

**Iowa Ambient Air Monitoring
Annual Report
2003**



**Air Quality Bureau
Department of Natural Resources**

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IOWA AMBIENT AIR MONITORING NETWORK REVIEW: 2003

by
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Iowa Department of Natural Resources-Air Quality Bureau-Air Monitoring Group

Introduction

The purpose of this review is to compare ambient air monitoring data gathered in Iowa during the year 2003 with federal ambient air standards. These federal standards, known as National Ambient Air Quality Standards (NAAQS), have been established by the Environmental Protection Agency (EPA) for seven “criteria” pollutants: particulate matter with a diameter less than 10 microns (PM₁₀), particulate matter with a diameter less than 2.5 microns (PM_{2.5}), sulfur dioxide, ozone, nitrogen dioxide, carbon monoxide, and lead. Continuous monitoring methods have been approved by EPA for all monitoring methods except PM_{2.5}. Filter samplers and laboratory filter weighing procedures have been approved by EPA for both PM_{2.5} and PM₁₀. All data summarized in this review was obtained using methods approved by EPA for comparison with the NAAQS.

This report is divided into two parts. The first part is an executive summary, indicating where an exceedance of the NAAQS was measured in Iowa during 2003. A more comprehensive review comprises the second part of the report, which includes the location and summary data for each monitor in the network.

Gaseous pollutant monitors (ozone, nitrogen dioxide, sulfur dioxide, and carbon monoxide) and continuous PM₁₀ monitors provide hourly values and operate 24 hours a day, seven days a week. Ozone monitors are operated only when ozone levels are highest, from April through October. Particulate filter samplers collect one filter per day and usually are not operated on successive days. Most PM₁₀ filter based monitors are operated at a sampling frequency of one sample every sixth day, and most PM_{2.5} monitors are run at a frequency of one sample every third day. Some particulate monitoring sites are run at frequencies greater than these nominal frequencies if they are located in highly populated areas or near pollution sources. Lead was not monitored in Iowa during the year 2003.

Incomplete data may skew the summary statistics for a monitor. In order to alert the reader to data completeness problems, data completeness statistics have been provided for each monitor. If a monitor collected all of the scheduled samples, then it has an associated data completeness of 100%. If the data capture from a monitor is insufficient to compute a valid annual average according to EPA completeness criteria, then the bar representing the comparison of the annual average to the NAAQS for the monitor is hatched on the corresponding bar chart.

In 2003, there was only one NAAQS exceedance. This exceedance was measured at Lake Sugema State Park for Ozone. This monitored value was likely to have been representative of a large area of poor air quality, perhaps a county or more.

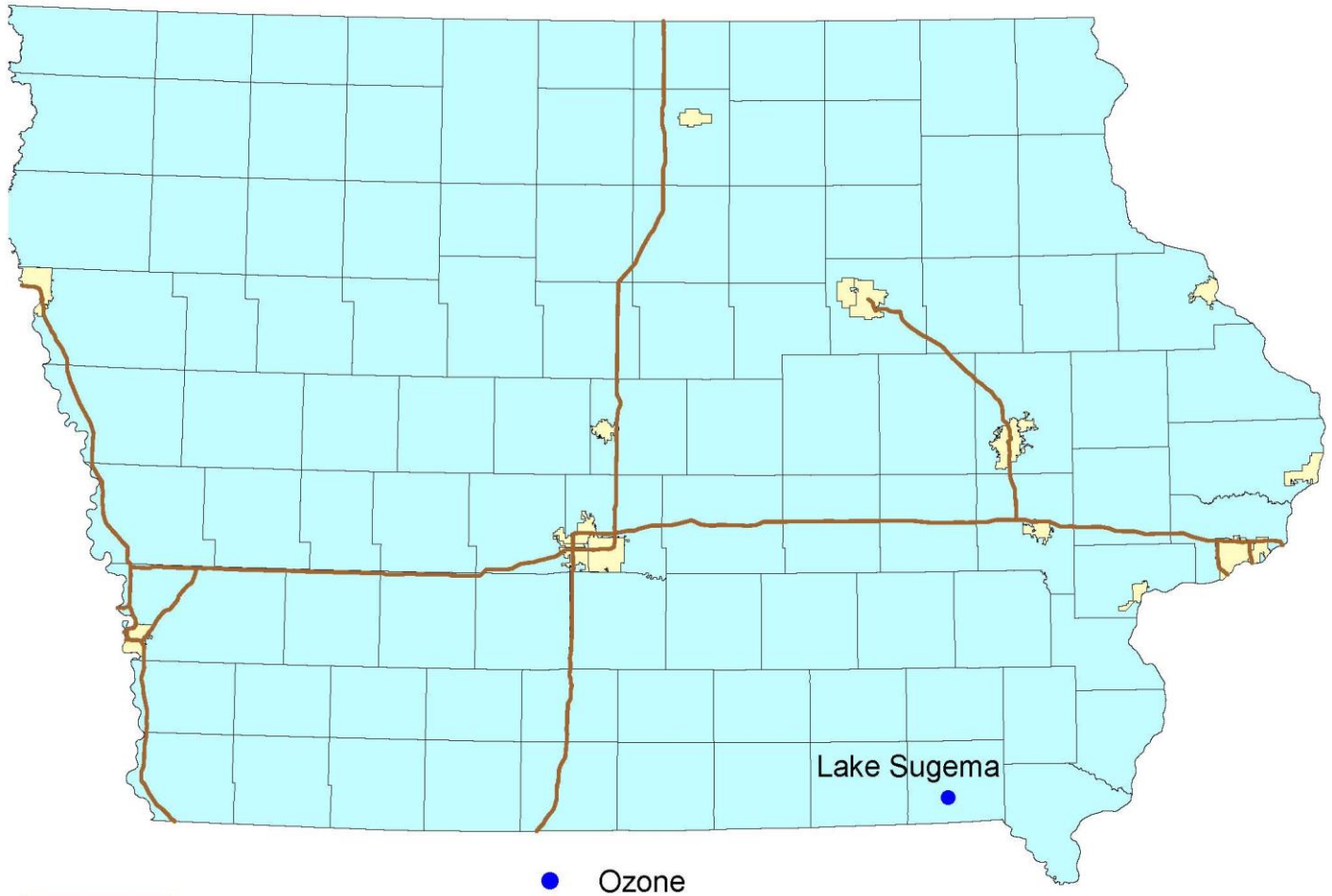
Data used to create this report were gathered by three organizations under contract with the Iowa Department of Natural Resources: the University of Iowa Hygienic Laboratory, the Polk County Health Department, and the Linn County Public Health Department. Contract funds were provided by US EPA, the state of Iowa legislature, and regulated industry. Air pollution data for Iowa and all other states are available online at: <http://www.epa.gov/air/data/>. Additional information on the NAAQS is available at: <http://www.epa.gov/air/criteria.html>.

