The "Path Forward" for the Southeast Missouri Region with Regards to Ground-Level Ozone and Other Air Pollutants

Revised October, 2015

Air Quality Committee

Southeast Missouri Regional Planning Commission

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AUTHORS: David P. Grimes, Deputy Director, Principal Author
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1 West St. Joseph Street
Perryville, MO 63701
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ABSTRACT:

The seven-county southeast Missouri region faces the potential for two, and possibly more, counties being designated as nonattainment areas for ground-level ozone under the National Ambient Air Quality Standards (NAAQS). With the recently released NAAQS establishing allowable levels of ground-level ozone at 70 parts per billion (ppb) both monitors within the region are in compliance, but barely. Leaders in the region had their wake-up call when the NAAQS was revised in 2008 and the standard was changed from 84 ppb to 75 ppb. Understanding that under the new standards air quality had become a rural issue, the Southeast Missouri Regional Planning Commission established an Air Quality Committee (since renamed as the Environmental Quality Committee) in 2009. This Committee oversaw the preparation of a Clean Air Action Plan which was adopted in 2009 by the Commission and later received resolutions of support from all seven member counties and the larger municipalities.

When the Ozone Advance program was established by the U.S. Environmental Protection Agency, the Commission applied to, and was accepted into the program. This document represents the second revision to the "Path Forward" that the Environmental Quality Committee has adopted. The Commission lacks the authority to impose any restrictions or controls. Instead, this "Path Forward" continues to propose a wide ranging citizen outreach and education program to address the myriad area sources of ozone precursors.

This document was prepared by professional staff employed by the Southeast Missouri Regional Planning and Economic Development Commission. It was funded by donations from local governments and private sector participants in the Air Quality Committee. It may be freely reprinted with the customary crediting of the source.

Cover photo: Mississippi River workboat engines replaced under the Diesel Emissions Reduction Act program. The man in the picture for scale is 6'5" tall.

Background:

The Southeast Missouri Regional Planning Commission (RPC) serves seven counties in Missouri. Within these counties are two ozone air quality monitors, one in Ste. Genevieve County near the city of Bonne Terre, and one in Perry County near the unincorporated community of Farrar. These monitors brought a sense of urgency to the RPC in 2008 when the National Ambient Air Quality Standard (NAAQS) for ground-level ozone was reviewed. When the allowable standard was reduced from 84 parts per billion (ppb) atmospheric ozone to 75 ppb the region's monitors were in danger of being noncompliant with the new standard.

The RPC worked closely with the Missouri Department of Natural Resources (DNR) from April, 2008 through the completion of the nonattainment area recommendation process in December of that year. This coordination involved:

1. hosting meetings in cooperation with DNR;
2. attending every meeting on the subject held by DNR;
3. undertaking independent research;
4. preparing a formal Position Paper;
5. contracting with a private engineering firm with a national reputation in environmental matters; and,
6. testifying before the Missouri Air Conservation Commission (MACC).

These efforts were successful. The final recommendations, prepared by DNR, approved by the MACC, and ultimately forwarded to the U.S. Environmental Protection Agency (EPA) by Governor Jay Nixon in December, 2008 included Ste. Genevieve and Perry Counties as separate, single-county nonattainment areas. This reflected the best outcome from the point of view of the RPC. Ultimately, as the latest monitor readings were finalized, neither county was designated as a nonattainment area based on readings that had a design value in compliance with the 2008 NAAQS standard of 75 parts per billion.

There has been a similar sense of urgency since discussions of revising the NAAQS down to the "range of 60-70 ppb" began as early as 2010. That effort was subsequently dropped and EPA did not release the new NAAQS until October 1, 2015. At that time the new standard was set at 70 ppb. At this level both of the monitors within the RPC service area are in compliance as of October 13, 2015 monitoring data (unverified and still awaiting full quality control protocols). With the Bonne Terre monitor's design value at 65 ppb and the Farrar monitor's design value at 66 and only two more weeks in the ozone season for 2015 at this writing the RPC is confident that these numbers will be essentially unchanged for 2015.

