# Caroline County Ozone Advance Action Plan

## Annual Report

# Abbreviations

| | |
|---|---|
| CMAQ | Congestion, Mitigation, and Air Quality |
| DMME | Virginia Department of Mines, Minerals, and Energy |
| EGU | electrical generating unit |
| EPA | United States Environmental Protection Agency |
| EV | electric vehicles |
| FAMPO | Fredericksburg Area Metropolitan Planning Organization |
| FGD | flue gas desulfurization unit |
| FRM | Federal reference method |
| LEED | Leadership in Energy and Environmental Design |
| MATS | Mercury and Air Toxics Rule |
| $\mu g/m^3$ | micrograms per cubic meter |
| MW | megawatts |
| NAAQS | National Ambient Air Quality Standard |
| $NO_X$ | nitrogen oxides |
| ORE | On Road Emissions Program |
| $PM_{2.5}$ | fine particulate matter less than 2.5 micrometers in diameter |
| ppb | parts per billion |
| SCR | selective catalytic reduction |
| SF | square foot |
| $SO_2$ | sulfur dioxide |
| VCC | Virginia Clean Cities, Inc. |
| VDEQ | Virginia Department of Environmental Quality |
| VEMP | Virginia Energy Management Program |
| VOC | volatile organic compounds |
| VPA | Virginia Port Authority |

# Virginia Ozone and $PM_{2.5}$ Air Quality, October 2014 Update

The Ozone Advance program is a collaborative effort between federal, state, and local governments as well as area stakeholders to develop an Action Plan for a particular area. Action Plans encourage programs and practices that facilitate emission reductions of ozone and fine particulate ($PM_{2.5}$) precursors so that citizens may continue to benefit from healthy air quality. These Action Plans help to ensure that covered areas remain compliant with federal National Ambient Air Quality Standards (NAAQS) and provide a roadmap for progress toward compliance with any future NAAQS updates. The U.S. Environmental Protection Agency (EPA) provided programmatic guidance concerning the Ozone Advance program in April 2012. After reviewing air quality data and considering the information in the guidance document, leaders in Caroline County and the Commonwealth of Virginia developed the Caroline County Ozone Advance Action Plan to promote continued good air quality.

The Action Plan, which EPA received in October 2013, provided a great deal of information on the air quality in Caroline County and across Virginia. The plan is available on the Virginia Department of Environmental Quality (VDEQ) website at http://www.deq.virginia.gov/Programs/Air/AirQualityPlans/OzoneandPM25RegionalPlanningActivities.aspx. The data below updates the air quality information in the Action Plan and shows that air quality improvements are continuing. The improvements are the result of the emission reductions achieved from the many state, federal, and local air pollution control programs being implemented as well as the favorable meteorology during the summers of 2013 and 2014.

## Ozone

Photochemical reactions between volatile organic compounds (VOC) and nitrogen oxides ($NO_X$) create ozone when they combine in the presence of sunlight. Ozone is the primary component of smog and a lung irritant. Populations that are especially susceptible to impacts from this pollutant include elderly people, children, and those with lung ailments such as asthma and emphysema. Ozone also interferes with plants' abilities to process food and ward off diseases.

Emission reductions of $NO_X$, the primary precursor to ozone in the Commonwealth, have been significant in recent years. More reductions are expected, as detailed in the Action Plan, due to the new Tier 3 Motor Vehicle Emission and Fuel Standards that EPA finalized on April 28, 2014 (79 FR 23414).

Meteorology also plays a key role in ozone formation. The meteorology in 2009 and 2013 was not conducive to ozone formation due to cooler temperatures and more precipitation. Both years had cooler-than-average daily maximum temperatures during the May through September ozone season and higher-than-average precipitation, contributing to decreased ozone concentrations. The meteorology during the summers of 2010, 2011, and 2012 was more conducive to ozone formation. The 2010 ozone season in Virginia was the warmest on record with a maximum daily temperature averaging 84.9°F (+3.8°F above normal) and had below average precipitation (-0.71 inches). The 2011 and 2012 ozone seasons also had higher-than-average maximum daily temperatures although precipitation in 2011 and 2012 was near or above normal levels. During the summer of 2014, Virginia experienced cooler-than-normal temperatures and above normal rainfall, which again was not conducive to ozone formation.

# Virginia Ozone and $PM_{2.5}$ Air Quality, October 2014 Update

Chart 1 below shows the ozone air quality as measured at the Caroline County monitor and at the Stafford County monitor, which is located nearby. Air quality in this part of the Commonwealth has greatly improved over the last decade. This long term improvement indicates that the emission reductions achieved both locally and regionally have been successful in improving air quality to the point where ozone air quality complies with, and is significantly beneath, the 2008 ozone NAAQS of 75 parts per billion (ppb).