Exceedances of the National Ambient Air Quality Standards in Iowa

Pollutant	Averaging Period	Exceedance Level	Units	Number of Exceedances
Ozone	1hr	0.125	ppm	0
	8hr	0.085	ppm	1
PM 2.5	24hr	65.5	micrograms per cubic meter	0
	annual	15.05	micrograms per cubic meter	0
PM10	24hr	155	micrograms per cubic meter	0
	annual	50.5	micrograms per cubic meter	0
Sulfur dioxide	3hr	0.55	ppm	0
	24hr	0.145	ppm	0
	annual	0.0305	ppm	0
Carbon monoxide	1hr	35.5	ppm	0
	8hr	9.5	ppm	0
Nitrogen dioxide	annual	0.0535	ppm	0
Lead	quarterly	1.55	micrograms per cubic meter	N/A*

*Lead was not monitored in 2003

NAAQS Exceedance In 2003



Exceedance Level and Occurrence Date

Site ID	Pollutant	Averaging Period	Exceedance Level	Number of Exceedances	Site	Date
Lake Sugema State Park	Ozone	8hr	85	1	Lake Sugema	4/11/2003

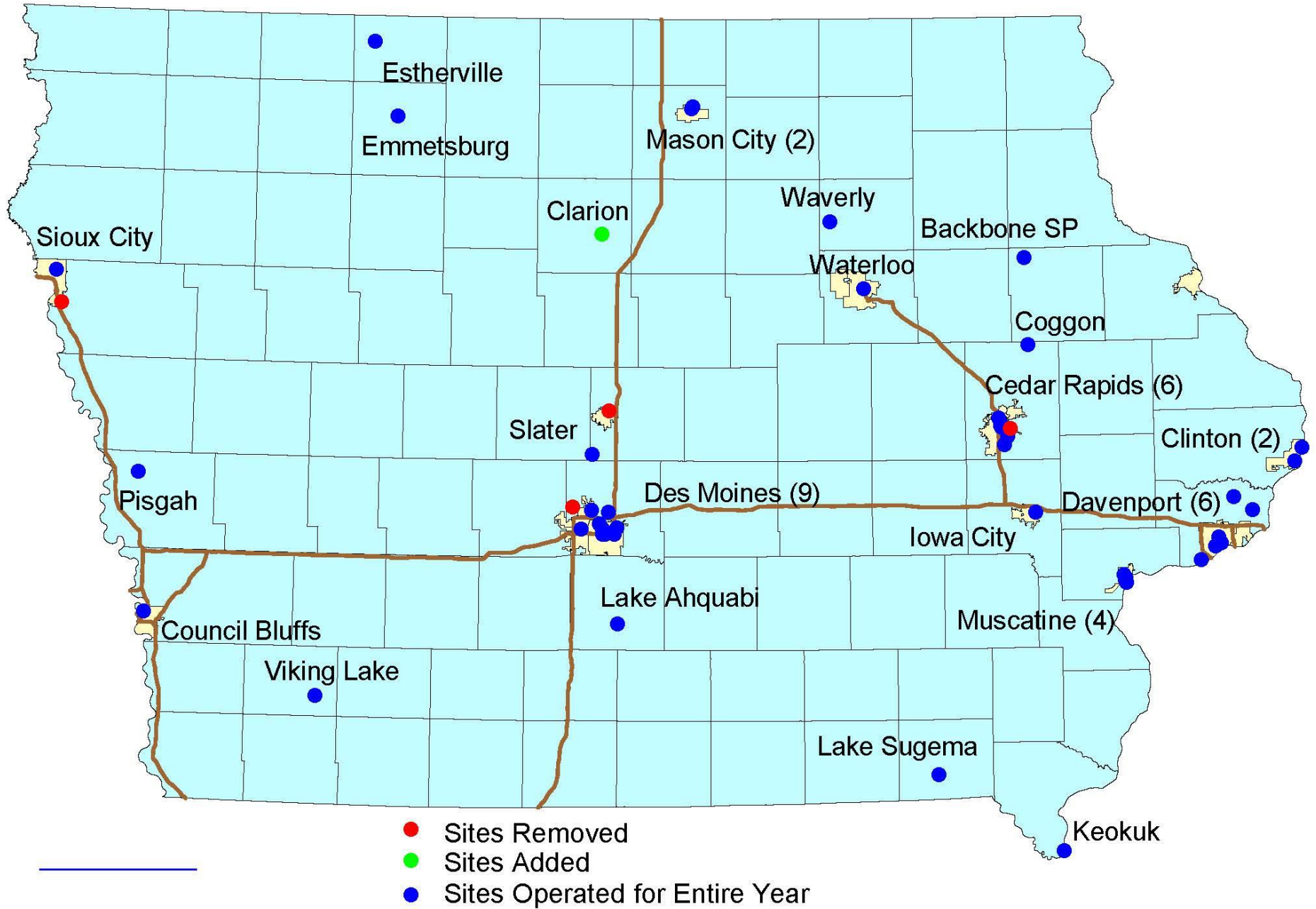
Ambient Air Monitoring Network in 2003

Site Locations

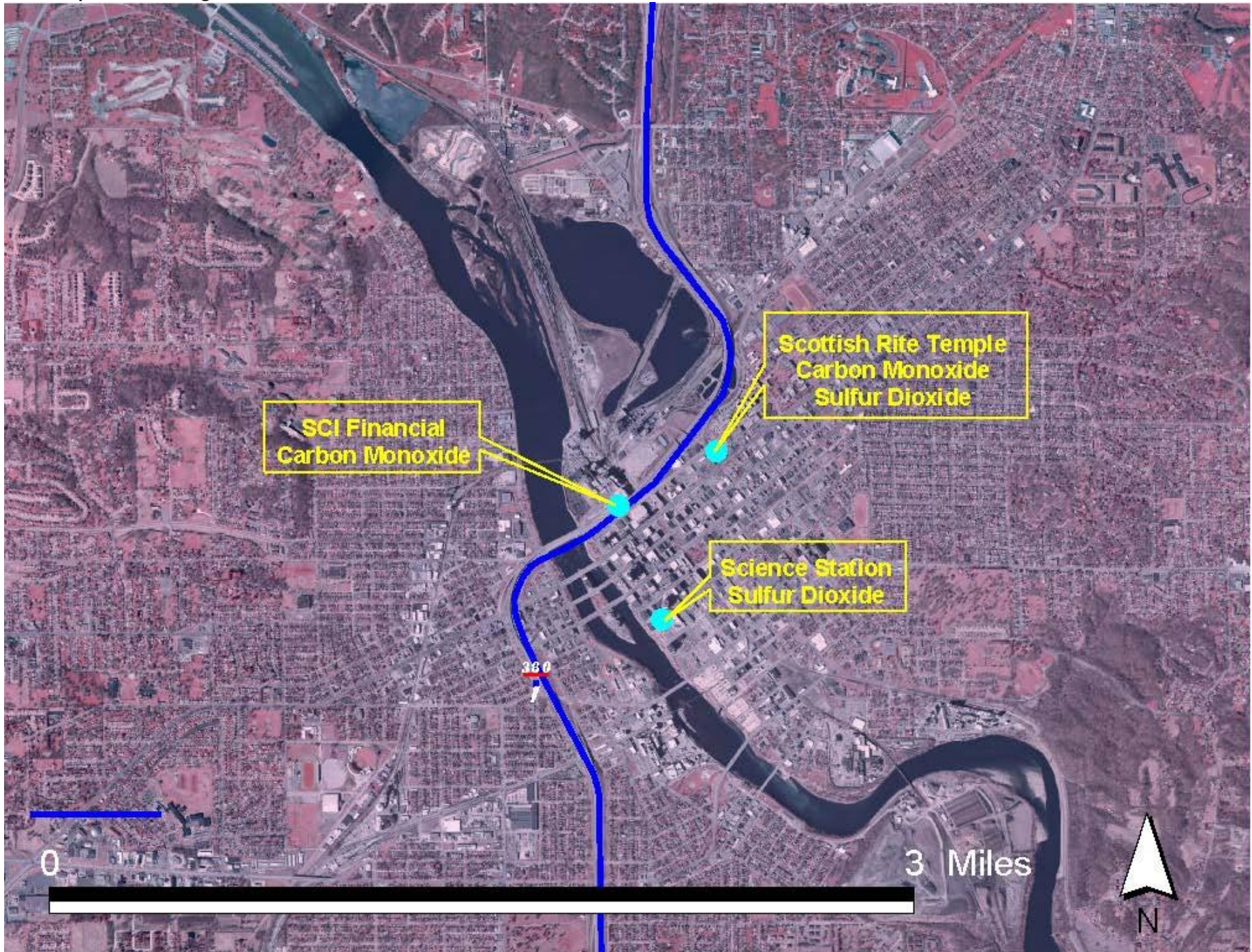
Site ID	Name	City	Address	County	Site Label	Pollutants
190130008	Grout Museum	Waterloo	West Park St. & South St.	Black Hawk	Waterloo, Grout Museum	PM2.5, PM10
190170011	Waverly Airport	Waverly	Waverly Airport	Bremer	Waverly, Airport	O3
190330018	Holnam Cement	Mason City	17th St. & Washington St.	Cerro Gordo	Mason City, Holnam Cement	SO2, PM10
190330019	12th and Monroe	Mason City	10th & Monroe	Cerro Gordo	Mason City, 12th & Monroe	PM2.5, PM10
190450019	Chancy Park	Clinton	23rd & Camanche	Clinton	Clinton, Chancy Park	SO2, PM10
190450021	Rainbow Park	Clinton	Roosevelt St.	Clinton	Clinton, Rainbow Park	O3, PM2.5
190550001	Backbone State Park		Fish Hatchery Backbone State Park	Delaware	Backbone State Park	PM10
190630003	Iowa Lakes College	Estherville	19 S 7th St.	Emmet	Estherville, Iowa Lakes Coll.	PM2.5, PM10
