

Using Aerial Photography and GIS Data to Improve Quarry Equipment Emissions Inventories

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Quarry Emissions

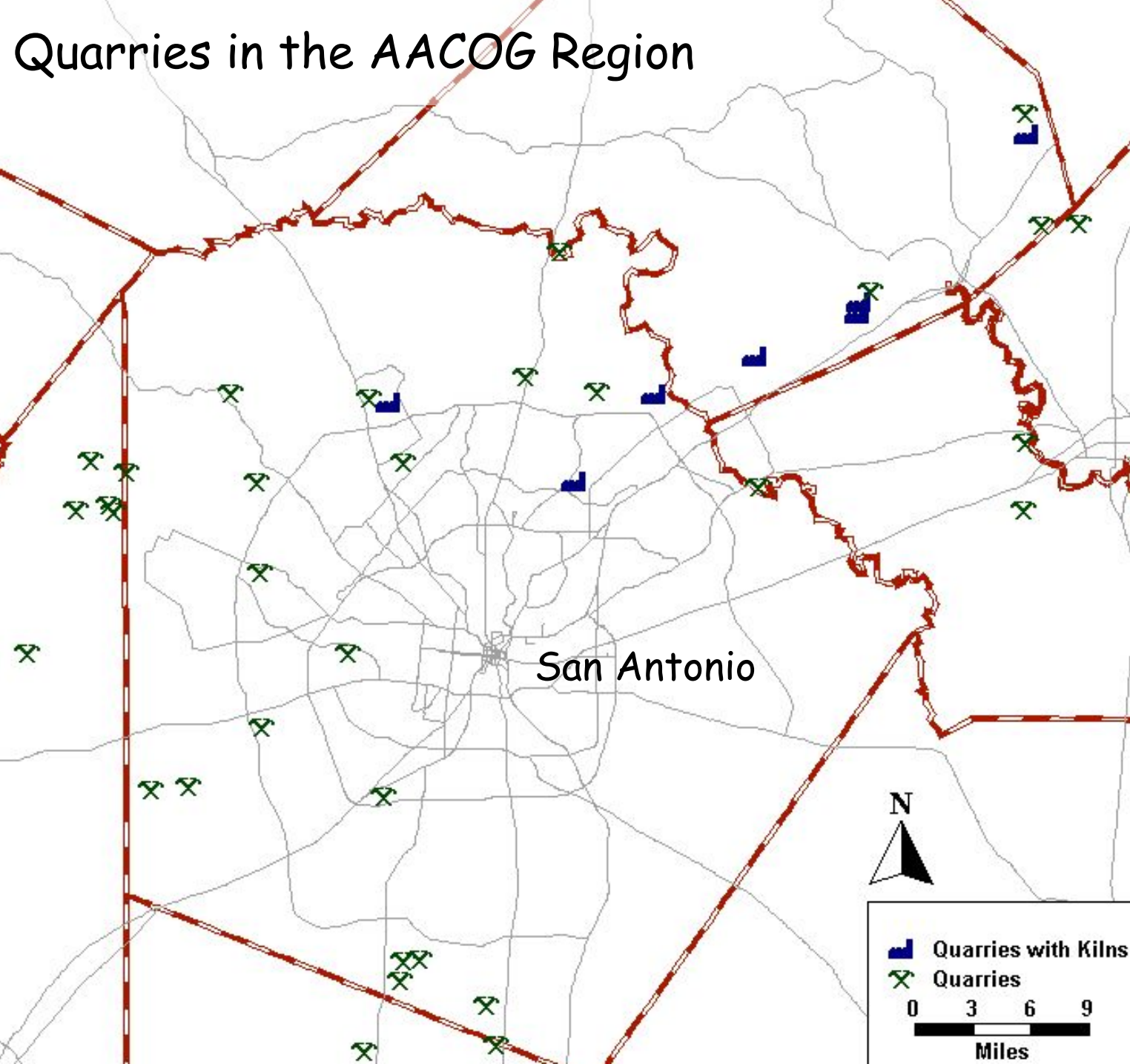
- There are 29 large Quarries in the 4-county region of San Antonio
- Three Types of Quarries emission sources:
 - 1) Point Sources: Kilns/Asphalt Plants
 - 2) Emissions from processes: Explosives, PM from Quarry Activity, etc.
 - 3) Non-Road Equipment: Front End Loaders, Scrapers, Excavators, etc.
- Point Source Emission Inventory is provided by the state for Kilns and Asphalt Plants through emission monitoring
- Processes Emissions are insignificant for the VOC/NO_x Emission Inventory
- Non-Road emissions are the focus of this study
- Latest emission data available is San Antonio's 2005 NET Emission Inventory

Non-Road Equipment at Quarries

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- ❑ In the past, off-road emission inventories of quarries were frequently incomplete or contained inaccuracies.
- ❑ The NONROAD model default hp, population, and activity rates for construction equipment were inappropriate for quarry emission calculations due to the larger equipment and higher activity rates
- ❑ However, getting access to equipment population and activity rates is difficult; quarry companies are reluctant to release this data.
- ❑ The accuracy of emission calculations increases with the use of local data acquired through aerial photography.

