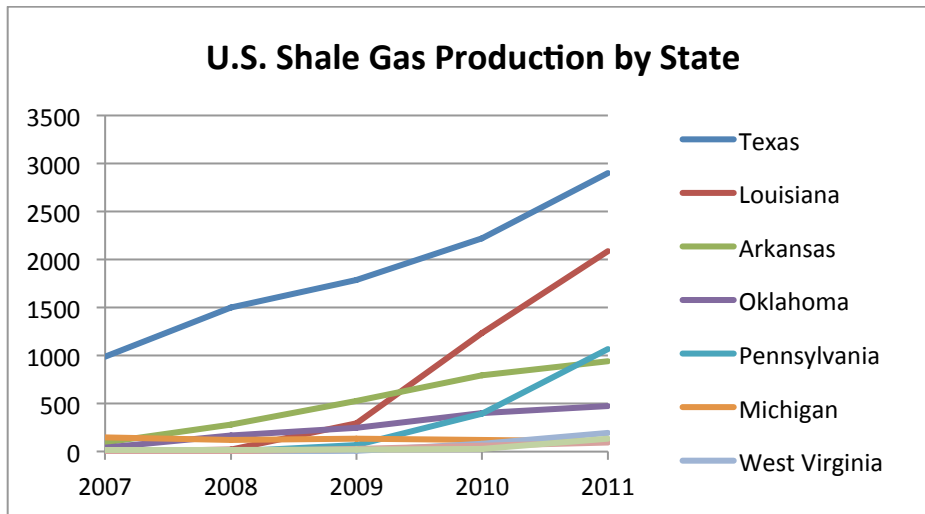


Figure 2.3. Shale gas production by State<sup>7</sup>

By 2011, shale gas production was contributing 30% of the total natural gas production in the country and its contribution was increasing rapidly (Figure 2.4).

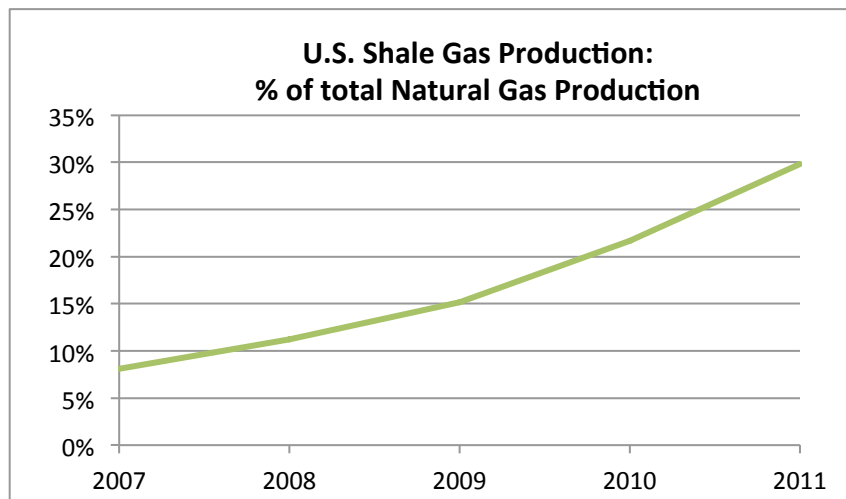


Figure 2.4. Percent contribution of shale gas to total U.S. natural gas production<sup>8</sup>

### 2.2.1 Natural gas liquids

Many shale gas wells produce a mixture of natural gas and natural gas liquids. The Congressional Research Service has pointed out that “[n]atural gas liquids (NGLs) have taken on a new prominence as shale gas production has increased and prices have fallen. NGL is a general term for all liquid products separated from natural gas at a gas processing plant and includes ethane, propane, butane, and

<sup>7</sup> Based on Data available at US Energy Information Administration. (2013, August 01). Data: Shale Gas Production. Retrieved October 08, 2013, from [http://www.eia.gov/dnav/ng/ng\\_prod\\_shalegas\\_sl\\_a.htm](http://www.eia.gov/dnav/ng/ng_prod_shalegas_sl_a.htm)

<sup>8</sup> Based on natural gas gross withdrawals data available at US Energy Information Administration. (2013, September 30). Natural Gas Gross Withdrawals and Production Data. Retrieved October 08, 2013, from [http://www.eia.gov/dnav/ng/ng\\_prod\\_sum\\_dc\\_u\\_NUS\\_a.htm](http://www.eia.gov/dnav/ng/ng_prod_sum_dc_u_NUS_a.htm)

pentanes.... Once the NGLs are removed from the methane the natural gas is referred to as “dry” gas, which is what most consumers use. Each NGL has its own market and its own value. As the price for dry gas has dropped because of the increase in supply and other reasons such as the warm winter of 2011, the natural gas industry has turned its attention to producing more wet gas in order to bolster the value they receive. Some companies have shifted their production portfolios to tight oil formations, such as the Bakken in North Dakota, to capitalize on the experience they gained in shale gas development. Historically, the individual NGL products have been priced against oil, and as oil prices have remained higher since 2005 relative to natural gas, it has driven an increase of wet gas production, thereby maintaining the amount of dry gas as a production “byproduct” despite its low price.”<sup>9</sup>

### 2.3 North Carolina State geology

It is important to understand the term “Basin” when studying shale gas geology. A basin is a “low area in the earth’s crust, formed by the warping of the crust from mountain building forces, in which sediments have accumulated.”<sup>10</sup> NC State has four basins exposed to the earth’s surface and estimated to be formed 235-200 million years ago in a period called the Triassic era. The Triassic period is one of the three time periods of a larger Mesozoic era (252- 66 million years ago). Hence, the four basins are often interchangeably called Triassic or Mesozoic Basins (Figure 2.5). The four basins are Deep River Basin, Dan River Basin, Davie Basin and Ellerbe Basin.

The Deep River Basin has the most promising shale gas potential in NC. It is also most relevant to the concerns of the Town of Cary due to its proximity to the town. The following material, therefore, is restricted to hydraulic fracturing in the Deep River Basin. The Deep River Basin can be divided into 3 sub-basins. Going from north to south these are the Durham sub-basin, the Sanford sub-basin, and the Wadesboro sub-basin (Figure 2.6). In terms of counties the basin runs across Durham, Orange, Wake, Chatham, Lee, Moore, Montgomery, Richmond, Anson in NC and Union counties in South Carolina.

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<sup>9</sup> Priog, R. & Ratner, M. (2012, November 06). Congressional Research Service Report - Natural Gas in the U.S. Economy: Opportunities for Growth. R42814. Retrieved October 03, 2013, from <http://www.fas.org/sgp/crs/misc/R42814.pdf>

<sup>10</sup> North Carolina Oil and Gas Study. (April 2012). Section 1- Potential Oil and Gas Resources. Retrieved September 09, 2013, from [http://portal.ncdenr.org/c/document\\_library/get\\_file?uuid=1d204fcb-719e-47b4-85c4-8e112b2a66b7&groupId=14](http://portal.ncdenr.org/c/document_library/get_file?uuid=1d204fcb-719e-47b4-85c4-8e112b2a66b7&groupId=14).



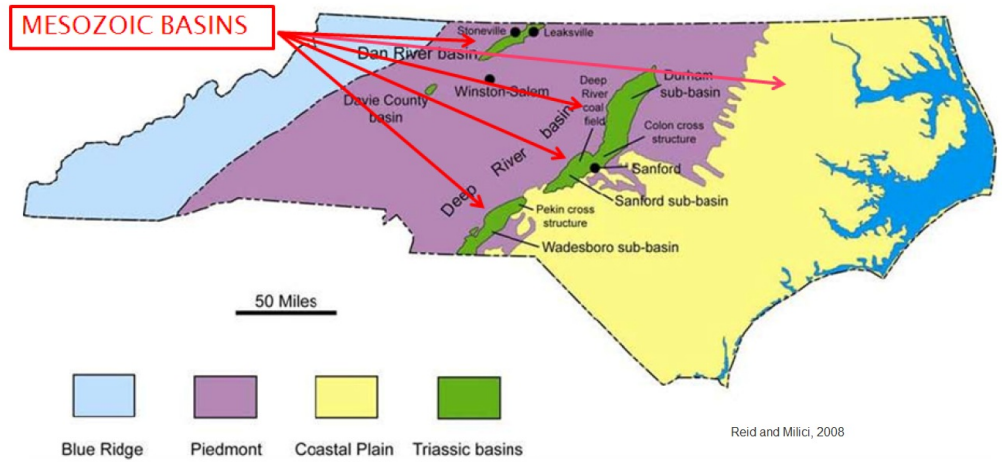


Figure 2.5: The four Mesozoic basins in NC<sup>11</sup>

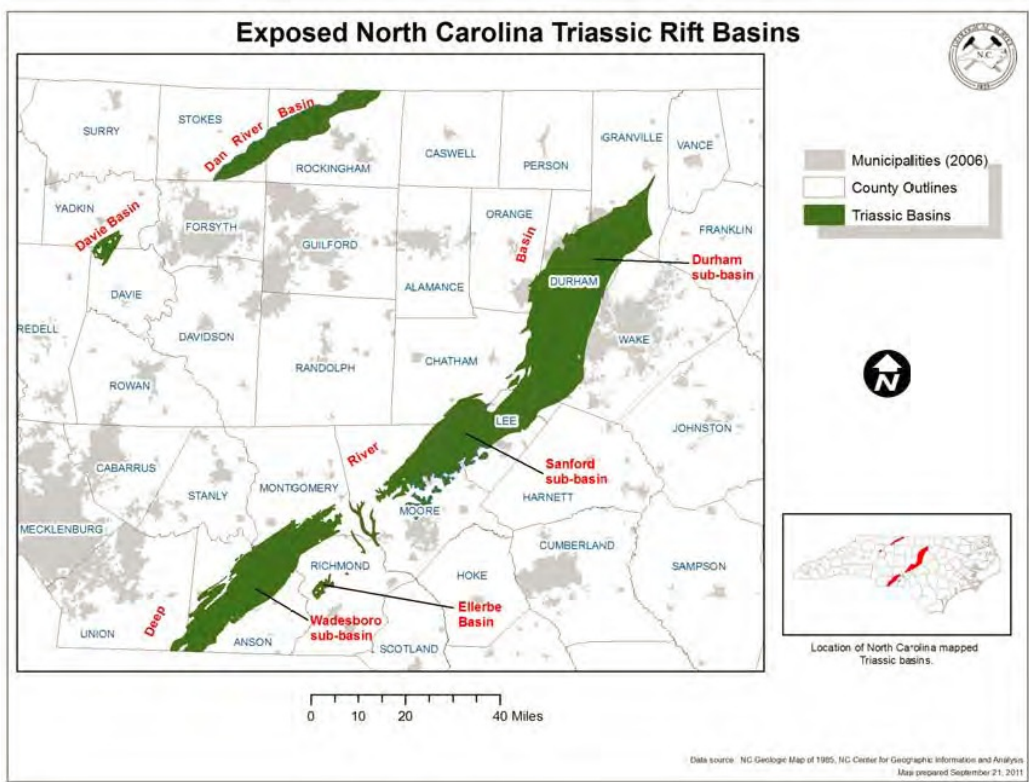


Figure 2.6: Exposed basins in NC<sup>12</sup>

Based on the available geological data, the Sanford sub-basin is the most promising area for shale gas extraction in the Deep River Basin. Shale can be found at depths ranging from 2,100-6,000 feet in this

<sup>11</sup> Reid, J. C. & Milici, R. (2008) as cited in <http://nc.water.usgs.gov/projects/shalegas/overview.html>

<sup>12</sup> NC Department of Environment and Natural Resources. (n.d.). Geologic Assessment Information. Retrieved September 16, 2013, from <http://www.ncdenr.gov/web/guest/geologic-assessment>

sub-basin<sup>13</sup> which has the Triassic strata as deep as 7000 feet. The thickness of the shale formation itself ranges from 180-540 feet and is estimated to have a maximum thickness of 800 feet. It is estimated that this 800 foot thick shale layer occurs at depths of less than 3000 feet and extends across 25,000 acres in the Sanford sub-basin. The geology of Sanford sub basin's Triassic strata is composed of roughly 3 different geological formations. The shale layer is a part of the Cumnock Formation in the Sanford sub-basin of Lee and Chatham counties.

Coal mining in Deep River Basin occurred from the 1920's until 1940's. In 1974, the first oil well was drilled in Lee County by Chevron. This was followed by more wells in later years by several different companies. In 1998, 2 wells (Simpson #1 and Butler # 3) were drilled hydraulically. The fracturing effort involved nitrogen foam and was unsuccessful in both wells although gas did flow from both. The wells were shut down immediately. In 2009 these were retested for gas pressure. The pressures were recorded at 50 per square inch (psi) and 900 psi for Simpson #1 and Butler # 3, respectively.

## 2.4 Potential Shale Gas reserves in NC

In 2008, North Carolina Geological Survey (NCGS) in an open file report identified the 800-foot thick organic rich sedimentary rock section of Cumnock formation as a potential source of natural gas.<sup>14</sup> That led to gas samples taken in 2009 from the 2 closed wells, Simpson #1 and Butler # 3. In 2009, the presence of shale gas reserves were announced in the Deep and Dan River Basins in 12 NC counties. The DENR then extrapolated the available limited gas estimates from the 2 wells to get a preliminary estimate of potential gas volume present in 59,000 acres of Sanford sub-basin in the Deep River Basin. It is estimated that there is 1546 bcgf (billion cubic feet) of gas-in-place, and assumed that only 20% of the gas is recoverable,<sup>15</sup> resulting in an estimate of total technically recoverable gas volume of 309 bcgf. Assuming an average well spacing of 160 acres in the Sanford sub-basin, DENR then estimated that there would be 368 wells each producing 840 million cubic feet of gas.<sup>16</sup>

DENR sent these estimates to the U.S. Geological Survey (USGS) for a second opinion in 2011. In 2012 USGS estimated there is a 95% chance that that Deep River Basin has at least 779 bcgf of technically recoverable gas, with a mean estimate of 1660 bcgf of gas.<sup>17</sup> This is a 5.6-year supply for NC based on 2010 gas demand.<sup>18</sup> It is further estimated that 83 million barrels of natural gas liquids are present in the

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<sup>13</sup> North Carolina Oil and Gas Study. (April 2012). Executive Summary. Retrieved September 09, 2013 from [http://portal.ncdenr.org/c/document\\_library/get\\_file?uuid=a4546484-3b9c-4feb-90ef-ef29b8f337b2&groupId=14](http://portal.ncdenr.org/c/document_library/get_file?uuid=a4546484-3b9c-4feb-90ef-ef29b8f337b2&groupId=14)

<sup>14</sup> North Carolina Oil and Gas Study. (April 2012). Section 1- Potential Oil and Gas Resources. Retrieved September 09, 2013 from [http://portal.ncdenr.org/c/document\\_library/get\\_file?uuid=1d204fcb-719e-47b4-85c4-8e112b2a66b7&groupId=14](http://portal.ncdenr.org/c/document_library/get_file?uuid=1d204fcb-719e-47b4-85c4-8e112b2a66b7&groupId=14).

<sup>15</sup> "Technically recoverable gas is gas (both discovered and undiscovered) that can be recovered with the available technology, irrespective of economics involved." Gas reservoir indicates total volume of gas available in a reservoir, regardless of the ability to extract it.

<sup>16</sup> North Carolina Oil and Gas Study. (April 2012). Section 1- Potential Oil and Gas Resources. Retrieved September 09, 2013 from [http://portal.ncdenr.org/c/document\\_library/get\\_file?uuid=1d204fcb-719e-47b4-85c4-8e112b2a66b7&groupId=14](http://portal.ncdenr.org/c/document_library/get_file?uuid=1d204fcb-719e-47b4-85c4-8e112b2a66b7&groupId=14)

<sup>17</sup> USGS. Assessment of Undiscovered Oil and Gas Resources of the East Coast Basins of the Piedmont, Blue Ridge Thrust Belt, Atlantic Coastal Plain, and New England Provinces, 2011. Reston, VA: U.S. Geological Survey, U.S. Department of the Interior (2012). Retrieved September 08, 2013 from <http://pubs.usgs.gov/fs/2012/3075/fs2012-3075.pdf>

<sup>18</sup> Shale Gas News Releases. (2012, 06 June). Statement on Release of U.S. Geological Survey Assessment of North Carolina Oil and Gas Resources. Retrieved September 11, 2013 from <http://portal.ncdenr.org/web/opa/shale-gas->

basin (mean estimate). NC shale formations occur in ancient fresh water environments,<sup>19</sup> while most US shale plays have developed in ancient marine environments. The significance of this is to the shale gas production process, as well as the environmental impacts of materials removed from the well along with natural gas, such as drill cuttings and wastewater, is not known.<sup>20</sup>

## 2.5 Shale Gas Development in Cary

In recent years, shale gas development via horizontal drilling and hydraulic fracturing has become a matter of public concern. In communities where it has occurred there have been reports of wide range of adverse impacts on the local environment, economy, infrastructure, and quality of life. (These impacts are explored in Chapter 4 of this report.) Figure 2.7 indicates several parts of west Cary are within the Sanford Sub-basin where shale gas has been projected to exist.

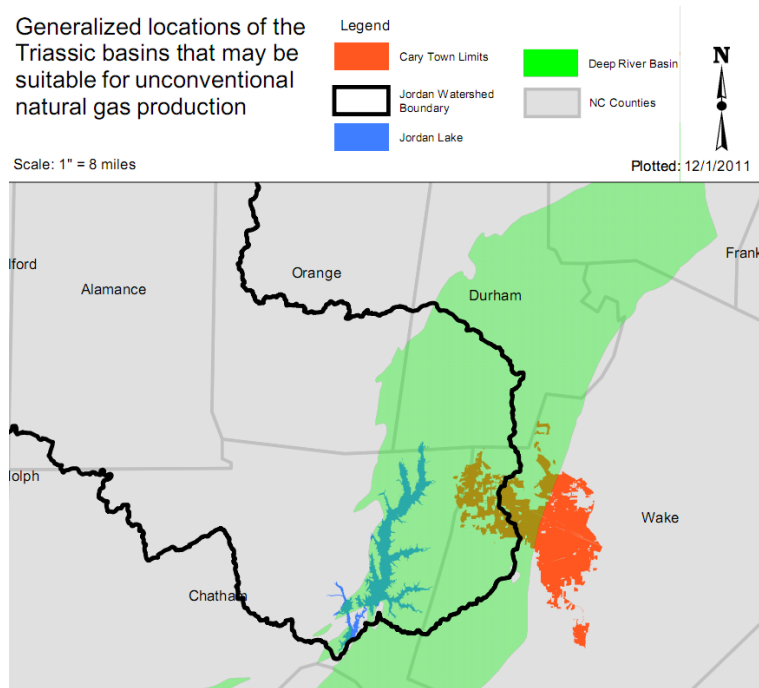


Figure 2.7 Location of the Deep River basin and the Town of Cary<sup>21</sup>

[news-releases/-/asset\\_publisher/Uj51/content/statement-on-release-of-u-s-geological-survey-assessment-of-north-carolina-oil-and-gas-resources?redirect=%2Fweb%2Fopa%2Fshale-gas-news-releases](#)

<sup>19</sup> Reid, J.C., Taylor, K.B., Olson, P.E., & Patterson, O.F. (2011). Natural GAS Potential of the Sanford Sub-basin, Deep River Basin, North Carolina. Search and Discovery Article # 10366. Retrieved September 11, 2013 from [http://www.searchanddiscovery.com/documents/2011/10366reid/ndx\\_reid.pdf](http://www.searchanddiscovery.com/documents/2011/10366reid/ndx_reid.pdf)

<sup>20</sup> Ibid as cited in Adair, S.K., Pearson, B.R., Monast, J., Vengosh, A., & Jackson, R.B. (2012). Considering Shale Gas Extraction in North Carolina: lessons from other states. Retrieved September 25, 2013, from <http://scholarship.law.duke.edu/cgi/viewcontent.cgi?article=1232&context=delpf>

<sup>21</sup> Town of Cary Staff Report PWUT12-16, Report on Activities of the Shale Gas Development Task force, March 13, 1012

# Chapter 3: Law and Regulations Affecting Shale Gas Development

## 3.1 Federal Law and Regulations

Natural gas operations are covered by a number of Federal laws and EPA regulations. The list below is likely not complete and the summaries are not intended to be comprehensive, however this is an extensive list of some of the pertinent regulations.

EPA has a website dedicated to providing information about Hydraulic Fracturing, including the current scientific knowledge, regulations and protections in place for known risks, assuring compliance, and promoting transparency and outreach.<sup>22</sup> Much of the following material is based on the information from EPA (2000).<sup>23</sup> Where the material is based on updated information from other sources, those sources are identified.

### 3.1.1 Clean Air Act

#### 3.1.1.1 Greenhouse Gas Emissions Reporting Program:<sup>24</sup>

In November, 2010, the U.S. EPA finalized rules expanding EPA's Mandatory Greenhouse Gas Reporting Rule to include shale gas operations in 40 CFR 98, Subpart W. The rule requires petroleum and natural gas facilities with 25,000 metric tons or greater of carbon dioxide equivalent emissions per year to report (1) annual CH<sub>4</sub> and CO<sub>2</sub> emissions from equipment leaks and venting; (2) emissions of CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O from gas flaring; (3) combustion emissions of CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O from stationary and portable equipment at onshore petroleum and natural gas production facilities; and (4) combustion emissions of CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O from stationary natural gas distribution equipment.

#### 3.1.1.2 Criteria air pollutants:

Among the emissions from shale gas operations are substances called criteria pollutants. Criteria pollutants have national ambient air quality standards attached to them. The controls required for these pollutants will vary depending on what is needed in a specific location. The controls required on criteria air pollutants can be more restrictive than New Source Performance Standards if needed to meet ambient air quality standards. EPA provides the following description of criteria pollutants and the national ambient air quality standards applying to them.

“The Clean Air Act, which was last amended in 1990, requires EPA to set National Ambient Air Quality Standards (40 CFR part 50) for pollutants considered harmful to public health and the environment. The Clean Air Act identifies two types of national ambient air quality standards. Primary standards provide public health protection, including protecting the health of "sensitive" populations such as asthmatics, children,

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<sup>22</sup> EPA Website on Natural Gas Extraction – Hydraulic Fracturing <http://www2.epa.gov/hydraulicfracturing>, accessed December 2013

<sup>23</sup> EPA (2000) EPA Office of Compliance Sector Notebook Project: Profile of the Oil and Gas Extraction Industry, EPA/310-R-99-006, October 2000

<sup>24</sup> USEPA Greenhouse Gas Reporting Program website, <http://www.epa.gov/ghgreporting/index.html>, accessed December 2013

and the elderly. Secondary standards provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings.”

“EPA has set National Ambient Air Quality Standards for six principal pollutants, which are called "criteria" pollutants. They are listed below. Units of measure for the standards are parts per million (ppm) by volume, parts per billion (ppb) by volume, and micrograms per cubic meter of air (µg/m<sup>3</sup>).”<sup>25</sup>

The current standards are shown in the following table.<sup>26</sup>

Table 3.1 Ambient air quality standards for criteria pollutants

Pollutant [final rule cite]	Primary/ Secondary	Averaging Time	Level	Form	
<a href="#">Carbon Monoxide</a> [76 FR 54294, Aug 31, 2011]	primary	8-hour	9 ppm	Not to be exceeded more than once per year	
		1-hour	35 ppm		
<a href="#">Lead</a> [73 FR 66964, Nov 12, 2008]	primary and secondary	Rolling 3 month average	0.15 µg/m <sup>3</sup> <sup>(4)</sup>	Not to be exceeded	
<a href="#">Nitrogen Dioxide</a> [75 FR 6474, Feb 9, 2010] [61 FR 52852, Oct 8, 1996]	primary	1-hour	100 ppb	98th percentile, averaged over 3 years	
	primary and secondary	Annual	53 ppb <sup>(2)</sup>	Annual Mean	
<a href="#">Ozone</a> [73 FR 16436, Mar 27, 2008]	primary and secondary	8-hour	0.075 ppm <sup>(3)</sup>	Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years	
<a href="#">Particle Pollution</a> Dec 14, 2012	PM <sub>2.5</sub>	primary	Annual	12 µg/m <sup>3</sup>	
		secondary	Annual	15 µg/m <sup>3</sup>	
	PM <sub>10</sub>	primary and secondary	24-hour	35 µg/m <sup>3</sup>	98th percentile, averaged over 3 years
		primary and secondary	24-hour	150 µg/m <sup>3</sup>	Not to be exceeded more than once per year on average over 3 years
<a href="#">Sulfur Dioxide</a> [75 FR 35520, Jun 22, 2010] [38 FR 25678, Sept 14, 1973]	primary	1-hour	75 ppb <sup>(4)</sup>	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years	
	secondary	3-hour	0.5 ppm	Not to be exceeded more than once per year	

Areas not meeting air quality standards are called “non-attainment areas”. Wake County is currently meeting ambient air quality standards, but in 2004, 2005 and 2006 the County was non-attainment for ozone, and in 1992, 1993, and 1994 was non-attainment for carbon monoxide.<sup>27</sup>

EPA states that;

“States are required to adopt enforceable plans<sup>28</sup> to achieve and maintain air quality meeting the air quality standards. State plans also must control emissions that drift across state lines and harm air quality in downwind states.

<sup>25</sup> USEPA National Ambient Air Quality Standards (NAAQS) web site, <http://www.epa.gov/air/criteria.html>, accessed Nov. 21, 2013

<sup>26</sup> USEPA National Ambient Air Quality Standards (NAAQS) web site, <http://www.epa.gov/air/criteria.html>, accessed Nov. 21, 2013

<sup>27</sup> USEPA Nonattainment Status for Each County by Year for North Carolina website, [http://www.epa.gov/airquality/greenbk/anay\\_nc.html](http://www.epa.gov/airquality/greenbk/anay_nc.html), accessed Nov. 21, 2013

<sup>28</sup> These are called State Implementation Plans, or SIPs

Other key provisions are designed to minimize pollution increases from growing numbers of motor vehicles, and from new or expanded industrial plants. The law calls for new stationary sources (e.g., power plants and factories) to use the best available technology, and allows less stringent standards for existing sources.”<sup>29</sup>

In non-attainment areas or in places where new sources could affect non-attainment areas, sources are subject to a Prevention of Significant Deterioration (PSD) review. Shale gas operations that met the applicability thresholds in the law would be subject to this review. EPA describes the PSD review process as follows.

“It requires the following:

1. installation of the "Best Available Control Technology (BACT)";
2. an air quality analysis;
3. an additional impacts analysis; and
4. public involvement.

...PSD does not prevent sources from increasing emissions. Instead, PSD is designed to:

1. protect public health and welfare;
2. preserve, protect, and enhance the air quality in national parks, national wilderness areas, national monuments, national seashores, and other areas of special national or regional natural, recreational, scenic, or historic value;
3. insure that economic growth will occur in a manner consistent with the preservation of existing clean air resources; and
4. assure that any decision to permit increased air pollution in any area to which this section applies is made only after careful evaluation of all the consequences of such a decision and after adequate procedural opportunities for informed public participation in the decision making process.

...BACT is an emissions limitation which is based on the maximum degree of control that can be achieved. It is a case-by-case decision that considers energy, environmental, and economic impact. BACT can be add-on control equipment or modification of the production processes or methods. This includes fuel cleaning or treatment and innovative fuel combustion techniques. BACT may be a design, equipment, work practice, or operational standard if imposition of an emissions standard is infeasible.

...The main purpose of the air quality analysis is to demonstrate that new emissions emitted from a proposed major stationary source or major modification, in conjunction with other applicable emissions increases and decreases from existing sources, will not cause or contribute to a violation of any applicable NAAQS or PSD increment.

Generally, the analysis will involve (1) an assessment of existing air quality, which may include ambient monitoring data and air quality dispersion modeling results, and (2)

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<sup>29</sup> USEPA Clean Air Act Requirements and History website, <http://www.epa.gov/air/caa/requirements.html>, accessed Nov. 21, 2013

predictions, using dispersion modeling, of ambient concentrations that will result from the applicant's proposed project and future growth associated with the project.”<sup>30</sup>

**3.1.1.3 New Source Performance Standards (NSPS):**

In 2012, EPA issued modified NSPS for the oil and gas industry. Under the new regulations, among other things, beginning in January 2015, “green completions” (also called reduced emission completions or RECs) will be required of new shale gas wells. Until then, fractured and refractured wells must reduce their emissions by routing the flows to combustion devices (flares). Both the green completion and flaring requirements are expected to reduce emissions of volatile organic compounds, a group of chemicals that includes most of the hazardous air pollutants associated with shale gas development, by 95%.<sup>31 32</sup> The requirements of the updated NSPS are summarized in Table 3.1.

Table 3.2 Summary of NSPS requirements for oil and gas production operations<sup>33</sup>

Affected facility	Pollutant	Standard	Compliance dates
Hydraulically fractured wildcat and delineation wells.	VOC .....	Route flowback emissions to completion combustion device.	October 15, 2012.
Hydraulically fractured low pressure wells, non-wildcat and non-delineation wells.	VOC .....	Route flowback emissions to completion combustion device.	October 15, 2012.
All other hydraulically fractured gas wells .....	VOC .....	Route flowback emissions to completion combustion device.	Prior to January 1, 2015.
All other hydraulically fractured gas wells .....	VOC .....	Use REC and route flowback emissions to completion combustion device.	On or after January 1, 2015.
Centrifugal compressors with wet seals .....	VOC .....	Reduce emissions by 95 percent .....	October 15, 2012.
Reciprocating compressors .....	VOC .....	Change rod packing after 26,000 hours or after 36 months.	October 15, 2012.
Continuous bleed natural gas-driven pneumatic controllers at natural gas processing plants.	VOC .....	Natural gas bleed rate of zero .....	October 15, 2012.
Continuous bleed natural gas-driven pneumatic controllers with a bleed rate greater than 6 scfh between wellhead and natural gas processing plant or oil pipeline.	VOC .....	Natural gas bleed rate less than 6 scfh .....	October 15, 2013.
Storage vessels with VOC emissions equal to or greater than 6 tpy.	VOC .....	Reduce emissions by 95 percent .....	October 15, 2013.
Equipment leaks at onshore natural gas processing plants.	VOC .....	LDAR program .....	October 15, 2012.
Sweetening units at onshore natural gas processing plants.	SO <sub>2</sub> .....	Reduce SO <sub>2</sub> emissions based on sulfur feed rate and sulfur content of acid gas.	October 15, 2012.

**3.1.1.4 Emissions of Hazardous Air Pollutants (HAPs) and National Emission Standards for Hazardous Air Pollutants (NESHAP):**

EPA must set NESHAPs for emissions of air toxics, also called hazardous air pollutants. Air toxics are pollutants known or suspected of causing cancer and other serious health effects. These standards apply to existing and new sources. In 2012, in conjunction with the updated NSPS, EPA issued updated NESHAPs

<sup>30</sup> USEPA Prevention of Significant Deterioration (PSD) Basic Information website, <http://www.epa.gov/NSR/psd.html>, accessed on Nov. 21, 2013

<sup>31</sup> EPA (2012) EPA’s Air Rules for the Oil & Natural Gas Industry: Summary of Key Changes to the New Source Performance Standards. Available at <http://www.epa.gov/airquality/oilandgas/pdfs/20120417changes.pdf>

<sup>32</sup> EPA (2012) Oil and Natural Gas Sector: New Source Performance Standards and National Emission Standards for Hazardous Air Pollutants Reviews; Final Rule - 40 CFR Parts 60 and 63, Federal Register Vol. 77, No. 159, August 16, 2012

<sup>33</sup> EPA (2012) Oil and Natural Gas Sector: New Source Performance Standards and National Emission Standards for Hazardous Air Pollutants Reviews; Final Rule - 40 CFR Parts 60 and 63, Federal Register Vol. 77, No. 159, August 16, 2012

for oil and gas (including shale gas) operations. The NESHAP in place before this was issued in 1999 and covered a number of emissions sources at gas production operations. EPA describes these earlier requirements as calling for “the application of maximum achievable control technology (MACT) in order to reduce the emissions of hazardous air pollutants (HAP) at facilities classified as major sources. The primary HAPs released by the industry are benzene, toluene, ethyl benzene, and mixed xylenes (BTEX) and n-heptane. The technology requirements involve the following emission points: process vents on glycol dehydration units, storage vessels with flash emissions, and equipment leaks at natural gas processing plants. Additional requirements include the installation of air emission control devices, and adherence to test methods and procedures, monitoring and inspection requirements, and recordkeeping and reporting requirements.”<sup>34</sup>

In the 2012 updated NESHAP, EPA established emission limits for certain emission points not regulated under the earlier regulations. These limits again reflect maximum achievable control technology (MACT).<sup>35</sup> It is also important to note that there are important co-benefits with respect to HAP reduction attached to the NSPS (described above) promulgated by EPA at the same time as the updated NESHAP. The HAPs likely to be present in emissions from oil and gas operations are likely to be reduced by NSPS technologies by approximately the same amount as overall volatile organic compounds (VOCs) are reduced (i.e. by 95%).