190851101	Highway Maintenance Shed	Pisgah	1575 Hwy 183	Harrison	Pisgah, Highway Maintenance	O3
191032001	Hoover Elementary	Iowa City	2200 East Court	Johnson	Iowa City, Hoover Sch.	PM2.5
191110008	Fire Station	Keokuk	111S. 13th St.	Lee	Keokuk, Fire Station	PM10
191130028	Kirkwood College	Cedar Rapids	6301 Kirkwood Blvd SW (Iowa Hall)	Linn	Cedar Rapids, Kirkwood Coll.	O3
191130029	Science Station	Cedar Rapids	1st St.& 5th Ave. SW	Linn	Cedar Rapids, Science Station	SO2
191130030	SCI Financial Group	Cedar Rapids	200 2nd Ave. SE	Linn	Cedar Rapids, SCI Financial	CO
191130031	Scottish Rite Temple	Cedar Rapids	616 A Ave.	Linn	Cedar Rapids, Scottish Rite Temple	CO, SO2
191130033	Coggon	Cedar Rapids	408 E Linn St.	Linn	Cedar Rapids, Coggon	NO2, O3
191130037	Army Reserve Center	Cedar Rapids	1599 Wenig Rd. NE	Linn	Cedar Rapids, Army Reserve	PM2.5, PM10
191130038	Ely Rd. SW	Cedar Rapids	Ely Rd. SW	Linn	Cedar Rapids, Ely Rd. SW	SO2
191370002	Viking Lake State Park		2780 Viking Lake Road	Montgomery	Viking Lake State Park	O3, PM2.5
191390015	Garfield School	Muscatine	1409 Wisconsin	Muscatine	Muscatine, Garfield Sch.	PM2.5, PM10
191390016	Greenwood Cemetary	Muscatine	Fletcher St. & Kimble St.	Muscatine	Muscatine, Greenwood Cemetary	SO2
191390017	Muscatine Power & Water	Muscatine	2200 Steward Rd.	Muscatine	Muscatine, Power and Water	SO2
191390020	Musser Park	Muscatine	Oregon St. & Earl Ave.	Muscatine	Muscatine, Musser Park	SO2, PM10
191471002	Iowa Lakes College	Emmetsburg	Iowa Lakes Community College - S Camp	Palo Alto	Emmetsburg, Iowa Lakes Coll.	O3, PM10
191530030	Public Health Bldg.	Des Moines	1907 Carpenter	Polk	Des Moines, Public Health Bldg.	PM2.5