The RPC recognized that ozone in particular and air quality in general were issues of ongoing concern and as a result an Air Quality Committee, comprised of elected officials, industry representatives, concerned citizens, and representatives from local schools, was formally established. This committee provided guidance as the Southeast Missouri Clean Air Action Plan (CAAP) was developed and later publicized through local media outlets. This plan was ultimately adopted by Resolution by the RPC in October, 2009. The plan subsequently received formal Resolutions of Support from all seven member counties and most of the member communities. The CAAP received an Innovation Award from National Association of Development Organizations in 2010. The "path forward" presented in the following pages is based on the CAAP. In 2013, recognizing

that the Regional Planning Commission should be addressing environmental issues beyond air quality the committee was renamed as the Environmental Quality Committee although its focus has remained largely on air quality since 2014-15 saw the NAAQS reviewed. The Environmental Quality Committee also serves as the Advisory Committee to the Southeast Missouri Solid Waste Management District.

During the exceptionally hot summer of 2012, both of the region's ozone monitors had readings that were out of compliance with the NAAQS for ground level ozone. Fourth highest readings were up to 83 ppb. These readings drove the "design value" of the two monitors up from previous levels. The "design value," the rolling average of the most recent three year's fourth highest readings, is important because that is the number on which nonattainment area designations are based. When all was said and done, the design value of the Bonne Terre monitor remained in compliance, although barely, at 75 ppb. The Farrar monitor was out of compliance with a design value of 77 ppb.

The Summer of 2013 was much cooler. Fourth highest readings for the Perry and Ste. Genevieve County monitors were 65 and 64 ppb respectively. This yielded a design value for the monitors for the 2011-13 period of 71 ppb for the Perry County monitor and 70 ppb for the Ste. Genevieve County monitor. The ozone season of 2014 repeated this pattern with a design value of 72 for the Bonne Terre monitor and 71 for the Farrar monitor. One more cool summer in 2015 (to date) has brought those values to 65 for Bonne Terre and 66 for Farrar. By definition, then, both of these monitors are in compliance and the counties would continue to be designated as "unclassifiable/attainment" under the existing, 2015, standards.

Proposal:

To address the issue of ground-level ozone the Southeast Missouri Regional Planning Commission proposes the following program:

> Saturation program to educate, inform, and persuade citizens of the southeast Missouri region to undertake the no-cost changes in behavior that can affect levels of ozone in the atmosphere.

Rationale:

Ozone is not normally formed directly. Rather, a combination of Volatile Organic Compounds (VOCs) and Oxides of Nitrogen (NOx), called "precursors," combine on warm days in the presence of sunlight to form ozone (O_3). If any of these components are absent, ozone formation simply does not occur. 2012, with its well documented "heat wave," low wind levels, high humidity and clear skies provided the perfect recipe for ozone formation and this resulted in the high monitor readings seen.

The problems facing the rural southeast Missouri region were further highlighted when the 2011 National Emissions Inventory was released. This information, combined with a better understanding of whether or not an area is "NOx limited" or "VOC limited" points out very clearly just how limited the options available to the region are when it comes to dealing with the issue of ground-level ozone.

Since ozone is not a "primary" pollutant a better understanding of how it is formed is needed. It is not formed directly except in rare and extreme cases (the vicinity of a lightning strike for example). Rather, ozone is a secondary pollutant formed from reactions with primary pollutants. These are the "precursors" we have been discussing for years now and include oxides of nitrogen (NOx) and volatile organic compounds (VOCs).

There are two separate cycles that need to be understood. The NOx cycle is, in its simplest form:

NO_2 + sunlight → NO + O
or
NO_3 + sunlight → NO_2 + O

The free oxygen atom, then, being a gregarious sort does –

O + O_2 (normal atmospheric oxygen) → O_3 (ozone)

And the cycle is completed when the sun goes down, removing the "sunlight" from the cycle and yielding –

NO + O_3 → NO_2 + O_2

And the Cycle is complete.

The NOx part of the cycle, then, is more or less a "zero sum game." The problem is when those VOCs get involved. They do not actually produce ozone but, rather, they disrupt the natural process that destroys ozone during the "after dark" part of the NOx cycle. The VOC part of the cycle is shown as, again vastly simplified:

Volatile Organic Compounds are carbon based compounds, typically long chains of carbon and hydrogen atoms (hence the term hydrocarbons). The VOCs photochemical cycle results in more NO_2 available than would be normally, thereby increasing the ozone volume. To follow this cycle two more terms are necessary.