Quarries in the AACOG Region



Does not include some size 1 and 2 Quarries. These quarries are very small and have insignificant emissions

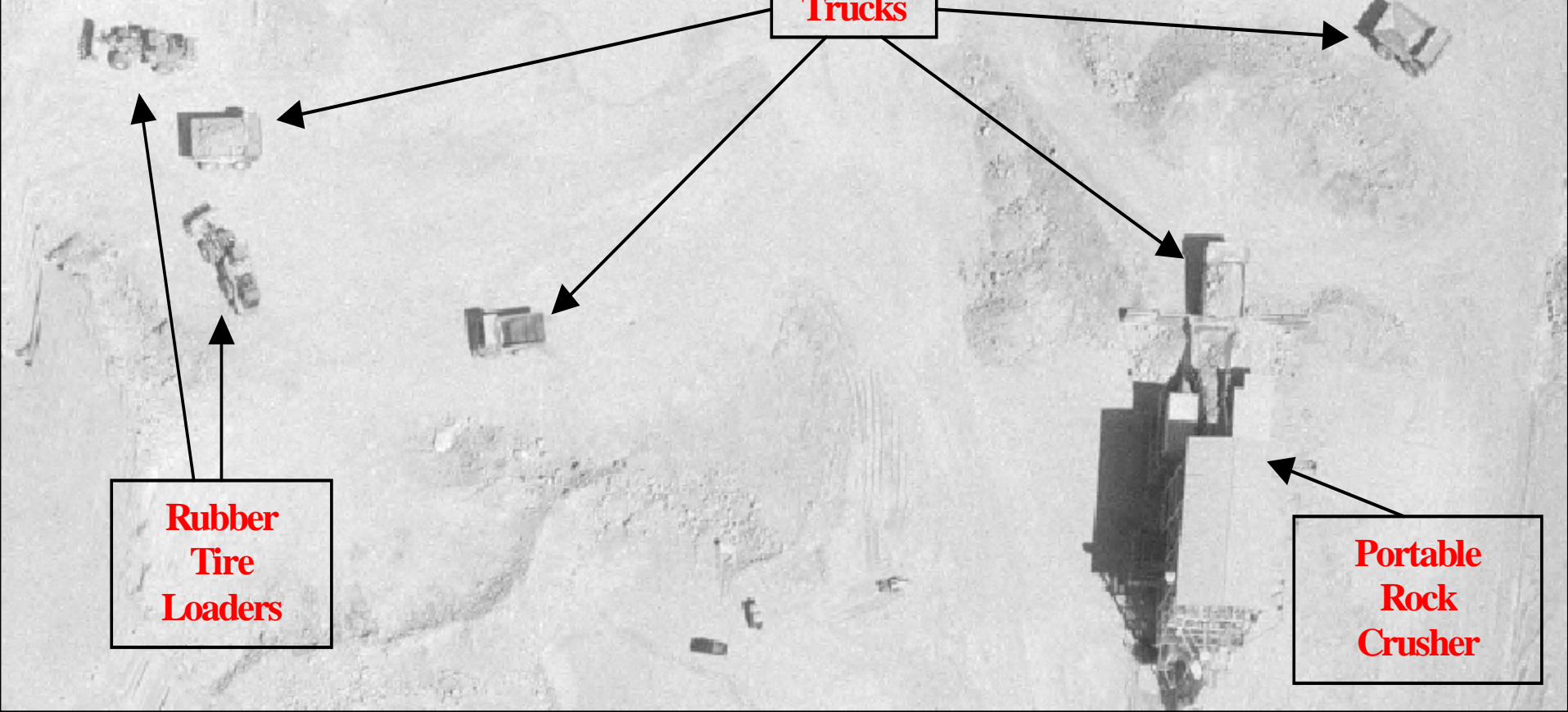
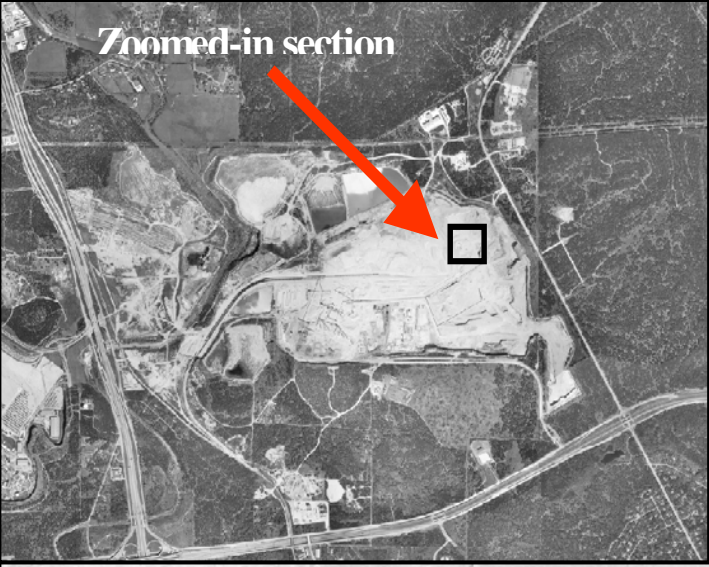
Plot Date: May 10, 2006