Site ID	Name	City	Address	County	Site Label	Pollutants
191530052	Tech High School	Des Moines	19th & Grand Ave.	Polk	Des Moines, Tech High	CO
191530058	Phillips School	Des Moines	1701 Lay St.	Polk	Des Moines, Phillips Sch.	NO2, O3
191530059	National By-Products	Des Moines	SE 18th & Scott St.	Polk	Des Moines, Nat. By-Products	PM10
191530061	Easter Seals	Des Moines	2916 30th St. NW	Polk	Des Moines, Easter Seals	CO
191530062	Fire Station	Johnston	6011 NW 62nd Ave.	Polk	Johnston, Fire Station	CO
191532001	Fire Station	Des Moines	9th & Mulberry St.	Polk	Des Moines, Fire Station	PM10
191532510	Indian Hills Junior High	Clive	9401 Indian Hills	Polk	Clive, Indian Hills Sch.	PM2.5, PM10
191532520	Cornell Elementary	Des Moines	5817 NE 3rd St.	Polk	Des Moines, Cornell Sch.	PM2.5
191550009	Franklin Elementary	Council Bluffs	3130 C Ave.	Pottawattamie	Council Bluffs, Franklin Sch.	PM2.5, PM10
191630014	Scott County Park	Davenport	Scott County Park	Scott	Scott County Park	NO2, O3
191630015	Jefferson Elementary	Davenport	10th St. & Vine St.	Scott	Davenport, Jefferson Sch.	SO2, PM2.5, PM10
191630017	Linwood Mining	Buffalo	11100 110th Ave.	Scott	Buffalo, LW Mining	PM10
191630018	Adams Elementary	Davenport	3029 N Division St.	Scott	Davenport, Adams Sch.	PM2.5, PM10
191630019	Black Hawk Foundry	Davenport	300 Wellman St.	Scott	Davenport, BH Foundry	PM10
191632011	Highway Maintenance Shed	Argo	Hwy Z-30 1.5 miles N of Argo	Scott	Argo, Highway Maintenance	O3
191690011	Slater Elementary	Slater	505 Linn St.	Story	Slater, Slater Sch.	O3
191770005	Lake Sugema State Park		PO Box 538	Van Buren	Lake Sugema State Park	O3, SO2, PM2.5, PM10
191810022	Lake Ahquabi State Park		1650 118th Ave.	Warren	Lake Ahquabi State Park	O3
191930017	Lowell Elementary	Sioux City	27th at Morgan	Woodbury	Sioux City, Lowell Sch.	PM2.5, PM10
191970004	Jannsen Farm	Clarion	Jannsen Farm	Wright	Clarion, Jannsen Farm	PM2.5