First is "Free Radical." In chemical terms, this is a highly reactive group of atoms that combine with other atoms very easily

Second is the hydroxyl radical (OH), a single oxygen and single hydrogen atom. This is abundant in the atmosphere.

The OH radicals react with VOCs (long chain hydrocarbons) to produce a free radical RO_2 where R is one of the many possible VOC compounds.

The chemical transformations are, then –

VOC + OH → R + H_2O (water vapor)

R + O_2 → RO_2

$$RO_2 + NO \rightarrow NO_2 + RO$$

Leaving that excess NO_2 available to go back to the first set of transformations and make more ozone leading to a buildup. The University of North Carolina at Chapel Hill has done a study on this and identified areas that are "NOx limited" and areas that are "VOC limited." This has important implications for what can be accomplished.

"A NOx limited region is one where the concentration of ozone depends on the amount of NOx in the atmosphere. This occurs when there is a lack of Nitrogen Dioxides thus inhibiting ozone titration when oxygen mixes with VOCs. In these regions, controlling NOx would reduce ozone concentrations." Further in that study they note that "Rural areas are usually NOx limited due to the large amount of trees that produce high levels of VOCs."

This is clearly the case for the Southeast Missouri region as identified in the charts and graphs which follow. For purposes of this analysis the top four sources of either NOx or VOCs were selected from the 2011 National Emissions Inventory (NEI). Only 7 major categories of sources were needed to cover the top four sources in all seven counties.

It appears clear that the region meets the conditions to be described as NOx limited. Reviewing the "VOC Top Four Sources" section of the chart in Exhibit No. 1 shows that VOCs dramatically outweigh NOx in every county. Moreover, the total volume of VOCs outstrips all other factors, again, dramatically. Since the majority of these VOCs are identified as coming from "Biogenics – Vegetation and Soil" they are of a completely natural origin and not subject to controls or limits in any meaningful way.

And that leaves control of NOx as the potential method for local impact on our ozone levels. The only significant sources for NOx as identified in the area are "Biogenics – Vegetation and Soil," "Mobile," "Fuel Combustion" and "Industrial processes." Biogenics are, again, primarily trees and plants in the forests as they fall and decompose. Mobile sources include on- and off-road vehicles, airplanes, rail and river transportation. Fuel combustion includes primarily process and space heat for manufacturing and other industrial operations. Industrial processes include, most relevant for purposes of this analysis, Cement Manufacturing and Mining.

In order then, let us review the potential mitigating actions that could be taken:

Biogenics – are essentially uncontrollable. In theory massive efforts to clean out decomposing plant matter from the forest floor would be possible, but it is not economically feasible nor does any entity have the authority to undertake such a project.

Mobile – mobile sources are far and away the most significant sources of NOx and have been the primary targets of our efforts. These include the "stop at the click," "plan your trips," "watch your idling," and other efforts to mobilize citizen involvement that have been centerpieces of the region's efforts. In addition we have worked with Mississippi River barge operators and repowered seven workboats making significant improvements to the emissions characteristics of the inland waterway fleet.

Fuel Combustion – industrial space and process heat that involves air emissions above a *de minimis* level are already permitted and held to Best Available Control Technology (BACT) standards. Beyond that local government lacks any authority.

Industrial Processes – the same comments apply. Industry is already permitted and held to BACT standards. Local government lacks authority to impose more restrictions.

A very high percentage of ozone precursors are the result of citizen's actions. About half, for example, are from highway and off-highway vehicles. Each trip to the store, in other words, adds some VOCs and NOx to the atmosphere. For VOCs, the great majority (in excess of 90%) are produced by "biogenics." For NOx, the more important consideration in this "NOx limited" area, "mobile" sources account for almost half (47%) of emissions, with "industrial processes" the single largest other source at 34%.

In rural areas such as the southeast Missouri region, there is essentially no "low hanging fruit." In urban areas, for example, "Other Industrial Processes" might be addressed through controls on large manufacturing operations. Few such opportunities are available in rural areas. Similarly, controls on dry cleaners alone were considered important enough to be specifically included in the St. Louis nonattainment area programs. In rural areas, there are simply not enough dry cleaners to make this significant.