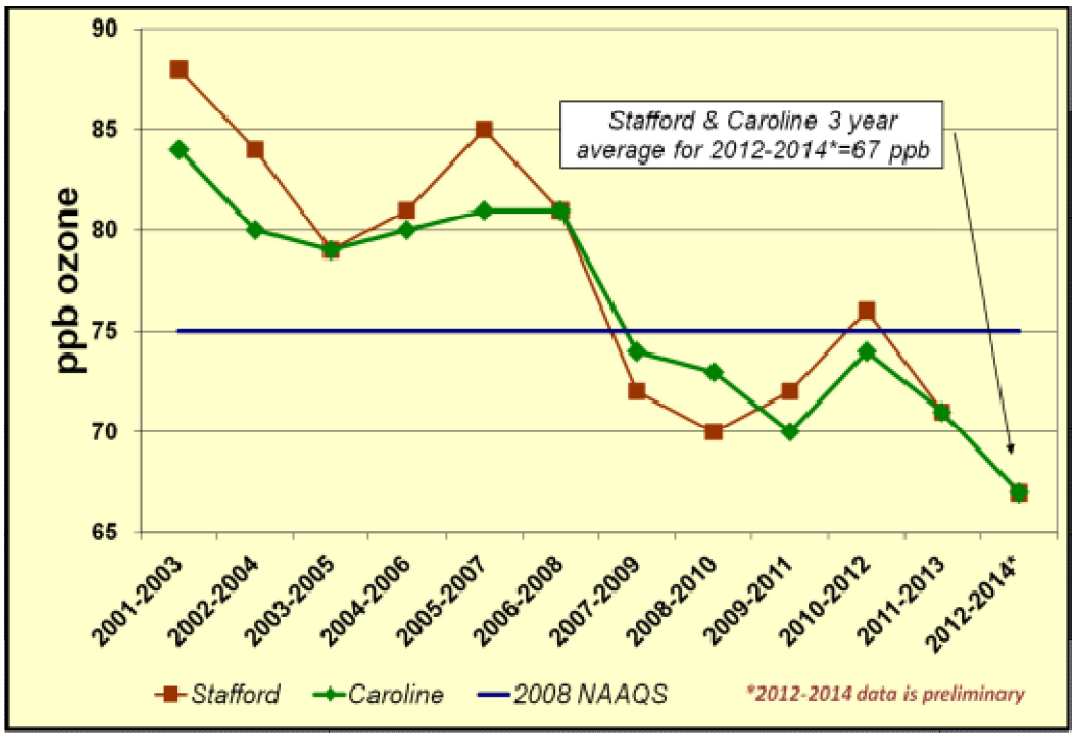
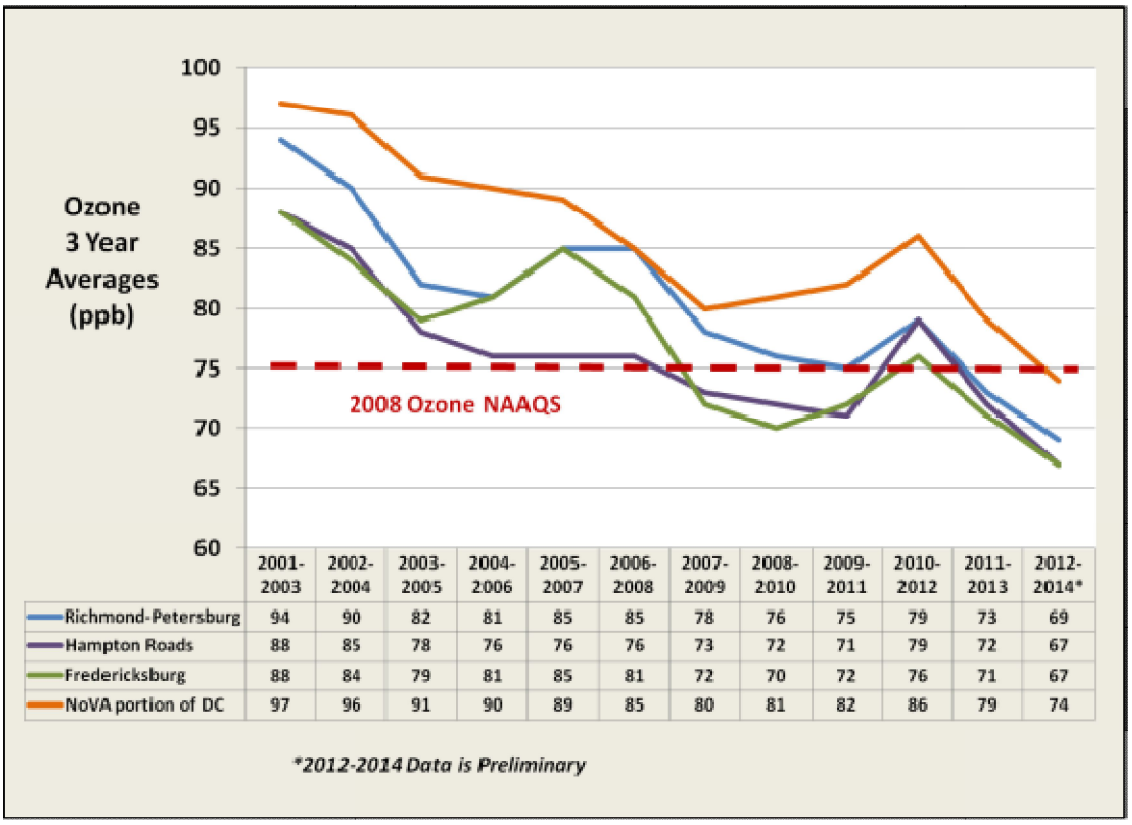



**Chart 1: Ozone Air Quality, Caroline County and Stafford County**

Monitoring data across Virginia show similar patterns, as evinced by the information in Chart 2. All areas of the Commonwealth are benefitting from the ozone precursor emission reductions generated by federal, state, and local control programs, and the Commonwealth has seen tremendous improvements in ozone air quality over the last decade.