Monitoring Sites



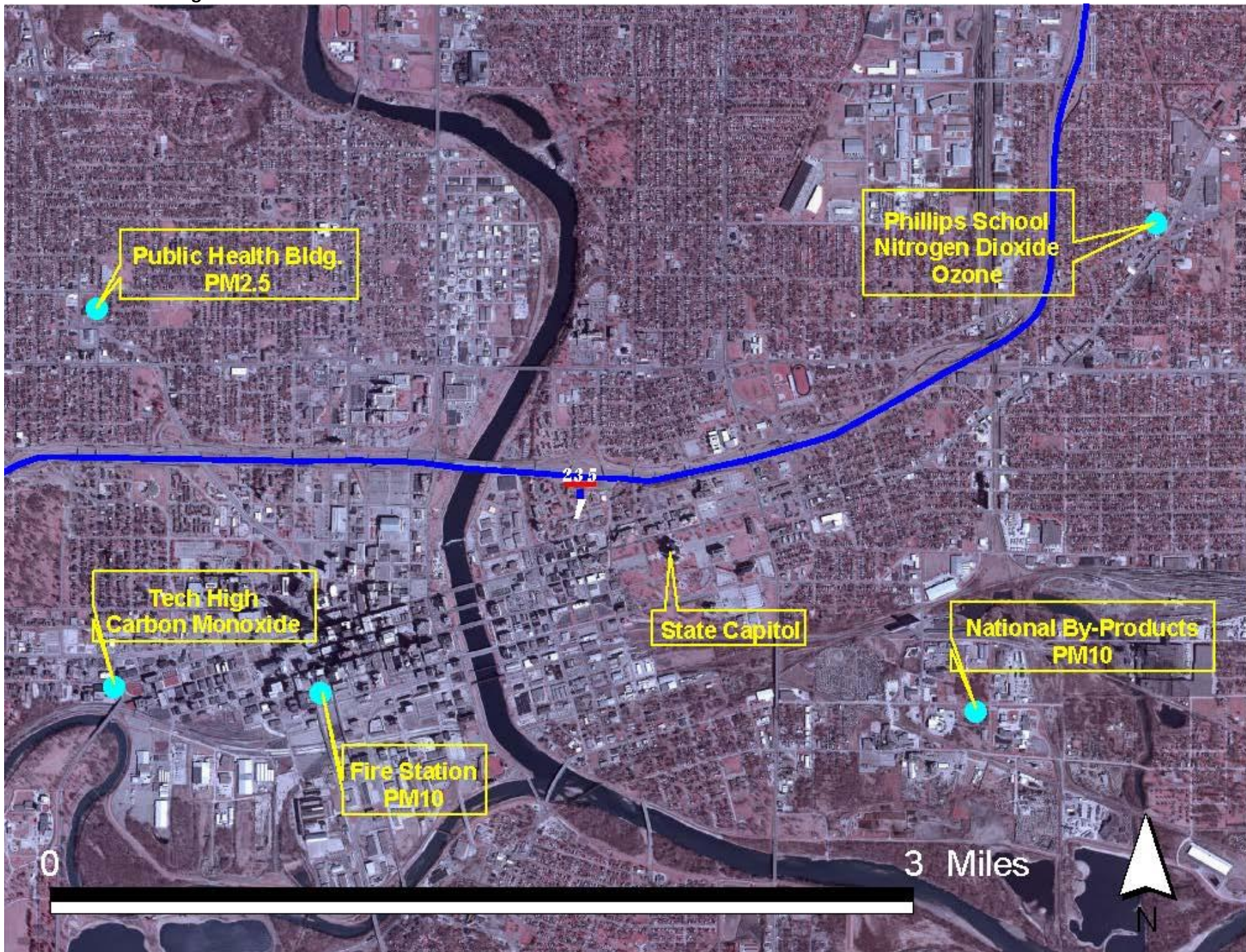
Cedar Rapids Monitoring Sites



Davenport Monitoring Sites



Des Moines Monitoring Sites



Site Changes**Sites Added**

Site ID	Name	City	County	Site Label	Pollutant	Date
191970004	Jannsen Farm	Clarion	Wright	Jannsen Farm	PM2.5	1/1/2003

Sites Removed

Site ID	Name	City	County	Site Label	Pollutant	Date
191130036	Monroe Elementary	Cedar Rapids	Linn	Cedar Rapids, Monroe Sch.	PM2.5	1/1/2003
191130039	Hawkeye Downs	Cedar Rapids	Linn	Cedar Rapids, Hawkeye Downs	SO2	1/1/2003
191530026	Dallas Center - Grimes School	Grimes	Polk	Grimes, D.C.-Grimes Sch.	PM10	1/1/2003
191692530	Meeker Elementary	Ames	Story	Ames, Meeker Sch.	PM2.5	1/1/2003
191930018	Sergeant Bluff	Sergeant Bluff	Woodbury	Sergeant Bluff	SO2	1/1/2003

Monitor Changes**Monitors Added**

Site ID	Name	City	County	Site Label	Pollutant	Date
191532510	Indian Hills Junior High	Clive	Polk	Clive, Indian Hills Sch.	PM10	1/1/2003