### 3.1.2 Clean Water Act

#### 3.1.2.1 National effluent limitation guidelines:

National effluent limitations guidelines for onshore oil and natural gas production facilities prohibit the discharge of water pollutants from any source associated with production, field exploration, drilling, well completion, or well treatment (40 CFR Part 435.30). In specific, the rules state that “Except as provided in §§ 125.30 through 125.32 [which allow for variances for facilities that can demonstrate that they are fundamentally different from those for which the rule was developed], any existing point source subject to this subpart shall achieve the following effluent limitations representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available (BPT): there shall be no discharge of waste water pollutants into navigable waters from any source associated with production, field exploration, drilling, well completion, or well treatment ( i.e. , produced water, drilling muds, drill cuttings, and produced sand).” (see 40 CFR 435.32) EPA has noted that “[d]uring the issuance process for the guidelines, EPA identified different technologies that operators can use to comply with this technology-based regulation (e.g., underground injection, use of pits/ponds for evaporation).”<sup>36</sup>

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<sup>34</sup> EPA (2000) EPA Office of Compliance Sector Notebook Project: Profile of the Oil and Gas Extraction Industry, EPA/310-R-99-006, October 2000

<sup>35</sup> EPA (2012) Oil and Natural Gas Sector: New Source Performance Standards and National Emission Standards for Hazardous Air Pollutants Reviews; Final Rule - 40 CFR Parts 60 and 63, Federal Register Vol. 77, No. 159, August 16, 2012

<sup>36</sup> EPA (2011) Answers to Frequently Asked Questions: Attachment to memorandum from James Hanlon, Director of EPA’s Office of Wastewater Management to the EPA Regions titled, “Natural Gas Drilling in the Marcellus Shale under the NPDES Program” March 16, 2011. Available at <http://cfpub.epa.gov/npdes/hydrofracturing.cfm>



### ***3.1.2.2 Pretreatment requirements for wastewater taken to publically owned treatment works (POTWs):***

Current Federal regulations do not include pretreatment standards for shale gas wastewaters taken to publically owned treatment works (POTWs). However, in addressing questions on this topic in the context of shale gas development in the Marcellus deposits, EPA explained the following.<sup>37</sup>

“EPA’s General Pretreatment regulations prohibit the introduction of wastewater into a POTW in certain defined circumstances, including the introduction of any pollutants which ‘pass through’ or cause ‘interference’ with POTW operations. 40 CFR Part 403.3(k)(1) defines interference as inhibiting or disrupting the POTW, its treatment processes or operations, or its sludge processes, use or disposal. Therefore, in addition to prohibiting the introduction of pollutants into the POTW that would disrupt the treatment process, the general regulations also prohibit the introduction of pollutants in concentrations that contaminate biosolids and make them inconsistent with the POTW’s chosen method of use or disposal. Pass through is defined at 40 CFR 403.3(p) to mean ‘a discharge which exits the POTW into waters of the United States in quantities or concentrations which, alone or in conjunction with a discharge or discharges from other sources, is a cause of a violation of any requirement of the POTW’s NPDES permit (including an increase in the magnitude of a violation)...’

...POTWs must provide adequate notice to [EPA and/or the state NPDES permitting/pretreatment authority] of ...any substantial change in the volume or character of pollutants being introduced into that POTW by a source introducing pollutants into the POTW at the time of issuance of the [POTW’s] permit...

...To the extent that a permit so requires, when considering the acceptance of such wastewater, a POTW needs to collect information from the industry on the quality and quantity of the shale gas extraction (SGE) wastewater proposed to be introduced to the POTW and assess the potential impact to the POTW if the POTW were to accept the wastewater. For SGE wastewater, that discharge characterization should include the concentrations of total dissolved solids, specific ions, such as chlorides and sulfate, specific radionuclides, metals, and other pollutants that could reasonably be expected to be present in wastewater from a well. In addition to the ions, radionuclides, and metals that can be expected to be present in wastewater produced from a well, the characterization should include all chemicals used in well drilling, completions, treatment, workover, or production, that could reasonably be expected to be present in wastewater. Pursuant to the permit, this information must generally be reported to EPA and/or the State program before the POTW may accept the hydraulic fracturing flowback water (HFFW)...

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<sup>37</sup> EPA (2011) Answers to Frequently Asked Questions: Attachment to memorandum from James Hanlon, Director of EPA’s Office of Wastewater Management to the EPA Regions titled, “Natural Gas Drilling in the Marcellus Shale under the NPDES Program” March 16, 2011. Available at <http://cfpub.epa.gov/npdes/hydrofracturing.cfm>

...Because there is a significant possibility that SGE wastewater may ‘pass through’ the POTW, causing the POTW to violate its permit, cause ‘interference’ with the POTW’s operation, or contamination of biosolids, acceptance of the waste is not advisable unless it’s effects on the treatment system are well understood and the wastewater is not reasonably expected to cause pass through or interference....

...Radionuclides in Marcellus SGE wastewater also pose a challenge for POTWs ....

...Appropriate limits and pretreatment requirements will need to be developed by the permitting authority and the pretreatment control authority....”

### **3.1.2.3 Stormwater:**

EPA has stated the following regarding the federal regulation of storm water discharges from shale gas operations<sup>38</sup>.

“...In general, [EPA] may not require a permit for discharges of storm water runoff from any field activities or operations associated with oil and gas exploration, production, processing, or treatment operations or transmission facilities, including activities necessary to prepare a site for drilling and for the movement and placement of drilling equipment, whether or not such field activities or operations may be considered to be construction activities...<sup>39</sup>

...While oil and gas-related construction is subject to the conditional exemption, operators should still implement best management practices when undertaking earth disturbing activities to prevent discharging pollutants, including sediment, that would cause or contribute to water quality violation, and which would trigger storm water permitting requirements.”

The exclusion from EPA storm water discharge permits suggests the need for attention to storm water issues by state and local governments.

### **3.1.2.4 Spill Prevention Control and Countermeasure Plans (SPCC):**

SPCC requirements are intended to address spills of oil onto surface waters. A facility is subject to SPCC requirements if it meets the following specifications applying to oil and gas operations<sup>40</sup>.

“A facility is SPCC-regulated if the facility, due to its location, could reasonably be expected to discharge oil into or upon the navigable waters of the United States or

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<sup>38</sup> EPA (2011) Answers to Frequently Asked Questions: Attachment to memorandum from James Hanlon, Director of EPA’s Office of Wastewater Management to the EPA Regions titled, “Natural Gas Drilling in the Marcellus Shale under the NPDES Program” March 16, 2011. Available at <http://cfpub.epa.gov/npdes/hydrofracturing.cfm>

<sup>39</sup> In spite of the conditional exemption, there are certain circumstances where permits may be required, primarily where there have been discharges of oil or hazardous substances or where the facility contributes to a violation of a water quality standard. See CFR 122.26(c)(1)(iii) for detail.

<sup>40</sup> EPA (2000) EPA Office of Compliance Sector Notebook Project: Profile of the Oil and Gas Extraction Industry, EPA/310-R-99-006, October 2000

adjoining shorelines, and the facility meets one of the following criteria regarding oil storage: (1) the capacity of any aboveground storage tank exceeds 660 gallons, or (2) the total aboveground storage capacity exceeds 1,320 gallons, or (3) the underground storage capacity exceeds 42,000 gallons..

...All facilities subject to SPCC requirements must prepare a site-specific spill prevention plan that incorporates requirements specified in 40 CFR Part 112.7. For production facilities, these include considerations for the following processes and procedures:

- Drainage Tank materials
- Secondary containment
- Visual inspection of tanks
- Fail-safe engineering methods for tank battery installations
- Tank repair and maintenance
- Facility transfer operations
- Inspection and testing measures
- Record-keeping
- Security
- Personnel training...

...A portion of SPCC-regulated facilities may also be subject to Facility Response Planning (FRP) requirements if they pose a threat of 'substantial harm' to navigable waters. The determination of a 'substantial harm' facility is made on the basis of meeting either of two sets of criteria – one involving transfer over water, and the other involving oil storage capacity or other factors. If the facility were subject to FRP requirements, it would be required to develop a facility response plan which would involve, among other requirements, identification of small, medium and worst-case discharge scenarios and response actions; a description of discharge detection procedures and equipment; detailed implementation plans for containment and disposal; diagrams of facility and surrounding layout, topography, and evacuation paths; and employee training, exercises, and drills.”

Regarding natural gas operations in specific, EPA states the following<sup>41</sup>.

“Following are five example scenarios of facilities that are involved in producing or treating natural gas and how the SPCC rule would apply for each. Each of these scenarios is hypothetical and is not intended to provide a policy interpretation for any specific existing facility.

#### Scenario A. Oil and Gas Production Facility

The wellhead at this type of facility produces a mixture of oil, gas, and produced water. Because this facility produces oil from the wellhead, it is considered an oil

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<sup>41</sup> EPA SPCC Guidance for Regional Inspectors, Chapter 2, August 28, 2013, Available at [http://www.epa.gov/oem/docs/oil/spcc/guidance/2\\_Applicability.pdf](http://www.epa.gov/oem/docs/oil/spcc/guidance/2_Applicability.pdf)

production facility according to the SPCC rule and must comply with the requirements at §112.9...

#### Scenario B. 'Wet Gas' Production Facility

The wellhead at this type of facility produces a mixture of gas, produced water, and condensate. Condensate that is liquid at atmospheric pressures and temperatures is considered an oil, and the facility could be subject to the SPCC rule if it meets the SPCC rule applicability criteria. Because the facility produces oil, this facility is considered an oil production facility and must comply with the requirements at §112.9 if subject to the SPCC rule...

#### Scenario C. 'Dry Gas' Production Facility

The wellhead at this facility produces a mixture of gas and produced water only. A dry gas production facility that produces natural gas from a well (or wells) but does not also produce condensate or crude oil that can be drawn off the tanks, containers, or other production equipment at the facility is not subject to the SPCC rule...

#### Scenario D. Gas Processing/Treatment Facility/Plant

This type of facility receives gas after it is separated from oil and produced water. The gas typically contains condensate, which is removed from the gas stream at this facility. Petroleum distillate that is produced by natural gas wells and stored at atmospheric pressures and temperatures is considered an oil. If the total aboveground storage capacity for condensate tanks and all other ancillary oil storage is greater than 1,320 gallons, and the facility otherwise meets the applicability of the rule, then this facility is considered a bulk storage facility subject to the requirements under §112.8...

However, when gas plant or compression activities are co-located at an SPCC-regulated oil production facility with a tank battery, then the containers associated with gas separation that store or process oil (i.e., separation vessels containing oil/liquid condensate) are typically considered part of the oil production facility operations and therefore subject to the onshore oil production facility requirements under 40 CFR part 112.9 (or §112.11 for offshore facilities).

#### Scenario E. Facility Supporting a Gas Pipeline

At a facility supporting a gas pipeline, EPA regulates compressors or equipment containing oil (including condensate when it turns into liquid at atmospheric temperatures and pressures), but not gas-filled portions of equipment. If the aboveground oil storage capacity is greater than 1,320 gallons, and the facility

otherwise meets the applicability of the rule, the facility is considered a bulk storage facility under the SPCC rule subject to the requirements under §112.8.”

### **3.1.3 Safe Drinking Water Act**

#### ***3.1.3.1 Underground injection of wastewater:***

EPA has stated the following regarding federal regulation of underground injection activities at oil and gas operations<sup>42</sup>.

“The Underground Injection Control (UIC) program of the SDWA regulates injection wells used in the oil and gas production process for produced water disposal or for enhanced recovery. Wells used in this industry for produced water are classified as Class II. Minimum UIC Class II well requirements, as outlined in 40 CFR Part 144, involve specific construction, operation, and closure standards, as well as provisions for ensuring that the owner, operator and/or transferor of the well maintain financial responsibility and resources to plug and abandon the well. Included are casing and cementing requirements based on the depth to the injection zone, location of aquifers, and estimated injection pressures as well as other possible considerations. Operational standards involve regular (at least once every five years) mechanical integrity tests (MITs); monitoring of injection pressure, flow rate, and volume; monitoring of the nature of injected fluid as needed; and annual reporting of monitoring results. Finally, closure procedures must be performed in accordance with an approved plugging and abandonment plan, which includes the placement and composition of cement plugs, the amount of casing to be left in the hole, the estimated cost of plugging, and any proposed tests or measurements. Additional requirements may be imposed in states that have been delegated implementation of the UIC program.”

### **3.1.4 Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)**

#### ***3.1.4.1 Spill reporting requirements under CERCLA:***

The spill reporting requirements under CERCLA, which apply to oil and gas operations, are described by EPA as follows.

“Hazardous substance release reporting regulations (40 CFR Part 302) direct the person in charge of a facility to report to the National Response Center (NRC) any environmental release of a hazardous substance which equals or exceeds a reportable quantity. Reportable quantities are listed in 40 CFR Part 302.4. A release report may trigger a response by EPA or by one or more federal or state emergency response authorities...”<sup>43</sup>

“...The term ‘hazardous substance’ is defined in CERCLA section 101(14) to include substances listed under four other environmental statutes (as well as those designated

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<sup>42</sup> EPA (2012) Oil and Natural Gas Sector: New Source Performance Standards and National Emission Standards for Hazardous Air Pollutants Reviews; Final Rule - 40 CFR Parts 60 and 63, Federal Register Vol. 77, No. 159, August 16, 2012

<sup>43</sup> EPA website on CERCLA, <http://www.epa.gov/oecaagct/lcla.html>

under CERCLA section 102(a)). The definition excludes ‘petroleum, including crude oil or any fraction thereof,’ unless specifically listed or designated under CERCLA... EPA interprets CERCLA section 101(14) to exclude crude oil and fractions of crude oil - including the hazardous substances, such as benzene, that are indigenous in those petroleum substances - from the definition of hazardous substance. Under this interpretation, petroleum includes hazardous substances that are normally mixed with or added to crude oil or crude oil fractions during the refining process. This includes indigenous hazardous substances, the levels of which are increased as a normal part of the refining process. However, hazardous substances that are added to petroleum or that increase in concentration as a result of contamination of the petroleum during use are not considered part of the petroleum, and are therefore regulated under CERCLA... The definition of hazardous substance also excludes natural gas, natural gas liquids, liquified natural gas, and synthetic gas usable for fuel.”<sup>44</sup>

The list of hazardous substances in 40 CFR Part 302.4 is long and includes some that might be found in a range of industrial facilities (e.g. hydrochloric acid, various solvents). These would require reporting if spilled in excess of reportable quantities. Lacking detailed knowledge of the shale gas industry, no attempt has been made in this report to determine whether any of the listed hazardous substances are specific to shale gas production or natural gas production in general.

### **3.1.5 Emergency Planning and Community Right-to-Know Act (EPCRA)**

#### ***3.1.5.1 Toxics Release Inventory (TRI) reporting:***

“The Toxics Release Inventory (TRI) was established in 1986 by the Emergency Planning and Community Right-to-Know Act (EPCRA). In 1990, Congress passed the Pollution Prevention Act (PPA), which required that facilities report additional data on waste management and source reduction activities under TRI. The TRI-specific sections of these two laws are Section 313 of EPCRA and Section 6607 of PPA.”<sup>45</sup> The only natural gas-related facilities required to report under the TRI program are those that recover sulfur from natural gas.<sup>46</sup>

### **3.1.6 Resource Conservation and Recovery Act (RCRA)**

#### ***3.1.6.1 Hazardous waste regulation:***

Under RCRA’s Subtitle C regulations, there are basically two types of hazardous wastes, those specifically listed and those that have certain characteristics. If a waste is hazardous, the rules specify stringent management and disposal requirements. “Under the 1980 Amendments to RCRA, Congress conditionally exempted certain categories of solid waste from regulation as hazardous wastes under RCRA including drilling fluids, produced waters, and other wastes associated with the exploration, development, or production of crude oil or natural gas. ... In general, [exploration and production]

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<sup>44</sup> EPA website on Substances Covered Under Reporting Requirements. Available at [http://www.epa.gov/osweroel/content/reporting/faq\\_subs.htm#exclusion](http://www.epa.gov/osweroel/content/reporting/faq_subs.htm#exclusion) . Accessed October 2, 2013

<sup>45</sup> EPA website “TRI Laws, Rulemakings and Notices”. Available at <http://www2.epa.gov/toxics-release-inventory-tri-program/tri-laws-rulemakings-and-notices> . Accessed October 2, 2013

<sup>46</sup> EPA website “Is My Facility's Six-Digit NAICS Code a TRI-Covered Industry?”. Available at <http://www2.epa.gov/toxics-release-inventory-tri-program/my-facilitys-six-digit-naics-code-tri-covered-industry> . Accessed October 2, 2013

exempt wastes are generated in “primary field operations,” and not as a result of maintenance or transportation activities. Exempt wastes are typically limited to those that are intrinsically related to the production of oil or natural gas. The exclusion does not extend to unused fracturing fluids or acids, which if they became wastes, could be hazardous wastes if they exhibited any of the characteristics of hazardous waste.<sup>47</sup>

EPA has provided the following guidance relevant to the application of RCRA Subtitle C to wastes from the natural gas sector.

“In general, the exempt status of an [exploration and production] waste depends on how the material was used or generated as waste, not necessarily whether the material is hazardous or toxic. For example, some exempt E&P wastes might be harmful to human health and the environment, and many non-exempt wastes might not be as harmful. The following simple rule of thumb can be used to determine if an E&P waste is exempt or non-exempt from RCRA Subtitle C regulations: [First], [h]as the waste come from down-hole, i.e., was it brought to the surface during oil and gas E&P operations? [Second], [h]as the waste otherwise been generated by contact with the oil and gas production stream during the removal of produced water or other contaminants from the product? If the answer to either question is yes, then the waste is likely considered exempt from RCRA Subtitle C regulations.”<sup>48</sup>

### ***3.1.6.2 Non-hazardous waste regulation:***

Solid wastes that are not hazardous wastes are regulated under Subtitle D of RCRA. Wastes from the oil and gas industry are subject to these regulations. EPA describes these requirements as follows.

"Under Subtitle D, the state and local governments are the primary planning, permitting, regulating, implementing, and enforcement agencies for management and disposal of ...non-hazardous solid wastes. EPA establishes technical design and operating criteria (which, at a minimum, the States include in their own regulations) for disposal facilities. Also, per Subtitle D, EPA must determine the adequacy (approval status) of the State permit programs....EPA's minimum national technical criteria (regulations) include specific requirements for location, operation, design (liner, leachate collection, run-off controls, etc), groundwater monitoring, corrective action, closure and post-closure care, and financial assurance responsibility. The primary regulations are found in 40 CFR Part 257 and Part 258 of the Code of Federal Regulations.”<sup>49</sup>

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<sup>47</sup> EPA (2000) EPA Office of Compliance Sector Notebook Project: Profile of the Oil and Gas Extraction Industry, EPA/310-R-99-006, October 2000

<sup>48</sup> EPA (2002) Exemption of Oil and Gas Exploration and Production Wastes from Federal Hazardous Waste Regulations. EPA530-K-01-004. October 2002. Available at <http://www.epa.gov/epawaste/nonhaz/industrial/special/oil/oil-gas.pdf>

<sup>49</sup> EPA website “Managing Non-Hazardous Municipal and Solid Waste (RCRA)” Available at [http://yosemite.epa.gov/r10/owcm.nsf/RCRA/nonhaz\\_waste](http://yosemite.epa.gov/r10/owcm.nsf/RCRA/nonhaz_waste)

### 3.1.7 Bureau of Land Management rules for shale gas development on public lands

The current federal regulations, overseen by Bureau of Land Management (BLM) and governing shale gas development on public lands are more than 30 years old. The U.S. Department of the Interior (DOI) proposed updated draft rules in May 2012 to ensure these were able to address the modern hydraulic fracturing operations being used on 90 percent of the wells drilled on Federal and Indian lands.<sup>50</sup> Revised draft rules were issued in May 2013 and are now being finalized by the DOI.<sup>51</sup> The rules address three primary aspects related to hydraulic fracturing: disclosure of chemicals used by the drillers for hydraulic fracturing, how to ensure groundwater was not getting contaminated by the chemicals being used in the wellbore for fracturing; adequate management and treatment plan for the flow back liquids.

### 3.1.8 Executive Order 13605

On April 13, 2012, The White House issued Executive Order 13605 (EO 13605), “Supporting Safe and Responsible Development of Unconventional Domestic Natural Gas Resources.”<sup>52</sup> EO 13605 states the following.

“Because efforts to promote safe, responsible, and efficient development of unconventional domestic natural gas resources are underway at a number of executive departments and agencies (agencies), close interagency coordination is important for effective implementation of these programs and activities. To formalize and promote ongoing interagency coordination, this order establishes a high-level, interagency working group that will facilitate coordinated Administration policy efforts to support safe and responsible unconventional domestic natural gas development.”<sup>53</sup> The “Interagency Working Group to Support Safe and Responsible Development of Unconventional Domestic Natural Gas Resources” consists of the following entities:

- (i) the Department of Defense;
- (ii) the Department of the Interior;
- (iii) the Department of Agriculture;
- (iv) the Department of Commerce;
- (v) the Department of Health and Human Services;
- (vi) the Department of Transportation;
- (vii) the Department of Energy;
- (viii) the Department of Homeland Security;
- (ix) the Environmental Protection Agency;

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<sup>50</sup> DEPARTMENT OF THE INTERIOR. Bureau of Land Management. 43 CFR Part 3160. Retrieved September 25, 2013, from [http://www.blm.gov/pgdata/etc/medialib/blm/wo/Communications\\_Directorate/public\\_affairs/hydraulicfracturing.Pa.r.91723.File.tmp/HydFrac\\_SupProposal.pdf](http://www.blm.gov/pgdata/etc/medialib/blm/wo/Communications_Directorate/public_affairs/hydraulicfracturing.Pa.r.91723.File.tmp/HydFrac_SupProposal.pdf)

<sup>51</sup> DEPARTMENT OF THE INTERIOR. Bureau of Land Management. 43 CFR Part 3160. Retrieved September 25, 2013, from [http://www.blm.gov/pgdata/etc/medialib/blm/wo/Communications\\_Directorate/public\\_affairs/hydraulicfracturing.Pa.r.91723.File.tmp/HydFrac\\_SupProposal.pdf](http://www.blm.gov/pgdata/etc/medialib/blm/wo/Communications_Directorate/public_affairs/hydraulicfracturing.Pa.r.91723.File.tmp/HydFrac_SupProposal.pdf)

<sup>52</sup> National Archives. 2012 Executive Orders Disposition Tables. Available at <http://www.archives.gov/federal-register/executive-orders/2012.html>

<sup>53</sup> National Archives. 2012 Executive Orders Disposition Tables. Available at <http://www.archives.gov/federal-register/executive-orders/2012.html>



- (x) the Council on Environmental Quality;
- (xi) the Office of Science and Technology Policy;
- (xii) the Office of Management and Budget;
- (xiii) the National Economic Council”

The functions of the Working Group are to “(i) coordinate agency policy activities, ensuring their efficient and effective operation and facilitating cooperation among agencies, as appropriate; (ii) coordinate among agencies the sharing of scientific, environmental, and related technical and economic information; (iii) engage in long-term planning and ensure coordination among the appropriate Federal entities with respect to such issues as research, natural resource assessment, and the development of infrastructure; (iv) promote interagency communication with stakeholders; and (v) consult with other agencies and offices as appropriate.”<sup>54</sup>

### 3.2 State Regulatory Framework & Legislation

Although a number of federal regulations govern the hydraulic fracturing process, specific implementation decisions are left to the states through their respective state primacy agencies. The National Conference of State Legislatures has compiled a report on hydraulic fracturing legislation proposed or enacted by State Legislatures in 2012.<sup>55</sup> There are multiple layers of regulation and legislation that impact shale gas exploration and hydraulic fracturing at the local level. The purpose of this section is to outline the existing state regulations, recent changes to state regulations, existing local ordinances and recent changes to municipal authority to enact local ordinances. Each state differs in the constitutional authority given to municipalities and ultimately, case law influences interpretation. Therefore, the two subsequent sections also provides a summary of municipal regulations and regional initiatives, including North Carolina municipalities that have made policy decisions regarding shale gas exploration and existing case law in other states.

Resources for the Future (RFF), a D.C. based non-profit working on environmental policy and research, has been tracking shale gas development nationally and for the individual states. In September 2012, it updated “Review of Shale Gas Regulations by State.”<sup>56</sup> In summarizing the information presented in its review, RFF mentions that:

“The heterogeneity of shale gas regulations is pervasive; it can be seen in what states regulate and how stringently they do so (though states do show a consistent preference for command and control regulations). Of course, similar heterogeneity exists in many types of state regulations—from income and sales taxes to speed limits. Regulatory differences may reflect underlying differences of geology, hydrology, demographics, or other factors that affect the local risks of shale gas development—or they could be a

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<sup>54</sup> National Archives. 2012 Executive Orders Disposition Tables. Available at <http://www.archives.gov/federal-register/executive-orders/2012.html>

<sup>55</sup> States Taking the Lead on Regulating Hydraulic Fracturing: Overview of 2012 State Legislation <http://www.ncsl.org/research/energy/regulating-hydraulic-fracturing-legislation.aspx> . Accessed November 23, 2013

<sup>56</sup> Resources for the Future (RFF). 2013. Maps showing the results of A Review of Shale Gas Regulations by State [http://www.rff.org/centers/energy\\_economics\\_and\\_policy/Pages/Shale\\_Gas\\_Featured\\_Project.aspx](http://www.rff.org/centers/energy_economics_and_policy/Pages/Shale_Gas_Featured_Project.aspx) , accessed June 4, 2013

result of random variation built up over decades of changing oil and gas regulation, or even political factors.”<sup>57</sup>

The variability in state regulations is not surprising, but it eliminates the possibility of identifying a “typical” approach to regulating shale gas development at the state level.

### **3.2.1 North Carolina State Legislation Regarding Shale Gas Development**

North Carolina has no past history of active oil and gas production.<sup>58</sup> However, in July 2012, hydraulic fracturing was legalized in North Carolina by Senate Bill 820 when it became S.L. 2012-143. The law, called the “Clean Energy and Economic Security Act,” authorized natural gas horizontal drilling and hydraulic fracturing in the state, but prohibits issuing permits until new rules are developed and then reviewed and approved by the State Legislature. It was the intent of the general assembly to establish a modern regulatory program based on the following principles:<sup>59</sup>

- 1) Protection of public health and safety
- 2) Protection of public and private property
- 3) Protection and conservation of the State’s air, water and other natural resources
- 4) Promotion of economic development and expanded employment opportunities
- 5) Productive and efficient development of the State’s oil and gas resources

S.L. 2012-143 approved the formation of a new Mining and Energy Commission (MEC) to develop the rules and regulations for gas drilling.<sup>60</sup> The rules will be adopted by MEC by October 1, 2014 and will be enforced by NCDENR Division of Energy, Mineral and Land Resources (DEMLR).

S.L. 2012-143 contains specific instructions on the environmental (and other) risks that are to be addressed in rules developed by the MEC. The specific requirements of the law regarding the regulations to be developed by MEC are as follows.<sup>61</sup>

“... the Commission shall adopt rules for all of the following purposes:

- (1) Regulation of pre-drilling exploration activities, including seismic and other geophysical and stratigraphic surveys and testing.
- (2) Regulation of drilling, operation, casing, plugging, completion, and abandonment of wells.
- (3) Prevention of pollution of water supplies by oil, gas, or other fluids used in oil and gas exploration and development.

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<sup>57</sup> Richardson, N., Madeline, G. Krupnick, A. & Wiseman, H. (2013) The State of State Shale Gas Regulation – Executive Summary. Resources for the Future, May 2013

<sup>58</sup> Reid, J. C., & Taylor, K. B. (2009). Shale gas potential in the Triassic strata of the Deep River Basin, Lee and Chatham counties, N. C. with pipeline and infrastructure data. Retrieved September 01, 2013 from [http://www.geology.enr.state.nc.us/pubs/PDF/NCGS\\_OFR\\_2009-01\\_20090709.pdf](http://www.geology.enr.state.nc.us/pubs/PDF/NCGS_OFR_2009-01_20090709.pdf)

<sup>59</sup> NC Cooperative Extension: Natural Gas Exploration: What you need to know. Retrieved on November 23, 2013 from <http://lee.ces.ncsu.edu/site-lee-naturalgasexploration/>

<sup>60</sup> State of North Carolina Legislature. SL 2012-143: Clean Energy and Economic Security Act. Effective 2 Jul 2012. Retrieved September 01, 2013 from <http://www.ncleg.net/gascripts/billlookup/billlookup.pl?Session=2011&BillID=S820>

<sup>61</sup> See SL 2012 – 143 SECTION 2.(c) G.S. 113-391 § 113-391

- (4) Protection of the quality of the water, air, soil, or any other environmental resource against injury or damage or impairment.
- (5) Regulation of horizontal drilling and hydraulic fracturing treatments for the purpose of oil and gas exploration. Such rules shall, at a minimum, include standards or requirements related to the following:
  - a. Information and data to be submitted in association with applications for permits to conduct oil and gas exploration and development activities using horizontal drilling and hydraulic fracturing treatments, which may include submission of hydrogeological investigations and identification of mechanisms to prevent and diagnose sources of groundwater contamination in the area of drilling sites. In formulating these requirements, the Commission shall consider (i) how North Carolina's geology differs from other states where oil and gas exploration and development activities using horizontal drilling and hydraulic fracturing treatments are common and (ii) the routes of possible groundwater contamination resulting from these activities and the potential role of vertical geological structures such as dikes and faults as conduits for groundwater contamination.
  - b. Collection of baseline data, including groundwater, surface water, and air quality in areas where oil and gas exploration and development activities are proposed. With regard to rules applicable to baseline data for groundwater and surface water, the Commission shall adopt rules that, at a minimum, establish standards to satisfy the pre-drilling testing requirement established under G.S. 113-421(a), including contaminants for which an operator or developer must test and necessary qualifications for persons conducting such tests.
  - c. Appropriate construction standards for oil and gas wells, which shall address the additional pressures of horizontal drilling and hydraulic fracturing treatments. These rules, at a minimum, shall include standards for casing and cementing sufficient to handle highly pressurized injection of hydraulic fracturing fluids into a well for purposes of fracturing bedrock and extraction of gas, and construction standards for other gas production infrastructure, such as storage pits and tanks.
  - d. Appropriate siting standards for wells and other gas production infrastructure, such as storage pits and tanks, including appropriate setback requirements and identification of areas, such as floodplains, where oil and gas exploration and production activities should be prohibited. Siting standards adopted shall be consistent with any applicable water quality standards adopted by the Environmental Management Commission or by local governments pursuant to water quality statutes, including standards for development in water supply watersheds.
  - e. Limits on water use, including, but not limited to, a requirement that oil and gas operators prepare and have a water and wastewater management plan approved by the Department, which, among other things, limits water withdrawals during times of drought and periods of low flows. Rules adopted shall be (i) developed in light of water supply in the areas of proposed

activity, competing water uses in those areas, and expected environmental impacts from such water withdrawals and (ii) consistent with statutes, and rules adopted by the Environmental Management Commission pursuant to those statutes, which govern water quality and management of water resources, including, but not limited to, statutes and rules applicable to water withdrawal registration, interbasin transfer requirements, and water quality standards related to wastewater discharges.

- f. Management of wastes produced in connection with oil and gas exploration and development and use of horizontal drilling and hydraulic fracturing treatments for that purpose. Such rules shall address storage, transportation, and disposal of wastes that may contain radioactive materials or wastes that may be toxic or have other hazardous wastes' characteristics that are not otherwise regulated as a hazardous waste by the federal Resource Conservation and Recovery Act (RCRA), such as top-hole water, brines, drilling fluids, additives, drilling muds, stimulation fluids, well servicing fluids, oil, production fluids, and drill cuttings from the drilling, alteration, production, plugging, or other activity associated with oil and gas wells. Wastes generated in connection with oil and gas exploration and development and use of horizontal drilling and hydraulic fracturing treatments for that purpose that constitute hazardous waste under RCRA shall be subject to rules adopted by the Commission for Public Health to implement RCRA requirements in the State.
- g. Prohibitions on use of certain chemicals and constituents in hydraulic fracturing fluids, particularly diesel fuel.
- h. Disclosure of chemicals and constituents used in oil and gas exploration, drilling, and production, including hydraulic fracturing fluids, to State regulatory agencies and to local government emergency response officials, and, with the exception of those items constituting trade secrets, as defined in G.S. 66-152(3), and that are designated as confidential or as a trade secret under G.S. 132-1.2, requirements for disclosure of those chemicals and constituents to the public.
- i. Installation of appropriate safety devices and development of protocols for response to well blowouts, chemical spills, and other emergencies, including requirements for approved emergency response plans and certified personnel to implement these plans as needed.
- j. Measures to mitigate impacts on infrastructure, including damage to roads by truck traffic and heavy equipment, in areas where oil and gas exploration and development activities that use horizontal drilling and hydraulic fracturing technologies are proposed to occur.
- k. Notice, record keeping, and reporting.
- l. Proper well closure, site reclamation, post-closure monitoring, and financial assurance. Rules for financial assurance shall require that an oil or gas developer or operator establish financial assurance that will ensure that sufficient funds are available for well closure, post-closure maintenance and

monitoring, any corrective action that the Department may require, and to satisfy any potential liability for sudden and nonsudden accidental occurrences, and subsequent costs incurred by the Department in response to an incident involving a drilling operation, even if the developer or operator becomes insolvent or ceases to reside, be incorporated, do business, or maintain assets in the State.

- (6) To require surveys upon application of any owner who has reason to believe that a well has been unlawfully drilled by another person into land of the owner without permission. In the event such surveys are required, the costs thereof shall be borne by the owner making the request.
- (7) To require the making of reports showing the location of oil and gas wells and the filing of logs and drilling records.
- (8) To prevent "blowouts," "caving," and "seepage," as such terms are generally understood in the oil and gas industry.
- (9) To identify the ownership of all oil or gas wells, producing leases, refineries, tanks, plants, structures, and all storage and transportation equipment and facilities.
- (10) To regulate the "shooting," perforating, and chemical treatment of wells.
- (11) To regulate secondary recovery methods, including the introduction of gas, air, water, or other substances into producing formations.
- (12) To regulate the spacing of wells and to establish drilling units.
- (13) To regulate and, if necessary in its judgment for the protection of unique environmental values, to prohibit the location of wells in the interest of protecting the quality of the water, air, soil, or any other environmental resource against injury, damage, or impairment.
- (14) Any other matter the Commission deems necessary for implementation of a modern regulatory program for the management of oil and gas exploration and development in the State and the use of horizontal drilling and hydraulic fracturing for that purpose.”

The law goes on to place additional requirements on the Environmental Management Commission.<sup>62</sup>

“The Environmental Management Commission shall adopt rules, after consideration of recommendations from the Mining and Energy Commission, for all of the following purposes:

- (1) Stormwater control for sites on which oil and gas exploration and development activities are conducted.
- (2) Regulation of toxic air emissions from drilling operations. In formulating appropriate standards, the Department shall assess emissions from oil and gas exploration and development activities that use horizontal drilling and hydraulic fracturing technologies, including emissions from associated truck traffic, in order to (i) determine the adequacy of the State's current air toxics program to protect

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<sup>62</sup> See SL 2012 – 143 SECTION 2.(c) G.S. 113-391 § 113-391

landowners who lease their property to drilling operations and (ii) determine the impact on ozone levels in the area in order to determine measures needed to maintain compliance with federal ozone standards.”