Chart 3 shows the number of ozone air quality exceedence days in Virginia since 1997. In 1998, Virginia recorded 82 exceedence days statewide. In 2010, the hottest and one of the driest summers on record, this value dropped to 25 exceedence days, and preliminary data for the summer of 2014 shows only 3 exceedence days recorded.

# Virginia Ozone and $PM_{2.5}$ Air Quality, October 2014 Update




| | 2001-2003 | 2002-2004 | 2003-2005 | 2004-2006 | 2005-2007 | 2006-2008 | 2007-2009 | 2008-2010 | 2009-2011 | 2010-2012 | 2011-2013 | 2012-2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Richmond-Petersburg | 94 | 90 | 82 | 81 | 85 | 85 | 78 | 76 | 75 | 79 | 73 | 69 |
| Hampton Roads | 88 | 85 | 78 | 76 | 76 | 76 | 73 | 72 | 71 | 79 | 72 | 67 |
| Fredericksburg | 88 | 84 | 79 | 81 | 85 | 81 | 72 | 70 | 72 | 76 | 71 | 67 |
| NoVA portion of DC | 97 | 96 | 91 | 90 | 89 | 85 | 80 | 81 | 82 | 86 | 79 | 74 |

**2012-2014 Data is Preliminary*

**Chart 2: Ozone 3-Year Averages in Virginia Metropolitan Areas**

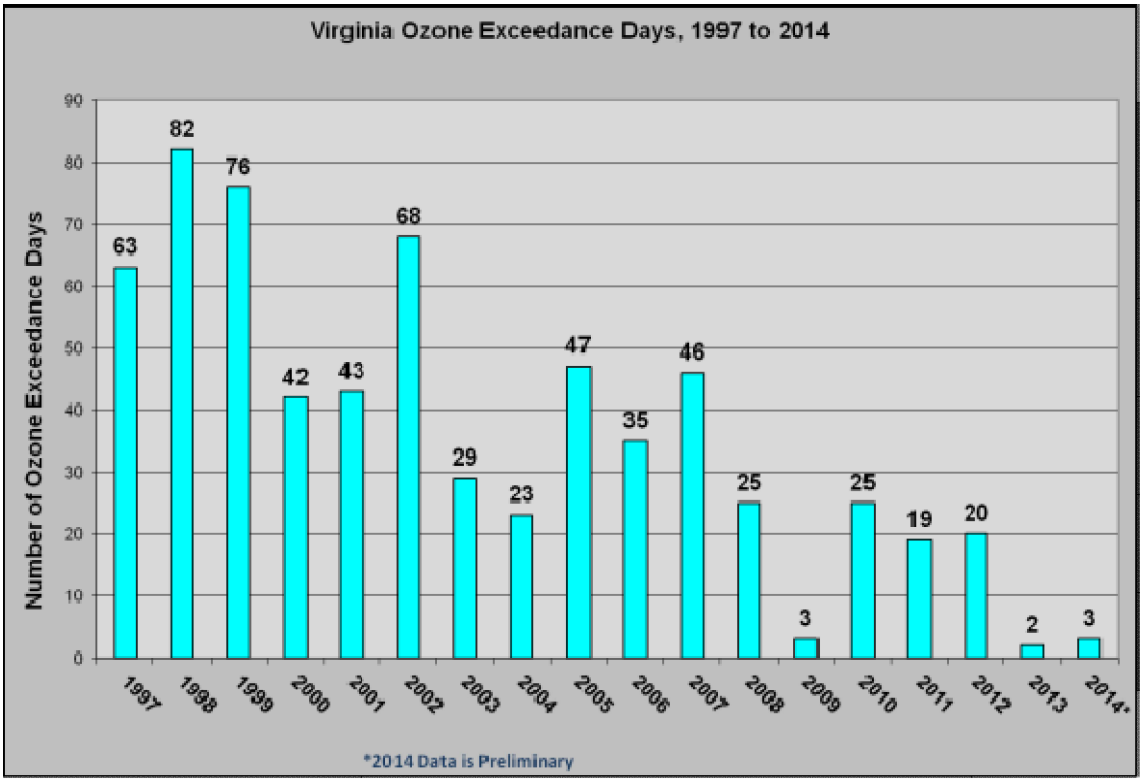



**Chart 3: Virginia Ozone Exceedence Day Trends**

# Virginia Ozone and $PM_{2.5}$ Air Quality, October 2014 Update

$PM_{2.5}$

The federal regulations define $PM_{2.5}$ as any airborne particle of solid or liquid matter that is less than or equal to 2.5 micrometers in diameter, approximately $1/30^{th}$ the width of a human air. Exposure to high levels of $PM_{2.5}$ adversely affects human health, and the main impacts of $PM_{2.5}$ are on the respiratory system and the cardiovascular system. Children, the elderly, and individuals with pre-existing pulmonary or cardiac disease are the most susceptible to $PM_{2.5}$ pollution.