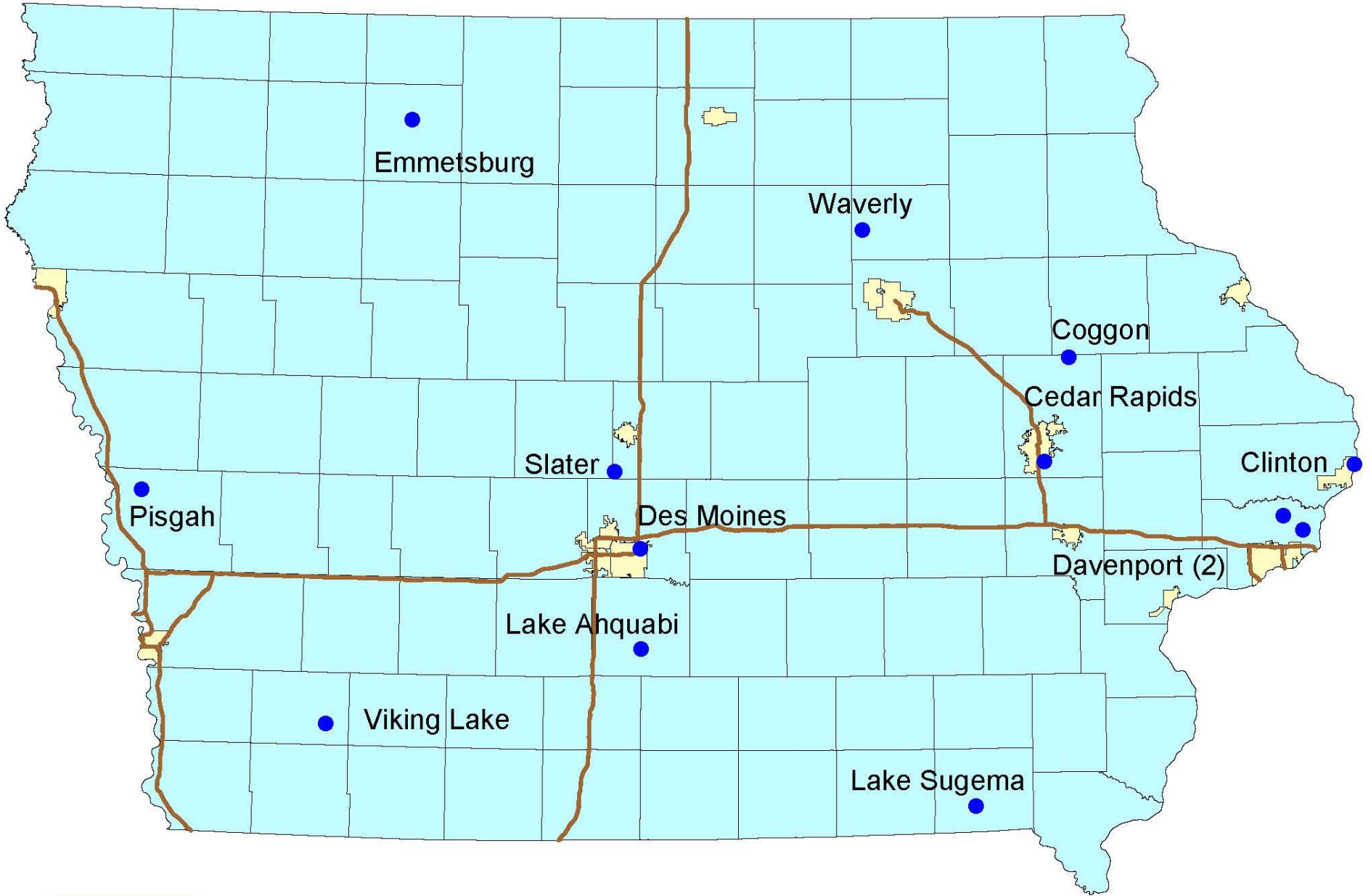
Monitors Removed

Site ID	Name	City	County	Site Label	Pollutant	Date
191130029	Science Station	Cedar Rapids	Linn	Cedar Rapids, Science Station	PM10	1/1/2003