Map Compilation Date: Nov. 17, 2006

Obtaining Data on Quarries' Non-Road Equipment

- Step 1: A mail and telephone survey was used to determine equipment population, horsepower (hp), and activity rates
- AACOG only surveyed quarries with more than 9 employees (10% response rate)
- Step 2: Aerial photography was used to determine equipment populations of quarries that did not respond to the survey in San Antonio
- The equipment for each quarry was identified, marked, and counted using 6-inch resolution imagery
- Step 3: The companies that did not respond to the initial survey, they were sent a second survey with AACOG's estimations for their equipment and they were asked to make corrections (40% response rate)
- Step 4: The NONROAD 2004 model was used to calculate emissions with local data

Satellite Imagery of Quarry



Rock Trucks

Rubber Tire Loaders

Portable Rock Crusher

Equipment Counts from Survey data and Aerial Imagery

Diesel Equipment Type	SCC	Eq. counts from Surveyed Quarries								Eq. counts based on Aerial Imagery										
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Scrapers	2270002018					1	1							3						
Excavators	2270002036	1	1					1			4	1	1	8	1	2		2		1
Graders	2270002048			1			1				1			1						
Trucks	2270002051	3	3	5	1	3	2	3			11	4	4	11	3	6	9	4	5	2
Loaders	2270002060	3	7	7	1	3	3	3	1		9	4	4	18	3	7	7	5	4	2
Backhoes	2270002066	3	3	3	3			3		6	3	3	3	6	3	4	6	3	3	3
Dozers	2270002069	1	1	3			1	1			1	1	1	3	1	1	1	2		

There was no available suitable aerial imagery for the other 10 Quarries

Estimated HP by equipment type for San Antonio quarries, 2005

Equipment Type	SCC	NONROAD Model Default HP	AACOG Study Estimated HP
Scrapers	2270002018	409	400
Excavators	2270002036	171	500
Graders	2270002048	204	200
Trucks	2270002051	783	411
Loaders	2270002060	243	400
Backhoes	2270002066	93	80
Dozers	2270002069	260	250

Annual hours of use by equipment type, 2005

Equipment Category	SCC	NONROAD Model Default Hours/year	AACOG Study Estimated Hours/Year
Scrapers	2270002018	914	2208
Excavators	2270002036	1092	1092*
Graders	2270002048	962	1135
Trucks	2270002051	1641	2138
Loaders	2270002060	761	1692
Backhoes	2270002066	1135	1172
Dozers	2270002069	936	1467