Federal regulations provide two health-based standards for $PM_{2.5.}$ The first is a daily, or 24-hour, standard of 35 $\mu g/m^3$, established in 2006. The second is an annual average of 12.0 $\mu g/m^3$, established in 2012. All monitors in Virginia comply with the 2006 daily $PM_{2.5}$ NAAQS and the 2012 annual $PM_{2.5}$ NAAQS. Recorded data is well below the federal standards. On October 6, 2014, EPA finalized a redesignation request for the only $PM_{2.5}$ nonattainment area in Virginia, the Metropolitan Washington, D.C. 1997 $PM_{2.5}$ NAAQS nonattainment area (79 FR 60081). This redesignation will be effective November 5, 2014. Air quality in this region of the Commonwealth has been in the healthy range for several years, and redesignation of the area validates the numerous implemented and on-going controls programs in Northern Virginia and across the Commonwealth.

Table 1 provides information from one $PM_{2.5}$ Federal Reference Method (FRM) monitoring site in each area of the Commonwealth. While Caroline County does not have a $PM_{2.5}$ FRM monitoring site located within its boundaries, $PM_{2.5}$ air quality within Caroline County should reflect similar values due to the regional nature of $PM_{2.5}$ pollution. These data also show that $PM_{2.5}$ air quality continues to improve so that there is a significant buffer between the monitored values and the health-based standards of 35 $\mu g/m^3$ on a 24-hour basis and 12.0 $\mu g/m^3$ on an annual basis. This improvement is largely due to $SO_2$ emission reductions because $SO_2$ forms sulfates, a component of $PM_{2.5}$, in the atmosphere.

**Table 1: Annual and 24-Hour $PM_{2.5}$ 3-Year Averages Across the Commonwealth**

| 3 Year Period | Arlington 51-013-0020 | | Chesterfield 51-041-0003 | | Bristol 51-520-0006 | | Virginia Beach 51-810-0008 | |
|---|---|---|---|---|---|---|---|---|
| | Annual | 24-Hour | Annual | 24-Hour | Annual | 24-Hour | Annual | 24-Hour |
| 2001-2003 | 14.6 $\mu g/m^3$ | 38 $\mu g/m^3$ | 13.6 $\mu g/m^3$ | 34 $\mu g/m^3$ | 14.3 $\mu g/m^3$ | 33 $\mu g/m^3$ | 12.6 $\mu g/m^3$ | 33 $\mu g/m^3$ |
| 2002-2004 | 14.5 $\mu g/m^3$ | 37 $\mu g/m^3$ | 13.4 $\mu g/m^3$ | 33 $\mu g/m^3$ | 13.9 $\mu g/m^3$ | 31 $\mu g/m^3$ | 12.5 $\mu g/m^3$ | 32 $\mu g/m^3$ |
| 2003-2005 | 14.6 $\mu g/m^3$ | 36 $\mu g/m^3$ | 13.6 $\mu g/m^3$ | 33 $\mu g/m^3$ | 14.0 $\mu g/m^3$ | 30 $\mu g/m^3$ | 12.6 $\mu g/m^3$ | 30 $\mu g/m^3$ |
| 2004-2006 | 14.2 $\mu g/m^3$ | 34 $\mu g/m^3$ | 13.4 $\mu g/m^3$ | 30 $\mu g/m^3$ | 13.9 $\mu g/m^3$ | 31 $\mu g/m^3$ | 12.5 $\mu g/m^3$ | 30 $\mu g/m^3$ |
| 2005-2007 | 14.0 $\mu g/m^3$ | 32 $\mu g/m^3$ | 13.3 $\mu g/m^3$ | 31 $\mu g/m^3$ | 13.9 $\mu g/m^3$ | 30 $\mu g/m^3$ | 12.1 $\mu g/m^3$ | 30 $\mu g/m^3$ |
| 2006-2008 | 12.9 $\mu g/m^3$ | 30 $\mu g/m^3$ | 12.4 $\mu g/m^3$ | 28 $\mu g/m^3$ | 12.7 $\mu g/m^3$ | 28 $\mu g/m^3$ | 11.9 $\mu g/m^3$ | 30 $\mu g/m^3$ |
| 2007-2009 | 11.9 $\mu g/m^3$ | 27 $\mu g/m^3$ | 11.2 $\mu g/m^3$ | 24 $\mu g/m^3$ | 11.2 $\mu g/m^3$ | 25 $\mu g/m^3$ | 10.7 $\mu g/m^3$ | 26 $\mu g/m^3$ |
| 2008-2010 | 10.8 $\mu g/m^3$ | 24 $\mu g/m^3$ | 10.3 $\mu g/m^3$ | 21 $\mu g/m^3$ | 10.2 $\mu g/m^3$ | 22 $\mu g/m^3$ | 10.3 $\mu g/m^3$ | 24 $\mu g/m^3$ |
| 2009-2011 | 10.1 $\mu g/m^3$ | 22 $\mu g/m^3$ | 9.6 $\mu g/m^3$ | 21 $\mu g/m^3$ | 9.9 $\mu g/m^3$ | 21 $\mu g/m^3$ | 9.6 $\mu g/m^3$ | 23 $\mu g/m^3$ |
| 2010-2012 | 9.9 $\mu g/m^3$ | 22 $\mu g/m^3$ | 9.5 $\mu g/m^3$ | 21 $\mu g/m^3$ | 9.8 $\mu g/m^3$ | 20 $\mu g/m^3$ | 9.3 $\mu g/m^3$ | 24 $\mu g/m^3$ |
| 2010-2013 | 9.4 $\mu g/m^3$ | 21 $\mu g/m^3$ | 8.7 $\mu g/m^3$ | 21 $\mu g/m^3$ | 9.0 $\mu g/m^3$ | 18 $\mu g/m^3$ | 8.5 $\mu g/m^3$ | 22 $\mu g/m^3$ |