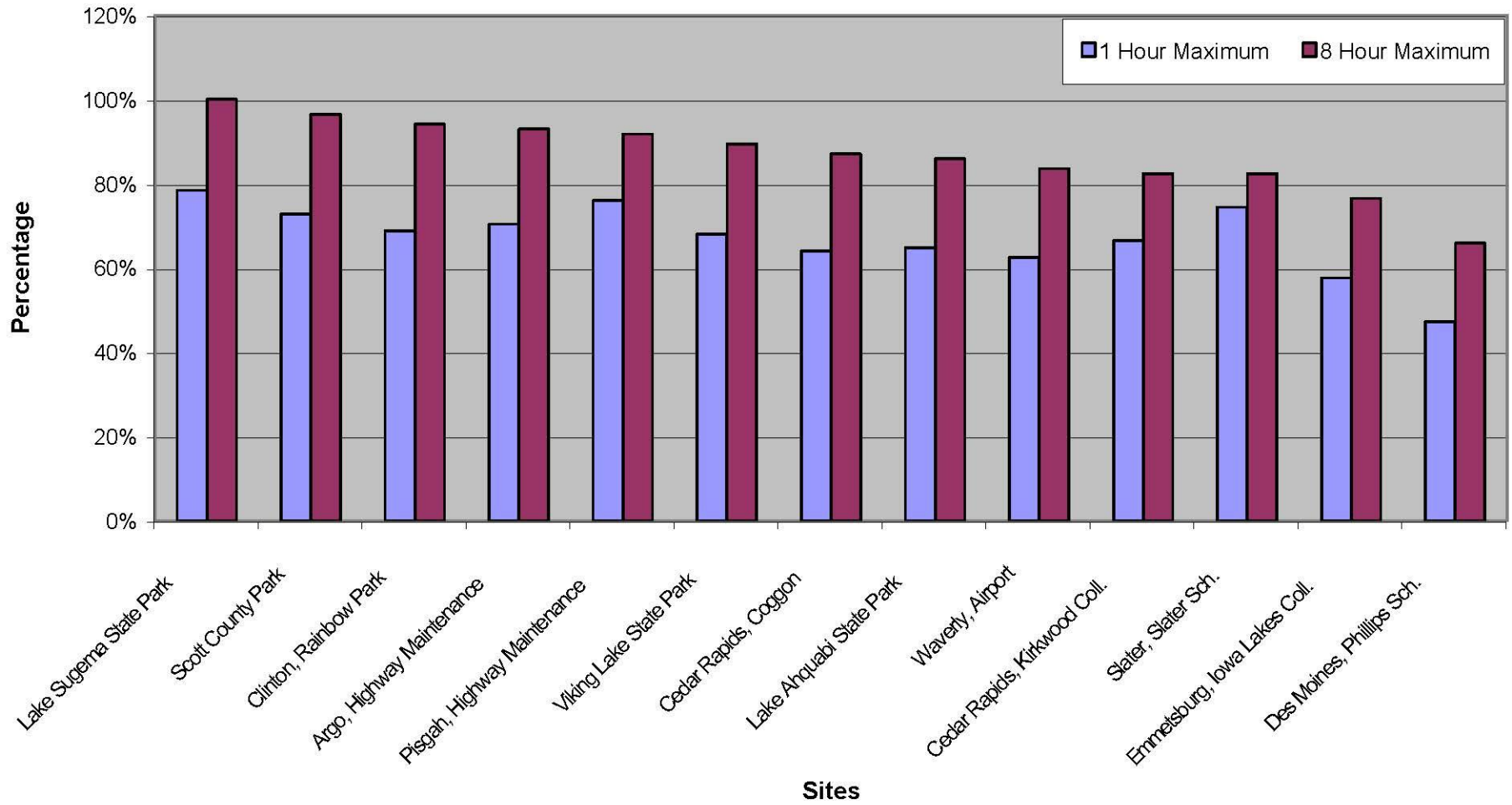
**Ozone Monitors
Site Locations**

Site	Name	City	County	Site Label
190170011	Waverly, Airport	Waverly	Bremer	Waverly, Airport
190450021	Clinton, Rainbow Park	Clinton	Clinton	Clinton, Rainbow Park
190851101	Pisgah, Highway Maintenance	Pisgah	Harrison	Pisgah, Highway Maintenance
191130028	Cedar Rapids, Kirkwood Coll.	Cedar Rapids	Linn	Cedar Rapids, Kirkwood Coll.
191130033	Cedar Rapids, Coggon	Cedar Rapids	Linn	Cedar Rapids, Coggon
191370002	Viking Lake State Park	0	Montgomery	Viking Lake State Park
191471002	Emmetsburg, Iowa Lakes Coll.	Emmetsburg	Palo Alto	Emmetsburg, Iowa Lakes Coll.