### 3.2.2 Status of regulation development activities at the Environmental Management Commission.

On Oct. 1, 2013 the Environmental Management Commission made a report to the Joint Legislative Committee on Energy Policy.<sup>63</sup> The following rules were identified as needing revision:

#### *“EMC Water Quality Rules Needing Revision*

- 15A NCAC 2H .1000 –Stormwater rules<sup>64</sup>
- 15 A NCAC 2T – Wastes not discharged to surface waters<sup>65</sup>
  - 2T.0113-Permitting by Regulation
  - 2T.1000-Closed-loop recycle
  - 2T.1500-Soil Remediation

#### *Stormwater Rules Needing Revision*

- Regulated discharges arise in three site phases
  - Initial grading – sediment
  - Initial drilling – sediment, hydrocarbons, brines, other
  - Production, less intense – sediment, peak flow, residuals
- Surface water protection to be accomplished by stormwater permit requirements, which must be supported by new rules.
- Stormwater Permit Requirements
  - Site stabilization per the current NPDES Construction
  - Structural BMPs, extend the rules in 15A NCAC 2H .1000
  - Full pad containment; and around battery units on the pad; approximate the no discharge model, but allow discharge through structural BMP above a certain 24-hr rainfall.
- Activities
  - Beginning staff level coordination with DEMLR Energy Program rule development
  - Represented in the Coordinated Permitting Study Group
  - Stakeholder group presentations; one accomplished, one pending October 3, 2013
  - On-going review of summer intern survey of other states’ approaches to regulating stormwater discharges.

#### *Land Application Rules Needing Revision*

- 2T .0113 Permitting by Regulation

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<sup>63</sup> <http://www.ncleg.net/documentsites/committees/BCCI-6576/1%20-%20Oct.%201,%202013/Energy%20Commission/1%20-%20Oct%201%202013/Materials%20for%20Website/7%20-%20Hutson%20EMC%20Fracking%20Update.pdf>

<sup>64</sup> [http://portal.ncdenr.org/c/document\\_library/get\\_file?uuid=0ff72135-222f-4e0c-a0ac-3c439030cb49&groupId=38364](http://portal.ncdenr.org/c/document_library/get_file?uuid=0ff72135-222f-4e0c-a0ac-3c439030cb49&groupId=38364)

<sup>65</sup> [http://portal.ncdenr.org/c/document\\_library/get\\_file?folderId=285750&name=DLFE-8541.pdf](http://portal.ncdenr.org/c/document_library/get_file?folderId=285750&name=DLFE-8541.pdf)

- On-site disposal of drilling muds, cuttings and produced water should not be permitted by rule [meaning that individual permits would be required]
- Reuse of flowback water for hydraulic fracturing fluid should be permitted by rule for sites regulated by DEMLR/MEC
- 2T .1000 Closed loop recycle
  - Clarify that reuse of flowback water is not a closed-loop recycle system
- 2T .1500 Soil remediation
  - Clarify that soil remediation permits are not appropriate for spreading of oil and gas drilling muds and cuttings.<sup>66</sup>

The report included the following Water Quality Rules Schedule

Schedule	Date
Present stormwater rules to stakeholders	10/13/2013
Present proposed rule to WQC	10/1/2013
WQC agenda item: send proposed rule to EMC	11/13/2013
EMC action, send rules to public comment	1/9/2014
Start of public comment period	2/3/2014 (approximate)
End of public comment period	4/21/2014 (approximate)
WQC Adoption	7/9/2014 or 9/10/2014
EMC Adoption	9/11/2014
Rules Review Commission Meeting	10/16/2014

The Environmental Management Commission report also contains the following related to the regulation of Air Emissions:

“The Division of Air Quality has reviewed:

- 1) The existing regulatory framework (Federal and State)
- 2) The types of emission sources associated with this activity
- 3) How other states are regulating air emissions

The DAQ does not believe additional regulations are needed. EPA’s new rules on air emissions from oil and gas sites will apply in NC. The rule requires that companies use “green completions” to capture gas during the well completion stage.<sup>67</sup> DAQ is gathering emission factors per pollutant to enable estimates of emissions per well developed. These include:

- 1) Truck trips and idling
- 2) Land clearing and unpaved roads
- 3) Drilling and drilling mud
- 4) Fracturing
- 5) Completion

<sup>66</sup> <http://www.ncleg.net/documentsites/committees/BCCI-6576/1%20-%20Oct.%201,%202013/Energy%20Commission/1%20-%20Oct%201%202013/Materials%20for%20Website/7%20-%20Hutson%20EMC%20Fracking%20Update.pdf>

<sup>67</sup> [http://epa.gov/ocir/hearings/pdf/2012\\_0619\\_hearing\\_witness\\_testimony\\_mccarthy.pdf](http://epa.gov/ocir/hearings/pdf/2012_0619_hearing_witness_testimony_mccarthy.pdf)

When combined with estimates of the number of wells in a particular area, DAQ will be able to assess impacts from the vicinity of drilling sites and downwind (e.g. local impacts in Lee County and ozone downwind in the Triangle.”

### **3.2.3 Status of regulation development activities at the North Carolina Mining and Energy Commission**

The new North Carolina Mining and Energy Commission (MEC), authorized in 2012, was formed to include working committees and study groups to study the complex interrelated considerations of shale gas exploration. MEC has October 1, 2014 established as a deadline for recommendations to the State Legislature, however there are several working committees and study groups that had October 1, 2013 as a deadline for reporting on their respective topics. The September 27, 2013 MEC meeting covered many of these topics and audio and video recordings of the meeting are available online.<sup>68</sup> The committees and study groups include:

#### *Standing Committees:*

- Committee on Mining
- Committee on Civil Penalty Remissions
- Water and Waste Management Committee
  - Water re-use, water and wastewater management plans, wastewater disposal, etc.
- Administration of Oil & Gas Committee
  - Unitization, pooling, pre-drilling activities, site development, well construction, impoundments, record keeping, etc.
  - 70 rules assigned, 22 rules in research, 9 moved out of committee, 6 rules approved by full MEC
- Environmental Standards Committee
  - Hydrogeological investigations, collection of baseline data, setbacks, chemical disclosure, testing & monitoring, etc.
- Rules Committee
  - Rules properly formatted, cross-referenced, integrated, master definition list, statutory change requests

#### *Study Groups:*

- Local Government Regulation Study Group
- Compulsory Pooling Study Group
- Funding Levels and Sources Study Group
- Severance Tax Study Group
- Landmen Registry Study Group
- Coordinated Permitting Study Group
- Protection of Trade Secrets and Proprietary Information Study Group

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<sup>68</sup> MEC webpage accessed online on September 29, 2013 at <http://portal.ncdenr.org/web/mining-and-energy-commission/mec-09-27-2013>



The Mining and Energy Commission (MEC) made a presentation on October 1, 2013 to the Joint Legislative Energy Policy Commission. The dates on which rules from each study group are due to be reviewed by the NC General Assembly are provided below, with additional information included in the following figure from their presentation:<sup>69</sup>

<u>Milestone</u>	<u>Date</u>
Statutory Change Requests to NCGA	January 14, 2014
Subsequent Study Group Reports	March/April 2014
Completion of MEC Internal Rule Writing	September 5, 2014
Public Comment Period	September/October 2014
MEC Adoption of Rule Set	November 15, 2014
MEC turnover of rules to RRC	20 Nov 2014
RRC Consideration of Rules	15 Dec 2014

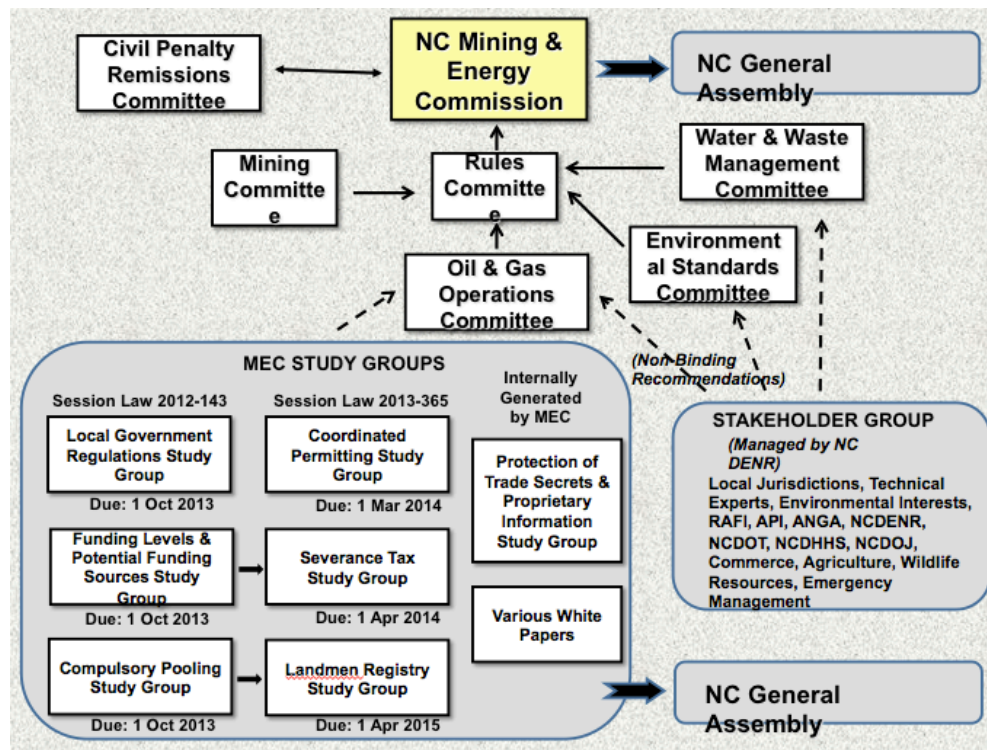


Figure 3.1 Organization of Mining and Energy Commission Rule Making Activities

<sup>69</sup> Womack et. Al. MEC Overview and Activity Update available at: <http://www.ncleg.net/gascripts/DocumentSites/browseDocSite.asp?nID=233&sFolderName=\1%20-%20Oct.%201,%202013\Energy%20Commission\1%20-%20Oct%201%202013\Materials%20for%20Website>

### *3.2.3.1 MEC Compulsory Pooling Study Group*<sup>70</sup>

The Compulsory Pooling Study Group utilized the following definition by Bruce Kramer, pooling is “the joining together of small tracts or portions of tracts for the purpose of having sufficient acreage to receive a well drilling permit under the state or local spacing laws and regulations.”<sup>71</sup>

The Study Group further elaborated, “under certain circumstances, pooling is a mechanism used to compel landowners, who have not elected to participate in a pool or drilling unit voluntarily through private contract, to join the pool. Compulsory pooling is also referred to as integration, forced pooling, or statutory pooling.”<sup>72</sup>

#### *Recommendation on Compulsory Pooling*

“In the interest of protecting the correlative rights of landowners and minimizing waste, the Study Group recommends that compulsory pooling be allowed where 90% of the owners of the surface acreage have voluntarily leased or consented to developing their oil and gas rights.”<sup>73</sup>

#### *Recommendation on Unitization*

“The Mining and Energy Commission is given the authority to establish unit or units for each pool. Due to the specialized technical expertise needed to determine the appropriate parameters of a unit, such as acreage and boundary, the Study Group recommends that the rules regarding unitization should be developed by the Administration of Oil and Gas Committee of the Mining and Energy Commission consistent with rationales made on recommendations for compulsory pooling found in this report.”<sup>74</sup>

#### *Recommendations on Landowner Protections*

“After reviewing the laws of various states, the Study Group made the following recommendations for mineral owners subject to a pooling order. The purpose of the

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<sup>70</sup> <http://www.ncleg.net/documentsites/committees/BCCI-6576/1%20-%20Oct.%201,%202013/Energy%20Commission/1%20-%20Oct%201%202013/Materials%20for%20Website/DENR%20-%20Compulsory%20Pooling.pdf>

<sup>71</sup> Final Report of the Compulsory Pooling Study Group (September 2013). Retrieved on October 1, 2013 from [http://portal.ncdenr.org/c/document\\_library/get\\_file?uuid=2908d2e4-5b4d-4213-8e3c-4880692f5ff1&groupId=8198095](http://portal.ncdenr.org/c/document_library/get_file?uuid=2908d2e4-5b4d-4213-8e3c-4880692f5ff1&groupId=8198095)

<sup>72</sup> Final Report of the Compulsory Pooling Study Group (September 2013). Retrieved on October 1, 2013 from [http://portal.ncdenr.org/c/document\\_library/get\\_file?uuid=2908d2e4-5b4d-4213-8e3c-4880692f5ff1&groupId=8198095](http://portal.ncdenr.org/c/document_library/get_file?uuid=2908d2e4-5b4d-4213-8e3c-4880692f5ff1&groupId=8198095)

<sup>73</sup> Final Report of the Compulsory Pooling Study Group (September 2013). Retrieved on October 1, 2013 from [http://portal.ncdenr.org/c/document\\_library/get\\_file?uuid=2908d2e4-5b4d-4213-8e3c-4880692f5ff1&groupId=8198095](http://portal.ncdenr.org/c/document_library/get_file?uuid=2908d2e4-5b4d-4213-8e3c-4880692f5ff1&groupId=8198095)

<sup>74</sup> Final Report of the Compulsory Pooling Study Group (September 2013). Retrieved on October 1, 2013 from [http://portal.ncdenr.org/c/document\\_library/get\\_file?uuid=2908d2e4-5b4d-4213-8e3c-4880692f5ff1&groupId=8198095](http://portal.ncdenr.org/c/document_library/get_file?uuid=2908d2e4-5b4d-4213-8e3c-4880692f5ff1&groupId=8198095)

recommendations below is to provide protections to owners who may be pooled and to encourage voluntary agreement among all owners and operators in a drilling unit.

### 1. Good Faith Negotiation

The Study Group recommends that the Mining and Energy Commission also require evidence that operators demonstrate good faith attempts at voluntary agreement by making fair and reasonable offers to all owners in the pool.

### 2. Minimum Voluntarily Agreement on Pooled Acreage

The Study Group recommends a minimum voluntary agreement minimum requirement of 90% of the owners of the surface acreage. Appendix III shows maps of how a standard natural gas parcel of 320 acres and one of 640 acres would look in Lee County, given different percentages of voluntary agreement. The regulations for a drilling unit have yet to be determined.

Assuming the drilling unit will be a square mile or 640 acres is only a hypothetical. The Administration of Oil and Gas Committee of the Mining and Energy Commission will determine future drilling unit regulations.

### 3. Landowner Consent for Surface Use

The Study Group recommends that unleased mineral owners who are compulsory pooled should have to give consent to use of the surface. That is, surface operations should be prohibited without the express agreement of the unleased mineral interest owner subject to the pooling order.

Additionally, the Study Group recommends that prior to applying for a pooling application, the applicant should have a surface use agreement in place.”<sup>75</sup>

#### *Recommendation on Notice of Subsurface Entry*

“The Study Group recommends that all operators within a drilling unit shall provide written notice between 30 days and six months prior to initiating drilling in the production unit containing the compelled mineral estate to the following parties:

1. owners of compelled mineral rights who were required to be provided notice of the compulsory pooling process;

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<sup>75</sup> Final Report of the Compulsory Pooling Study Group (September 2013). Retrieved on October 1, 2013 from [http://portal.ncdenr.org/c/document\\_library/get\\_file?uuid=2908d2e4-5b4d-4213-8e3c-4880692f5ff1&groupId=8198095](http://portal.ncdenr.org/c/document_library/get_file?uuid=2908d2e4-5b4d-4213-8e3c-4880692f5ff1&groupId=8198095)

2. owners of surface estates above the compelled mineral rights whose names are recorded as surface owners with the county register of deeds at the time that the application for a compulsory pooling order was filed;
3. owners of surface estates above the compelled mineral rights that provide the operator with a request for notice subsequent to a pooling order;
4. each holder of a mortgage lien against the compelled property that has recorded the lien with the county register of deeds at the time that the application for a mandatory pooling order was filed; and
5. each mortgage lien holder against a compelled property that subsequent to a pooling order requests a notice and provides the operator a copy of a recorded lien against the compelled property.”<sup>76</sup>

### *Recommendation on Reporting on Production*

“Operators should be required to provide the following information in a clearly written statement accompanying each royalty payment or working interest share payment:

#### Identification Information:

1. Name of oil and gas rights owner (lessor or working interest owner);
2. Owner’s identification number (account number or payee number utilized by producer), and
3. Lease number (if applicable), property name, API well number, and well name.

#### Payment Calculation Information:

1. Total volume sold of oil (in barrels), of gas (in MMBtu (1000’s of Btus)), of natural gas liquids (NGL) (in gallons or barrels), and of other products (in relevant units);
2. Price per unit of oil, gas, NGL, and other products sold;
3. Month and year of sale (to confirm price);
4. Owner’s interest in sale expressed as a decimal;
5. Owner’s share in dollars before deductions and adjustments;
6. Each deduction including severance, production, and other taxes, transportation, line loss, compression, processing, treatment, marketing, gathering, third party charges and a key explaining each deduction; and
7. Owner’s share in dollars after deductions and adjustments.

Contact Information to be included with every payment:

1. Address;
2. Telephone number; and
3. Email address where additional information may be obtained and questions answered.

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<sup>76</sup> Final Report of the Compulsory Pooling Study Group (September 2013). Retrieved on October 1, 2013 from [http://portal.ncdenr.org/c/document\\_library/get\\_file?uuid=2908d2e4-5b4d-4213-8e3c-4880692f5ff1&groupId=8198095](http://portal.ncdenr.org/c/document_library/get_file?uuid=2908d2e4-5b4d-4213-8e3c-4880692f5ff1&groupId=8198095)

The following persons should receive the report:

1. Each recipient of well production proceeds who is compelled into a production unit;
2. Each holder of a mortgage lien against the compelled property that has recorded the lien with the county register of deeds at the time that the application for a compulsory pooling order is filed; and
3. Each mortgage lien holder against a compelled property that subsequent to a pooling order provides the operator a copy of a recorded lien against the compelled property.

Records subject to review include records containing the source of information identified in the above recommendation and should include, at a minimum, the following information necessary to verify those records: third party evidence of pricing (e.g., purchase contract), wellhead charts, master meter readings, and meter calibration reports. In addition, mineral rights owners should have the right to audit any records used or relied upon by the operator in determining well production or calculating payments.”<sup>77</sup>

#### *Recommendation on Dissolution of the Drilling Unit*

“Once a unit is established, there may be instances in which the unit should be dissolved automatically. This will protect landowner rights by freeing the property for other uses and development where the oil and gas exploration has failed to commence in a timely manner. It will also provide incentive for oil and gas companies to begin exploration where a unit has been established.

Consistent with Texas law on the dissolution of the drilling unit, the Study Group recommends that a drilling unit be automatically dissolved if no production occurs one year after the pooling order has been issued, six months after the completion of a dry hole or six months after production has ended, whichever occurs first.”<sup>78</sup>

#### *Recommendation on the Clarification of Mineral Rights Ownership*

“The Study Group recommends that the issue of amending the dormant minerals statutes be studied further. It was determined that making a recommendation on this issue is outside the scope of the Study Group. It was further recommended that the Mining and Energy Commission consult with the Department of Revenue and county register of deeds offices on the issue.

One model that may be followed is the process to register rights to submerged lands as provided in N.C. Gen Stat. § 113-205. This statute required that persons claiming submerged land property rights had three years to register claims with the Secretary of

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<sup>77</sup> Final Report of the Compulsory Pooling Study Group (September 2013). Retrieved on October 1, 2013 from [http://portal.ncdenr.org/c/document\\_library/get\\_file?uuid=2908d2e4-5b4d-4213-8e3c-4880692f5ff1&groupId=8198095](http://portal.ncdenr.org/c/document_library/get_file?uuid=2908d2e4-5b4d-4213-8e3c-4880692f5ff1&groupId=8198095)

<sup>78</sup> Final Report of the Compulsory Pooling Study Group (September 2013). Retrieved on October 1, 2013 from [http://portal.ncdenr.org/c/document\\_library/get\\_file?uuid=2908d2e4-5b4d-4213-8e3c-4880692f5ff1&groupId=8198095](http://portal.ncdenr.org/c/document_library/get_file?uuid=2908d2e4-5b4d-4213-8e3c-4880692f5ff1&groupId=8198095)

the Department of Environment and Natural Resources after notice was given by publication each year.”<sup>79</sup>

### *Recommendation on Cost Sharing and Compulsorily Pooled Interests*

“In the interest of developing a modern framework for compulsory pooling that is protective of owners who are compulsorily pooled, the Study Group recommends that the General Assembly repeal the free ride provision of N.C. Gen. Stat. § 113-393(a) and adopt a cost sharing statute that allows the compelled owner to choose from various cost sharing options. Experts have noted that free ride statutes can create reverse incentives to hold out; the landowner may be discouraged from joining voluntary pooling agreements where no risk or penalty is associated with being compulsorily pooled. The Study Group recommends the following options for the election of the compelled owner once a pooled order has issued:

- a. Share in Costs as a Participating Owner: The oil and gas interest owner pays its share of the costs of drilling, equipping, and operating the well as the costs are incurred.
- b. Surrender of Working Interest: The oil and gas interest owner surrenders its working interest in the well in exchange for reasonable consideration, which may be a combination of a bonus payment and royalty interest.
- c. Risk Penalty: The oil and gas interest owner may have its portion of the costs of drilling, equipping, and operating the well carried by the other interest owners until the production stage, but will be charged a risk penalty to be determined by the Mining and Energy Commission.

The Study Group felt that the cost sharing options are designed to ensure that owners receive a fair and equitable share without incentivizing operators or owners to resort to the administrative process. In addition to providing fair and equitable alternatives for owners, the options approach is designed to reduce the administrative burden of reviewing pooling applications and orders by encouraging all parties to come to a voluntary agreement.”<sup>80</sup>

### *Additional Recommendations: The Risk Penalty*

“The Study Group recommends that the operator be required to quantify the risk associated with drilling a well in a pooled unit as part of its application for a pooling order and to recommend a risk penalty for landowners based upon the estimated risk for the Mining and Energy Commission’s consideration but that in no instance should the

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<sup>79</sup> Final Report of the Compulsory Pooling Study Group (September 2013). Retrieved on October 1, 2013 from [http://portal.ncdenr.org/c/document\\_library/get\\_file?uuid=2908d2e4-5b4d-4213-8e3c-4880692f5ff1&groupId=8198095](http://portal.ncdenr.org/c/document_library/get_file?uuid=2908d2e4-5b4d-4213-8e3c-4880692f5ff1&groupId=8198095)

<sup>80</sup> Final Report of the Compulsory Pooling Study Group (September 2013). Retrieved on October 1, 2013 from [http://portal.ncdenr.org/c/document\\_library/get\\_file?uuid=2908d2e4-5b4d-4213-8e3c-4880692f5ff1&groupId=8198095](http://portal.ncdenr.org/c/document_library/get_file?uuid=2908d2e4-5b4d-4213-8e3c-4880692f5ff1&groupId=8198095)

risk penalty exceed 200%. The costs associated with the risk penalty are the costs of drilling, equipping and completing the well.

There was a concern that small landowners would not receive a just and equitable share under the risk penalty provision. Thus, the Study Group further recommended having an acreage threshold requirement that would allow the Commission to set the risk penalty at zero percent for small landowners. The Study Group agreed that a threshold between half an acre and 10 acres would ensure small landowners receive a just and equitable share of production.

The North Carolina Oil and Gas Conservation Act requires that each owner be provided “the opportunity to recover or receive his just and equitable share of the oil and gas in the pool without unnecessary expense.” Accordingly, the Study Group recommends that in assigning risk penalties to each landowner, the Mining and Energy Commission take into account that owners of small acreage interests must bear legal and administrative costs similar in size to those borne by larger area landowners but from a significantly smaller share of the pool’s revenue. Specifically, the Study Group recommends that in assigning risk penalties to small acreage landowners, the Mining and Energy Commission take into consideration the expenses incurred by an owner in retaining legal counsel to evaluate and respond to lease offers as recommended by the State, in defending the owner’s rights in responding to the pooling application and participating in the pooling order process, and in monitoring and auditing the payments it receives over the life of the well.

The Study Group further recommends unleased owners be treated differently under the risk penalty option of a cost sharing statute. The unleased owner will have the costs of drilling, equipping, and operating the well carried until the production stage, but will be charged a risk penalty to be determined by the Mining and Energy Commission. The risk penalty will be paid from seven-eighths of the carried interest owner’s share of production. The carried interest owner will receive one-eighth of his or her share of production until the share of costs and the risk penalty have been paid.”<sup>81</sup>

#### *Recommendations of Compensation to Landowners for Damages Associated with Exploration and Development*

“Investigating compulsory pooling led the Study Group to consider associated issues, such as mechanisms for ensuring that landowners are held harmless and compensated for damages sustained as a result of exploration and development activities that take place on their property. Based on its review of regulatory frameworks of other states, the Study Group became aware of deficiencies in North Carolina law that should be addressed.”

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<sup>81</sup> Final Report of the Compulsory Pooling Study Group (September 2013). Retrieved on October 1, 2013 from [http://portal.ncdenr.org/c/document\\_library/get\\_file?uuid=2908d2e4-5b4d-4213-8e3c-4880692f5ff1&groupId=8198095](http://portal.ncdenr.org/c/document_library/get_file?uuid=2908d2e4-5b4d-4213-8e3c-4880692f5ff1&groupId=8198095)

North Carolina law addresses indemnification for all landowners. Section 422 of the North Carolina Oil and Gas Conservation Act, as amended by Session Law 2012-143, states:

“An oil or gas developer or operator shall indemnify and hold harmless a surface owner against any claims related to the developer's or operator's activities on the surface owner's property, including, but not limited to, (i) claims of injury or death to any person; (ii) for damage to impacted infrastructure or water supplies; (iii) damage to a third party's property that is real or personal property; and (iv) violations of any federal, State, or local law, rule, regulation, or ordinance, including those for protection of the environment.”

The purpose of the following recommendations is to expand on the above section and address concerns particular to compulsory pooling. All rights to indemnification should survive dissolution of the unit.

#### A. Unleased Owners

The Study Group recommends that an unleased owner with involvement in neither exploration for, nor production of, gas, oil, or related resources from said owner's property should have absolute tort immunity from any action arising from any exploration or production activities on or near said owner's property. Mere receipt of payments in lieu of bonus, royalty, or damage payments by an unleased owner should not constitute involvement in either exploration or production activities. An unleased owner should be held harmless in that the production company should have a duty to defend against any third-party actions, including but not limited to private lawsuits and governmental actions of whatever nature, brought against the unleased owner. The unleased owner should be entitled to indemnification from the production company for any sums ordered paid and expenses, including attorney fees and costs, incurred as the result of any third-party action.

An unleased owner should be entitled to indemnification for any injuries to his or her own property, person, person of a family member or guest, and other economic interests that are not merely speculative. Other interests may include, but are not limited to, loss of value of real or personal property, rollback taxes under the present use value (PUV) tax program, increased taxes as the result of the partial or complete loss of present use value (PUV) tax program eligibility, loss of income from agriculture, forestry, agritourism, or other business resulting from oil and gas exploration and production activities, and losses associated with violations of federal or state conservation programs, provisions of conservation easements, or acceleration or other clauses or provisions in security agreements for which oil and gas exploration or production activities trigger liability. These protections should not be allowed to be waived by contract.

#### B. Production Companies



Where two or more production companies are compelled to participate in a single production unit, with a single company selected to conduct exploration or production, rights to indemnification, if any, should be governed by the terms of the joint operating agreement, either as agreed upon by the parties or, in the absence of agreement, as imposed by the Mining and Energy Commission.

### C. Leased Owners

The rights of a leased owner (lessor) should be determined by the terms of the joint operating agreement, the original lease, or N.C.G.S. §§ 113-421, -422, whichever provides greater protection of the owner.”<sup>82</sup>

Additionally, as a follow up to the Compulsory Pooling Study Group Report, NCDENR

“recommends that prior to establishing new laws related to compulsory pooling, the General Assembly should consider the rules adopted by the Mining and Energy Commission related to oil and gas exploration, including, but not limited to, rules concerning drilling units, spacing requirements, and setbacks, all of which will affect the regulation of compulsory pooling in the state. The Department recommends that decisions on the status and implementation of a compulsory pooling law precede decisions related to cost sharing, notifications, and compensation for damages.

The Department also recommends further study on the issue of amending current dormant mineral statutes regarding extinguishment and other consumer protection issues related to split estates.”<sup>83</sup>

#### ***3.2.3.2 MEC Local Government Regulation Study Group***

Municipalities are granted Zoning and Development Regulation Powers and those powers have been discussed specifically by the MEC Local Government Regulation Study Group. “The study group researched whether or not a local government could or should apply its zoning ordinances to the oil and gas industry and developed these recommendations:

- a. Local zoning ordinances should only apply to surface land use, not to subsurface use;
- b. Local governments should retain their existing zoning and land use authorities and be able to apply these ordinances to the oil and gas industry;
- c. Local governments should not be allowed to apply zoning ordinances to exclusively prohibit oil or gas operations;
- d. Local governments could implement special use permitting for specific properties, such as forestry districts, agricultural areas, and family farms, while also allowing

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<sup>82</sup> Final Report of the Compulsory Pooling Study Group (September 2013). Retrieved on October 1, 2013 from [http://portal.ncdenr.org/c/document\\_library/get\\_file?uuid=2908d2e4-5b4d-4213-8e3c-4880692f5ff1&groupId=8198095](http://portal.ncdenr.org/c/document_library/get_file?uuid=2908d2e4-5b4d-4213-8e3c-4880692f5ff1&groupId=8198095)

<sup>83</sup> <http://www.ncleg.net/documentsites/committees/BCCI-6576/1%20-%20Oct.%201,%202013/Energy%20Commission/1%20-%20Oct%201%202013/Materials%20for%20Website/DENR%20-%20Compulsory%20Pooling.pdf>

- other land uses, such as development of resources (e.g. shale gas) on these same properties;
- e. A special use permit could include a provision for oil and gas operations, so that these operations could still occur within designated special use permitted lands;
  - f. Local governments implementing a special use permitting program should be aware of the potential for land-owner abuse of a “present use value” designation to avoid taxation on the production of subsurface resources;
  - g. Appeals to zoning decisions should be adjudicated through existing local and judicial processes.”<sup>84</sup>

Additionally, the MEC Local Government Regulation Study Group addressed several other mechanisms, including:

- a. “Setbacks for oil and gas development and hydraulic fracturing need to be detailed for well head, well lateral lines, gathering lines and transmission lines. Setbacks should be used only for environmental, health and safety purposes. As a result, local governments cannot implement setbacks to exclusively prevent oil and gas development and exploration.” (p. 3)
- b. “The study group recommends that the Commission adopt state setback rules.” (p. 4)
- c. “The study group recommends that local governments continue addressing odor, noise, and light-related issues under their current police power authority.” (p. 5)
- d. “Groundwater and surface water monitoring activities will continue to be performed by local health departments, DWR, DWM, and eventually by DEMLR. Additionally, a “baseline” sampling and testing rule set has been developed by DEMLR staff, in consultation with the MEC’s Environmental Standards Committee, which will require oil and gas companies to sample and test private drinking water wells in the vicinity of operations. The new rule also has requirements for follow-up testing after operations have been completed. The study group has no recommendations for water testing beyond continuing current sampling programs and implementing the new baseline sampling rule set. DENR’s Division of Air Quality (DAQ) plans to continue its program of collecting sampling data using its current ambient air monitoring network. DAQ also plans to install a new monitoring network near an area where initial shale gas operations are expected to occur.” (p. 7)
- e. “The study group also researched waste generation from oil and gas operations and recommends that any wastewater that is discharged to a municipal wastewater collection system for treatment must meet local standards for industrial pretreatment.”<sup>85</sup> (p. 7)

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<sup>84</sup>North Carolina Mining and Energy Commission Local Government Regulation Study Group Report, p. 9, accessed on September 19, 2013 at [http://portal.ncdenr.org/c/document\\_library/get\\_file?uuid=48665ab9-244f-4e94-ad75-6d338339ebf2&groupId=8198095](http://portal.ncdenr.org/c/document_library/get_file?uuid=48665ab9-244f-4e94-ad75-6d338339ebf2&groupId=8198095)

<sup>85</sup>North Carolina Mining and Energy Commission Local Government Regulation Study Group Report accessed on September 19, 2013 at [http://portal.ncdenr.org/c/document\\_library/get\\_file?uuid=48665ab9-244f-4e94-ad75-6d338339ebf2&groupId=8198095](http://portal.ncdenr.org/c/document_library/get_file?uuid=48665ab9-244f-4e94-ad75-6d338339ebf2&groupId=8198095)

The report noted that local officials are responsible for the health, safety, and welfare of their citizens. “They must balance a property owners’ right to quiet enjoyment of their property versus the other owners’ right to extract natural gas from their property. Local concerns include compatible land uses, water supply contamination, side effects of industrial operations, and the ability to follow federal rules.

Areas of traditional local control over heavy industry include:

- 1) Zoning: separation of uses, setbacks, allowable uses
- 2) Industrial Impacts
  - a. Health/Safety/welfare: noise/light/odors
  - b. Streets: weight limits on city-owned roads, placement of infrastructure in municipal right-of-way, truck routes and timing of truck operations
- 3) Federal/state environmental laws
  - a. Federal: Floodplain management, stormwater, hazardous waste, air quality
  - b. State: sedimentation/erosion control, Water Supply Watershed<sup>86</sup>

The report also identified the North Carolina Association of County Commissioners core value of “The Association promotes strengthening of local decision-making to respond to local needs”. Two guiding principles include “State agencies issuing permits for activities that affect the environment should give local governments ample opportunity to comment on proposed permits for consistency with local plans and policies,” and “The State should seek input from counties while developing rules and regulations that impact counties, particularly concerning property rights.”

### ***3.2.3.3 Funding Levels and Potential Funding Sources Study Group***

The Funding Levels and Potential Sources Study Group identified several “main sources for funding include permit fees, bonds, taxes, and impact fees. The Study Group’s major recommendations are:

#### **A. Impact Fees to Cover Costs to Local Governments:**

For local government cost recovery, other than transportation infrastructure upgrades and repair, the Study Group recommends that a permittee be required to pay an impact fee that comports with the level of industrial activity for a given well. The impact fees would be paid into a state trust fund from which impacted entities could apply for disbursement to fund necessary improvements. Additionally, the Study Group recognizes the need to sustain local taxing methods, such as ad valorem taxes.

#### **B. Bonds and Local Permit Fees to Cover Costs for Local Transportation Infrastructure:**

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<sup>86</sup> North Carolina Mining and Energy Commission Local Government Regulation Study Group Report accessed on September 19, 2013 at [http://portal.ncdenr.org/c/document\\_library/get\\_file?uuid=48665ab9-244f-4e94-ad75-6d338339ebf2&groupId=8198095](http://portal.ncdenr.org/c/document_library/get_file?uuid=48665ab9-244f-4e94-ad75-6d338339ebf2&groupId=8198095)

To recover the costs associated with impact to local transportation infrastructure, the Study Group recommends a bond and permit system modeled after the one in Pennsylvania.