More to the point, even when such specific sources can be identified the Regional Planning Commission lacks authority to mandate controls. Such measures are solely within the authority of the Missouri Department of Natural Resources and the U.S. Environmental Protection Agency. The Environmental Quality Committee assumes that, should one or both monitors be out of compliance and, as a result, one or more counties designated as a nonattainment area(s), the State Implementation Plan would include any applicable measures.

With no large "point sources" to control, the much more dispersed "area sources" must, of necessity, become the target for reduction of ozone precursors. This, in rural areas, means basically all citizens.

Program:

In order to reach such a broad group the Commission has been engaged in a "Saturation Campaign of Awareness." Beginning in February, 2013, all media outlets were asked to help in reaching as many citizens as possible with a program to reduce ozone precursors being emitted. Staff provided information at the beginning of the ozone season, putting out the first information in March in anticipating of the April 1 start of the season. This has been followed up by weekly reports distributed to a broad mailing list including all local media.

Interest among media has fallen off since regular weekly reports have been consistently "no exceedances." As the old saying goes, "you never see a headline that reads '10,000 Airplanes Landed Safely Today.'" Consistently good news does not draw much attention. Nevertheless the activities of the Environmental Quality Committee have received reasonable coverage from the local media, especially when specific events such as the release of the new NAAQS drive interest.

The staff of the Regional Planning Commission will continue these outreach efforts. Regular press releases, email notifications, and reports on monitor readings will continue. This information campaign will focus on the specifics identified below.

Specifics:

1. "Stop At the Click for Clean Air." Modern vehicles are so well sealed that refueling is essentially pollution free, unless the systems are overridden. The most common way that this occurs is with "topping off" the tank. A simple "stop at the click" program can avoid this. Since every vehicle is fueled regularly, this is also the most direct way of reaching the widest audience.
2. "Fuel in the Evening for Clean Air." Although fueling a modern vehicle is "almost" pollution free, it is not "completely" pollution free. By simply waiting until the evening, or changing your habit to fueling on the way home from work rather than on the way to work, the pollutants that do escape into the atmosphere have time to disperse before the heat of the following day starts cooking ozone.
3. "Mow in the Evening for Clean Air." Oddly, the small engines that power Outdoor Power Equipment are much more polluting that the much larger modern vehicle engines. Small engines lack the sophisticated fuel management systems of vehicles, virtually all of which use electronic fuel injection. Also, the two-stroke cycle engines require oil mixed with fuel for lubrication, leading to air pollution issues.
4. "Plan Your Trip for Clean Air." This specific component focuses on habits. It is common to "hop into the car" and run to the store for a small purchase. Later, a second trip might be made to the video rental store and a third to the library and a fourth to visit a friend and so on. The simple combination of trips to eliminate some takes vehicles off of the road and pollutants out of the air.
5. "Tune Your Car for Clean Air." Cars that are tuned up pollute less. It is that simple. As part of this other maintenance such as checking tire air pressures is important to keeping your vehicle as efficient as possible.
6. "Conserve Energy for Clean Air." This component of the project focuses on the biggest producer of precursors, electric generation utilities (EGUs). Lowering demand has two impacts. First, the utilities can run at something under 100% and therefore emit less into the air. Second, enough reduction in demand means that new plants will not have to be built. This is important since even modern, well controlled EGUs are still large emitters of pollutants. Also, reduction in energy use equates to a reduction in energy bills.
7. "Ozone Alert System." This component of the project focuses on tracking weather and temperature conditions and instituting an "ozone alert" or "ozone warning" system. The existing systems available through the National Oceanic and Atmospheric Administration will be a central component of this effort and the RPC will serve as the dissemination point. A simple email alert system will get the information to the media.

The Regional Planning Commission has been closely involved in the formation of a new Metropolitan Planning Organization (MPO) for transportation planning in the Cape Girardeau/Jackson Micropolitan Area. Specifically for the City of Cape Girardeau, the largest city in the region, a recommendation will be made to the MPO encouraging the city to investigate the possibility of timing traffic signals for improved traffic flow. Anecdotally, the existing system lends itself to forced idling at virtually every stop light. This improvement would cut down on idling time, reduce trip time and reduce fuel use through improved efficiencies.