*Data Source: VDEQ-Air Quality Monitoring Division*

Chart 4 shows the improvement in monitored sulfate concentrations over the last several years, as measured by the $PM_{2.5}$ speciation monitor located in Henrico, Virginia. This monitor has the ability to measure the components of $PM_{2.5}$ pollution. The sulfate portion of $PM_{2.5}$ has decreased markedly, as has the organic carbon portion.

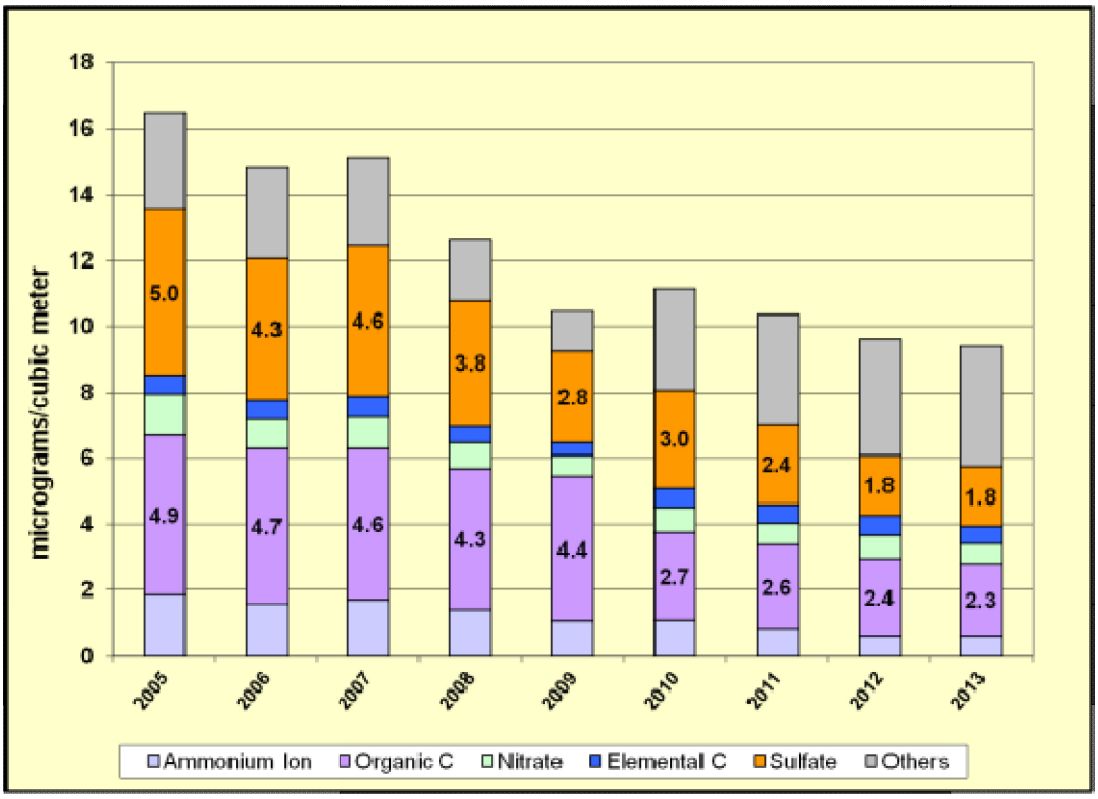



**Chart 4: Henrico Speciation Data**

Emission Reduction Programs

Existing control programs are reducing pollution and improving air quality. These programs are helping Virginia get a head start on meeting the new, health-based ozone standard, which is due to be proposed by the end of this year. Upcoming control programs, such as the Tier 3 vehicle standards, should continue improving ozone air quality in the Commonwealth of Virginia.

The following table provides an update on the programs described in the Caroline County Ozone Advance Action Plan. VDEQ has provided a CD containing supporting information, including the various documents referenced in Table 2 below.

One such program is the energy conservation efforts implemented by Fort A.P. Hill in Caroline County. Fort A.P. Hill is a regional training center that provides support to America's defense forces with an all-purpose, year-round training facility that sits on 75,794 acres. Mission requirements have dictated an expansion of Fort A.P. Hill's facilities. However, the increase in building square footage has not contributed to a major increase in energy utilization. Upgrades of heating and cooling equipment, improved insulation, better day-to-day practices at existing

buildings, and the construction of highly energy efficient new facilities resulted in only minimum increases in energy use and decreases in air emissions from Fort A.P. Hill over the last 5 years. Chart 5 compares electricity and fuel consumption against building square footage since federal fiscal year 2009 and demonstrates the improvements seen in energy efficiency. Important to note is that these changes also save taxpayer money on operating expenses at this installation. Chart 6 shows Fort A.P. Hill's transition from distillate heating oil to propane as a heating source and the resulting reductions in NOx emissions. Chart 7 shows overall criteria pollutant emission reductions at Fort A.P. Hill.