C. Severance Tax to Cover State Program Costs:

The Study Group recommends that a severance tax be used to fund the direct costs to the State for implementing and overseeing an active oil and gas regulatory program. These total estimated costs for the Department of Environment and Natural Resources are expected to be approximately \$1.6-1.9 million annually. The costs for the Department of Transportation are estimated to be approximately \$70,000 to nearly \$1 million per year, depending on the estimated level of natural gas production activity in the state. See Table V.I. The projected NCDOT costs therefore illustrate a ramp up in activity over a 7-year period. The recommended severance tax rate is 1.5%. In addition, the Study Group recognizes the contribution from the existing state severance tax of 5% on the value of produced natural gas liquids and recommends no change to this severance tax. In addition, the Study Group recognizes the contribution from the existing state severance tax of 5% on the value of produced natural gas liquids and recommends no change to this severance tax.

Additionally, a statutory fee of \$3,000 for well-permit applications currently exists and the Study Group recommends no change to this fee.

As the level of activity in oil and gas production in the state will increase with time, the Study Group recommends that the General Assembly initially fund the costs associated with the Oil and Gas program as noted above with general appropriated funds during the initial years.

D. Bonds:

The Study Group recommends a comprehensive bonding program to consist of the following types of required bonds: a surface owner bond, geophysical exploration bond, well plugging and abandonment bond, and a site reclamation bond.”<sup>87</sup>

Additionally, the report specified that local government will experience increased costs associated with:

- 1) Transportation infrastructure upgrades & repair
- 2) Waste handling
- 3) Hazmat training
- 4) Emergency response
- 5) Training of local government staff – tax assessors, register of deeds, inspectors/code compliance officers, public safety officers

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<sup>87</sup> [http://portal.ncdenr.org/c/document\\_library/get\\_file?uuid=f7ff4382-fe0a-4308-8a97-82875f7dcb9e&groupId=8198095](http://portal.ncdenr.org/c/document_library/get_file?uuid=f7ff4382-fe0a-4308-8a97-82875f7dcb9e&groupId=8198095)

- 6) Increase in local government personnel or overtime needed
- 7) Drinking water well testing

#### **3.2.3.4 Environmental Standards Committee**

The Environmental Standards Committee of the Mining and Energy Commission met on November 21, 2013 and approved a draft setback rule including the following recommendations:<sup>88</sup>

“(A) The location for a new oil and gas well(s) on a wellpad, tank, tank battery, or the location of a new pit for use during oil and gas well operations shall meet the following minimum setback distances to minimize or mitigate potential adverse impacts to public health, public safety, the environment, and wildlife.

(B) The permittee shall ensure that the surface location of a new oil and gas well(s), tank(s), tank battery, or the location of a new pit(s) shall be located to comply with the following setback distances as measured from the center of the wellhead or production facility, location of tank or battery, and edge of the pit closest to the features below:

- (1) for an occupied dwellings and high occupancy buildings: 500 feet unless the owner of the dwelling consents in writing, in accordance with section 4 below.
- (3) from the edge a public road, highway, utility or a railroad track right-of-way, or other right-of-way: 100 feet;
- (4) for a stream, river, watercourse, pond, lake or other natural and artificial bodies of water: 100 feet and 300 feet for wetlands and trout streams;
- (5) for a public or private water supply well.”<sup>89</sup>

#### **3.2.4 NC Regional Haze Mid-course State Implementation Plan – May 2013**

The Federal Regional Haze rule requires that the state certify that it is on track to meet the 2018 reasonable progress goals for North Carolina Class I areas. North Carolina DENR prepares the emission estimates. NC submitted their Regional Haze Mid-course State Implementation plan to EPA in May 2013. This plan documented the current estimated 2010 State Emissions in Table 4.2 of Appendix B.<sup>90</sup> The State will be required to submit another SIP Review in Dec. 2017 based on the status towards meeting visibility goals for the period 2011-2015. NC participates in a regional planning organization known as VISTAS (Visibility Improvement – State and Tribal Association of the Southeast). The SIP

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<sup>88</sup> Environmental Standards Committee. (2013). Retrieved on November 25, 2013 from [http://portal.ncdenr.org/c/document\\_library/get\\_file?uuid=2c45abb5-8469-4422-88f8-12b2c1f6c490&groupId=8198095&cm\\_mid=2915773&cm\\_crmid={f56ec924-cdcc-e011-b0f4-005056a07b49}&cm\\_medium=email](http://portal.ncdenr.org/c/document_library/get_file?uuid=2c45abb5-8469-4422-88f8-12b2c1f6c490&groupId=8198095&cm_mid=2915773&cm_crmid={f56ec924-cdcc-e011-b0f4-005056a07b49}&cm_medium=email)

<sup>89</sup> Environmental Standards Committee. (2013). Retrieved on November 25, 2013 from [http://portal.ncdenr.org/c/document\\_library/get\\_file?uuid=2c45abb5-8469-4422-88f8-12b2c1f6c490&groupId=8198095&cm\\_mid=2915773&cm\\_crmid={f56ec924-cdcc-e011-b0f4-005056a07b49}&cm\\_medium=email](http://portal.ncdenr.org/c/document_library/get_file?uuid=2c45abb5-8469-4422-88f8-12b2c1f6c490&groupId=8198095&cm_mid=2915773&cm_crmid={f56ec924-cdcc-e011-b0f4-005056a07b49}&cm_medium=email)

<sup>90</sup> [http://daq.state.nc.us/planning/RH\\_Appendix-B\\_EI\\_Documentation\\_05312013.pdf](http://daq.state.nc.us/planning/RH_Appendix-B_EI_Documentation_05312013.pdf)

will need to identify any changes in the emissions (such as a new mixture of air pollutants from shale gas development) that will need to be addressed to meet the 2018 reasonable progress goals.

### 3.2.5 NC CAIR Rules

#### 3.2.5.1 N.C. Hazardous Chemicals Right to Know Act. N.C.G.S Chapter 95, Article 18<sup>91</sup>

“The act requires all employers who “manufacture, process, use, store, or produce hazardous chemicals to maintain a list of each hazardous chemical stored in the facility of 55 gallons or 500 pounds; including material safety data sheets (MSDS). The act also requires the employer to provide this information to the local fire marshal and provide other information when requested in writing. Certain exemptions to the provision of the Right to Know Act are included.”

Under the Hazardous chemicals right to know act, Operational Procedure Notice 135F, Special Emphasis Program for Exposures to Health Hazards, exposure to silica is discussed.

“Silica is present in almost every process where natural minerals are handled. It is prevalent in foundries, in the manufacture and use of abrasives, in the construction industry in construction materials and/or byproduct of activities, and in the manufacture of glass and pottery. Silicosis is one of the world’s oldest known occupational diseases. Although silicosis is preventable, silicosis continues to be a major health threat in the workplace. Annually, more than 250 silica-related deaths occur and greater than one million workers are exposed to silica nationwide. In North Carolina, doctors and laboratories are required to report and hospitals are encouraged to report suspected silicosis in adults.”<sup>92</sup>

### 3.2.6 Spills of Petroleum and Hazardous Substances

The reporting requirements for spills of petroleum products are in North Carolina's Oil Pollution and Hazardous Substances Control Act of 1978, §143-215.85(a and b). The requirements are summarized on the NCDNR Frequently Asked Questions website from which the material below was taken.<sup>93</sup>

“What quantities of hazardous substances and petroleum must be reported?  
The quantities and reporting times vary. The quantities of hazardous substances are available at the following Web site: [www.nclabor.com/legal/righttoknow.pdf](http://www.nclabor.com/legal/righttoknow.pdf). Hazardous substances are reportable only if the spill exceeds the reportable quantity.

If the petroleum discharged, released or spilled:  
is 25 gallons or more,  
or  
causes a sheen on nearby surface water,  
or

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<sup>91</sup> [http://www.nclabor.com/osha/etta/A\\_to\\_Z\\_Topics/right\\_to\\_know.htm](http://www.nclabor.com/osha/etta/A_to_Z_Topics/right_to_know.htm)

<sup>92</sup> Analysis of BTEX groundwater concentrations from surface spills associated with hydraulic fracturing operations. Available at <http://www.ncbi.nlm.nih.gov/pubmed/23687727>

<sup>93</sup> NCDNR Frequently Asked Questions website <http://portal.ncdenr.org/web/deao/faq>, accessed December 18, 2013

is 100 feet or less from surface water body, then the person owning or having control over the oil must immediately take measures to collect and remove the discharge, and report the discharge to NCDENR within 24 hours of discharge, and begin to restore area affected by discharge.

If the petroleum released or spilled:

Is less than 25 gallons, does not cause a sheen on nearby surface water, and is more than 100 feet from surface water bodies, THEN the person who owns or has control over the oil must immediately take measures to collect and remove the discharge. If it cannot be cleaned up within 24 hours of the discharge or causes a sheen on nearby surface water, the person must immediately notify the NCDENR.

If the petroleum released or spilled in any circumstances does not meet one of the above requirements, or is not permitted by GS 143-215.1, or it is not pursuant to a rule adopted by the Environmental Management Commission or, a regulation of USEPA, it must be reported to NCDENR immediately.”

The Oil Pollution and Hazardous Substances Control Act of 1978 can be reviewed in entirety online.<sup>94</sup> The act starts at Article 21A, §143-215.75.

Under the act, oil is defined as follows; "Oil" shall mean oil of any kind and in any form, including, but specifically not limited to, petroleum, crude oil, diesel oil, fuel oil, gasoline, lubrication oil, oil refuse, oil mixed with other waste, oil sludge, petroleum related products or by-products, and all other liquid hydrocarbons, regardless of specific gravity, whether singly or in combination with other substances.<sup>95</sup>

### **3.2.7 NC DENR Online Permit Tracker**

NC DENR has an online permit tracker that allows applicants and the public to check the status of pending environmental permit applications or plan approvals. “Phase 2 of this system, which went live in early October 2012, includes additional water quality permit applications and Division of Water Resource Public Water Supply plans. An earlier phase of this system includes information on 25 different permits, including Air Quality small, synthetic minor and Title V major permits; Water Quality NPDES Wastewater, State Stormwater, Collection Systems and Gravity Sewer Extensions; and Water Resources capacity use permits.”<sup>96</sup>

### **3.2.8 Colorado Hydraulic Fracturing State Review**

It is useful to review the reports from State Review of Oil and Natural Gas Environmental Regulations, Inc. (STRONGER) especially for States that have an extensive history with oil and gas development to review of state exploration and production (E&P) waste management programs against the guidelines.

The recommendations included

- 1) Evaluate NORM (and TENORM)
- 2) Evaluate availability of water

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<sup>94</sup> [www.ncga.state.nc.us/EnactedLegislation/Statutes/html/byarticle/chapter\\_143/article\\_21a.html](http://www.ncga.state.nc.us/EnactedLegislation/Statutes/html/byarticle/chapter_143/article_21a.html) .

<sup>95</sup> Oil Pollution and Hazardous Substances Control Act of 1978 available at [www.ncga.state.nc.us/EnactedLegislation/Statutes/html/byarticle/chapter\\_143/article\\_21a.html](http://www.ncga.state.nc.us/EnactedLegislation/Statutes/html/byarticle/chapter_143/article_21a.html) .

<sup>96</sup> <http://www.ncdenr.gov/web/deao/permit-tracker>

The following is found under Water and Waste Management Section of the report:<sup>97</sup>

“In Colorado over 50% of the flowback water is recycled. Multi-well pits are provided for in Rules 903 and 907 with the intent of promoting recycling. All pits except certain drilling pits must be lined. Pipelines between multi-well pit locations are sometimes used to transfer water used for hydraulic fracturing.”

“There are 290 Class II disposal wells in Colorado. Hydraulic fracturing fluid that is not recycled is disposed in Class II wells or evaporation pits, or at commercial disposal facilities. In addition, some E&P wastes, including hydraulic fracturing fluids, are transported between Colorado and the states of Wyoming, New Mexico, Utah, and Kansas. No hydraulic fracturing flowback water is discharged to surface waters.”

### **3.3 The relationship between State and Local authority**

#### **3.3.1 Dillon’s Rule Relationship to Municipal Authority in North Carolina**

There is great diversity among states regarding the relationship between state and local government. North Carolina is one of 39 states that operate under “Dillon’s Rule” (John Dillion being the judge who, in 1868, issued the court decisions upon which the rule is based). Under Dillon’s Rule, local government’s authority is generally limited to areas specifically granted by state law.<sup>98</sup> In regards to how this affects regulation of shale gas development, in March 2012, the law firm Styers, Kemerait & Mitchell has pointed out that, “As a general rule in North Carolina, local governments have no inherent authority; rather local governments may exercise only those powers delegated to them by the General Assembly. Despite the fact that the General Assembly has made no explicit grant of regulatory authority to local governments regarding exploration and development of oil and gas, local governments have been granted “health, safety and welfare” ordinance-making authority. N.C. Gen. Stat. § 160A-4 (Cities and Towns); § 153A-4 (Counties). Thus, the issue arises as to whether, and the extent to which, this broad construction authority empowers local governments to regulate oil and gas development.”<sup>99</sup>

#### **3.3.2 N.C. Regulatory Reform Act of 2013 (HB 74 – S.L. 2013-143)<sup>100</sup>**

Cities, Towns (and Counties) are temporarily inhibited from adopting ordinances regulating a field that is also regulated by a state or federal environmental agency under Section 10.2. This section applies to new ordinances, but not to existing ordinances. The law allows new city or county ordinances if they are approved by a unanimous vote of the city or county board members present and voting. This legislation contains a sunset date of Oct. 1, 2014. Between now and then, the Environmental Review Commission has been charged with studying the circumstances which local governments should be allowed to regulate

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<sup>97</sup> <http://www.strongerinc.org/sites/all/themes/stronger02/downloads/Colorado%20HF%20Review%202011.pdf>

<sup>98</sup> National League of Cities (NLC) (2013) Local Government Authority. Available at <http://www.nlc.org/build-skills-and-networks/resources/cities-101/city-powers/local-government-authority>, Retrieved on September 25, 2013

<sup>99</sup> Styers, Kemerait & Mitchell (2012) Legal Update: State versus Local Regulation of Shale Gas Development. Available at <http://www.styerskemerait.com/2012/03/state-versus-local-regulation-of-shale-gas-development>. Accessed on September 25, 2013

<sup>100</sup> <http://www.ncleg.net/Sessions/2013/Bills/House/PDF/H74v5.pdf>



matters already regulated by state or federal environmental agencies and reporting these findings to the legislature by May 2014.<sup>101</sup>

### **3.3.3 Difference Between Authority Given to Cities and Counties in North Carolina**

North Carolina broadconstruction authority differs slightly for Counties than for Cities and Towns. Counties are authorized to exercise powers that are “reasonably expedient”, while Cities and Towns exercise of power “shall not be contrary to State or federal law or to the public policy.” Pertinent to Cities and Towns exercise of power, the State of North Carolina is taking the lead on policies and laws relative to shale gas exploration. Broadconstruction for Cities and Towns:

“It is the policy of the General Assembly that the cities of this State should have adequate authority to execute the powers, duties, privileges, and immunities conferred upon them by law. To this end, the provisions of this Chapter and of city charters shall be broadly construed and grants of power shall be construed to include any additional and supplementary powers that are reasonably necessary or expedient to carry them into execution and effect: Provided, that the exercise of such additional or supplementary powers shall not be contrary to State or federal law or to the public policy of this State” (1971, c. 698, s. 1.)<sup>102</sup>

Broadconstruction for Counties:

“It is the policy of the General Assembly that the counties of this State should have adequate authority to exercise the powers, rights, duties, functions, privileges, and immunities conferred upon them by law. To this end, the provisions of this Chapter and of local acts shall be broadly construed and grants of power shall be construed to include any powers that are reasonably expedient to the exercise of the power” (1973, c. 822, s. 1.)<sup>103</sup>

### **3.3.4 Zoning and Development Regulation Powers Granted to Cities in North Carolina**

Cities, Towns (and Counties) are granted Zoning and Development Regulation Powers by the State of North Carolina:

“(a) For the purpose of promoting health, safety, morals, or the general welfare of the community, any city may adopt zoning and development regulation ordinances. These ordinances may be adopted as part of a unified development ordinance or as a separate ordinance. A zoning ordinance may regulate and restrict the height, number of stories and size of buildings and other structures, the percentage of lots that may be occupied, the size of yards, courts and other open spaces, the density of population, the location and use

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<sup>101</sup> North Carolina League of Municipalities – Regulatory Reform Report Available at <http://www.nclm.org/SiteCollectionDocuments/Legislative/2013%20--%20Regulatory%20Reform.pdf> , accessed on November 23, 2013.

<sup>102</sup> Chapter 160A-Cities and Towns, A-4 Broadconstruction, obtained on September 3, 2013 at [http://statutes.laws.com/north-carolina/Chapter\\_160A/GS\\_160A-4#sthash.2h0pDRCr.dpuf](http://statutes.laws.com/north-carolina/Chapter_160A/GS_160A-4#sthash.2h0pDRCr.dpuf)

<sup>103</sup> Chapter 153A – Counties, A-4 Broadconstruction, obtained on September 3, 2013 at [http://statutes.laws.com/north-carolina/Chapter\\_153A/GS\\_153A-4#sthash.6G1jPCy4.dpuf](http://statutes.laws.com/north-carolina/Chapter_153A/GS_153A-4#sthash.6G1jPCy4.dpuf)

of buildings, structures and land. The ordinance may provide density credits or severable development rights for dedicated rights-of-way pursuant to G.S. 136-66.10 or G.S. 136-66.11.”<sup>104</sup>

### 3.3.5 Municipal Regulatory Actions in Other States

In Duke Environmental Law & Policy Forum, Adair, et al. (2012) discuss the legal implications of municipal regulatory action in other states, specifically noting that:

“municipalities in Pennsylvania and New York are attempting to utilize local zoning ordinances to prevent drilling operations from disturbing residents with excessive noise and light and from engaging in other activities that the municipalities consider incompatible with existing land uses. For example, some municipalities have attempted to control the parameters of drilling operations by passing ordinances that make gas drilling a conditional use rather than a permitted use. Permitted uses are allowed as a matter of right within a zoning district, whereas conditional uses are recognized as potentially consistent with the zone but must be evaluated on a case- by-case basis. Conditional use permitting allows a municipality to exercise some control over land use, for example, by requiring a public hearing or a review by the municipal planning commission” (p. 278-9).<sup>105</sup>

Adair et al. (2012) also elaborate on several mechanisms that may help address impacts on local communities and landowners including 1) setback requirements or the minimum required distance between a well and municipal water supply intakes and reservoirs, private water wells, private property lines, protected lands, floodplains, and other valuable land uses, 2) operating requirements in urban areas including managing the site to minimize standing water, weeds, trash, dust, vibration, and odors; prohibiting construction activities at night; and imposing noise restrictions, and 3) imposing outright bans within municipalities (p. 279).<sup>106</sup>

## 3.4 Town of Cary and Regional Considerations

The Duke Environmental Law and Policy Forum report considers the implications of municipal ordinances, suggesting, “the degree to which a local government is able to exert control over drilling activities varies from state to state. For example, Pennsylvania expressly preempts municipal oversight of oil and gas drilling to the extent that it addresses aspects of oil and gas drilling that are already regulated at the state level. North Carolina’s constitution similarly preempts municipal ordinances that overlap with

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<sup>104</sup> Chapter 160A-381, obtained on September 3, 2013 at [http://statutes.laws.com/north-carolina/Chapter\\_160A/GS\\_160A-4#sthash.2h0pDRCr.dpuf](http://statutes.laws.com/north-carolina/Chapter_160A/GS_160A-4#sthash.2h0pDRCr.dpuf)

<sup>105</sup> Adair, Sarah K., Pearson, Brooks P., Monast, J., Vengosh, A. and Jackson, Robert B. (Spring 2012). Considering Shale Gas Extraction in North Carolina: Lessons from Other States. Duke Environmental Law & Policy Forum, Vol. 22:257. Obtained on September 5, 2013 at <http://scholarship.law.duke.edu/cgi/viewcontent.cgi?article=1232&context=delpf>.

<sup>106</sup> Adair, Sarah K., Pearson, Brooks P., Monast, J., Vengosh, A. and Jackson, Robert B. (Spring 2012). Considering Shale Gas Extraction in North Carolina: Lessons from Other States. Duke Environmental Law & Policy Forum, Vol. 22:257. Obtained on September 5, 2013 at <http://scholarship.law.duke.edu/cgi/viewcontent.cgi?article=1232&context=delpf>.

state law.”<sup>107</sup> However, the MEC Local Government Study Group recommends maintaining certain existing authorities, such as zoning, as long as those authorities are not utilized as an outright ban of shale gas development. The following is a discussion of various local and regional organizations, authorities and plans related to shale gas development.

### **3.4.1 Triangle J Council of Government (TJCOG)**

For issues impacting an entire region, the Council of Governments is an organizational body that coordinates and collaborates among multiple units of government. The Triangle J Council of Government<sup>108</sup> serves this region, including Wake, Durham, Orange, Chatham, Lee, Moore and Johnston Counties, which are coincidentally many of the same counties within the Deep River Basin. Triangle J has four program areas including Development & Infrastructure, Water Resources, Sustainable Energy and Environment, and Economic Development. Triangle J does not currently have a Shale Gas Development subcommittee, however the organization could be utilized as a resource and collaborating agency. Other activities relevant to shale gas development include the Triangle Area Water Supply Monitoring Project, initiated in 1998 by a number of local governments in the six-county region with assistance from TJCOG.<sup>109</sup>

### **3.4.2 Municipal Zoning**

#### **3.4.2.1 General description of zoning**

Municipal zoning is described in detail by the UNC-Chapel Hill School of Government, as follows:<sup>110</sup>

“Of all the programs, tools, and techniques associated with land use planning, zoning is perhaps the best known. It may be used to achieve a variety of purposes. First, it can ensure that the community’s land uses are properly situated in relation to one another so that one use does not become a nuisance for its neighbors. Second, zoning can ensure that adequate land and space are available for various types of development. Third, it can ensure that the location and the density of development are consistent with the government’s ability to provide the area with streets, utilities, fire protection, and recreation services. Finally, it can set minimum design standards so that new development reflects aesthetic values, is of appropriate scale, and helps protect privacy.

Zoning involves the exercise of the state’s police power to regulate private property in order to promote the public health, the public safety, and the general welfare. It may legitimately be used to protect property values. Zoning can foster economic development and expansion. However, it can also have the effect of restricting competition among commercial activities because the land available for certain uses may be limited. Promotion of the general welfare is a sufficiently elastic purpose to allow the adoption of

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<sup>107</sup>Adair, Sarah K., Pearson, Brooks P., Monast, J., Vengosh, A. and Jackson, Robert B. (Spring 2012). Considering Shale Gas Extraction in North Carolina: Lessons from Other States. Duke Environmental Law & Policy Forum, Vol. 22:257. Obtained on September 5, 2013 at

<http://scholarship.law.duke.edu/cgi/viewcontent.cgi?article=1232&context=delpf>

<sup>108</sup> Information retrieved on December 18, 2013 from <http://www.tjcog.org/regional-plannin.aspx>

<sup>109</sup> Information retrieved on December 18, 2013 from <http://nc.water.usgs.gov/triangle/overview.html>

<sup>110</sup> Community Planning, Land Use, and Development. UNC-Chapel Hill School of Government. Retrieved on December 18, 2013 from

standards that are justified solely in terms of aesthetics. Because zoning is concerned with the use of property and not its ownership, the identity of owners is irrelevant from a legal perspective. Permits, approvals, and requirements of zoning “run with the land” and apply to future owners as well as present ones. Similarly, zoning distinctions based on whether property is owner- or renter-occupied are unenforceable. Zoning may legitimately be used to protect property values, but requirements that new developments meet minimum- floor-area standards or cost a certain amount may well be legally indefensible. The obligation of North Carolina local governments to accommodate low- and moderate-income housing through zoning remains unclear; nonetheless, zoning may not be used as a tool to discriminate on the basis of race or national origin.

Although zoning is primarily a tool for influencing the use of private property, in North Carolina it is also applicable to the construction and the use of buildings by the state and its political subdivisions (G.S. 160A-392; G.S. 153A-347). Zoning is prospective in nature: only land uses begun after the ordinance’s effective date must comply with all the regulations. However, existing buildings and lots with characteristics that do not comply with the regulations are said to be *nonconforming* (see the discussion under the heading “Nonconformities and Amortization,” later in this article), and a special section of the ordinance deals with nonconformities.

The characteristic of zoning that distinguishes it from most other types of land use regulations is that zoning regulations are different from district to district rather than uniform throughout a city. This feature permits the tailoring of zoning to address development problems, but also means that local governing bodies may be tempted to abuse the power by giving arbitrary and discriminatory treatment to certain property owners.

### **Basic Elements**

A *zoning ordinance* consists of a text and a map (or series of maps). The text includes the substantive standards applicable to each district on the map and the procedures that govern proposals for changes in both the text and the map. The zoning ordinance divides the land within a city’s jurisdiction into a number of zoning districts. The land in each district is governed by several types of regulations: (1) use regulations; (2) dimensional requirements, including setback and density standards; and (3) other miscellaneous requirements dealing with matters such as off-street parking, landscaping and screening, property access, required public improvements, and signs.

### ***Uses Permitted by Right***

If a use is permitted by right, the zoning standards for that use are typically spelled out in specific terms, and the zoning enforcement official grants the applicant routine permission to proceed. In some cases an applicant for a zoning permit must hire a design professional (e.g., an engineer, a landscape architect, or an architect) to prepare a site

plan for a use authorized by right. Such a site plan may have to be reviewed by various departments, outside agencies, or a technical review committee made up of representatives of those departments or agencies. In some cities the city council or the planning board approves such a site plan. As a general rule, however, such a site plan must be approved as submitted, if it meets local standards.

### ***Uses Permitted by Conditional Use Permits***

Many jurisdictions contain a variety of uses that merit closer scrutiny because of their scale and effect or their potential for creating a nuisance. These conditional uses may be permissible in a particular district but only at particular locations and then only under particular conditions. *Conditional use permits* (also known as *special use permits* or *special exceptions*) may be issued by the council, the zoning board of adjustment, or the planning board. Regardless of which body issues the permit, the decision to grant or to deny it must be based on evidence supplied at a quasi-judicial hearing. The zoning ordinance must explicitly list the requirements that the applicant must meet and the findings that the issuing body must make in order for the permit to be issued. If these requirements are met, the board may not refuse to issue the permit. However, it may impose additional conditions and requirements on the permit that are not specifically mentioned in the ordinance. Such conditions may include specifications on the particular use to be made of the property; sign, parking, or landscaping requirements; requirements that the property owner dedicate land for and construct certain public improvements like streets, utilities, and parks; and specifications dealing with the timing of development. Conditional use permits may be used to deal with small-scale land uses like electric substations and day-care centers or with large-scale developments like shopping centers and group housing developments. Permission to develop or use land in accordance with a conditional use permit runs with the land and applies with equal force to future owners of the property.

### ***Types of Zoning Districts***

Zoning districts may also be classified as *general use districts*, *conditional use districts* (also known as *special use districts*), or *conditional districts*. All zoning ordinances include at least some general use districts. Various uses or activities are permitted to locate and operate in a general use district either (1) by right or (2) subject to a conditional use permit or a special use permit). Generally, any use not specifically listed as permitted is, by implication, prohibited.

Most zoning ordinances include three basic types of zoning districts—residential, commercial, and industrial—and a variety of more specialized types of zones—office and institutional, flood hazard, mobile home park, agricultural, and perhaps planned unit development. There may be a number of residential districts, each based on different permissible dwelling types and required lot sizes (or densities).

The zoning ordinances of some North Carolina cities and counties provide not only for general use districts, but for conditional use districts. Any use of land in a conditional use district is subject to a conditional use permit; there are no uses permitted by right. Thus all development in a conditional use district is subject to discretionary review. In cities and counties that rely on conditional use districts, it is customary for the governing board to grant the conditional use permit. This way the governing board can consider the application for a conditional use permit at the same time that it considers a petition for the rezoning of land to the conditional use district that authorizes such a permit.

A third type of zoning district that is authorized for cities and counties is the conditional district. Each conditional district is one-of-a-kind. The text of the zoning amendment adopting the zoning map change incorporates a series of conditions, stipulations, and requirements agreed to by both the property owner and the local governments, typically including a site development plan that shows in some detail just how and when the property will be developed. No conditional use permit or special use permit is involved.”<sup>111</sup>

#### ***3.4.2.2 Town of Cary Land Development Ordinance (LDO)***

The Town of Cary zoning and development regulations are consolidated into the Town’s Land Development Ordinance (LDO). Currently in the LDO, Shale Gas Development is an “Unlisted Use” and an applicant would go through a request process to get it classified according to the nearest definition. The nearest definition currently with the LDO would likely be Resource Extraction, which may occur by Special Use Permit within the Industrial Zone (5-12). Currently within the LDO, when applying for a Special Use Permit, a State Mining Permit is first required. Various other requirements, including 300’ setbacks, are outlined in the regulations (5-41, 5-42).<sup>112</sup>

If shale gas development was to occur, it is useful to consider those areas within the town that are currently zoned Industrial or likely to be zoned industrial. The Town has three locations currently zoned industrial, which may be partially or entirely located within the Deep River Basin (with potential for shale gas extraction). This includes: a) an area east of 55 and south of Kit Creek, b) an area north of James Jackson Avenue and south of Norfolk-Southern Railroad, located primarily between Cary Parkway and NW Maynard Rd, and c) an area south of Old Apex Road and CSX Railroad, primarily east of Cary Parkway. Two additional Industrial locations are generally projected to be outside but close to the Deep River Basin, including: a) a portion of MacGregor Park, north and south of Highway 1 and b) an area south of NW Maynard Rd, between CSX Railroad and W. Chatham St.<sup>113</sup> Any future amendments to the LDO and zoning districts would occur through the standard Town process. At this time, it is not known whether these areas are likely candidates for shale gas development.

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<sup>111</sup> Community Planning, Land Use, and Development. UNC-Chapel Hill School of Government. Retrieved on December 18, 2013 from <http://sogpubs.unc.edu/cm/cmg25.pdf>

<sup>112</sup>Town of Cary Land Development Ordinance, accessed on September 25, 2013 at [http://www.townofcary.org/Departments/Planning\\_Department/Development\\_Regulations/Land\\_Development\\_Ordinance.htm](http://www.townofcary.org/Departments/Planning_Department/Development_Regulations/Land_Development_Ordinance.htm)

<sup>113</sup> Town of Cary Zoning Map, June 13, 2013, accessed on September 25, 2013 at <http://www.townofcary.org/Assets/Planning+Department/Maps/Zoning+Map.pdf>

Additionally, if the State accepts the recommendations of the MEC study group, zoning will only apply to surface land use, not subsurface area. Therefore, if a mining company has oil and gas rights and utilizes horizontal drilling techniques, extraction may be allowed by the state (regardless of local zoning) UNDER lands within other zones. Additional work will be necessary to identify the owners and to determine whether subsurface mineral rights have been severed (on these areas in Cary, similar areas in Cary's ETJ, in Morrisville and other properties adjacent to Cary). Concerns related to severed oil and gas rights and property ownership is discussed in greater detail below.

### **3.4.3 Town of Cary Secondary and Cumulative Impacts Master Mitigation Plan**

The Town of Cary has adopted a Secondary and Cumulative Impacts Master Mitigation Plan<sup>114</sup>, which does not currently address impacts from shale gas development. Revisions to the plan are currently being considered and shale gas development can be addressed in the revised plan.

### **3.4.4. Severed Oil and Gas Rights in Cary and the Triangle**

Rights to develop oil and gas, including shale gas development through the hydraulic fracturing process, can be severed from a property. According to a recent news report at least 425 lots in Wake, Durham and Chatham counties have had mineral rights sold to DRH Energy, a subsidiary of D.R. Horton development. D.R. Horton develops residential subdivisions in the Triangle region. DRH Energy is just one potential development company of oil and gas. According to the report, within the Town of Cary, Bellemont at Cary Park, Cary Park, Prestwyck, and Old Millburnie Crossing have some parcels affected by the D.R. Horton and DRH Energy transactions. In Chatham County, Legend Oaks is reported to be affected. Not all properties in these communities are affected.<sup>115</sup> The news item recommends the following process for owners interested in researching this information for their own parcel(s).

“Because mineral rights issues are new in North Carolina, before buying a home or property ask the Realtor or seller about the mineral deed. The *Indy* determined these areas by searching for D.R. Horton and DRH Energy as the grantor and grantee in each county's Register of Deeds database. After we retrieved the mineral deed, we entered the property's Tax ID number, which is found on the right side of the document, into the county's property's tax bill search page. That yielded the addresses, which we are not listing for privacy reasons. In some cases, there was only a lot description on the deed, as in the case of Keystone Crossing and Ashfield Place.”<sup>116</sup>

### **3.4.5 Town of Cary Water Supply**

The Town of Cary's water supply is from Jordan Lake. Jordan Lake and the Jordan Land Watershed are

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<sup>114</sup> Town of Cary Secondary and Cumulative Impacts Master Mitigation Plan, accessed on September 25, 2013 at [http://www.townofcary.org/Departments/Public Works and Utilities/Secondary and Cumulative Impacts Master Mitigation Plan\\_Cary\\_North\\_Carolina.htm](http://www.townofcary.org/Departments/Public Works and Utilities/Secondary and Cumulative Impacts Master Mitigation Plan_Cary_North_Carolina.htm)

<sup>115</sup> Sorg, Lisa. (April 4, 2012). Does a developer's sale of mineral rights to an energy company foreshadow fracking? *Indy Week*. Retrieved on October 30, 2013 from <http://www.indyweek.com/indyweek/does-a-developers-sale-of-mineral-rights-to-an-energy-company-foreshadow-fracking/Content?oid=2970445>

<sup>116</sup> Sorg, Lisa. (April 4, 2012). Does a developer's sale of mineral rights to an energy company foreshadow fracking? *Indy Week*. Retrieved on October 30, 2013 from <http://www.indyweek.com/indyweek/does-a-developers-sale-of-mineral-rights-to-an-energy-company-foreshadow-fracking/Content?oid=2970445>

located within the Deep River Basin (an area with potential for shale gas extraction). Information about the Town's water supply and demand is available on the Town's website.<sup>117</sup> Jordan Lake provides drinking water for 300,000 people and is an important recreational destination. Recently, there has been significant controversy regarding changes to legislation affecting the water quality in Jordan Lake. While allowing existing water quality measures to remain in place, including existing riparian buffer rules, the Jordan Lake Water Quality Act (SB 515) delayed for three years additional measures that were to be implemented by July 1, 2013.<sup>118</sup> In 2012 S.L. 2012-200, pushed back the deadline for local governments to adopt ordinances requiring control of stormwater from new development from 2012 to 2014.<sup>119</sup> About one-half the jurisdictions in the watershed have already adopted and have implemented new development ordinances<sup>120</sup> including the Town of Cary.<sup>121</sup>

### 3.4.6 Town of Cary Pre-Treatment Requirements for Industrial Wastewater

The Town of Cary requires pre-treatment to dispose of industrial wastewater.<sup>122</sup> There is a general prohibition on "discharge [of] wastewater into the POTW<sup>123</sup>, directly or indirectly, which causes interference or pass-through."<sup>124</sup> The terms interference and pass through defined as follows.<sup>125</sup>

"Pass through shall mean a discharge which exits the POTW into waters of the state in quantities or concentrations which, alone or with discharges from other sources, causes a violation, including an increase in the magnitude or duration of a violation, of the control authority's (and/or POTW's, if different from the control authority) NPDES, collection system, or nondischarge permit, or a downstream water quality standard."