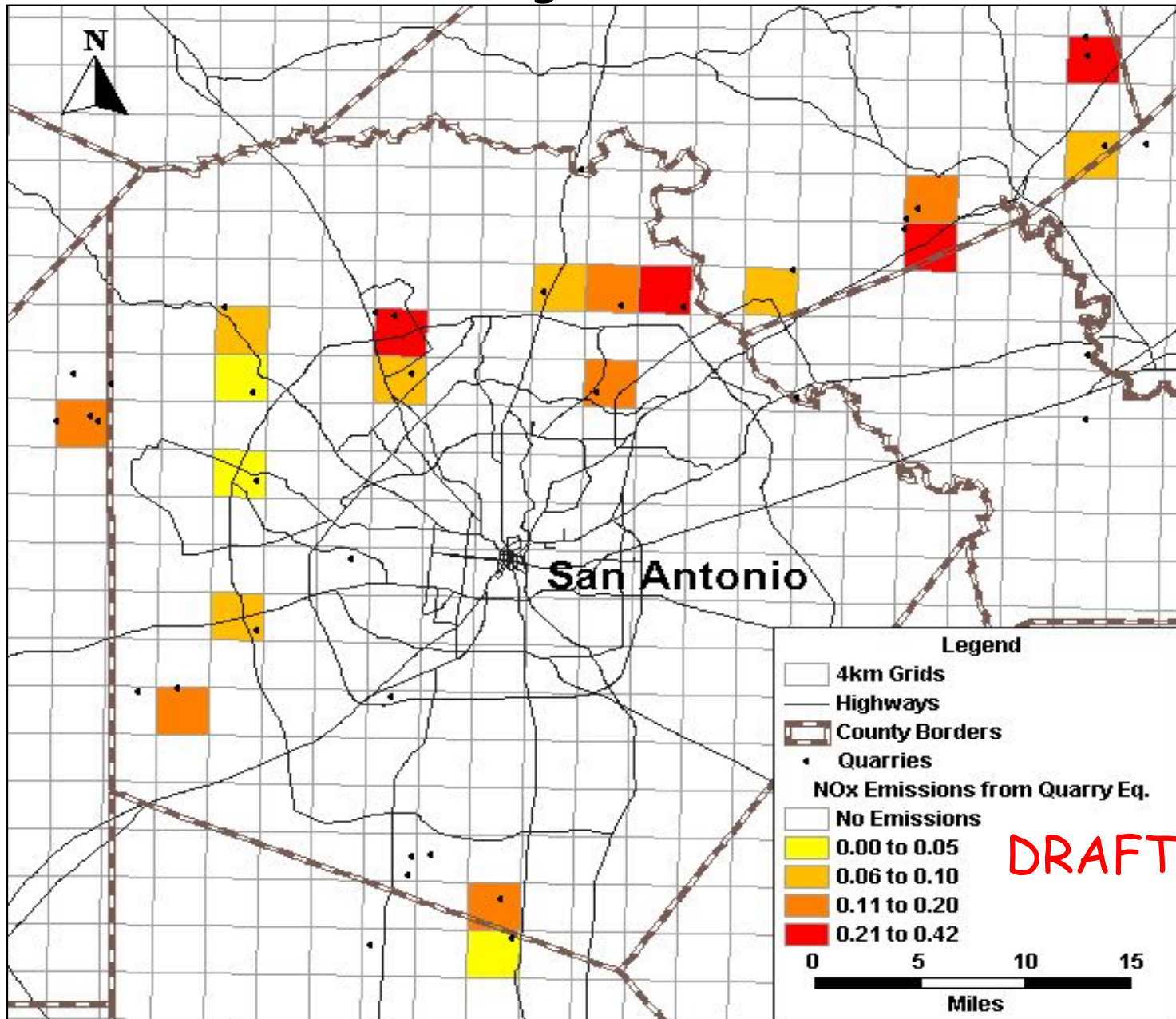
* The NONROAD Model default for hours/year was used for excavators; survey responses were not statistically significant.

Allocating Emissions to 4km Photochemical Modeling grids

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- Emissions were geo-coded to quarry locations using TransCAD and then aggregated to 4km photochemical model grids
- By allocating emissions to actual quarry sites, ozone calculations in the photochemical model are predicted to be more accurate

Allocation of quarry equipment emissions to photochemical model grids, 2005



Next Steps

- Update Quarries in other counties using aerial photograph
- Run results in photochemical model to determine impact on Ozone levels