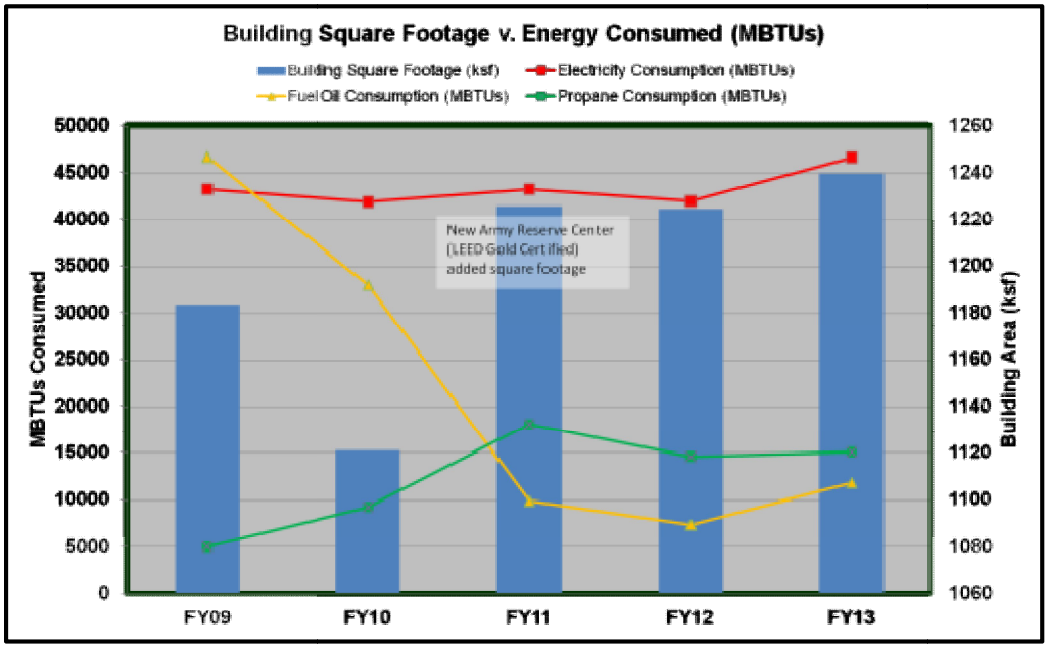



**Chart 5: Fort A.P. Hill's Energy Consumption, FY 2009-FY 2013**

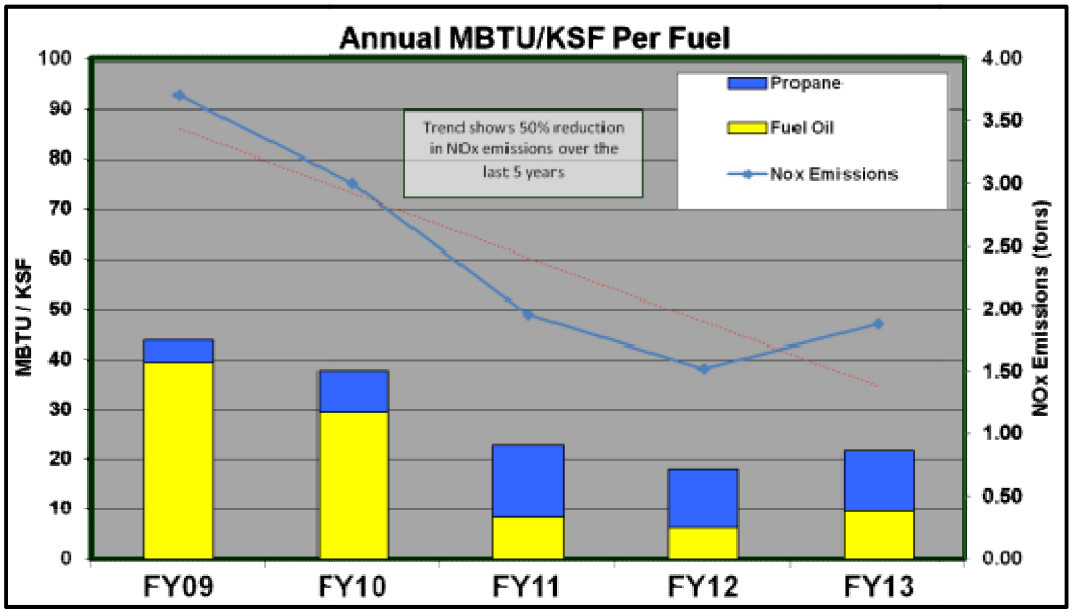
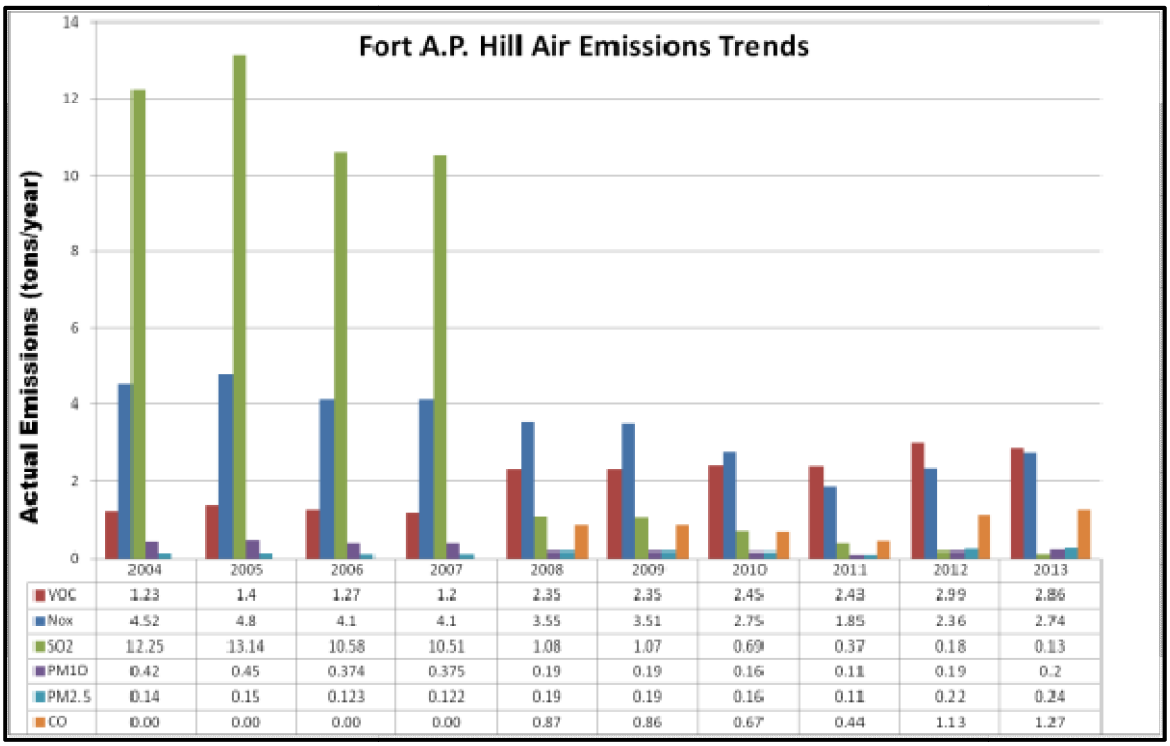