"Interference shall mean the inhibition or disruption of the POTW collection systems, its treatment processes or operations, or its residual solids processes, use or disposal, which causes or contributes to a violation of any requirement of the control authority and/or POTW, if different from the Control Authority, NPDES, collection systems, or nondischarge permit or prevents residual solids use or disposal in compliance with applicable state and federal statutes, regulations, or permits. The term includes prevention of sewage residual solids use or disposal by the POTW in accordance with section 405 of the Act (33 USC 1345), or any criteria, guidelines, or regulations developed pursuant to the Solid Waste Disposal Act (SWDA) (42 USC 6901 et seq.), the Clean Air Act, the Toxic Substances Control Act, the Marine Protection Research and Sanctuary Act (MPRSA), or more stringent state criteria (including those contained in any state residual

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<sup>117</sup> Town of Cary

<sup>118</sup> [http://www.ciclt.net/sn/leg/l\\_detail2.aspx?ClientCode=nclm&L\\_State=nc&L\\_Session=2013-2014&L\\_ID=556341](http://www.ciclt.net/sn/leg/l_detail2.aspx?ClientCode=nclm&L_State=nc&L_Session=2013-2014&L_ID=556341)

<sup>119</sup> <http://www.ncleg.net/Sessions/2011/Bills/Senate/PDF/S229v5.pdf>

<sup>120</sup> NCDENR Jordan Lake Rules, accessed on November 23, 2013 at <http://portal.ncdenr.org/web/jordanlake/draft-new-development-programs>

<sup>121</sup> Town of Cary's Jordan Lake New Development Rule, accessed on November 23, 2013 at [http://portal.ncdenr.org/c/document\\_library/get\\_file?uuid=70634c86-5970-4f07-ae9d-f6e40c0541e2&groupId=235275](http://portal.ncdenr.org/c/document_library/get_file?uuid=70634c86-5970-4f07-ae9d-f6e40c0541e2&groupId=235275)

<sup>122</sup> [http://www.townofcary.org/Departments/Public\\_Works\\_and\\_Uilities/Sewer/seweruse.htm](http://www.townofcary.org/Departments/Public_Works_and_Uilities/Sewer/seweruse.htm)

<sup>123</sup> POTW is Publically Owned Treatment Works, which is the Cary wastewater treatment plant

<sup>124</sup> [http://www.amlegal.com/pdffiles/Cary\\_pdf/code\\_CH36.pdf](http://www.amlegal.com/pdffiles/Cary_pdf/code_CH36.pdf)

<sup>125</sup> [http://www.amlegal.com/pdffiles/Cary\\_pdf/code\\_CH36.pdf](http://www.amlegal.com/pdffiles/Cary_pdf/code_CH36.pdf)



solids management plan prepared pursuant to Title IV of the SWDA) applicable to the method of disposal or use employed by the POTW.”

This prohibition, and a range of other requirements in the Town’s rules, would apply to any wastewater sent to the city’s wastewater treatment plant from a shale gas operation.

### **3.4.7 Shale Gas Extraction Moratoriums and Bans in North Carolina Municipalities**

Within the State of North Carolina, two municipalities and one county have enacted policy to prohibit or temporarily prohibit the implementation of Shale Gas extraction. This includes the City of Raleigh, the City of Creedmoor, which is located approximately 20 miles northeast of Durham, and Anson County, located approximately 20 miles southeast of Charlotte. Granville County passed a resolution opposing hydraulic fracturing at the October 21, 2013 meeting.

Raleigh is mostly located outside of the Deep River Basin, however the City passed a ban in May 2012, prior to the passage of Clean Energy and Economic Security Act which authorized natural gas horizontal drilling and hydraulic fracturing in the state.<sup>126</sup>

Creedmoor is located in the southern portion of Granville County, entirely within the Deep River Basin. The ordinance enacted by the City of Creedmoor prohibits “oil and gas drilling which involve horizontal drilling with fracturing within the corporate limits of the City of Creedmoor and its extraterritorial jurisdiction.” This was enacted September 12, 2011, shortly after Session Law 2011-276/House Bill 242, approved June 23, 2011, in NCGS 113-424, Section 4, directed the North Carolina Department of Environmental and Natural Resources and the Consumer Protection Division of the Department of Justice to conduct a thorough study of the issue of oil and gas exploration in the State and the use of directional and horizontal drilling and hydraulic fracturing for that purpose.

Anson County is on the border of South Carolina and approximately one-third of the land area in Anson County is located within the Deep River Basin. On May 7, 2013, Anson County Commissioners adopted a “Moratorium, which temporarily prohibits natural gas development activities, including hydraulic fracturing and horizontal drilling, from occurring within Anson County while ordinance are developed, enacted and implemented to protect the rights of Anson County Residents and the natural resources we enjoy.”

Granville County is adjacent to Durham and Wake Counties. Approximately one-third of the land area in Granville County is located within the Deep River Basin, with the City of Creedmoor, where municipal action has been taken, fully engulfed within the Deep River Basin.

None of these bans and moratoriums has been challenged in North Carolina courts so it is not known whether they exceed local authorities under State law.

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<sup>126</sup>North Carolina Mining and Energy Commission Local Government Regulation Study Group Report, p. 8, accessed on September 19, 2013 at [http://portal.ncdenr.org/c/document\\_library/get\\_file?uuid=48665ab9-244f-4e94-ad75-6d338339ebf2&groupId=8198095](http://portal.ncdenr.org/c/document_library/get_file?uuid=48665ab9-244f-4e94-ad75-6d338339ebf2&groupId=8198095)

### 3.4.8 Case Law on Municipal Bans in Other States

According to Adair, et al. (2012), “some municipalities in Pennsylvania, New York, and West Virginia have banned hydraulic fracturing within and around their borders. A state court recently overturned one such ban in Morgantown, West Virginia. The judge held that a municipality did not have the authority to preempt the Department of Environmental Protection’s drilling regulations. In contrast, municipal bans in both Dryden and Middlefield, New York, were upheld by New York state courts in February 2012. Whether such bans will prevail in court under various state constitutions is unclear.”<sup>127</sup>

“Colorado has seen extensive oil and gas development in recent decades and, like Ohio and Texas, has court decisions on preemption in the oil and gas context going back decades.” Historically, “Colorado has not witnessed the same assault on municipal authority that has taken place in states like Ohio and Pennsylvania. Instead, a more cooperative approach has prevailed.” However, more “recently, three Colorado cities approv[ed] bans or moratoriums on hydraulic fracturing, known as fracking.”<sup>128</sup>

In the American Planning Association’s, July 2012 issue of Planning and Environmental Law, a review was conducted of various cases of state preemption of municipal efforts on shale gas development. The author, Shaun Goho, suggested “[a] ban provides the most straightforward way for a municipality to avoid the public health and environmental impacts associated with fracking. It is also, however, the type of ordinance most likely to provoke resistance from gas companies and some landowners. A ban is also...more likely to be struck down in court than a more limited zoning ordinance.”<sup>129</sup>

### 3.4.9 Land Use and Development Moratoria

According to the UNC School of Government,<sup>130</sup>

“it is likely that North Carolina local governments have the statutory authority to impose temporary development moratoria, though a firm conclusion on this question must await legislation or litigation. This can be done as an interim zoning ordinance if the full statutory procedures for zoning are followed. A moratorium also can be adopted by ordinance as a general police power regulation if it is needed for the protection of the public health, safety, or welfare.

It is important for a local government considering a moratorium to carefully tailor it to address the particular problem at hand in order for the action to be reasonable. Care should be exercised in determining the urgency of the need, with use of a moratorium

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<sup>127</sup> Adair, Sarah K., Pearson, Brooks P., Monast, J., Vengosh, A. and Jackson, Robert B. (Spring 2012). Considering Shale Gas Extraction in North Carolina: Lessons from Other States. Duke Environmental Law & Policy Forum, Vol. 22:257, p. 279-80. Obtained on September 5, 2013 at <http://biology.duke.edu/jackson/delpf2012.pdf>

<sup>128</sup> Wines, Michael. (November 7, 2013). Colorado Cities’ Rejection of Fracking Poses Political Test for Natural Gas Industry. New York Times. retrieved on December 18, 2013 from [http://www.nytimes.com/2013/11/08/us/colorado-cities-rejection-of-fracking-poses-political-test-for-natural-gas-industry.html?\\_r=0](http://www.nytimes.com/2013/11/08/us/colorado-cities-rejection-of-fracking-poses-political-test-for-natural-gas-industry.html?_r=0)

<sup>129</sup> Goho, Shaun A. (July 2012). Municipalities and Hydraulic Fracturing: Trends in State Preemption. Planning and Environmental Law. Vol. 64, No. 7. American Planning Association. Retrieved on December 18, 2013 from <http://blogs.law.harvard.edu/environmentallawprogram/files/2013/03/Municipalities-and-Hydraulic-Fracturing-Trends-in-State-Preemption.pdf>

<sup>130</sup> Owens, David W. Land Use and Development Moratoria. UNC-Chapel Hill School of Government. Retrieved on December 18, 2013 from <http://www.sog.unc.edu/node/1476>.

limited to those situations where there is a pressing public need for action that cannot be reasonably addressed in any other way. Moratoria should not be used to address routine land-use issues, as normal zoning and related land-use tools can adequately handle such issues.

A moratorium should have an explicitly limited duration, with its length being reasonably related to the time it is expected to take the local government to address the problem that led to adoption of the moratorium. For example, it would be unreasonable to have a two-year moratorium when its purpose is to maintain the status quo for six months while a plan and rezoning are considered. However, if it will take an estimated two years to plan and construct a necessary wastewater treatment plant expansion, it would be reasonable to have a two-year moratorium on sewer hookups. The notion of an explicitly limited duration of moratoria has been a critical factor in a number of court decisions upholding moratoria, as the courts have been willing to sanction temporary restrictions imposed in response to urgent needs that would not be allowed as permanent measures.

An ordinance establishing a moratorium should be as specific as is possible as to its cause, duration, geographic coverage, and subject matter coverage. There should be no vagueness as to what is being regulated. For example, it should be clear whether a moratorium applies to new land uses only or also to expansions or replacement of existing uses.

Lastly, it is important that action be initiated to address the problem leading to the moratorium. The moratorium itself cannot be the answer or solution. It should only be used as a good faith means of providing the time for a reasonable long-term solution--be it new plans, ordinances, or public improvements--to be developed and put into place.”<sup>131</sup>

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<sup>131</sup> Owens, David W. Land Use and Development Moratoria. UNC-Chapel Hill School of Government. Retrieved on December 18, 2013 from <http://www.sog.unc.edu/node/1476>.

# Chapter 4: Risk Assessment and Health/Economic/Environmental Impact Analysis

The exploration and development of shale gas resources in the Deep River Shale could impact the citizens of Cary in a variety of ways. The purpose of this section is to identify the potential risks associated with the shale gas development process to assist the Town in identifying policies and ordinances to address the concerns of the citizens of Cary. Issues that are primarily national or global in scope rather than local or regional (e.g. climate change, energy costs) are not included.

Several communities in Arkansas, Colorado, Pennsylvania, Texas, Virginia, West Virginia and Wyoming are reported to have experienced a wide range of negative impacts from natural gas production from shale gas development. In this section we examine these risks in the context of the interests of the Town of Cary. Many of these risks are, or are expected to be, addressed by national and state regulations. The challenge for the Town of Cary will be identifying gaps in those regulations that can and should be filled by the Town. Legislation and regulations addressing these potential risks are addressed in Chapter 3 of this report.

The material below is limited to potential impacts on Cary. For instance, issues of national energy policy and the impacts on societal greenhouse gas emissions of substituting natural gas for other fossil fuels are not addressed. In addition, the discussion of the potential economic impacts (positive or negative) on Cary is extremely limited as these impacts fall outside of the mission of the Environmental Resources Board.

## 4.1 Potential impacts

### 4.1.1 Water availability

Two to four million gallons of water or more is required to hydraulically fracture a single shale gas well.<sup>132</sup> While this water requirement is episodic, being related primarily to well development, the cumulative requirements associated with a large number of wells could be significant. Until the placement of wells is known, the source of water that will be required is not known. Given the constraints on Cary's water supply, however, it will be important to know whether the Town's current or future supply could be jeopardized by withdrawals needed to support shale gas development in the region.

The current and future water supply situation is described in a Long Range Water Resources Plan. That plan describes the situation as follows.<sup>133</sup>

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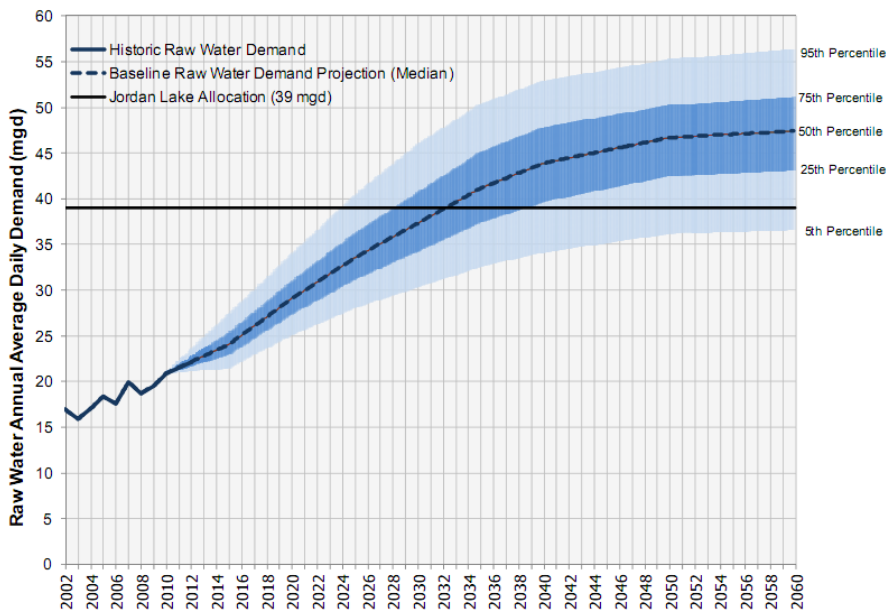
<sup>132</sup> Olmstead, S.M., Muehlenbachs, L.A., Shih, J., Chu, Z. & Krupnick, A. J., Shale gas development impacts on surface water quality in Pennsylvania. Proceedings of the National Academy of Sciences, March 2013, Vol. 110, No. 13, pp. 4962-4967

<sup>133</sup> CH2MHill (2013) Final Long Range Water Resources Plan – Prepared for Towns of Cary, Apex and Morrisville and Wake County. January 2013. Available at [http://www.townofcary.org/Departments/Public\\_Works\\_and\\_Uilities/Water/longrangeplan.htm](http://www.townofcary.org/Departments/Public_Works_and_Uilities/Water/longrangeplan.htm)

“The Towns of Apex, Cary and Morrisville and Wake County hold Jordan Lake water supply storage allocations granted by the State of North Carolina with a nominal total yield of 39 mgd. Currently, most of this water is consumed and/or discharged as highly treated wastewater effluent in the Neuse River basin. As a result, an interbasin transfer (IBT) certificate, approved by the State’s Environmental Management Commission (EMC), is required and was issued jointly to Apex, Cary, Morrisville and Wake County in 2001. Although the Towns are in the process of constructing a new regional water reclamation facility (WRF) that will discharge to the Cape Fear River downstream of Jordan Lake, any additional water supply allocation from Jordan Lake to the Towns could require a modification of the current IBT certificate.”<sup>134</sup>

The projected future demand is compared to the current allocations in Figure 4.1.

Figure 4.1. Annual Average Daily Raw Water Demand, Towns of Apex, Cary, and Morrisville, RDU Airport, and RTP South, 2002 through 2060 <sup>135</sup>



As the Water Resources Plan points out, it is apparent that the Towns will require additional fresh water supply and treatment capacity. In addition, waste water treatment plant capacity and inter-basin transfers of water may also become important issues. In the words of the plan, “[c]onsidered as a whole, the total required wastewater treatment capacity in 2060 is 44.5 mgd and the theoretically available capacity is 46.4 mgd, leaving 1.9 mgd of excess capacity (96 percent capacity utilization). Given the North Carolina Department of Environment and Natural Resources (NCDENR) requirement for facility expansion at 90

<sup>134</sup> CH2MHill (2013) Final Long Range Water Resources Plan – Prepared for Towns of Cary, Apex and Morrisville and Wake County. January 2013. Available at <http://www.townofcary.org/Departments/Public Works and Utilities/Water/longrangeplan.htm>

<sup>135</sup> CH2MHill (2013) Final Long Range Water Resources Plan – Prepared for Towns of Cary, Apex and Morrisville and Wake County. January 2013. Available at <http://www.townofcary.org/Departments/Public Works and Utilities/Water/longrangeplan.htm>

percent of capacity, it may be necessary to expand capacity at one or more facilities.” In addition, “the inter-basin transfer forecast indicates that ...the Towns will require a modification of their current IBT certificate to be able to fully access their current Jordan Lake water supply allocations.”

The Ecological Flows Science Advisory Board (EFSAB) has identified a scientifically defensible approach to establishing flow requirements for the maintenance of ecological integrity for streams and rivers which could be used to identify periods when water withdrawals by shale gas operations and others might be needed to be limited to protect ecological integrity.<sup>136</sup>

#### **4.1.2 Soil and Water Contamination**

Under current national regulations, natural gas operations cannot discharge wastewaters directly to surface waters. This is based on EPA’s assessment that options are available for managing this wastewater that do not involve direct discharge to surface waters. Three main options available under the EPA rules are deep well injection, evaporation in holding ponds or transferring to a publically owned treatment works (POTW) from which the wastewater can be discharged to surface waters. (For more on these rules, see the material in Chapter 3 on regulations affecting shale gas operation.)

One potential route for surface water contamination is passing of contaminants through, or interference of, municipal wastewater treatment plants receiving wastewaters from shale gas operations. In addressing questions about the treatment of wastewaters from Marcellus shale development in POTWs, EPA has observed that “[c]onstituents in SGE [shale gas extraction] wastewater such as total dissolved solids (TDS) have been found to be present at concentrations ranging from 280 mg/l to 345,000 mg/l. Chloride has been reported in concentrations up to 196,000 mg/l. TDS is not significantly removed by most conventional POTW treatment systems; therefore, pretreatment of the wastewater would be required prior to discharge to the POTW. However, very little comprehensive data have been collected nationwide on TDS treatment capability at POTWs. Common constituents of TDS include calcium and magnesium (also a measure of “hardness”), phosphates, nitrates, sodium, potassium, sulfates, chloride, and even barium, cadmium, and copper. A literature data search revealed that some of these individual constituents of TDS may result in POTW process inhibition in activated sludge, nitrification, and anaerobic digestion processes. POTWs may exhibit these process inhibitions from these individual constituents at concentrations that are several magnitudes lower than the composite TDS found in SGE wastewater (example: sulfate at 400-1000 mg/l disrupting anaerobic digestion processes; chloride at 180 mg/l disrupting nitrification processes). High concentrations of chlorides, such as in Marcellus SGE wastewater, can disrupt biological treatment units. Some POTWs that had previously accepted oil and gas extraction waste through their pretreatment programs experienced operational problems due to high concentrations and spikes in concentrations of TDS. In addition, some of the constituents in oil and gas extraction waste, such as metals, can precipitate during the treatment process and contaminate biosolids which may require expensive decontamination of biosolids drying beds or change the chosen method of use or disposal. Bromide, which can be present in SGE wastewater in significant concentrations, has the

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<sup>136</sup> [http://www.ncwater.org/files/eflows/sab/EFSAB\\_Final\\_Report\\_to\\_NCDENR.pdf](http://www.ncwater.org/files/eflows/sab/EFSAB_Final_Report_to_NCDENR.pdf)

potential to be present in POTW effluent as a disinfection byproduct and may cause an increase in whole effluent toxicity.”<sup>137</sup>

EPA goes on to observe that “[b]ecause there is a significant possibility that SGE wastewater may “pass through” the POTW, causing the POTW to violate its permit, cause “interference” with the POTW’s operation, or contamination of biosolids, acceptance of the waste is not advisable unless it’s effects on the treatment system are well understood and the wastewater is not reasonably expected to cause pass through or interference. POTWs cannot accept ... wastewater if acceptance of the wastewater would result in violations of the POTW’s permit, the POTW’s requirement under 40 CFR 403.5(c) to develop and enforce local limits to implement the general and specific prohibitions of 403.5(a)(1) and (b), or contamination that interferes or disrupts biosolids processes, uses, or disposal. NPDES permits for discharges from POTWs to water of the U.S. also must meet applicable water quality-based requirements... Radionuclides in Marcellus SGE wastewater also pose a challenge for POTWs. .... Appropriate limits and pretreatment requirements will need to be developed by the permitting authority and the pretreatment control authority.”<sup>138</sup>

A range of chemical additives are required to drill and fracture wells to produce shale gas. The FracFocus Chemical Disclosure Registry, a registry of voluntarily submitted data on hydraulic fracturing sponsored by the Ground Water Protection Council and Interstate Oil and Gas Compact Commission, indicates that the chemicals shown in Table 4.1 are the most frequently used<sup>139</sup>. The list does not include chemicals that the participating companies identify as trade secrets. Some of these chemicals are relatively benign (e.g. sodium chloride, sodium carbonate, citric acid), but some can cause significant toxicity to aquatic organisms (e.g. tetramethyl ammonium chloride<sup>140</sup>). Others can be toxic to humans in high doses (e.g. methanol and ethanol). The mere length of the list, and the knowledge that it is incomplete, explains some of the concern about potential environmental effects related to the release of substances used in hydraulic fracturing. In addition, as noted above, flowback water from natural gas wells can contain naturally occurring radioactive materials (NORM). The levels of NORM in water extracted with oil and natural gas can be higher than normally seen in groundwater, but the primary risk is associated with NORM-containing scale that accumulates in processing equipment. This scale can require special attention when it is disposed of.<sup>141</sup> Increased levels of radioactivity have been found downstream of a POTW treating wastewater from shale gas operations in Pennsylvania.<sup>142</sup>

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<sup>137</sup> EPA (2011) Answers to Frequently Asked Questions: Attachment to memorandum from James Hanlon, Director of EPA’s Office of Wastewater Management to the EPA Regions titled, “Natural Gas Drilling in the Marcellus Shale under the NPDES Program” March 16, 2011. Available at <http://cfpub.epa.gov/npdes/hydrofracturing.cfm>

<sup>138</sup> EPA (2011) Answers to Frequently Asked Questions: Attachment to memorandum from James Hanlon, Director of EPA’s Office of Wastewater Management to the EPA Regions titled, “Natural Gas Drilling in the Marcellus Shale under the NPDES Program” March 16, 2011. Available at <http://cfpub.epa.gov/npdes/hydrofracturing.cfm>

<sup>139</sup> FracFocus (2013) What Chemicals are Used. Available at <http://fracfocus.org/>. Accessed September 26, 2013

<sup>140</sup> MSDS for tetramethylammonium chloride. Available at <http://datasheets.scbt.com/sc-251199.pdf>. Accessed September 26, 2013

<sup>141</sup> USGS (1999) Naturally occurring radioactive materials (NORM) in produced water in oil-field equipment – An issue for the energy industry. USGS Fact Sheet FS-142-99. September 1999. Available at <http://pubs.usgs.gov/fs/fs-0142-99/fs-0142-99.pdf>. Accessed September 26, 2013

<sup>142</sup> Warner et al. (2013) Impacts of Shale Gas Wastewater Disposal on Water Quality in Western Pennsylvania *Environ. Sci. Technol.*, 2013, 47 (20), pp 11849–11857

Table 4.1 Chemicals most frequently used in hydraulic fracturing (from FracFocus)

<b>Chemical Name</b>	<b>Chemical Purpose</b>	<b>Function</b>
2-Butoxyethanol	Product stabilizer	Surfactant
Acetaldehyde	Prevents the corrosion of the pipe	Corrosion Inhibitor
Acetic Acid	Prevents precipitation of metal oxides	Iron Control
Acetic Acid	Adjusts the pH of fluid to maintains the effectiveness of other components	pH Adjusting Agent
Ammonium Persulfate	Allows a delayed break down of the gel	Breaker
Borate Salts	Maintains fluid viscosity as temperature increases	Crosslinker
Boric Acid	Maintains fluid viscosity as temperature increases	Crosslinker
Calcium Chloride	Product Stabilizer	Breaker
Choline Chloride	Prevents clays from swelling or shifting	Clay Stabilizer
Citric Acid	Prevents precipitation of metal oxides	Iron Control
Copolymer of Acrylamide and Sodium Acrylate	Prevents scale deposits in the pipe	Scale Inhibitor
Ethanol	Product stabilizer and / or winterizing agent.	Surfactant
Ethylene Glycol	Product stabilizer and / or winterizing agent.	Crosslinker
Formic Acid	Prevents the corrosion of the pipe	Corrosion Inhibitor
Glutaraldehyde	Eliminates bacteria in the water that produces corrosive by-products	Biocide
Guar Gum	Thickens the water in order to suspend the sand	Gelling Agent
Hydrochloric Acid	Helps dissolve minerals and initiate cracks in the rock	Acid
Hydrotreated Light Petroleum Distillate	Carrier fluid for borate or zirconate crosslinker	Crosslinker
Hydrotreated Light Petroleum Distillate	Carrier fluid for polyacrylamide friction reducer	Friction Reducer
Hydrotreated Light Petroleum Distillate	Carrier fluid for guar gum in liquid gels	Gelling Agent
Isopropanol	Product stabilizer and / or winterizing agent	Corrosion Inhibitor
Isopropyl Alcohol	Product stabilizer and / or winterizing agent.	Surfactant
Lauryl Sulfate	Used to prevent the formation of emulsions in the fracture fluid	Non-Emulsifier
Lauryl Sulfate	Used to increase the viscosity of the fracture fluid	Surfactant
Magnesium Oxide	Allows a delayed break down the gel	Breaker
Magnesium Peroxide	Allows a delayed break down the gel	Breaker
Methanol	Product stabilizer and / or winterizing agent	Corrosion Inhibitor
Naphthalene	Carrier fluid for the active surfactant ingredients	Surfactant
Petroleum Distillate	Carrier fluid for borate or zirconate crosslinker	Crosslinker
Petroleum Distillate	Carrier fluid for polyacrylamide friction reducer	Friction Reducer
Petroleum Distillate	Carrier fluid for guar gum in liquid gels	Gelling Agent
Phosphonic Acid Salt	Prevents scale deposits in the pipe	Scale Inhibitor
Polyacrylamide	“Slicks” the water to minimize friction	Friction Reducer
Polysaccharide Blend	Thickens the water in order to suspend the sand	Gelling Agent
Potassium Carbonate	Adjusts the pH of fluid to maintains the effectiveness of other components	pH Adjusting Agent
Potassium Hydroxide	Adjusts the pH of fluid to maintains the effectiveness of other components	pH Adjusting Agent
Potassium Metaborate	Maintains fluid viscosity as temperature increases	Crosslinker
Quaternary Ammonium Chloride	Eliminates bacteria in the water that produces corrosive by-products	Biocide
Sodium Carbonate	Adjusts the pH of fluid to maintains the effectiveness of other components	pH Adjusting Agent
Sodium Chloride	Product Stabilizer	Breaker
Sodium Erythorbate	Prevents precipitation of metal oxides	Iron Control
Sodium Hydroxide	Adjusts the pH of fluid to maintains the effectiveness of other components	pH Adjusting Agent
Sodium Polycarboxylate	Prevents scale deposits in the pipe	Scale Inhibitor
Sodium Tetraborate	Maintains fluid viscosity as temperature increases	Crosslinker
Tetrakis Hydroxymethyl-Phosphonium Sulfate	Eliminates bacteria in the water that produces corrosive by-products	Biocide
Tetramethyl ammonium chloride	Prevents clays from swelling or shifting	Clay Stabilizer
Thioglycolic Acid	Prevents precipitation of metal oxides	Iron Control
Triethanolamine Zirconate	Maintains fluid viscosity as temperature increases	Crosslinker
Zirconium Complex	Maintains fluid viscosity as temperature increases	Crosslinker



Sedimentation is the number one source of water pollution by volume in the state of North Carolina<sup>143</sup>. Surface waters in the vicinity of shale gas operation can be impacted by runoff during storm events. This can be especially significant during construction activities. The adherence to best management practices (BMPs) is especially critical during these activities.

Considering the range of potential causes of surface water contamination, a consensus of experts is that such contamination is usually caused by spills at the surface or leakage of containment and storage vessels. These can occur during site preparation and construction as well as drilling and fracturing.<sup>144</sup>

Groundwater drinking supplies have been found to become contaminated due to improper well casing and/or cementing, shallow drilling of wells, improper waste water treatment or disposal, leakage of gas and toxic fracking chemicals in drinking supplies<sup>145,146</sup> etc. Homes less than a kilometer in distance from gas wells have highest potential of getting their drinking water supplies contaminated from stray gases.<sup>147</sup> There is a growing consensus that where groundwater contamination is seen it is due to inadequacies in the construction of the vertical portion of the well or surface spills (e.g. see Groat and Grimshaw 2012<sup>148</sup> and Osborn et al. 2011<sup>149</sup>). Nonetheless, the potential for shale gas development and production to cause groundwater contamination continues to be the focus of a considerable amount of research.

There are several efforts underway near Cary to develop background surface and ground water quality data to assist in identifying impacts due to shale gas development. These are explained elsewhere in this report. The Town of Cary may want to examine these efforts to ensure that they are adequate to address the specific interests of the Town.

The design and operating standards applied to shale gas development can be expected to address the potential migration of these materials into surface and groundwater, but the requirements of these standards in North Carolina remains to be seen.

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<sup>143</sup> North Carolina Sedimentation Control Commission (2013) Sediments Newsletter. Vol 19 No 2 1 May 2012 - January 2013. Available at [http://www.bae.ncsu.edu/programs/extension/wqg/sediments\\_jan2013.pdf](http://www.bae.ncsu.edu/programs/extension/wqg/sediments_jan2013.pdf)

<sup>144</sup> Krupnick, A., Gordon, H. & Olmstead, S. Pathways to Dialogue: What the experts say about the environmental risks of shale gas development. Resources for the Future. February 2013. Available at [www.rff.org](http://www.rff.org). Accessed on September 26, 2013

<sup>145</sup> Lustgarten, A., & Kusnetz, N. (2011, December 09). Feds Link Water Contamination to fracking for the First Time. *High Country News*. Retrieved September 14, 2013, from <http://www.hcn.org/articles/feds-link-water-contamination-to-fracking-for-the-first-time>

<sup>146</sup> Jackson, R. B., Vengosh, A., Darrah, T.H., Warner, N. R., Down, A., Osborn, S.G., Zhao, K., & Karr, J.D. (2013). Increased stray gas abundance in a subset of wells near Marcellus shale gas extraction. Proceedings of the National Academy of Sciences of the United States of America. Vol 110 (28). Retrieved September 18, 2013, from <http://www.pnas.org/content/110/28/11250>

<sup>147</sup> *ibid*

<sup>148</sup> Groat, C.G. & Grimshaw, T.W. (2012) Fact-Based Regulation for Environmental Protection in Shale Gas Development. The Energy Institute of the U. of Texas at Austin. February 2012. Available on line at [http://www.velaw.com/UploadedFiles/VEsite/Resources/ei\\_shale\\_gas\\_reg\\_summary1202\[1\].pdf](http://www.velaw.com/UploadedFiles/VEsite/Resources/ei_shale_gas_reg_summary1202[1].pdf). Accessed September 25, 2013.

<sup>149</sup> Osborn, S.G., Vengosh, A., Warner, N.R. & Jackson, R.B. Methane contamination of drinking water accompanying gas-well drilling and hydraulic fracturing. PNCA **108** No. 20 May 2011. Available on line at <http://www.nicholas.duke.edu/cgc/pnas2011.pdf>. Accessed September 26, 2013

#### 4.1.3 Archaeological and historic architectural resources

If wells are located in close proximity to archaeological and historic architectural resources, it poses a threat to these valuable resources. Cary has several historic properties listed in the National Register of Historic Places; the Nancy Jones House, the Utley-Council House, the Page-Walker Hotel and the Ellington-Ivey-Waddell House. Additionally, Cary has three National Register districts; Cary, Green Level and Carpenter. There are several other properties listed in the Study List and local landmarks. Also, records at the Office of State Archaeology indicate the presence of 93 sites in and around Cary.<sup>150 151</sup>

#### 4.1.4 Parks, Open Space and Forest Fragmentation

Large scale development of shale gas resources can have a significant impact on the land surface due to well pad and gas pipeline infrastructure (See Figure 4.2 below). This can have aesthetic as well as ecological impacts. In a study of the impacts on the land surface in Pennsylvania, the U.S. Geological Survey concluded by saying that “[a]gricultural and forested areas are being converted to natural gas extraction disturbance. The disturbance and effects of both Marcellus and non-Marcellus development are clearly different over both counties in that Bradford County has very little non-Marcellus development, but it is important to note that the combined effect of both activities is substantial.”<sup>152</sup> Forest loss is clearly happening in Wake County due to development.<sup>153</sup>

The impacts of shale gas development on forest fragmentation and on the use and enjoyment of public lands have not yet been addressed in North Carolina.