Initial Organization

The key to this project is participation across the media spectrum. Print, radio and television must all be involved or there is no chance whatsoever that this project will accomplish anything. Therefore, the initial organizational outreach was directed at key personnel from this group.

Besides these traditional outreach vehicles, social media has been part of the effort. Facebook and LinkedIn pages were established and a Twitter feed was started by the RPC. Where online local information outlets can be identified (the Viburnum News for example), they were invited into the effort as well.

Diesel Emissions Reduction Act Program

Although there is no "low hanging fruit," a point made throughout this Path Forward, there is one program with potential to directly impact not only the Southeast Missouri Regional Planning Commission's service area, but the entire Mississippi, Ohio, Illinois, and Tennessee river valleys. The Regional Planning Commission has been very active and successful in participating in the Environmental Protection Agency's Diesel Emissions Reduction Act (DERA) program. DERA funds have shown a leverage ratio of roughly 4:1, private:public money and have been used or are being used at this writing, to repower seven Mississippi River workboats. The large diesel propulsion engines on these boats run 24/7/365 and, since the boats can be refitted and refurbished to a virtually indefinite useful life, old engines stay in service. Through the DERA program funding 14 unrated Tier 0 engines have been, or soon will be, replaced with new Tier 3 rated engines.

The Regional Planning Commission was recently awarded a grant to undertake a repower project for a smaller "fleeting boat" in 2015-16. Staff will continue contacting interested parties to promote future projects as future grant rounds are announced.

The Commission has not charged administrative costs to these grants. Rather, we have considered this as part of our participation in the Ozone Advance program. This policy will be carried forward next year.

Timing and Milestones

The program will be initiated and operated to correspond with the ozone season. Specifically:

February/March, 2016 – reminder contacts. This has been accomplished with every identifiable radio station and newspaper of record in the region contacted and alerted to the upcoming program.

March/April, 2016 – seek support for public service announcements. This was initiated but results so far have been disappointing.

April 1 through October 30, 2016 – regular updates, twitter and facebook announcements, ozone alert system, monitoring, press releases. This has been initiated. The Missouri Department of

Natural Resources provides a weekly summary of all ozone monitor readings in the state and this is forwarded to a wide mailing list of interested parties. A twitter account has been established as SEMO Air and regular "tweets" are posted regarding ozone and related issues.

February, 2017 – program review and analysis. A program report will be prepared by the end of February, 2017 summarizing the activities undertaken, and the results achieved.

Summary of Results So Far

The first year of the program, essentially the ozone season of 2013, was generally successful. The initial contacts were made regarding air quality issues, and specifically ozone issues received reasonably good coverage in the media. Weekly monitoring reports provided by DNR were forwarded to the Environmental Quality Committee and a mailing list of "interested parties" including all media outlets.

Since, however, 2014 and 2015 were seasons marked by extremely mild weather there was no particular sense of urgency. The old joke is that "you will never see a headline reading 10,000 planes landed safely today." In that vein, media coverage was spotty. The reports were picked up and staff gave a few interviews on the subject. The full participation never materialized though, as had been anticipated. Similarly, inquiries were made to prepare Public Service Announcements but no response was forthcoming.

For 2016 RPC staff will continue the program of forwarding weekly monitoring reports. This program has received regular feedback. The release of the new NAAQS by EPA has stimulated interest in air quality as well. Staff has already been interviewed a few times on that subject.

Exhibit 1

Top Four Sources of VOC and NOx

Table Form

Southeast Missouri Region

Sources of VOCs and Nox

	Biogenics - Vegetation and Soil	Mobile	Fuel Combustion	Industrial Processes	Waste Disposal	Solvents	Gas Stations
NOx Top Four Sources							
COUNTY							
Bollinger							
	212	457	2,942		5		
Cape Girardeau							
	312	3,929		1,213			
Iron							
	71	383	45	53			
Madison							
	91	472	269		7		
Perry							
	237	2,240	69		7		
St. Francois							
	111	1,704	124	417			
Ste. Genevieve							
	159	2,485	90	6,869			
REGION							
	1,193	11,670	3,539	8,552	19		
VOC Top Four Sources							
Bollinger	12,694	252	120			108	
Cape Girardeau	7,640	1,331		482		760	
Iron	17,800	241	73				36
Madison	13,240	421		98		91	
Perry	8,112	663				425	106
St. Francois	10,038	809				486	217
Ste. Genevieve	9,494	660		329		191	
REGION	79,018	4,377	193	909		2,061	359
Source: U.S. EPA 2011 National Emissions Inventory							