**Chart 6: Fuel Burning $NO_X$ Emissions at Fort A.P. Hill**




| | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|---|
| VOC | 1.23 | 1.4 | 1.27 | 1.2 | 2.35 | 2.35 | 2.45 | 2.43 | 2.99 | 2.86 |
| Nox | 4.52 | 4.8 | 4.1 | 4.1 | 3.55 | 3.51 | 2.75 | 1.85 | 2.36 | 2.74 |
| SO2 | 12.25 | 13.14 | 10.58 | 10.51 | 1.08 | 1.07 | 0.69 | 0.37 | 0.18 | 0.13 |
| PM10 | 0.42 | 0.45 | 0.374 | 0.375 | 0.19 | 0.19 | 0.16 | 0.11 | 0.19 | 0.2 |
| PM2.5 | 0.14 | 0.15 | 0.123 | 0.122 | 0.19 | 0.19 | 0.16 | 0.11 | 0.22 | 0.24 |
| CO | 0.00 | 0.00 | 0.00 | 0.00 | 0.87 | 0.86 | 0.67 | 0.44 | 1.13 | 1.27 |

**Chart 7: Annual Actual Emissions of Criteria Pollutants at Fort A.P. Hill**

# Caroline County Ozone Advance Action Plan
# Annual Report

## Table 2: Emission Reduction Programs

| Control Program | Stakeholders | Time Frame | Milestones | Feedback & Comments |
|---|---|---|---|---|
| ***Fredericksburg Area Metropolitan Planning Organization*** | | | | |
| CMAQ Projects | FAMPO | 2012-2018 | • Programs initiated | • See FAMPO-Resolution-13-13-Allocaiton-FY14-19-RSTP-CMAQ-Funds.pdf. |
| GWRideConnect | FAMPO GWRideConnect | On going | • VMT avoided annually<br>• Vehicle trips avoided annually<br>• Vanpools formed | • Programs ongoing<br>• See http://www.gwrideconnect.org |
| ***Fort A.P. Hill*** | | | | |
| Energy Efficiency/Renewable Energy | A.P. Hill | On going | • LEED certifications<br>• Fuel usage | • New Army Reserve Center Complex-LEED Certified Gold July 2013<br>• AWG Complex certified LEED Silver in near term. |
| Emissions Impact | A.P. Hill | On going | • Annual emissions estimates | • See Updated_figures_for OAPP_3-16-14.docx |
| ***Virginia Department of Environmental Quality*** | | | | |
| Expansion of ORE | VDEQ | Full implementation: 2014 | • Program implemented | • VDEQ received one proposal for an expanded On-Road Emissions (ORE) program, which will enable up to 30% of the vehicles currently requiring a biennial test at an inspection station to pay for an optional "clean screen" pass. VDEQ is currently in the process of negotiating the final terms of the contact and expects implementation by the end of this year. |
| ***DMME-Division of Energy*** | | | | |
| VEMP | DMME | Ongoing through 2020 | • SF of public buildings retrofitted<br>• Private capital deployed<br>• Energy savings | • Total value of contracts through FY 2012 is nearly $537 million. More information for FY2013 is being collected from contractors, including building square footage and quantification of avoided energy units. http://www.dmme.virginia.gov/DE/PerformanceContractingSupport.shtml<br>• See VEMP-All ESCOs and Contract totals Through FY12.xlsx |