#### 4.1.6 Infrastructure (roads, pipelines, utilities, water/wastewater treatment plants)

Shale gas often develops in places without adequate infrastructure to accommodate it. Of particular concern, based on the experience elsewhere, appear to be road capacity and maintenance, wastewater treatment plant capacity and suitability. Potential impacts on the Town’s wastewater treatment operations are addressed elsewhere in this report.

The risks to transportation infrastructure primarily occur with the increased truck traffic associated with site preparation, equipment delivery, materials, and water supply. Major roadway segments, interchanges, and intersections will experience an increase in average annual daily traffic (AADT) with potential impacts on the level of service. Local roads and minor collectors within Town limits may experience congestion during certain times of the day or during at heavily traveled intersections/interchanges. Rail traffic may also increase.

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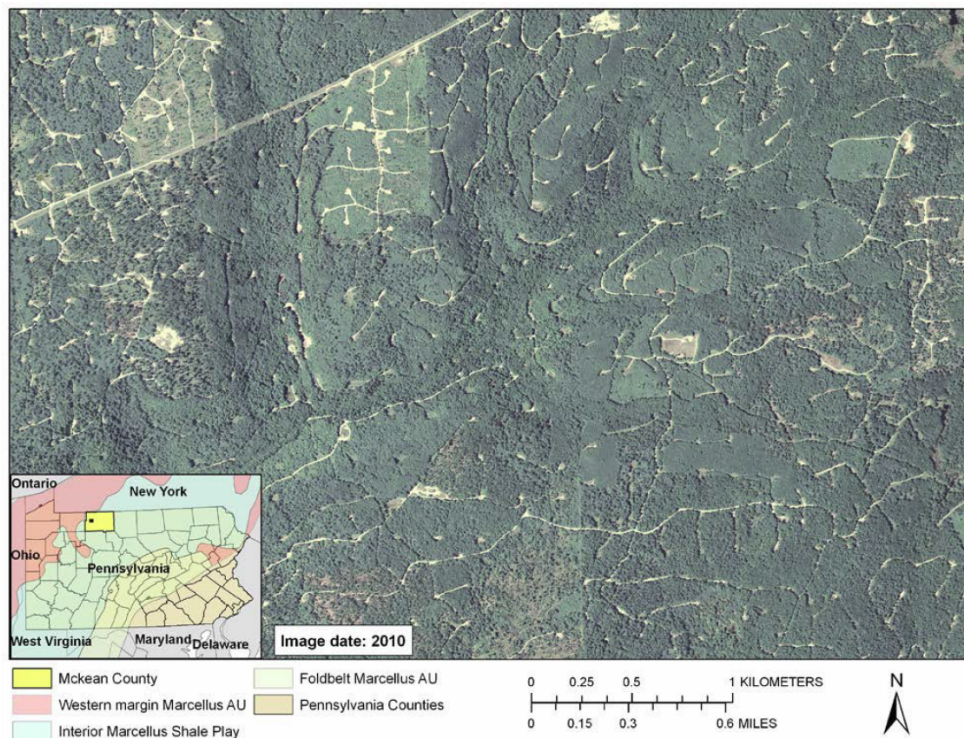
<sup>150</sup> Historic Preservation Master Plan, Volume VIII of the Town of Cary Master Plan (May 27, 2010). Available at [http://www.townofcary.org/Departments/Planning\\_Department/Projects\\_Plans/historicpreservation/Historic\\_Preservation\\_Master\\_Plan.htm](http://www.townofcary.org/Departments/Planning_Department/Projects_Plans/historicpreservation/Historic_Preservation_Master_Plan.htm) . Last accessed on 8/24/2013.

<sup>151</sup> North Carolina Natural Heritage Program. <http://www.ncnhp.org/> . Accessed September 25, 2013

<sup>152</sup> Slonecker, E.T., Milheim, L.E., Roig-Silva, C.M., Malizia, A.R., Marr, D.A., and Fisher, G.B., 2012, Landscape consequences of natural gas extraction in Bradford and Washington Counties, Pennsylvania, 2004–2010: U.S. Geological Survey Open-File Report 2012–1154, 36 p.

<sup>153</sup> ForWarn website. Development cuts forests near Raleigh. Available at <http://forwarn.forestthreats.org/highlights/70>

Figure 4.2. A forested landscape in McKean County, Pennsylvania, showing the spatial effects of roads, well pads, and pipelines related to natural gas development.<sup>154</sup>



Although truck traffic is expected to significantly increase in certain locations, most of the projected trips would be short. The largest component of the truck traffic for horizontal drilling would be for water deliveries, and these would involve very short trips between the water procurement area and the well pad. Since the largest category of truck trips involve water trucks, it is anticipated that the largest impacts from truck traffic would be near the wells under construction or on local roadways.

As a result of the anticipated increase in frequent truck trips carrying heavy equipment, local Town roads in the vicinity of the well pads may require more frequent repair. Damage to asphalt and concrete pavement can occur resulting in potholes, rutting, and complete failure of the surface, base, subbase, and even the subgrade layers of the pavement. Repeated maintenance on roads, culverts and bridges will be required to handle this additional load and capacity. Also, additional improvements to intersection turn lanes, bridge clearances, signal timings may be required.

An increase in traffic accidents is a concern associated with the increased truck volumes. Proper signing,

<sup>154</sup> Slonecker, E.T., Milheim, L.E., Roig-Silva, C.M., Malizia, A.R., Marr, D.A., and Fisher, G.B., 2012, Landscape consequences of natural gas extraction in Bradford and Washington Counties, Pennsylvania, 2004–2010: U.S. Geological Survey Open-File Report 2012–1154, 36 p.

pavement marking, and driver education will be essential to minimize and avoid crashes along designated truck routes.

Natural gas exploration and production may involve accident risks that are different from those for which the Town is equipped to respond.

As noted above, publically owned wastewater treatment plants (POTWs) may not have the capacity or the treatment technology needed to remove the substances in shale gas wastewater or to prevent shale gas wastewaters from interfering with their operation.

#### **4.1.7 Energy and greenhouse gas impacts to the Town Operations**

The Town has conducted a greenhouse gas inventory that clearly shows the energy and greenhouse gas impacts associated with treating the Town's wastewater. Additional wastewater will cause the Town's energy consumption and greenhouse gas emissions to increase.<sup>155</sup>

#### **4.1.8 Noise**

Drilling operations typically continues 24 hours a day until completion resulting in noise during nighttime hours. Noise associated with the drilling activities would be temporary and would end once drilling operations cease.

After the drilling process ends, drill sites require the use of equipment and vehicles. Specialized site equipment and vehicles, water trucks, tractor trailers, and delivery and employee vehicles will frequently use the site. Noise impacts can be expected in the immediate vicinity of the site as well as along truck routes.

#### **4.1.9 Air Quality**

Shale gas drilling can impact air quality. Some of these potential impacts are common to all industrial operations while others are primarily associated with natural gas drilling and well operation. Diesel equipment used in the drilling operations emit PM 2.5 and PM 10 particulate matter and other pollutants. Trucks emit nitrogen oxides, carbon monoxide, particulate matter, and hydrocarbons. Moreover, the use of dirt roads impacts air quality and fugitive dust. Methane, VOCs and hazardous air pollutants (HAPs), as defined under the Clean Air Act, are also released during drilling operations. The HAPs most often associated with shale gas development (and fossil fuel production in general) are benzene, ethylbenzene, toluene, xylene, sometimes collectively called BETX<sup>156</sup>. Other HAPs that have been associated with shale gas development are hexane and 2,2,4-trimethylpentane (also known as isooctane), which are commonly found in gasoline and other fossil fuels, and formaldehyde (formed in combustion of natural gas).<sup>157 158 159</sup>

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<sup>155</sup> Callaway (2011) Town of Cary, North Carolina Inventory of Energy Use and Greenhouse Gas Emission Report on Municipal Operations from 2005 to 2010. Available at <http://www.townofcary.org/Assets/Town+Manager%27s+Office/Sustainability/EnergyInventoryReport.pdf>

<sup>156</sup> Environmental Protection Agency (EPA) (2012) Oil and Natural Gas Sector: New Source Performance Standards and National Emission Standards for Hazardous Air Pollutants Reviews. Federal Register 77 No.159 pp. 49490-49600/Thursday, August 16, 2012

<sup>157</sup> Environmental Protection Agency (EPA) (2008) National Emission Standards for Hazardous Air Pollutants for Source Categories: Gasoline Distribution Bulk Terminals, Bulk Plants, and Pipeline Facilities; and Gasoline Dispensing Facilities. Federal Register 73 No. 7, January 10, 2008. Pp 1916-1953

The quality of ambient air in Wake County has at times failed to meet standards. In 2013, the American Lung Association gave Wake County a passing grade overall for air quality but assigned a grade of “D” for ozone as a result of the County’s having 9 “high ozone days” between 2009 and 2011.<sup>160</sup> In 2004, 2005 and 2006, The EPA reports that Wake County was non-attainment for ozone, meaning that it did not meet ambient air quality standards for ozone, but it was reclassified as being in attainment in 2007 and has remained in attainment since.<sup>161</sup> Ozone is formed by the reaction of nitrogen oxides and VOCs in the atmosphere, both of which are emitted by shale gas operations. The extent to which an increase in local emissions would increase ozone levels in Cary, however, is uncertain as ozone levels in Wake County are also affected by emissions from sources far upwind<sup>162</sup>, but this question could be examined as part of the process of permitting new sources.

Additional information on the emissions from shale gas operations and their control is presented in Chapter 3.

The State of North Carolina has a limited number of monitoring stations that may provide useful air quality data and a special study has been launched (described below). In addition, the N.C. Division of Air Quality has developed a plan to characterize baseline air quality in the Sanford sub-basin located in Lee County to address the potential effects of shale gas production. More information on these sampling programs is contained elsewhere in this report. The Town may want to examine these programs to determine whether the placement and scope of these activities is adequate to address the concerns of the citizens of Cary.

#### 4.1.10 Earthquakes

There have been several reports of small earthquakes in the vicinity of shale gas operations involving hydraulic fracturing. Although the causes for these are still debated, the likely causes appear to be deep well injection of wastewater from the shale gas operations,<sup>163 164</sup> although one recent study has also connected small earth quakes to hydraulic fracturing in shale gas wells.<sup>165</sup> The earthquakes that have been reported, whether associated with wastewater injection or shale gas wells, have been magnitude 3 to 4 or

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<sup>158</sup> Pennsylvania Department of Environmental Protection (PDEP). 2011 Unconventional Natural Gas Inventory. [http://files.dep.state.pa.us/Air/AirQuality/AQPortalFiles/Unconventional\\_Natural\\_Gas\\_Emissions\\_Well-Station-All.xlsx](http://files.dep.state.pa.us/Air/AirQuality/AQPortalFiles/Unconventional_Natural_Gas_Emissions_Well-Station-All.xlsx). Accessed September 26, 2013

<sup>159</sup> Environmental Protection Agency (EPA). AP-42 Chapter 1 Section 4. Natural Gas Combustion. Available at <http://www.epa.gov/ttnchie1/ap42>. Accessed on September 26, 2013

<sup>160</sup> American Lung Association. (2013) State of the Air 2013. Available at <http://www.stateoftheair.org/2013/assets/ala-sota-2013.pdf>

<sup>161</sup> USEPA Nonattainment Status for Each County by Year for North Carolina website, [http://www.epa.gov/airquality/greenbk/anay\\_nc.html](http://www.epa.gov/airquality/greenbk/anay_nc.html), accessed Nov. 21, 2013

<sup>162</sup> EPA website on ground-level ozone: Basic Information, at <http://www.epa.gov/glo/basic.html>

<sup>163</sup> Fischetti, M. Ohio earthquake likely caused by fracking wastewater. Scientific American. January 4, 2012. Available at <http://www.scientificamerican.com/article.cfm?id=ohio-earthquake-likely-caused-by-fracking>. Accessed September 25, 2013

<sup>164</sup> Elst N.J., Savage, H.M., Keranen, K.M. & Abers G.A. Enhanced remote earthquake trigger at fluid injection sites in the Midwestern United States. Science **12**. July 2013. Available at <http://www.sciencemag.org/content/341/6142/164.abstract> . Accessed September 25, 2013

<sup>165</sup> Frohlich, C. Two-year survey comparing earthquake activity and injection-well location in the Barnett Shale, Texas. PNAS on-line. August 6, 2012 . Available at <http://www.pnas.org/content/early/2012/07/30/1207728109.full.pdf+html> . Accessed September 25, 2013

less.<sup>166</sup> <sup>167</sup> As a precaution, however, it might be useful to understand whether local infrastructure (including the Shearon Harris nuclear plant) is designed to withstand earthquakes of this magnitude.

#### 4.1.11 Property Values

A key concern of property owners in areas where shale gas will be developed is the impact on property values. While it is difficult to generalize due to property valuations being so site-specific, some studies have attempted to assess these impacts. In one case, it was determined that the increased property values attributable to the drilling activity (e.g. lease payments or improved economic conditions) were fully offset by loss of property value in places where there were concerns about the impact of nearby shale gas operations.<sup>168</sup> Impacts on property values are not unique to shale gas development. Effects on property values are observed for other types of industrial operations, such as power plants, for instance.<sup>169</sup>

#### 4.1.12 Community Health impacts

There are few studies in the peer-reviewed literature estimating the potential risk levels for populations in the vicinity of shale gas operations. Dr. Lisa McKenzie and co-workers at the School of Public Health at the University of Colorado performed one notable study.<sup>170</sup> The researchers collected samples of ambient air near natural gas wells using hydraulic fracturing in tight sand formations (different from shale formations, but requiring fracturing nonetheless). Most of the samples were collected in 2008 during flowback periods (a time in the well development process when injected fracturing fluids and the dissolved gases they contain, are brought back up the well). The researchers indicate that the sampling was timed to coincide with the uncontrolled release of emissions from tanks receiving flowback water. In this regard, it is relevant to note that EPA's recent regulations on hydraulic fracturing, issued in 2011, would not allow, under normal circumstances, uncontrolled release of these emissions. Instead, starting in 2015, new operations are now required to use so-called "green completion" methods, which EPA estimates will reduce flowback emissions by 95%. Until then, new sources must burn these emissions.<sup>171</sup>

In the McKenzie study, a range of chemicals associated with oil and natural gas exploration was detected, with the concentrations being lowest in the upwind locations and highest in the samples collected downwind, closest to the wells. The results of the sampling were used to estimate health risks to the

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<sup>166</sup> Frohlich, C. Two-year survey comparing earthquake activity and injection-well location in the Barnett Shale, Texas. PNAS on-line. August 6, 2012 . Available at

<http://www.pnas.org/content/early/2012/07/30/1207728109.full.pdf+html> . Accessed September 25, 2013

<sup>167</sup> Kim, W. Induced seismicity associated with fluid injection into a deep well in Youngstown Ohio. Journal of Geophysical Research. **118** . July 2013. Available on line at <http://onlinelibrary.wiley.com/doi/10.1002/jgrb.50247/abstract>

<sup>168</sup> Muehlenbachs, L., Spiller, E. & Timmins, C. Shale gas development and the costs of groundwater contamination risk. Resources for the Future Paper RFF DP 12-40 Rev. March 2013. Available at <http://www.rff.org/RFF/Documents/RFF-DP-12-40-REV.pdf>. Accessed September 26, 2013

<sup>169</sup> Davis. L.W. (2008) The effect of power plants on local housing values and rents: evidence from restricted census microdata. MIT Energy Initiative and Sloan School of Management. June 2008. Available at <http://dspace.mit.edu/handle/1721.1/45653>. Accessed September 25, 2013

<sup>170</sup> McKenzie, L.M., Witter, R.Z., Newman, L.S. & Adgate, J.L. (2012) Human health risk assessment of air emissions from development of unconventional natural gas resources. Sci. Total Environ (2012), doi:10.1016/j.scitotenv.2012.02.018

<sup>171</sup> EPA (2012) EPA's Air Rules for the Oil and Natural Gas Industry: Summary of requirements for processes and equipment at natural gas well sites. Available on line at <http://www.epa.gov/airquality/oilandgas/pdfs/20120417summarywellsites.pdf>. Accessed September 30, 2013

exposed populations using conventional modeling methods and toxicity data. The authors summarized the non-cancer risk results as follows.

“Residents living  $\leq \frac{1}{2}$  mile from wells are at greater risk for health effects from [natural gas development] NGD than are residents living  $> \frac{1}{2}$  mile from wells. Subchronic exposures to air pollutants during well completion activities present the greatest potential for health effects. The subchronic non-cancer hazard index (HI) of 5 for residents  $\leq \frac{1}{2}$  mile from wells was driven primarily by exposure to trimethylbenzenes, xylenes, and aliphatic hydrocarbons. Chronic HIs were 1 and 0.4. for residents  $\leq \frac{1}{2}$  mile from wells and  $> \frac{1}{2}$  mile from wells, respectively.”

The Hazard Index (HI) represents, in a general sense, a multiple of the concentration below which non-cancer adverse health effects are unlikely.<sup>172</sup> A health index of 5, therefore, essentially means that the exposure is on the order of 5 times the level where effects may begin to be seen.

The results of calculations to estimate cancer risks were summarized as follows.

“Cumulative cancer risks were 10 in a million and 6 in a million for residents living  $\leq \frac{1}{2}$  mile and  $> \frac{1}{2}$  mile from wells, respectively, with benzene as the major contributor to the risk.”

These cancer risks are expressed as *increased* risks of cancer per million in exposed populations (not risks of cancer). In other words, the increased risks of 6 and 10 per million found in the McKenzie et al. paper are in addition to the background risks of developing cancer.<sup>173</sup> To put the cancer risk results of the study into context, it is useful to note that EPA examines two different cancer risk levels in deciding how to address risks remaining after applying maximum available control technology for hazardous air pollutants. The effectiveness of the control technologies are examined against a maximum individual lifetime increased cancer risk of 100 in a million while additional controls are considered based on a number of factors, including the number of exposed persons who could experience increased cancer risks of more than 1 in a million.<sup>174</sup>

As noted above, the relevance of the McKenzie study to persons living near *new* shale gas operations is uncertain as new operations would be required to control the types of emissions that were emitted without control in the McKenzie study.<sup>175</sup>

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<sup>172</sup> EPA (1989) Chapter 8 in Risk Assessment Guidance for Superfund: Volume I Human Health Evaluation Manual. Available at <http://www.epa.gov/oswer/riskassessment/ragsa/>

<sup>173</sup> The background lifetime risk of developing cancer is about 400,000 per million while the lifetime risk of dying from cancer is about 200,000 per million, as reported in the Surveillance, Epidemiology, and End Results (SEER) Program conducted by the National Cancer Institute. See SEER Cancer Statistics available at [http://seer.cancer.gov/csr/1975\\_2009\\_pops09/browse\\_csr.php](http://seer.cancer.gov/csr/1975_2009_pops09/browse_csr.php) Accessed September 30, 2013

<sup>174</sup> EPA (2011) Oil and Natural Gas Sector: New Source Performance Standards and National Emission Standards for Hazardous Air Pollutants Reviews. Federal Register Vol. 76, No. 163, August 23, 2011 pp 52738-52843

<sup>175</sup> EPA (2012) EPA's Air Rules for the Oil and Natural Gas Industry: Summary of requirements for processes and equipment at natural gas well sites. Available on line at <http://www.epa.gov/airquality/oilandgas/pdfs/20120417summarywellsites.pdf>. Accessed September 30, 2013

News reports reveal a significant level of public concern about the potential health effects of living near shale gas operations and indications that individuals living near these operations may experience elevated levels of stress.<sup>176</sup> A recent review of the effects of stress found that “chronic stress may cause physical, behavioral and/or neuropsychiatric manifestations: anxiety, depression, executive and/or cognitive dysfunction; cardiovascular phenomena, such as hypertension; metabolic disorders, such as obesity, the metabolic syndrome, and type 2 diabetes mellitus; atherosclerotic cardiovascular disease; neurovascular degenerative disease; osteopenia and osteoporosis; and sleep disorders, such as insomnia or excessive daytime sleepiness.”<sup>177</sup>

Perhaps the most frequently voiced concern about the potential for human health effects in the vicinity of shale gas facilities is that there is insufficient information on potential health effects and insufficient background data to monitor for impacts. (See, for instance Finkel,<sup>178</sup> Mitka,<sup>179</sup> Schmidt<sup>180</sup>, and Tillet<sup>181</sup>)

## 4.2 Monitoring the effects of shale gas development

To address public concern about the environmental effects of shale gas development, it will be helpful to have environmental quality data that allow environmental impacts to be identified. A number of efforts are in place that could be useful in this regard. Some of these programs, however, have not been designed with the specific purpose of monitoring the effects of shale gas development, or may not cover the regions of most concern to Cary, so it will be important for the Town of Cary and other potentially affected entities to understand the current capabilities of these programs. Such an understanding may suggest that the Town of Cary wants to recommend additional or modified monitoring programs to better serve the purpose of monitoring the potential environmental effects of shale gas development on the citizens of Cary.

### 4.2.1. Triangle Area Water Supply Monitoring Project

In the words of the project’s website;

“The greater Research Triangle Area is a six-county region within the upper Cape Fear and upper Neuse River Basins in North Carolina. Between 1990 and 1999, the population in the Triangle Area increased by 30 percent. Seventy-seven percent of the households in the region depend on water supplies drawn from streams and lakes. Two multipurpose

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<sup>176</sup> Science News (2013) <http://www.sciencedaily.com/releases/2013/04/130429130550.htm>

<sup>177</sup> Chrousos, G. P. Stress and disorders of the stress system. *Nat. Rev. Endocrinol.* 5, 374–381 (2009); Available at <http://d.yimg.com/kq/groups/18463231/1276535450/name/Stress%2520and%2520disorders%2520of%2520the%2520stress%2520system.pdf>

<sup>178</sup> Finkel, M.L. and Law, A. (2011) The rush to drill for natural gas: A public health cautionary tale. *Am J. Public Health* 101, No. 5

<sup>179</sup> Mitka, M. (2012) Rigorous Evidence Slim for Determining Health Risks From Natural Gas Fracking, *JAMA Medical News and Perspectives*. 2012;307(20):2135-2136. doi:10.1001/jama.2012.3726. Available at <http://jama.jamanetwork.com/article.aspx?articleid=1167312>

<sup>180</sup> Schmidt, C.W., NY DEC Takes on Fracking. *Environ Health Perspect. News/Forum*. 2011 December; 119(12): a513. Published online 2011 December 1. doi: 10.1289/ehp.119-a513. Available at <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3262000/>

<sup>181</sup> Tillet, T. (2013) Summit Discusses Public Health Implications of Fracking. *Environ Health Perspect. News/Forum*. 2013 January; 121(1): a15. Published online 2013 January 1. doi: 10.1289/ehp.121-a15. Available at <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3553449/>



reservoirs, eight smaller reservoirs, and six rivers supply water for the 30 municipalities in the area...

In 1988, a number of local governments in the six-county region, with assistance from [Triangle J Council of Governments \(TJCOG\)](#), formed the Triangle Area Water Supply Monitoring Project to systematically evaluate the quality of several water-supply sources in the region. With assistance from the U.S. Geological Survey (USGS), the Project has collected and analyzed water-quality samples from reservoirs and streams and collected continuous discharge record from streams in the study area for more than 20 years. These data, along with data collected by the North Carolina Division of Water Quality (DWQ) and with data collected as part of a program of the USGS, the U.S. Army Corps of Engineers, and the City of Durham, form a long-term comprehensive data base on the quality of many of the area's water-supply reservoirs and rivers, and selected tributaries to those water supplies.

In the last 20 years, concerns about water-quality of the area's water supplies and the impact of development on reservoir eutrophication and contaminant concentrations have remained prominent, although specific concerns have changed. Monitoring initially focused on determining the occurrence of synthetic organic compounds in the water column and bed sediments, later monitoring and interpretive efforts focused on nutrient and sediment loads and trends. Issues such as the occurrence of disinfection by-products, microbial pathogens, and pharmaceutical and personal care products have also been addressed.

Data collection began in October 1988 and will continue through at least June 2012. A key strength of the monitoring program has been the long-term consistency of data collection locations, constituents, and sampling methods. This was recognized during a workshop in December 1997 that was attended by a diverse group of scientists and government agency staff who were asked to review progress and design of the project.”

<sup>182</sup>

The location of the current monitoring stations is shown in Figure 4.3. The sampling schedule and list of parameters being monitors is shown in Table 4.2.

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<sup>182</sup> USGS (2013) USGS Triangle Area Water Supply Monitoring Project. Available at <http://nc.water.usgs.gov/triangle/>. Accessed September 25, 2013

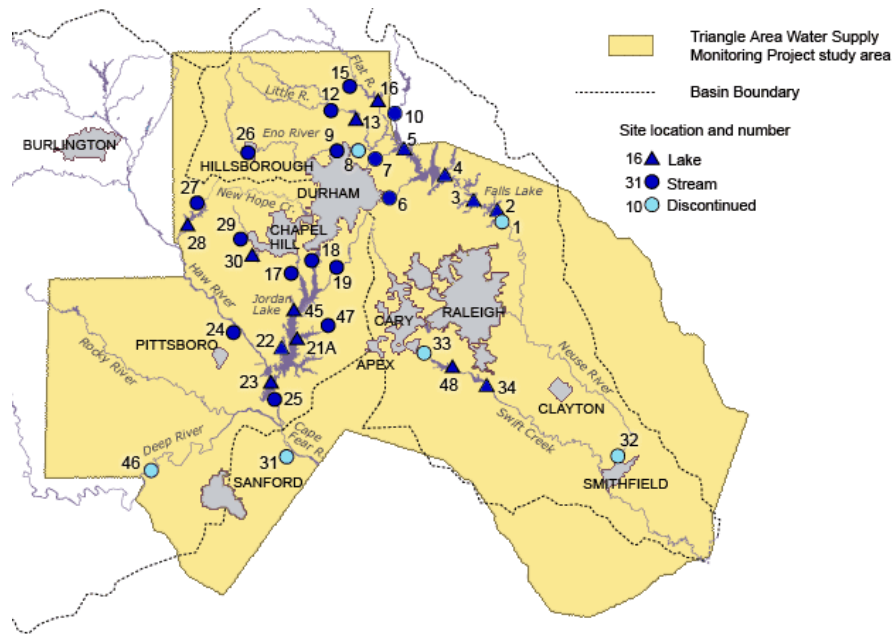


Figure 4.3. Map of Station Locations for the Triangle Area Supply Monitoring Project (from <http://nc.water.usgs.gov/triangle/stations/>)

Table 4.2 Triangle Area Supply Monitoring Project: Monitoring Schedule and Parameters (<http://nc.water.usgs.gov/triangle/stations/>)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
<b>Stream sites</b>												
Nutrients, major ions, and suspended sediment	X		X		X		X		X		X	
Metals and trace elements	X						X					
Runoff samples: nutrients, major ions, metals and trace elements, and suspended sediment	Two storm events per year at 8 sites per year											
<b>Lake sites</b>												
Near surface samples: Alkalinity, major ions, iron, and manganese	X		FJ*		FJ*		X		X		X	
Near surface samples: Metals, trace elements	X		FJ*		FJ*		X					
Photic-zone samples: Nutrients, chlorophyll <i>a</i> and <i>b</i> , phytoplankton	X		FJ*		FJ*		X		X		X	
Mid-column and near-bottom samples: Nutrients, iron, and manganese	X		FJ*		FJ*		X		X		X	
* - FJ indicates that only Falls and Jordan Lake sites are sampled.												

#### 4.2.2 North Carolina's Air Quality Monitoring Plan

The North Carolina Department of Natural Resources indicates "Local and regional air monitoring began with the initial passage of the federal Clean Air Act in the early 1970s. Under the act, EPA set federal standards for six major air pollutants (called criteria pollutants): ozone, lead, particulates, carbon monoxide, nitrogen dioxide, and sulfur dioxide. ... North Carolina has 65 air quality monitoring sites for criteria pollutants. The monitors are located in 45 counties and operated by DENR's Division of Air Quality (DAQ), local air programs, and EPA. The state also has special purpose air quality monitors – nine for measure acid precipitation and six to measure toxic air pollutants. Although monitors are distributed across the state, monitoring equipment tends to be concentrated in urban areas than have more air quality problems."<sup>183</sup>

The locations of the monitors in the Raleigh region are shown in Figure 4.4. The monitor in Chatham County is sampling for ozone and sulfur dioxide. The monitors in Wake County have various functions, but collectively they are sampling for ozone, particulates, carbon monoxide, reactive oxides of nitrogen, and one monitor is sampling unspecified "toxics".

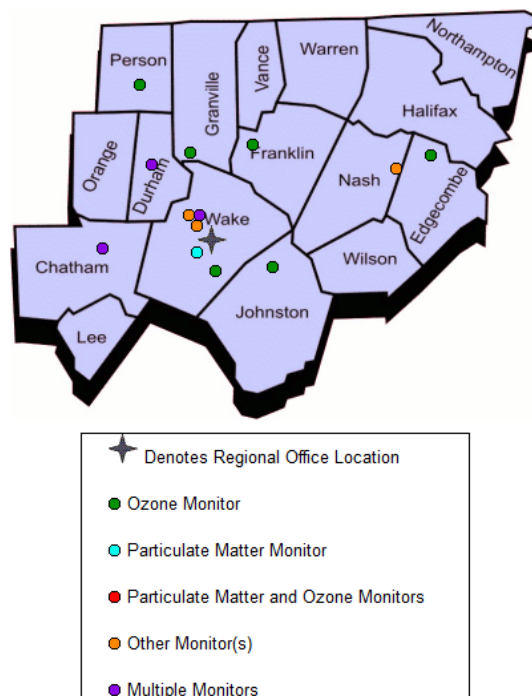


Figure 4.4. Ambient Air Quality Monitors in the Raleigh Region  
(<http://daq.state.nc.us/ambient/monitors/Raleigh.shtml>)

<sup>183</sup> North Carolina Department of Environment and Natural Resources (NCDENR) (2011) North Carolina State of the Environment Report 2011. Available at <http://portal.ncdenr.org/web/guest/2011-state-of-the-environment-report>. Accessed September 25, 2013

The N.C. Division of Air Quality has developed a plan to characterize baseline air quality in the Sanford sub-basin located in Lee County to address the potential effects of shale gas production. A description of the plan states the following.

“Based on a review of available literature, the predominant air pollutants from hydraulic fracturing operations are speciated volatile organic compounds (benzene, toluene, ethyl benzene, xylenes, hexanes, 2,2,4-trimethylbenzene, styrene), aldehydes (formaldehyde, acetaldehyde), criteria air pollutants (sulfur dioxide, nitrogen oxides, ozone, particulate matter) and reduced sulfur compounds.

An analysis of the existing air quality monitoring network indicates well-placed upwind and downwind multi-pollutant air monitoring locations in Candor (Montgomery County) and Raleigh (Wake County). These sites are near the Triassic Basin, but not within the area that may be considered most promising for shale gas production – the Sanford sub-basin located in Lee County. The DAQ does not currently operate any air quality monitors in Lee County. This project plan recommends establishing a multi-pollutant air monitoring site in Lee County that will employ identical monitoring methods and equipment as is used at all other monitoring sites.

The DAQ will leverage existing resources to the extent possible in implementing this project plan. However, it is estimated that \$158,000 of additional equipment will need to be purchased. Ongoing operating costs are projected to be approximately \$163,000 annually, including staff time for site maintenance and data analysis.”<sup>184</sup>

The impact on this program on recent funding decisions needs to be understood. In addition, the Town may want to examine the capability of this monitoring network to address air quality concerns in the Town of Cary to ensure that the ambient air quality monitoring program, after it is expanded to include the site in Lee County, is adequate to address concerns about the impact of shale gas development in, or upwind of, the Town of Cary.

#### **4.2.3 North Carolina Groundwater Monitoring Program**

There are several efforts underway to monitor the impact of shale gas development on groundwater in North Carolina. Here we briefly discuss some of the work most relevant to the Town of Cary.

The U.S. Geological Survey (USGS) North Carolina Water Science Center is conducting an inventory of well records and baseline groundwater-quality sampling in Lee and Chatham Counties, just west of Sanford. (See Figure 4.5) The objective is “to better delineate areas of groundwater use and groundwater-quality characteristics prior to potential shale gas exploration in the Triassic Basins of Lee and Chatham Counties, North Carolina... The compilation of baseline groundwater-quality data in North Carolina is an

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<sup>184</sup> North Carolina Department of Environment and Natural Resources (NCDENR) (2013) Project Plan for Baseline Ambient Air Monitoring near Potential Shale Gas Development Zones in Lee County, NC. February 19, 2013. Available at [http://daq.state.nc.us/news/shale/DAQ\\_Project\\_Plan.pdf](http://daq.state.nc.us/news/shale/DAQ_Project_Plan.pdf). Accessed September 25, 2013

opportunity for comparison to data collected after drilling activities commence should the State allow Shale Gas exploration to occur.”<sup>185</sup>

### Shale Gas Well Inventory Study Area

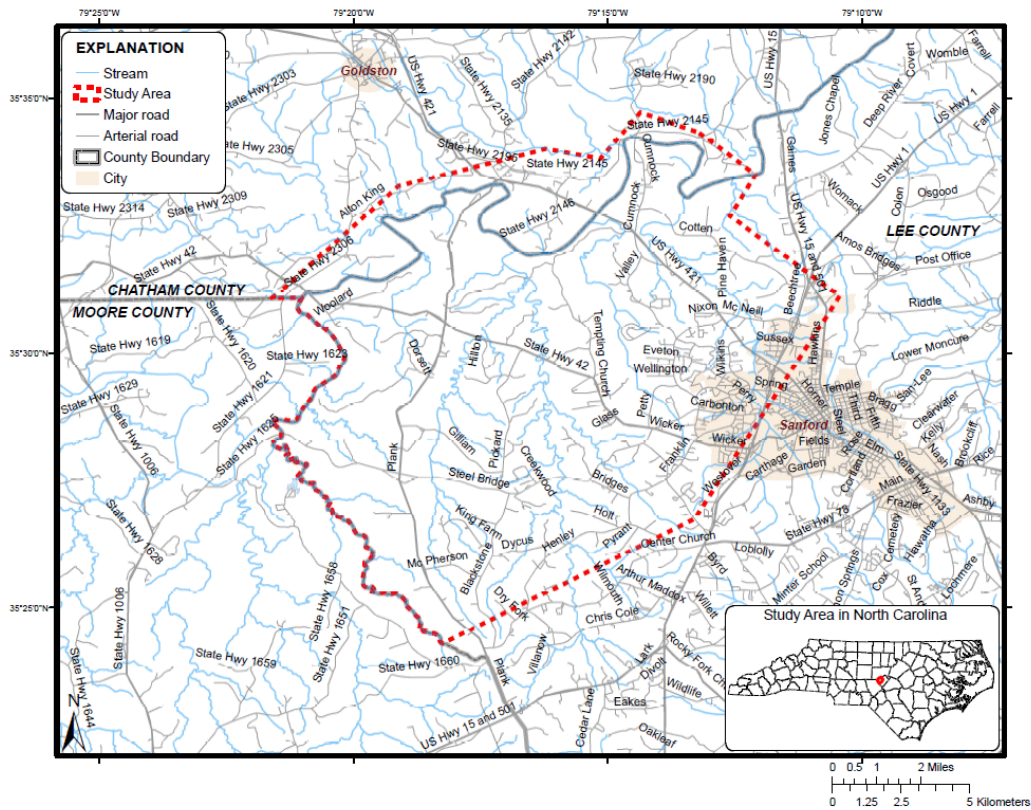


Figure 4.5. Study area for North Carolina Shale Gas Baseline Groundwater Sampling Project <http://nc.water.usgs.gov/projects/shalegas/>.