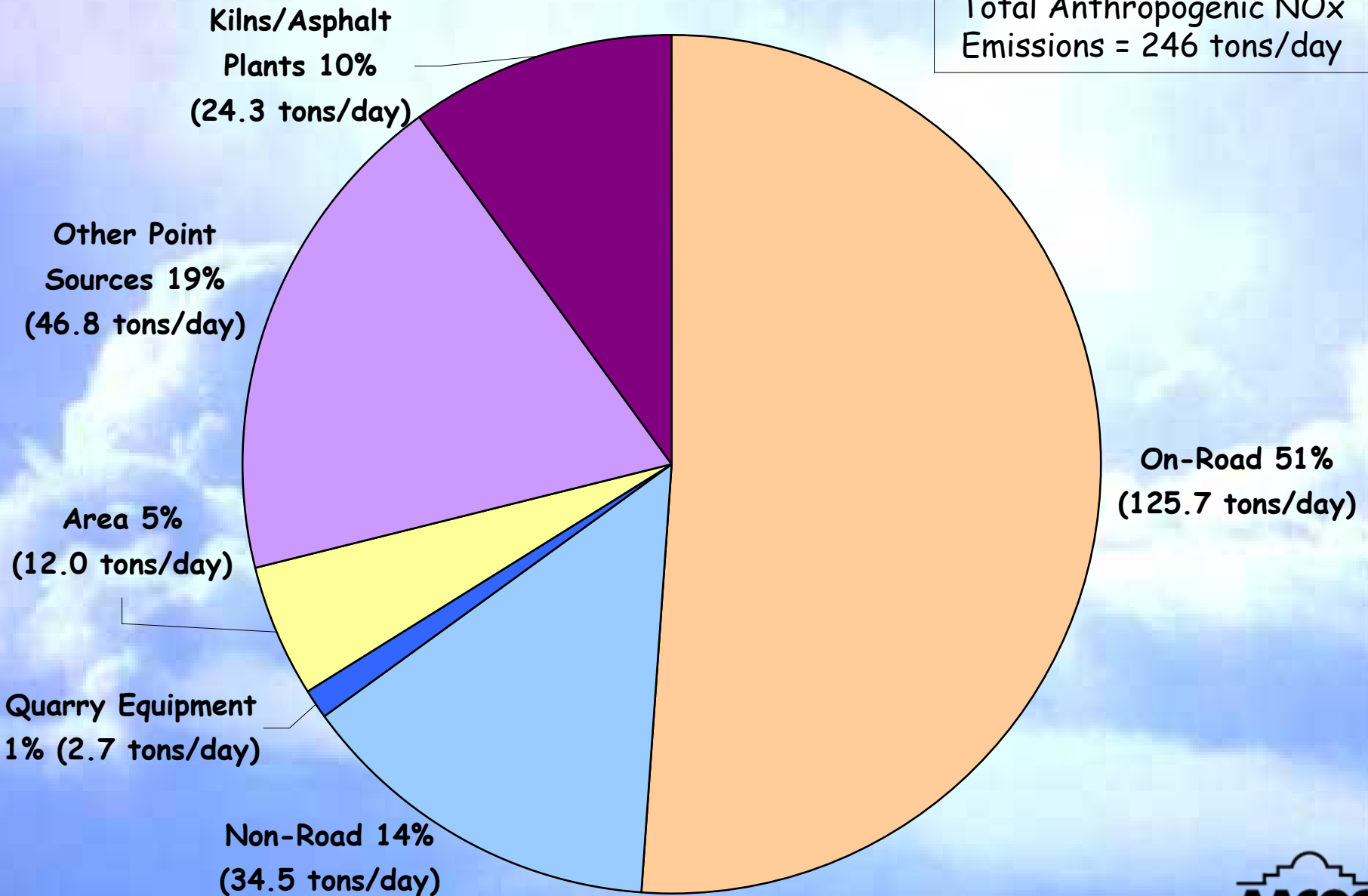
Emissions from Quarry Non-Road Equipment in the 4-County Region

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County	VOC	NOx	CO
	ton/day	ton/day	ton/day
Bexar	0.1	1.6	0.7
Comal	0.1	1.0	0.5
TOTAL	0.2	2.7	1.2

NO_x Emission Sources, 4-County Region, 2002 **DRAFT**

Total Anthropogenic NO_x Emissions = 246 tons/day



Point Source Emissions from Cement Kilns/Asphalt Plants in the 4-County Region

Company	County	VOC	NOx	CO	PM 10	PM 2.5
		tons/day	tons/day	tons/day	tons/day	tons/day
Alamo Cement	Bexar	0.1	6.9	3.0	0.3	0.2
Capital Cement	Bexar	0.4	5.9	1.8	0.5	0.1
Martin Marietta Materials	Bexar	0.1	0.1	0.2	0.3	0.0
Sunbelt Asphalt and Materials	Comal	0.0	0.0	0.0	0.3	0.1
TXI Operations	Comal	0.2	3.6	1.9	0.4	0.1
Chemical Lime	Comal	0.0	1.6	0.7	0.2	0.1
Cemex Cement of Texas	Comal	0.1	6.2	4.2	0.6	0.2
TOTAL	4 -County	0.9	24.3	11.9	2.7	0.8