# Caroline County Ozone Advance Action Plan
# Annual Report

| Control Program | Stakeholders | Time Frame | Milestones | Feedback & Comments |
|---|---|---|---|---|
| Energize Virginia | DMME | 2011-2016 | • Funds awarded<br>• Programs to be implemented | • More than $10M awarded. Projects include energy performance contracts, and a solar thermal system.<br>• See DMME-Performance Measures FY14Q1.xlsx, tab RLF 1.01.03 |
| ***Virginia Clean Cities*** | | | | |
| Virginia Get Ready | VCC | Ongoing | • Program ongoing | • Deployed two EV planning docs in 2013 as well as tools for advancing electric vehicles and infrastructure.<br>• See http://www.virginiaev.org/<br>• VA registrations of electric vehicles increased from 729 in 2012 to 1,257 in 2013.<br>• VA public charging stations increased in number from 140 in 2012 to 212 in 2013.<br>• See va_electric+hybrid_vehicles_and_stations_2008-2013.xlsx |
| Propane Autogas Program | VCC | Ongoing | • Program concluded in 2013 | • Converted 117 vehicles to autogas in VA<br>• Alternative fuel vehicles estimated to reduce $NO_X$ emissions 273 tons annually in VA<br>• See VCCC-2013report-NOxCalculations.xlsx |
| ***Regional Reductions*** | | | | |
| Honeywell SCR Installation | VDEQ | 12/2012 through 06/2019 | • # of SCR installed<br>• Annual emissions of $NO_X$ | • Two SCR commenced operation December of 2012.<br>• Two additional SCR under construction. |
| Invista Powerhouse Project | VDEQ | Estimated construction completion date of 2014 | • Project is completed | • New boilers started operation in January of 2014.<br>• Shutdown request for existing boilers 1 and 2 effective January 9, 2014.<br>• Shutdown request for existing boiler 3 effective March 13, 2014.<br>• Permanent shutdown of the existing coal fired boilers will result in hundreds of tons of $NO_X$ and $SO_2$ emissions. |
| Celco Powerhouse Project | VDEQ | Estimated construction completion date of 2015 | • Construction begun<br>• New units operational<br>• Coal units retired | • The facility informed VDEQ that construction commenced for the six natural gas boilers on 7/16/2013. |

# Caroline County Ozone Advance Action Plan
# Annual Report

| Control Program | Stakeholders | Time Frame | Milestones | Feedback & Comments |
|---|---|---|---|---|
| Generating unit retrofits and fuel switches | Dominion | 2013-2016 | • Facilities converted to gas or biomass<br>• Facilities retired<br>• Facilities retrofitted | • Bremo Bluff permit for gas conversion finalized 5/24/2013. Station ceased burning coal in fall of 2013. Outage and work commenced for unit fuel switch this winter. Title V permit was updated on 5/5/2014 to reflect only natural gas usage. Facility is now burning solely natural gas.<br>• See Title V permit for Bremo Bluff.pdf.<br>• Permits received for Hopewell, Altavista, and Southampton fuel switch from coal to biomass. Units have begun burning biomass and no longer burn coal.<br>• Installation of $SO_2$ scrubbers has been completed for all coal units at the Chesterfield Power Station near Richmond, VA.<br>• Dominion has submitted a MATS compliance extension request, notifying DEQ that they intend to retire coal fired units 1 and 2 at the Yorktown Power Station by 2017. See MATS Ext Req Dom.pdf |
| ***Other*** | | | | |
| Virginia Offshore Wind Technology Advancement Project | Dominion | 2017-2018 | n/a | • Dominion is planning an offshore wind technology testing facility, which will consist of two offshore wind turbines with a combined capacity of approximately 12 MW. See https://www.dom.com/about/stations/renewable/vowtap.jsp.<br>• On September 4, 2013, Dominion bid $1.6 million to win the lease for 112,800 acres off the Virginia coast to develop an off-shore wind farm capable of generating up to 2,000 MW of electricity, and is actively developing this large-scale commercial off-shore wind project. See https://www.dom.com/about/stations/renewable/commercial-offshore-wind-development-project.jsp.<br>• On May 7, 2014, Dominion was awarded $47,000,000 from the US Department of Energy to help fund the construction of a 12 MW demonstration project. See http://dom.mediaroom.com/2014-05-07-Dominion-Awarded-47-Million-by-DOE-for-Offshore-Wind-Turbine-Demonstration-Project.<br>• See Dominion Wind Power.pdf |

# Caroline County Ozone Advance Action Plan
# Annual Report

| Control Program | Stakeholders | Time Frame | Milestones | Feedback & Comments |
|---|---|---|---|---|
| National Parks | VCC, NPS | On going | n/a | • NPS is adding 12 prone lawn mowers and 2 electric vehicles to its fleet, along with a public EV charging station and 2 private EV charging stations. |