The material describing the program indicates that, “A subset of about 50 wells that have available construction data (total depth, casing depth, yield, and year drilled) will be selected for the collection of groundwater-quality samples. Funding estimates will limit the number of analyses. Detailed sampling of an estimated 3 to 10 wells will include: dissolved gases, methane and ethane isotopes, major ions, metals, volatile organic compounds (VOCs), semi-volatile organic compounds, radium isotopes, strontium isotopes, oxygen/deuterium/carbon stable isotopes, dissolved inorganic and organic carbon. A larger number of additional samples (estimated at 40 total) will include analyses of dissolved gases and major ions with locations scattered throughout the study area”

The study area appears to have been selected due to the potential for shale gas development.

<sup>185</sup> USGS North Carolina Water Science Center (USGS) 2013. NC Shale Gas Baseline Groundwater Sampling Project website. Available at <http://nc.water.usgs.gov/projects/shalegas/>. Accessed September 25, 2013.

Groundwater continues to be an important resource in Wake County. Almost one quarter of the County’s residents rely on groundwater for their water supply<sup>186</sup>. There may, therefore, be value in extending this type of sampling activity to other areas, in or close to Cary that may be suitable for shale gas development. It may also be useful to compare this groundwater program to others designed to monitor the impact of shale gas development on groundwater quality (e.g. see Palacios and Jackson (2012)).<sup>187</sup>

### 4.3 Prioritizing environmental risks

With a large number of potential concerns, it is important to know whether there is consensus on which risks warrant the most attention. In this regard it is helpful that the Resources for the Future has conducted a survey of experts to determine whether such a consensus exists.<sup>188</sup> That survey, involving 215 experts from academia, government, industry and nongovernmental organizations (NGOs), found results that “...stand in sharp contrast to the rhetoric of much of the public debate. For example, a key finding is the high degree of consensus among experts about the specific risks to mitigate. Survey respondents from all four expert groups most frequently identified these “consensus risks” as needing further regulatory or voluntary action.” These consensus risks, and the pathways leading to the risks, are illustrated in Figure 4.6 below, taken from the RFF report and summarized in Table 4.3. Notably, a majority of the consensus risks occur at the drilling site. As previously discussed, homeowners, properties and facilities within 1 kilometer of the drilling site at greatest risk of health, economic and environmental risks.

Table 4.3 Consensus Risks<sup>189</sup>

Surface water risks	<ul style="list-style-type: none"> <li>• Site preparation → Stormwater flows</li> <li>• Fracturing and completion → Freshwater withdrawals</li> <li>• Storage of wastewaters (fracturing fluids, flowback, produced water) → Losses to surface water</li> <li>• Treatment of wastewaters → Impacts to treatment and surface waters</li> </ul>
Groundwater risks	<ul style="list-style-type: none"> <li>• Fracturing and completion → Groundwater withdrawals</li> <li>• Storage of wastewaters (fracturing fluids, flowback, produced water) → Losses to groundwater</li> <li>• Drilling → Improper casing and cementing → Methane in groundwater</li> <li>• Drilling → Accidents involving casing and cementing → Groundwater contamination</li> </ul>
Air quality risks	<ul style="list-style-type: none"> <li>• Drilling → Venting of methane</li> <li>• Fracturing and completion → Venting of methane</li> </ul>
Habitat disruption	<ul style="list-style-type: none"> <li>• Site and infrastructure preparation → Land clearing</li> </ul>

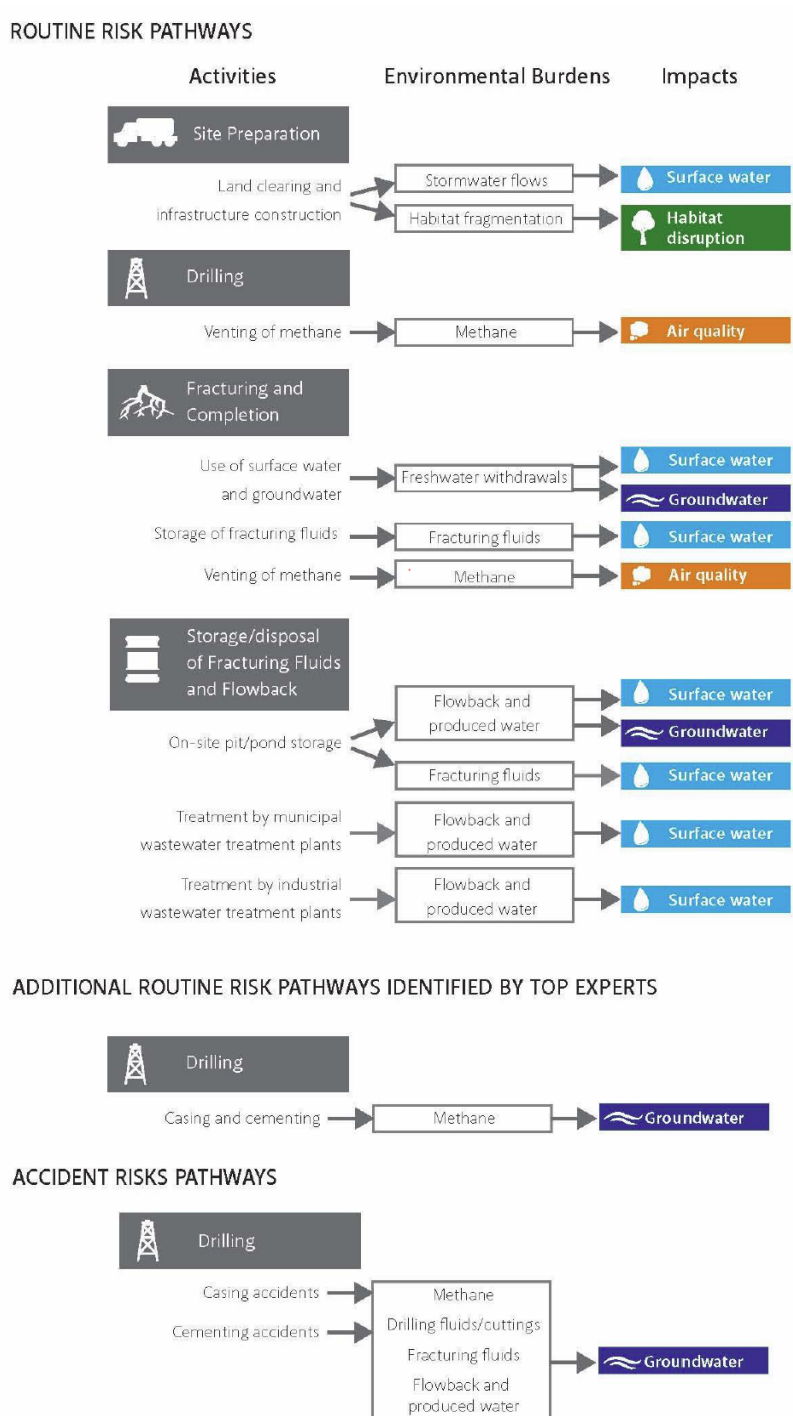
<sup>186</sup> Wake County Groundwater Sustainability Stakeholder Committee Report and Recommendations (2007): [http://www.wakegov.com/water/wells/Documents/GWSustainabilityCommitteeReport\\_FinalApril07.pdf](http://www.wakegov.com/water/wells/Documents/GWSustainabilityCommitteeReport_FinalApril07.pdf). April 2007. Accessed September 25, 2013

<sup>187</sup> Palacios, V.E. & Jackson, R.B. Baseline groundwater quality testing needs in the Eagle Ford Shale Region. Nicholas School of the Environment, Duke University. Available on-line at [http://dukespace.lib.duke.edu/dspace/bitstream/handle/10161/5370/2012\\_Palacios\\_Baseline%20groundwater%20quality%20testing%20needs%20in%20the%20Eagle%20Ford%20shale%20region.pdf?sequence=3](http://dukespace.lib.duke.edu/dspace/bitstream/handle/10161/5370/2012_Palacios_Baseline%20groundwater%20quality%20testing%20needs%20in%20the%20Eagle%20Ford%20shale%20region.pdf?sequence=3). Accessed September 25, 2013

<sup>188</sup> Krupnick, A., Gordon, H. & Olmstead, S. Pathways to Dialogue: What the experts say about the environmental risks of shale gas development. Resources for the Future. February 2013. Available at [www.rff.org](http://www.rff.org). Accessed on September 26, 2013

<sup>189</sup> Krupnick, A., Gordon, H. & Olmstead, S. Pathways to Dialogue: What the experts say about the environmental risks of shale gas development. Resources for the Future. February 2013. Available at [www.rff.org](http://www.rff.org). Accessed on September 26, 2013

Table 4.1: Expert consensus of risks for shale gas development<sup>190</sup>



<sup>190</sup> Krupnick, A., Gordon, H. & Olmstead, S. Pathways to Dialogue: What the experts say about the environmental risks of shale gas development. Resources for the Future. February 2013. Available at [www.rff.org](http://www.rff.org). Accessed on September 26, 2013

# Chapter 5: Recommendations

## 5.1 Short-term actions recommended by the Shale Gas Subcommittee

### 5.1.1 Recommendations Influencing state laws and regulations

- We reiterate the August 2012 recommendation of the Town of Cary Shale Gas Development Task Force regarding the need for the Town to ensure that State law not infringe on the Town's right to adapt and apply its zoning and land use authorities to the oil and gas industry as needed to protect Cary's environment and the health and welfare of its citizens. This includes the ability to retain its existing authority to require setbacks, such as the 300-foot setback required in Industrial zoned areas.
- In order to inform its efforts to influence the laws that might restrict the Town's authorities, we recommend that Town staff undertake an examination of experience elsewhere in the U.S. where shale gas development has infringed on populated areas.
- We recommend that the Town work to ensure that State law and regulations require full disclosure to local governments and the public of chemicals used in shale gas operations and the amounts stored on site.
- We recommend that the Town work to ensure that State law and regulations require green completion methods (which reduce VOC, HAP and PM 2.5 and criteria pollutants) be applied immediately, instead of being delayed until 2015. This will avoid combustion-related emissions associated with the control devices required under Federal regulations until 2015.
- We recommend that the Town work to ensure that State law and regulations set the applicability thresholds for New Source and Prevention of Significant Deterioration (PSD) reviews under State law at levels that will capture shale gas operations. This will help ensure that these reviews do not miss a cumulative impact that might be associated with many small sources.
- We recommend that the Town work to ensure that the state examines the potential impacts of shale gas development on forest fragmentation and on the public's use and enjoyment of public lands in and near Cary.
- The issue of "compulsory pooling" is an important one, particularly for owners of small parcels adjacent to large parcels, which could cause Cary citizens to be impacted by nearby shale gas operations. We recommend that the Town examine the issue with the objective of determining whether the Town should attempt to influence State law on this question.

### 5.1.2 Recommendations regarding town ordinances and plans

- We recommend a moratorium on shale gas development in the Town of Cary until the requirements of State law and the implementing regulations on shale gas are final and Town staff informs Town Council that (a) the impacts of these on the Town's legal authorities and activities are known, and (b) changes have been made to Town ordinances and activities as needed to reflect the requirements of State law and regulations.



### **5.1.3 Recommendations related to interaction with regional partners**

- Expanding on the August 2012 recommendation of the Shale Gas Development Task Force stating that “the Town of Cary should also participate in regional study and work groups as needed to stay informed on shale gas activities, in coordination with neighboring communities, to remain aware of other potential impacts to Cary”, we recommend that the Town of Cary seek to leverage the authority given to Wake County and Chatham County under state law in affecting the development of law and regulations on shale gas development. In addition, we recommend establishing a committee within the Triangle J Council of Government, with representation from each affected county and municipality, to ensure coordination of efforts among the counties and municipalities to mitigate the impacts of shale gas development.
- We recommend the Town determine Army Corp. of Engineer policies and plans regarding shale gas development in the Jordan Lake water supply watershed.
- We recommend that the Triangle J Council of Government work to require the use of best management practices for storm water and stream buffers for all shale gas operations within the Jordan Lake watershed.

### **5.1.4 Recommendations regarding monitoring**

- We recommend that the Town advocate for DNER to develop a network of monitoring stations to establish improved baselines for surface water, groundwater and air quality and to allow ongoing monitoring of the effects of shale gas operations.
- We recommend that the Town examine the State’s air quality monitoring network to ensure that the ambient air quality monitoring program, after it is expanded to include the site in Lee County, is adequate to address concerns about the impact of shale gas development in, or upwind of, the Town of Cary.
- We recommend that the EAB Establish a subcommittee to examine several issues related to the Jordan Lake watershed. These are (a) the adequacy of water quality monitoring in the Jordan Lake watershed to detect impacts on water quality related to shale gas development (including impacts on cumulative loadings and non-point inputs, and impacts on water treatment operations), and (b) the impacts of water withdrawals for shale gas development on the short- and long-term availability of water for the Town of Cary.

## **5.2 Longer-term actions recommended by the Shale Gas Subcommittee**

### **5.2.1 Recommendations regarding town ordinances and plans**

- We recommend that the Town examine current rules under its police power authority to ensure that they are adequate to address odor, noise and light-related issues associated with shale gas operations and associated activities.
- We recommend that the Town begin the process of identifying the protocols and limitations that should apply to the acceptance of shale gas wastewaters, including provisions related to dissolved solids and the presence of naturally occurring radioactive materials.

- We recommend that, consistent with existing permitting requirements covering similar activities, permits should be issued by the Town requiring the use of best management practices for storm water and stream buffers for shale gas operations within the Town.
- We recommend that the Town develop the ability to control and monitor spills and illegal discharges to the Town’s POTW from shale gas operations and ancillary activities, if it is found that current approaches are inadequate.
- We recommend that surface spraying of shale gas wastewaters not be allowed in the Town of Cary or its ETJ.
- We recommend that the Town revise its secondary and cumulative impacts master mitigation plan to include attention to the potential impacts of shale gas development.
- We recommend that the Town of Cary examine existing emergency response plans (e.g. Town of Cary Operations Plan) and related equipment and infrastructure to ensure that they are adequate to address emergencies at shale gas operations and related activities. These plans should be coordinated to ensure effective response, as well as rapid communication of emergencies to affected citizens (perhaps similar to the “Amber Alert” system).
- We recommend that the Town examine, within the context of the Water Resources Plan, the potential impact of shale gas development on Cary’s future water supply.
- We recommend that the process of issuing special use permits for oil and gas development include an assessment of the proximity of potentially exposed populations.

### **5.2.2 Recommendations regarding studies and monitoring**

- We recommend that the Town work with other affected entities to examine the effects of shale gas-related withdrawals from Jordan Lake on the Town’s current and future water supplies.
- We recommend that, in order to better understand the magnitude of potential direct environmental exposures to parcels and populations within one kilometer of shale gas development, the Town analyze locations, which have potential for shale gas development, such as large undeveloped parcels or large developed but under utilized parcels in or near Cary.

### **5.2.3 Recommendations regarding interaction with regional partners**

- We recommend that surface spraying of shale gas wastewaters not be allowed in jurisdictions adjacent to Cary or in the Jordan Lake water supply watershed.
- We recommend coordination with adjacent jurisdictions and groups (e.g. Wake County Local Emergency Planning Committee) to examine the collective adequacy of existing emergency response plans and related equipment and infrastructure.
- We recommend that, in order to limit potential exposure of Cary residents to releases to the environment from shale gas operations, jurisdictions adjacent to the Town of Cary include an assessment of the proximity of potentially exposed populations when issuing permits to shale gas operations.

### **5.3 Additional considerations regarding education, awareness and fiscal impacts related to potential future Shale Gas Development in the Town of Cary and ETJ that may require attention by other Town of Cary Boards, Commissions or Committees, as well as Town Staff**

- The Town may want to examine State law to determine whether current provisions regarding disclosure of conveyance of mineral rights are adequate. The Town may want to examine ways to ensure that current and prospective landowners understand the implications of separating subsurface mineral rights from surface rights on the ability to obtain mortgage funding. As a part of this, the Town may want to consider informing its citizens of the process for (a) discovering whether the land owner also owns the subsurface mineral rights and (b) how to obtain those rights. The Town may want to consider undertaking an analysis to identify those properties within the town limits where the subsurface mineral rights are not owned by the property owner and then alert the affected property owners
- The Town may want to consider a requirement that zoning/rezoning cases involving shale gas development include a requirement that property owners within one kilometer (0.6 miles) be notified of the rezoning proposal.
- The Town may want to consider a separate zoning/rezoning process within the LDO and comprehensive public engagement process for shale gas development activities similar to that for mixed use developments.
- The Town may want to more fully understand the implications of an issue raised by the MEC Local Government Regulation Study Group – i.e. local governments implementing a special use permitting program should be aware of the potential for land-owner abuse of a “present use value” designation to avoid taxation on the production of subsurface resources.
- Due to likelihood of increased truck and rail traffic, the Town’s transportation planners and engineers should consider a traffic impact analysis to identify needed transportation infrastructure improvements, including changes to height and weight limitations.
- It may be helpful for the Town to conduct a study to determine the potential costs arising from following activities involving the shale gas industry and options for recovering those costs.
  1. Transportation infrastructure upgrades & repair
  2. Waste handling
  3. Hazmat training
  4. Emergency response
  5. Training of local government staff – tax assessors, register of deeds, inspectors/code compliance officers, public safety officers
  6. Increase in local government personnel or overtime needed
  7. Drinking water well testing

### **5.4 Other recommendations that were discussed but lacked consensus in the Shale Gas Subcommittee**

- We recommend that the Town advocate for a state law that requires considering the cumulative impact of all sources, including shale gas operations, in issuing air and water permits. (Lack of

consensus is due to some members feeling that the Subcommittee does not have the time or expertise to determine whether existing laws are adequate to address cumulative impacts.)

- We recommend the EAB and the Town to provide inputs during the public comment period for the Rules developed by the EMC (02/03/14-04/21/14) and the MEC (Sept/Oct 2014). (Lack of consensus is due to some Subcommittee members feeling that it is not the job of the EAB, as a Board, to submit comments.)
- We recommend that the Department of Air Quality (DAQ) reconsider its decision that no new rules are required to address the potential air quality concerns from shale gas development. (Lack of consensus is due to some Subcommittee members feeling that the Subcommittee lacks the time and expertise to judge the basis for the DAQ decision. A recommendation regarding the permitting thresholds for such operations, however, received unanimous support and is included above.)
- We recommend that an Operational Procedure Notice be developed for Hydraulic Fracturing. (The lack of consensus is due to some Subcommittee members feeling that there was inadequate time and expertise available to the Subcommittee to know whether this is needed.)
- We recommend that a moratorium on shale gas development remain in place until late 2015 or 2016 when the results are available from a study at Colorado State University aimed at characterizing air emissions from shale gas operations. (Lack of consensus in the Subcommittee is due to some members feeling that the existing information on the likely emissions from shale gas operations is adequate to allow the development of appropriate laws and regulations.)
- We recommend that the Town make sure that air emissions from shale gas development not lead our region to being out of compliance for ozone or particulate matter under the Clean Air Act. (Lack of consensus in the Subcommittee is due to some members feeling that this request is too open ended and potentially beyond the scope of what should be asked of Town government.)
- We recommend that the Town of Cary restrict special use permits for oil and gas development to areas zoned industrial. (Lack of consensus is due to some Subcommittee members feeling that current industrial zoning is not, in itself, a good proxy for proximity to potentially exposed populations.)
- We recommend that, in order to limit potential exposure of Cary residents to releases to the environment from shale gas operations, jurisdictions adjacent to the Town of Cary restrict special use permits for oil and gas development to areas zoned industrial. (Lack of consensus is due to some Subcommittee members feeling that industrial zoning is not, in itself, a good proxy for proximity to potentially exposed populations.)
- We recommend that the Town advocate for the State to develop an Operational Procedure Notice that clarifies OSHA compliance requirements for shale gas operations. (Lack of consensus due to some Subcommittee members feeling that the group lacked expertise to know if this was needed)

# Generalized locations of the Triassic basins that may be suitable for unconventional natural gas production

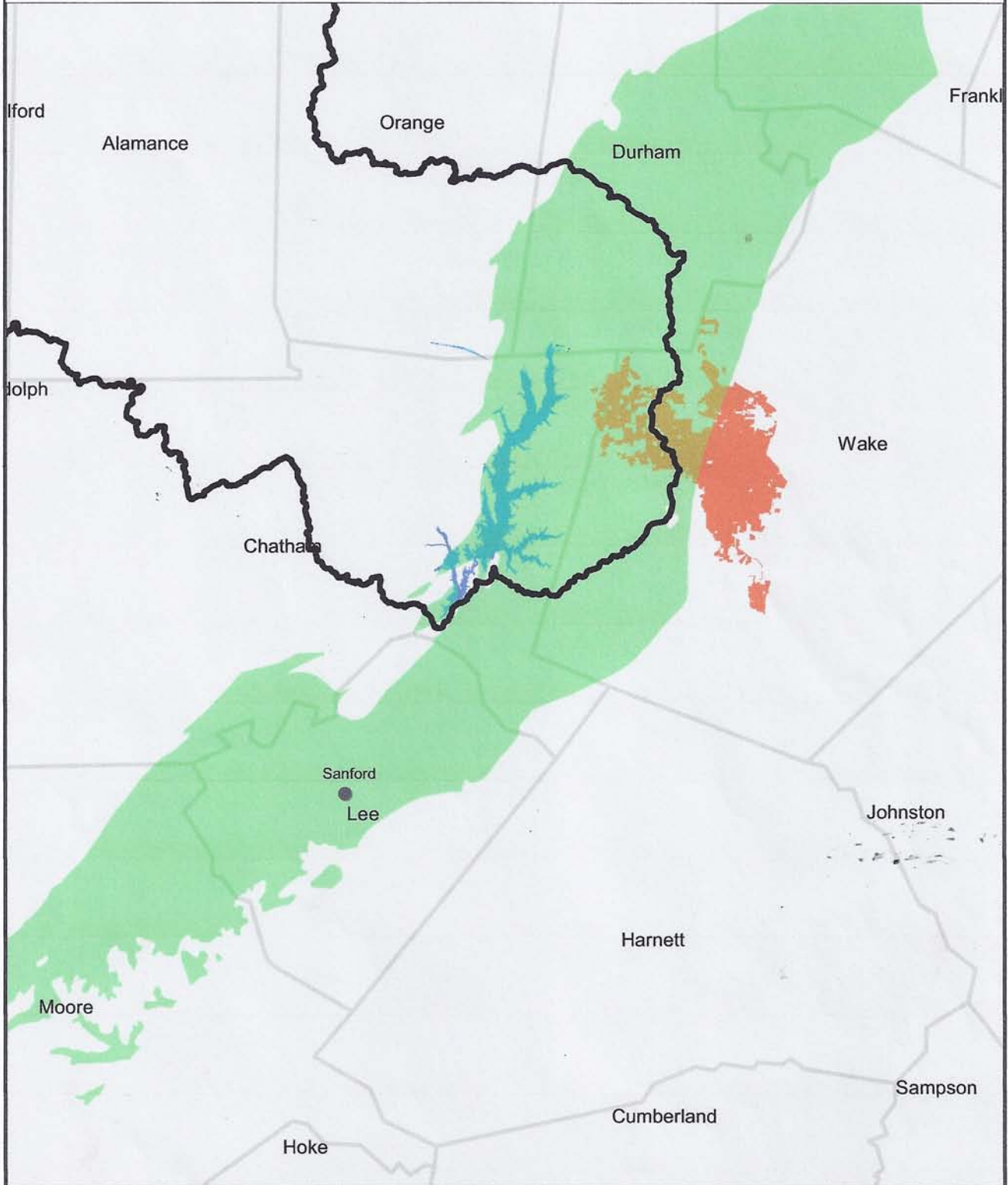
## Legend

-  Cary Town Limits
-  Deep River Basin
-  Jordan Watershed Boundary
-  NC Counties
-  Jordan Lake




Scale: 1" = 8 miles

Plotted: 12/1/2011

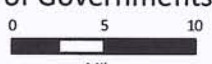


- Major River Basins
- Region J
- Rock Described as "Carbonaceous Shale"\*
- Major Geologic Belt\*\*
- Coalbed Methane (CBM) Resources by Coal Basin\*\*\*

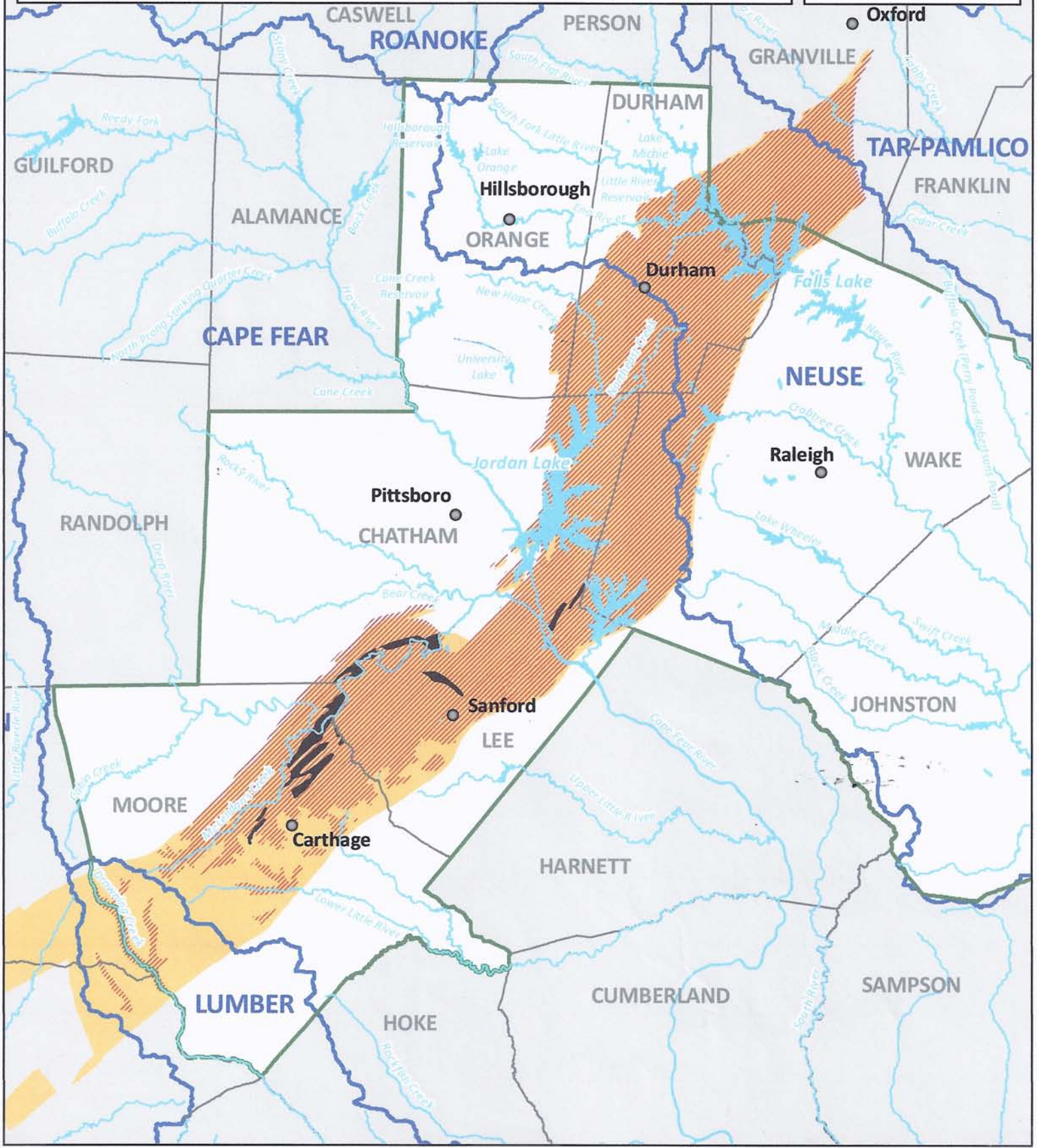
\* Rock or unit Description from the NC Geologic Survey Official Geologic Map of North Carolina  
 \*\* Major Geologic Belt Description from NC Geologic Survey Official Geologic Map of North Carolina  
 \*\*\* Based on "Coal Fields of the United States," John Tully, 1996, USGS Publication

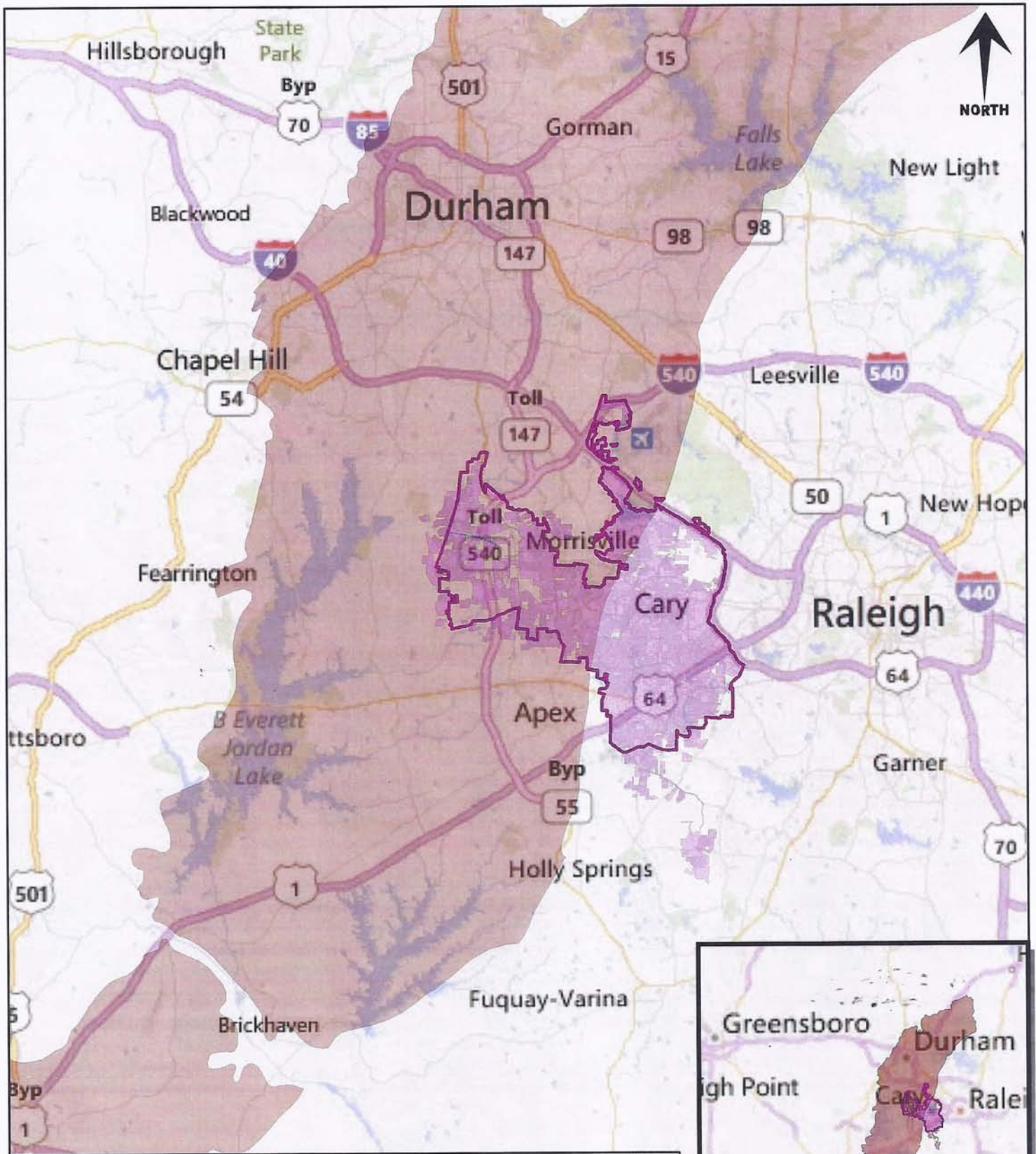


Triangle J Council  
of Governments



Miles





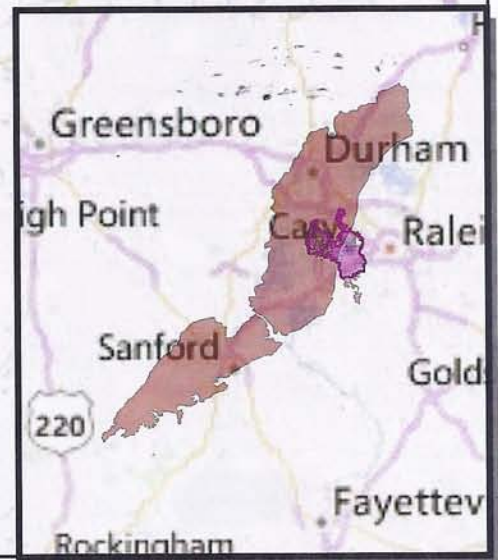
## Deep River Basin

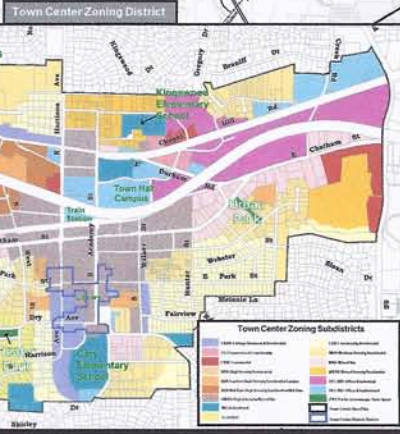
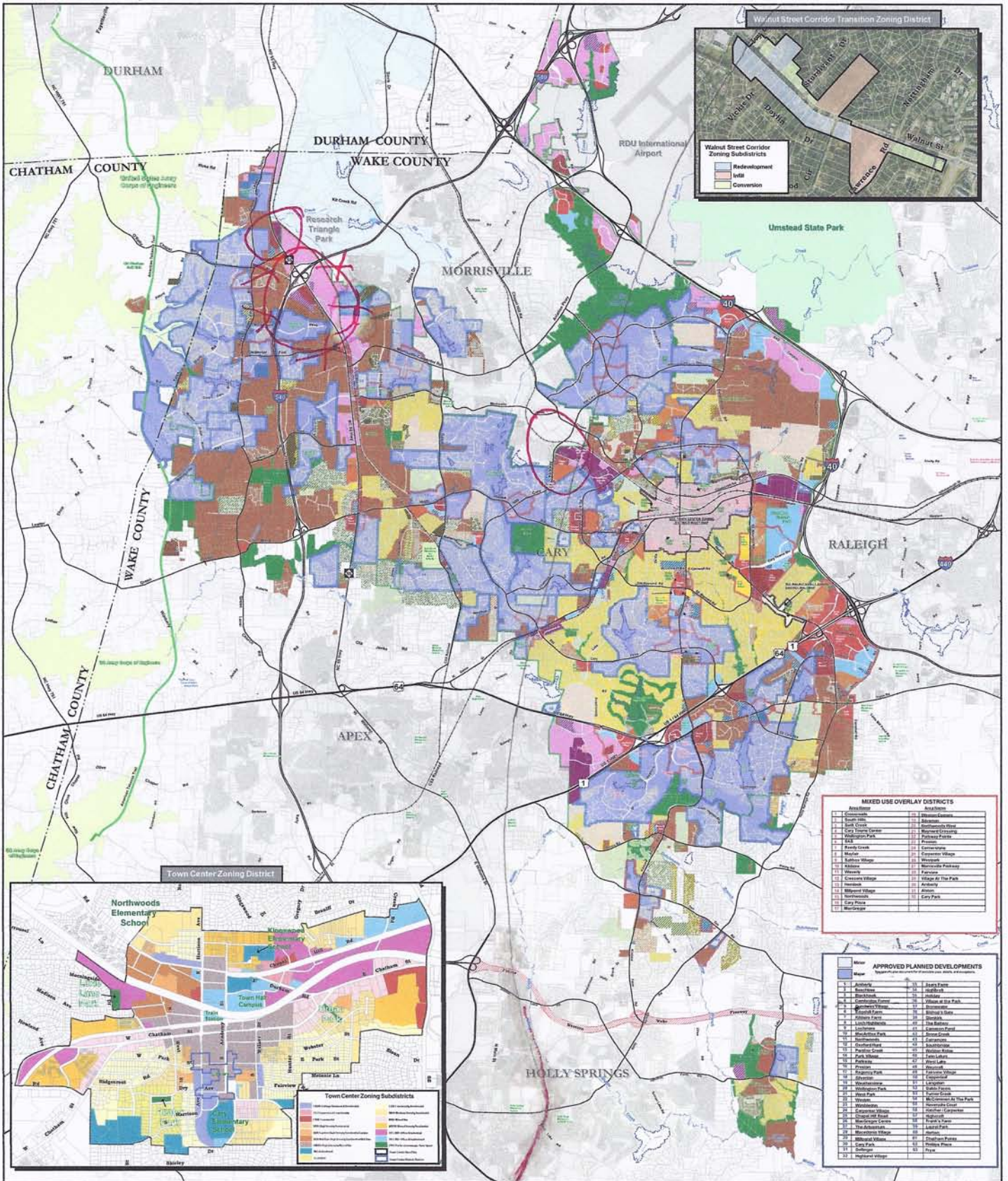
### LEGEND