Exhibit 2

Top Four Sources of VOC and NOx

Graphic Form

Southeast Missouri Region
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
VOC Top Four Sources (tons)
Biogenics - Vegetation and Soil
Mobile
Solvents
Industrial Processes

Southeast Missouri Region
12,000
10,000
8,000
6,000
4,000
2,000
0
NOx Top Four Sources (tons)
Mobile
Industrial Processes
Fuel Combustion
Biogenics - Vegetation and Soil

Bollinger County, MO
14000
12000
10000
8000
6000
4000
2000
0
TPY
12694
120
252
108
VOC (tons)
Biogenics - Vegetation and Soil
Fuel Combustion
Mobile
Solvents
2011 NEI

Bollinger County, MO
3000
2500
2000
1500
1000
500
0
TPY
2942
212
457
5
NOx (tons)
Biogenics - Vegetation and Soil
Fuel Combustion
Mobile
Waste Disposal
2011 NEI

Cape Girardeau County, MO
TPY
8000
7000
6000
5000
4000
3000
2000
1000
0
7640
482
1331
760
VOC (tons)
Biogenics - Vegetation and Soil
Industrial Processes
Mobile
Solvent
2011 NEI

Cape Girardeau County, MO
TPY
4000
3500
3000
2500
2000
1500
1000
500
0
312
246
1213
3929
NOx (tons)
Biogenics - Vegetation and Soil
Fuel Combustion
Industrial Processes
Mobile
2011 NEI

Iron County, MO
TONS
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
17800
36
241
73
VOC (tons)
2011 NEI
Biogenics - Vegetation and Soil
Gas Stations
Mobile
Solvents

Iron County, MO
TPY
400
350
300
250
200
150
100
50
0
71
45
53
383
NOx (tons)
2011 NEI
Biogenics - Vegetation and Soil
Fuel Combustion
Industrial Processes
Mobile

Madison County, MO
14000
12000
10000
8000
6000
4000
2000
0
TPY
13240
98
421
91
VOC (tons)
Biogenics - Vegetation and Soil
Industrial Processes
Mobile
Solvent
2011 NEI

Madison County, MO
500
450
400
350
300
250
200
150
100
50
0
TPY
472
269
91
7
NOx (tons)
Biogenics - Vegetation and Soil
Fuel Combustion
Mobile
Waste Disposal
2011 NEI

Perry County, MO
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
TPY
8112
106
663
425
VOC (tons)
Biogenics - Vegetation and Soil
Gas Stations
Mobile
Solvent
2011 NEI

Perry County, MO
2500
2000
1500
1000
500
0
TPY
237
69
2240
7
NOx (tons)
Biogenics - Vegetation and Soil
Fuel Combustion
Mobile
Waste Disposal
2011 NEI

St. Francois County, MO
Biogenics - Vegetation and Soil
Gas Stations
Mobile
TONS
12000
10000
8000
6000
4000
2000
0
10038
217
809
486
VOC (tons)
2011 NEI

St. Francois County, MO
TONS
1800
1600
1400
1200
1000
800
600
400
200
0
1704
417
111
124
Biogenics - Vegetation and Soil
Fuel Combustion
Industrial Processes
Mobile
NOx (tons)
2011 NEI

Ste. Genevieve County, MO
TONS
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
9494
329
660
191
VOC (tons)
2011 NEI
Biogenics - Vegetation and Soil
Industrial Processes
Mobile

Ste. Genevieve County, MO
Tons
7000
6000
5000
4000
3000
2000
1000
0
6869
2485
159
90
NOx (tons)
2011 NEI
Biogenics - Vegetation and Soil
Fuel Combustion
Industrial Processes
Mobile