-  Parcels
-  Cary Town Limits
-  Cary ETJ
-  Deep River Basin Region

Date source: NCDOT, NC OneMAP, Town of Cary GIS, Chatham County GIS, Wake County GIS. Parcel data dated 09/2013

0 12.5 25 50 75 100 Miles





**MIXED USE OVERLAY DISTRICTS**

Number	Number	Number
1	10	19
2	11	20
3	12	21
4	13	22
5	14	23
6	15	24
7	16	25
8	17	26
9	18	27
10	19	28
11	20	29
12	21	30
13	22	31
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82	91	100

**APPROVED PLANNED DEVELOPMENTS**

Number	Number	Number
1	11	21
2	12	22
3	13	23
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6	16	26
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80	90	100



**Legend**

CT-Corridor Transition	FED Major Planned Development District Map	TR-Traditional Residential
CC-Community Commercial	R/R-Resort/Recreation	Indicates Conditional Zoning (C)
I-Industrial	R2H-Residential 2H	Indicates Conditional Zoning (C)
MED-Medical Use	R2M-Residential 2M	Indicates Conditional Zoning (C)
OU-Office and Institutional	R3-Residential 3	Indicates Conditional Zoning (C)
OD-Office, Research and Development	R4-Residential 4	Indicates Conditional Zoning (C)
FED Major Planned Development District Map	MNF-Multi-Family	Indicates Conditional Zoning (C)
	TC-Town Center	Indicates Conditional Zoning (C)
		Other Corporate Leases
		Other Environmental Jurisdiction
		Planned Development District
		Map of Cary, North Carolina
		Map of Wake County, North Carolina
		Map of the State of North Carolina
		City of Cary, North Carolina
		County of Wake, North Carolina
		State of North Carolina
		United States of America

# Town of Cary Official Base Zoning Map

Last Amended: June 13, 2013



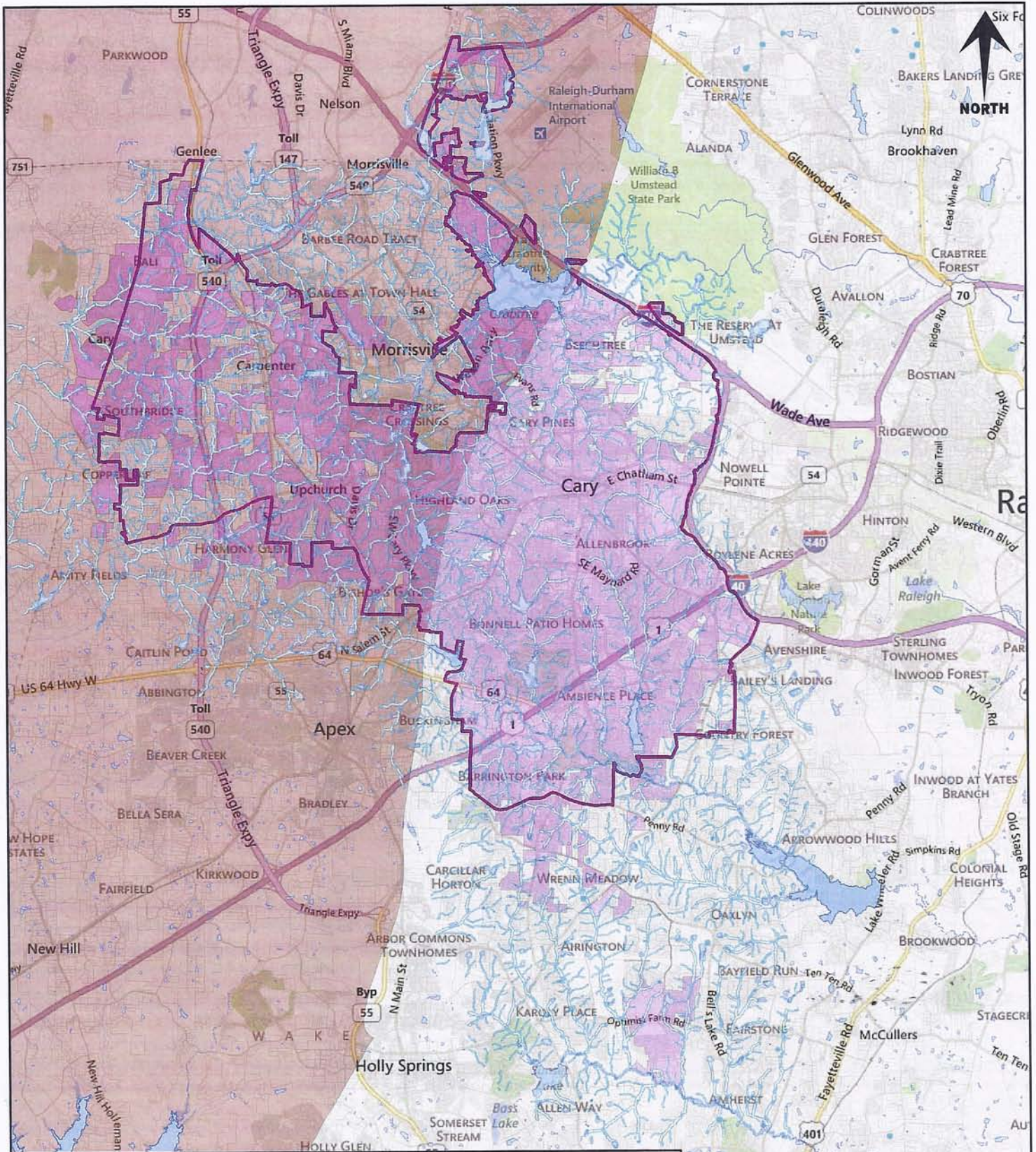
**DISCLAIMER:**

The Town of Cary is not responsible for any errors or omissions in this map. The Town of Cary is not responsible for any changes in zoning regulations or other laws that may affect the use of any property. The Town of Cary is not responsible for any damages or losses resulting from the use of this map. The Town of Cary is not responsible for any claims or lawsuits filed against the Town of Cary or any of its officials or employees. The Town of Cary is not responsible for any claims or lawsuits filed against any third party. The Town of Cary is not responsible for any claims or lawsuits filed against any third party.

Scale: 1 inch = 1,000 feet

**NORTH**





## Cary Lakes, Ponds, and River Buffers

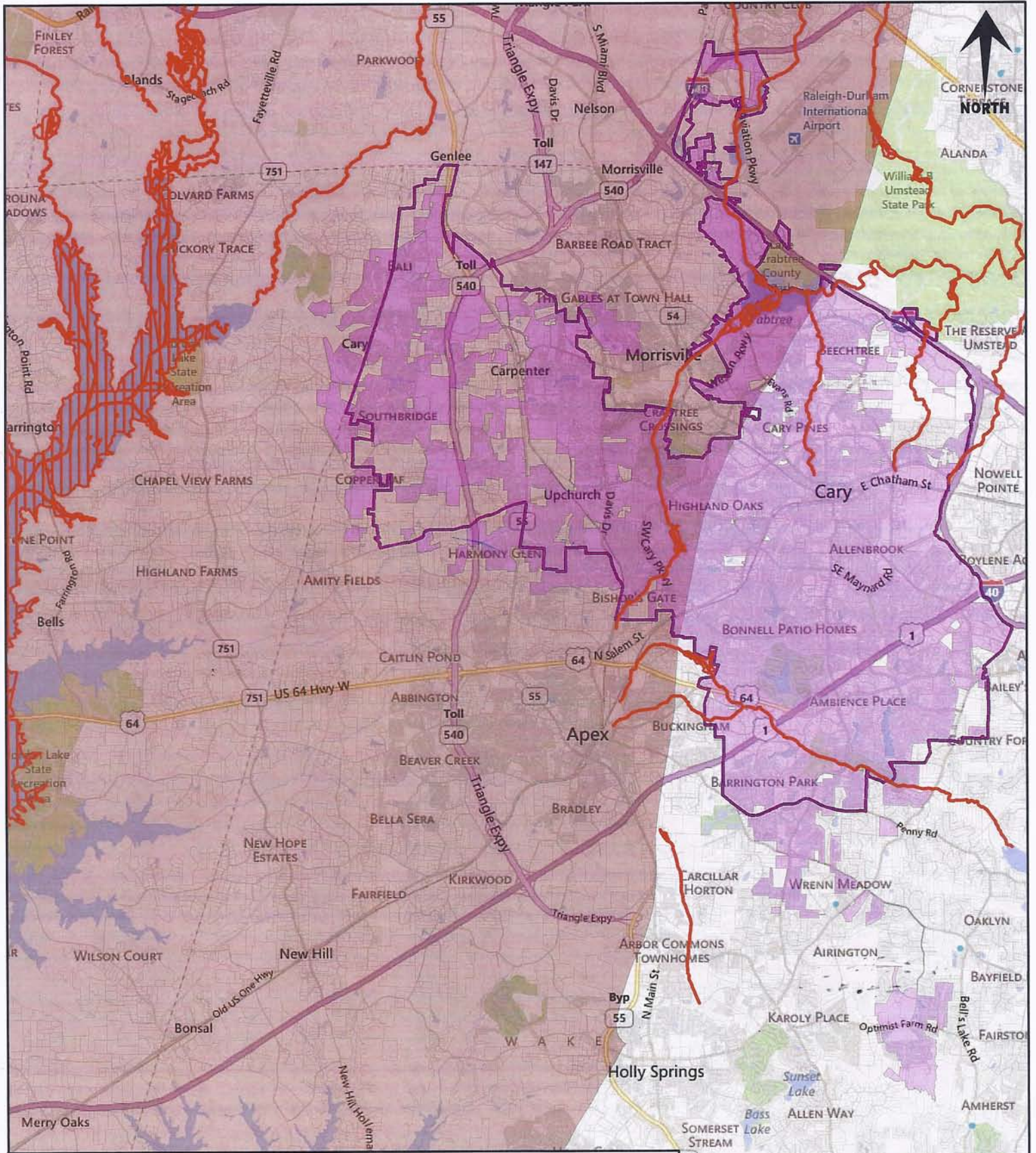
### LEGEND

- Parcels
- Cary Town Limits
- River Buffer
- Cary ETJ
- Deep River Basin Region
- Lakes and Ponds

Date source: NCDOT, NC OneMAP, Town of Cary GIS, Chatham County GIS, Wake County GIS. Parcel data dated 09/2013



Macks Village  
BROADHURST  
LITTLEJOHN ACRES  
Willow NC 42 HWY



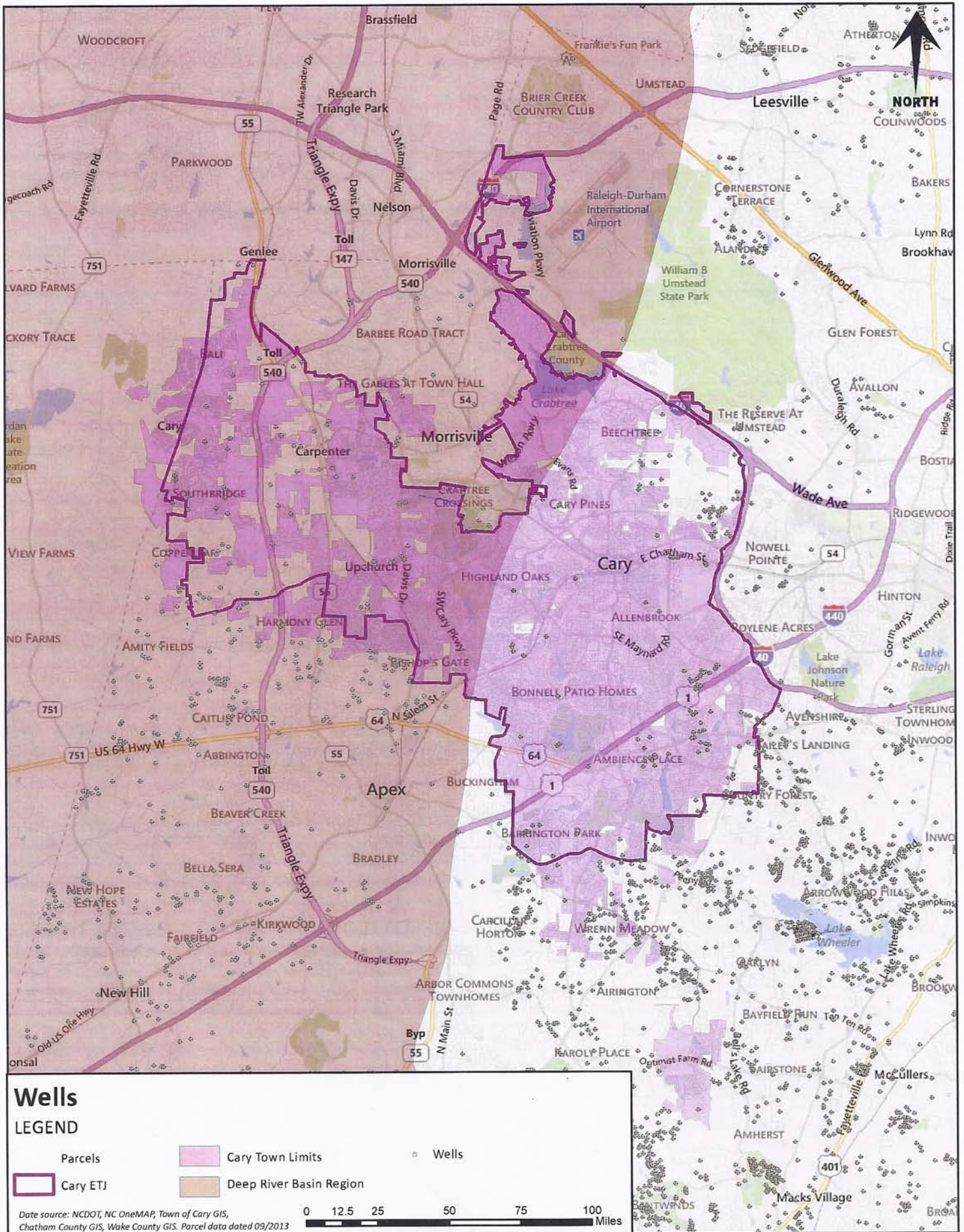
### 303 (d) Listed Impaired Waters

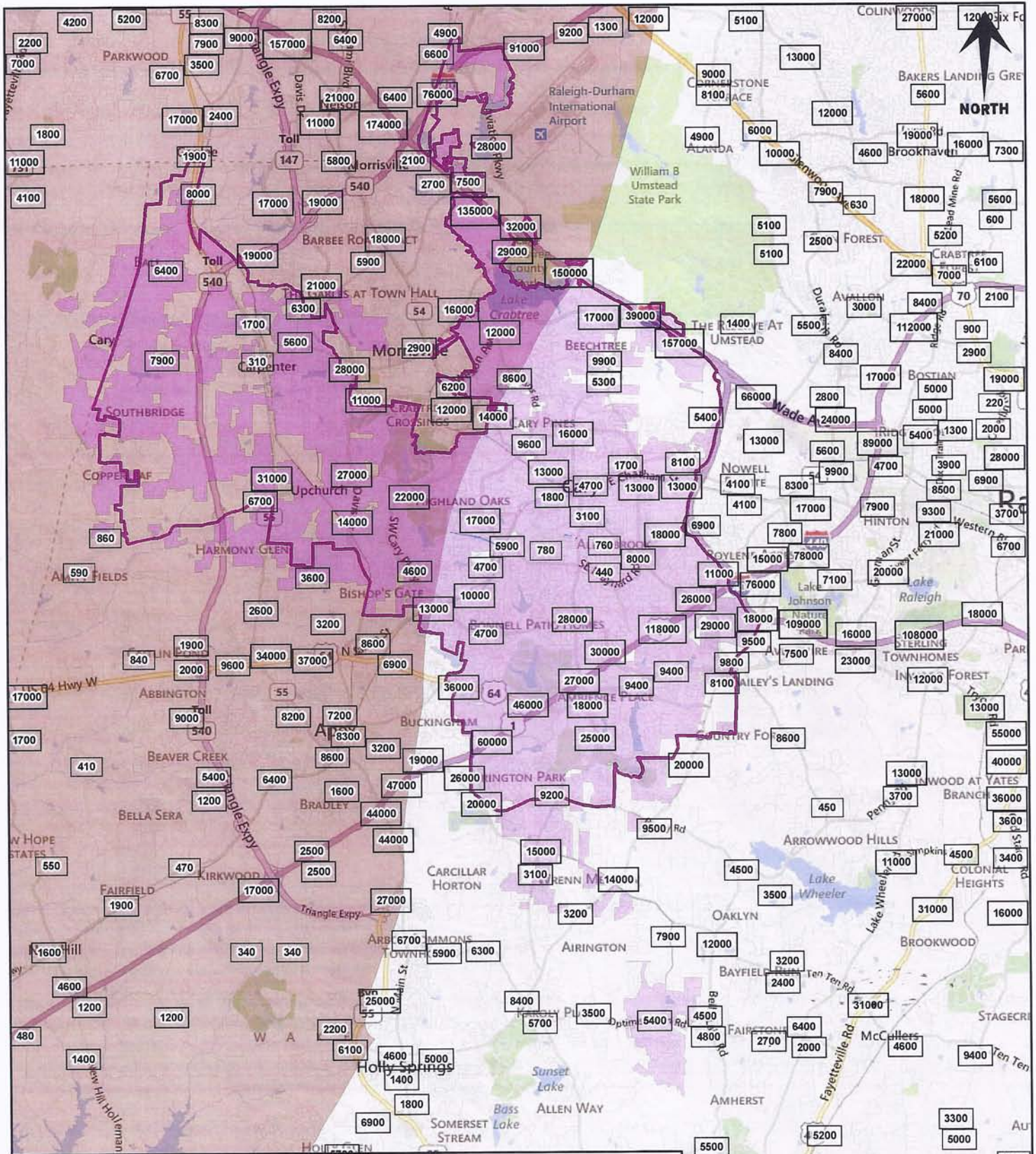
#### LEGEND

- Parcels
- Cary Town Limits
- 303(d) impaired streams
- Cary ETJ
- Deep River Basin Region
- 303 (d) impaired lakes

Date source: NCDOT, NC OneMAP, Town of Cary GIS, Chatham County GIS, Wake County GIS. Parcel data dated 09/2013





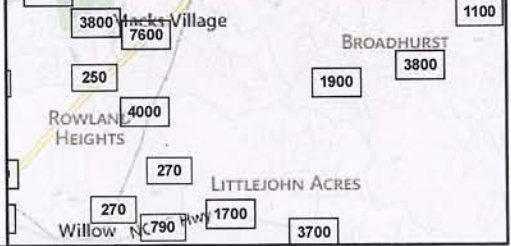


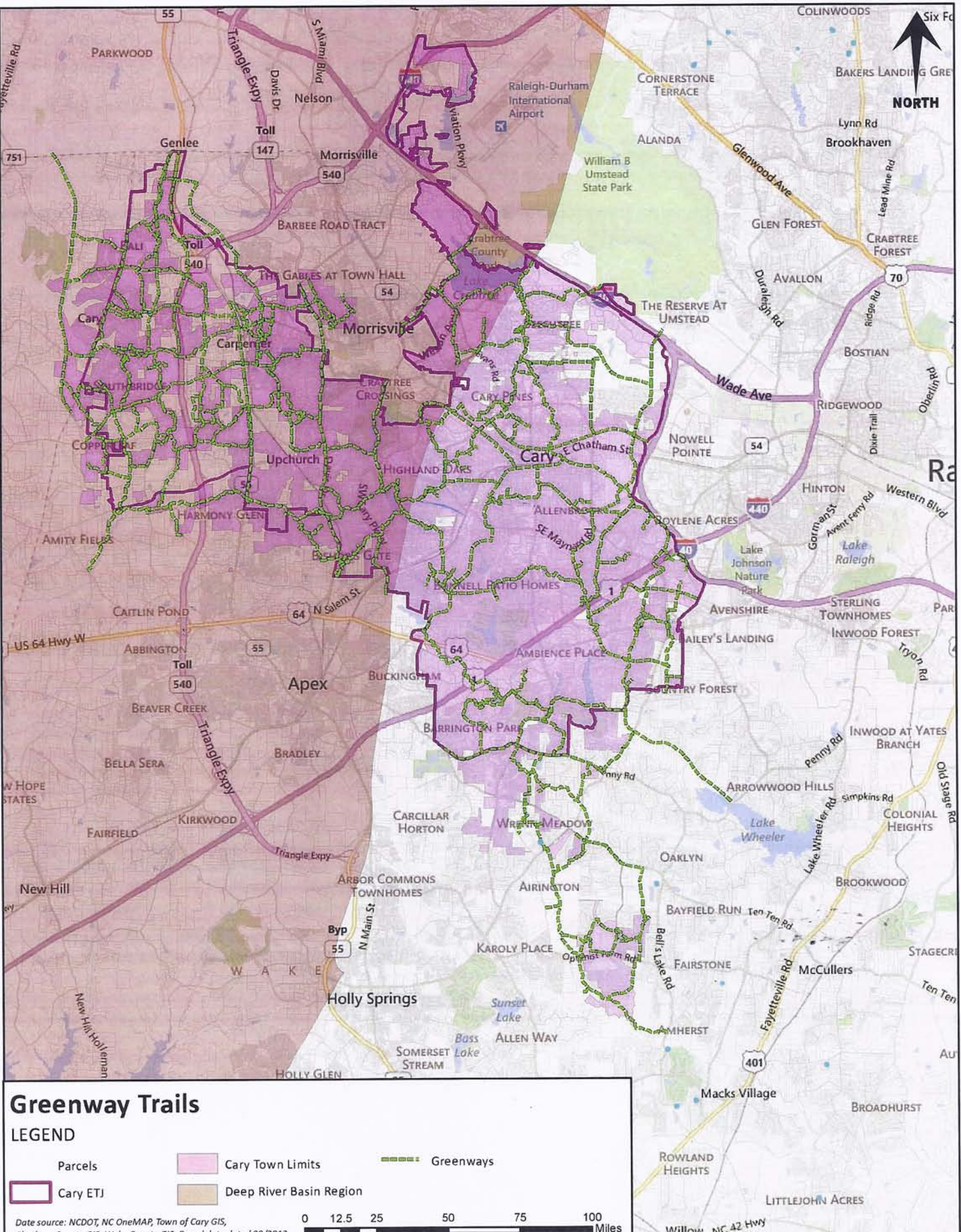
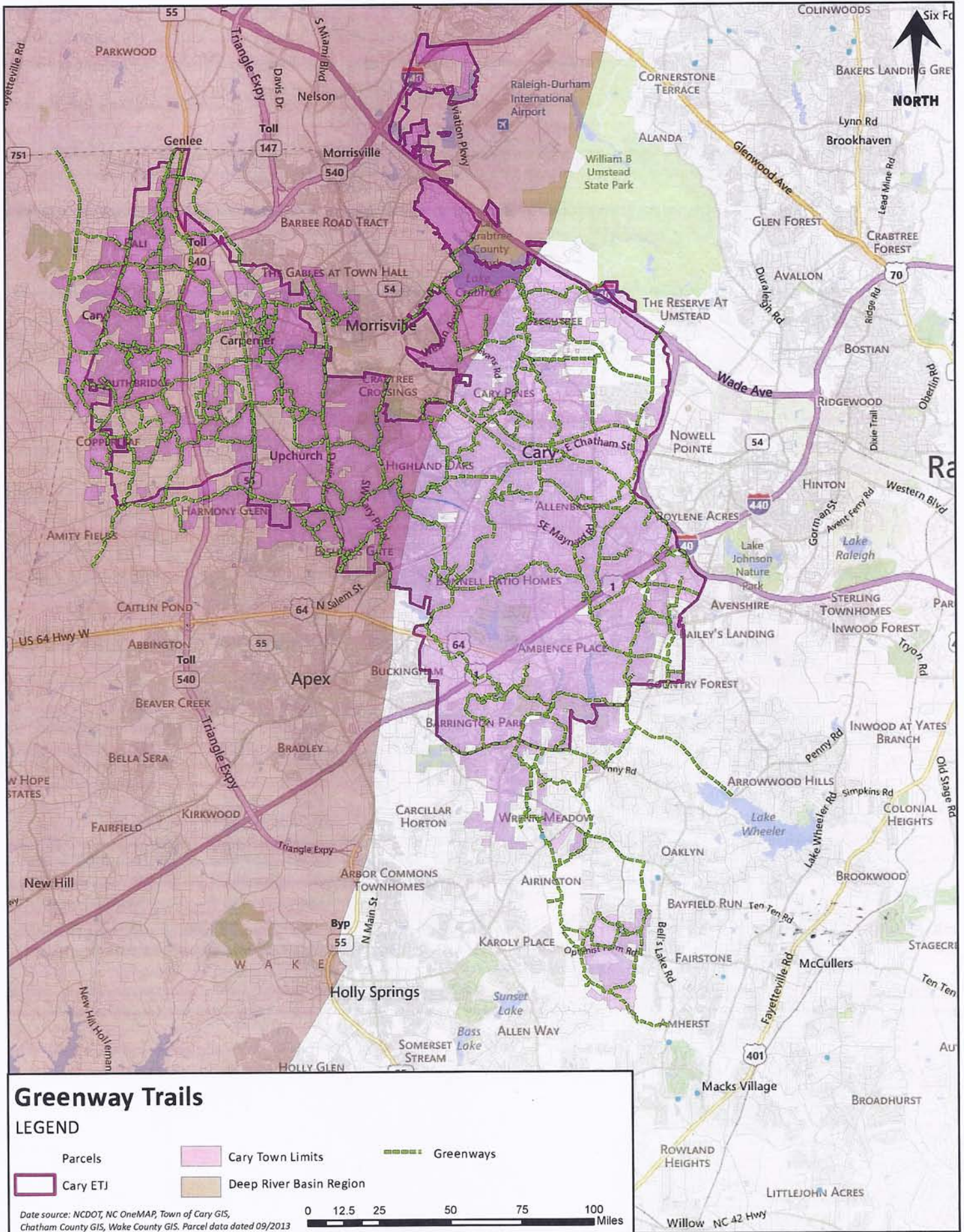
# NCDOT Traffic Volumes

## LEGEND

- Parcels
- Cary Town Limits
- Wells
- Cary ETJ
- Deep River Basin Region

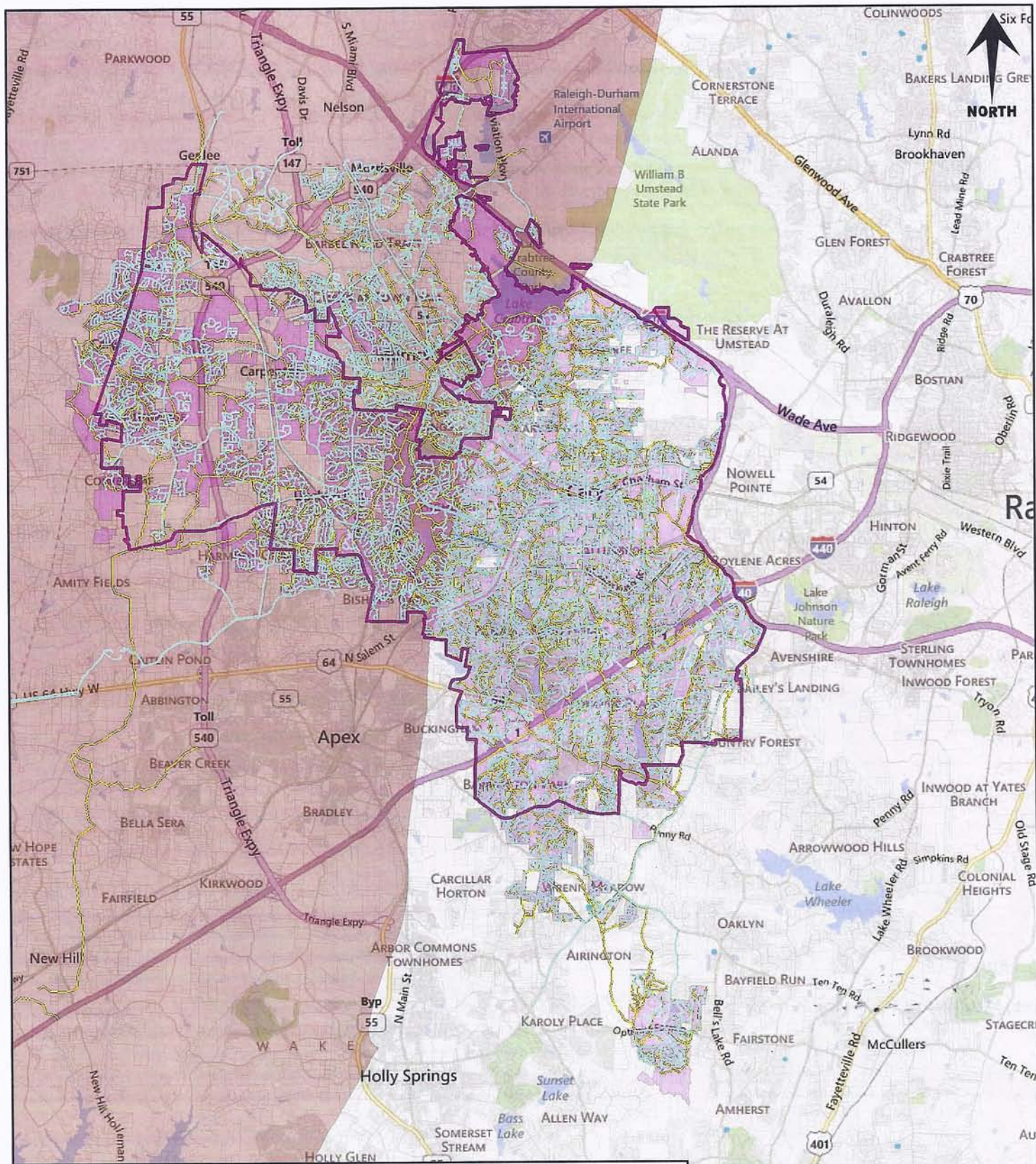
Date source: NCDOT, NC OneMAP, Town of Cary GIS, Chatham County GIS, Wake County GIS. Parcel data dated 09/2013





Date source: NCDOT, NC OneMAP, Town of Cary GIS, Chatham County GIS, Wake County GIS. Parcel data dated 09/2013





# Cary Water and Sewer Lines

## LEGEND

- Parcels
- Cary Town Limits
- Water Lines
- Cary ETJ
- Deep River Basin Region
- Sewer Lines

Date source: NCDOT, NC OneMap, Town of Cary GIS, Chatham County GIS, Wake County GIS. Parcel data dated 09/2013

0 12.5 25 50 75 100 Miles