191530058	Des Moines, Phillips Sch.	Des Moines	Polk	Des Moines, Phillips Sch.
191630014	Scott County Park	Davenport	Scott	Scott County Park
191632011	Argo, Highway Maintenance	Argo	Scott	Argo, Highway Maintenance
191690011	Slater, Slater Sch.	Slater	Story	Slater, Slater Sch.
191770005	Lake Sugema State Park		Van Buren	Lake Sugema State Park
191810022	Lake Ahquabi State Park		Warren	Lake Ahquabi State Park

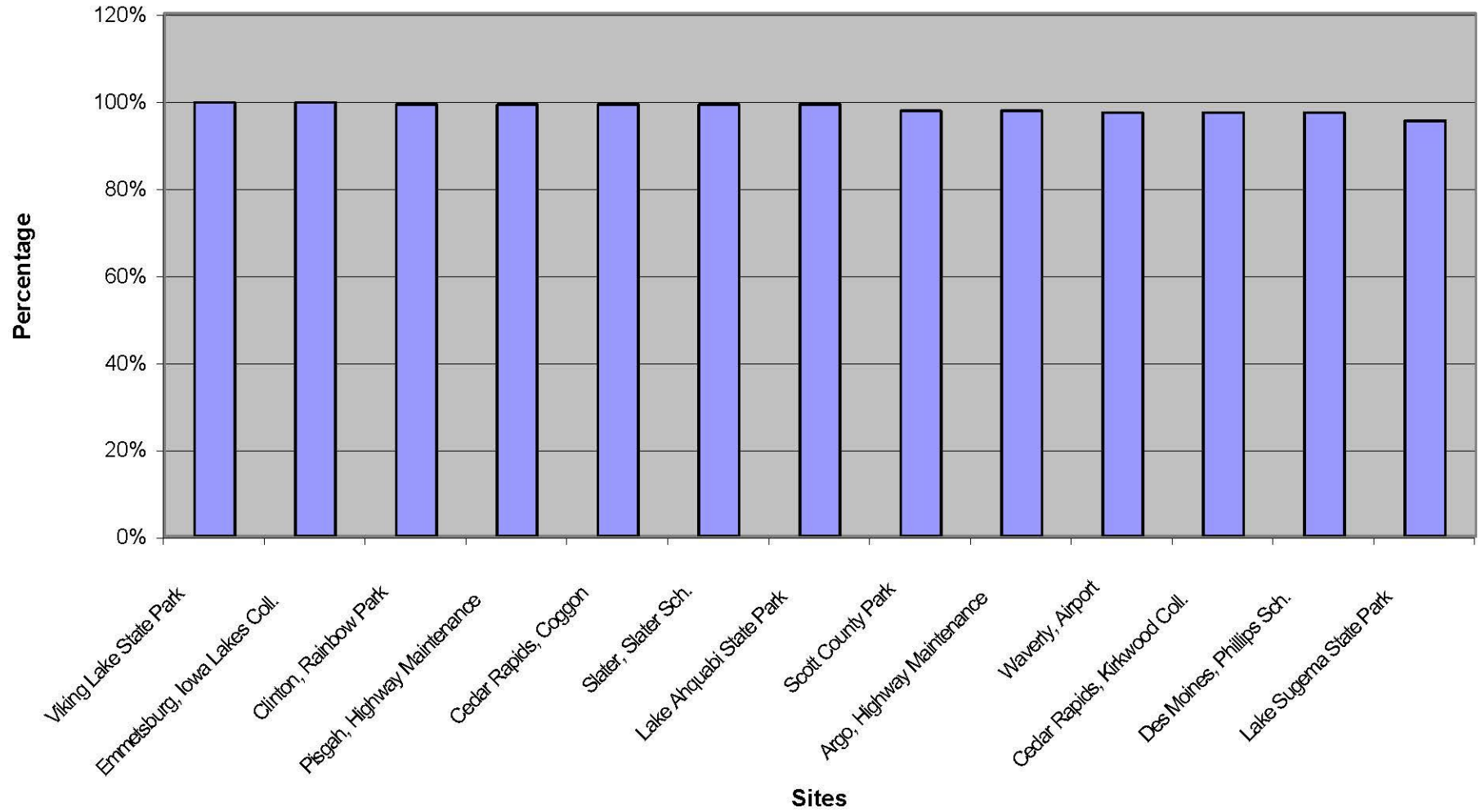
Ozone Monitors



Comparison of 2003 Ozone Data with National Ambient Air Quality Standards



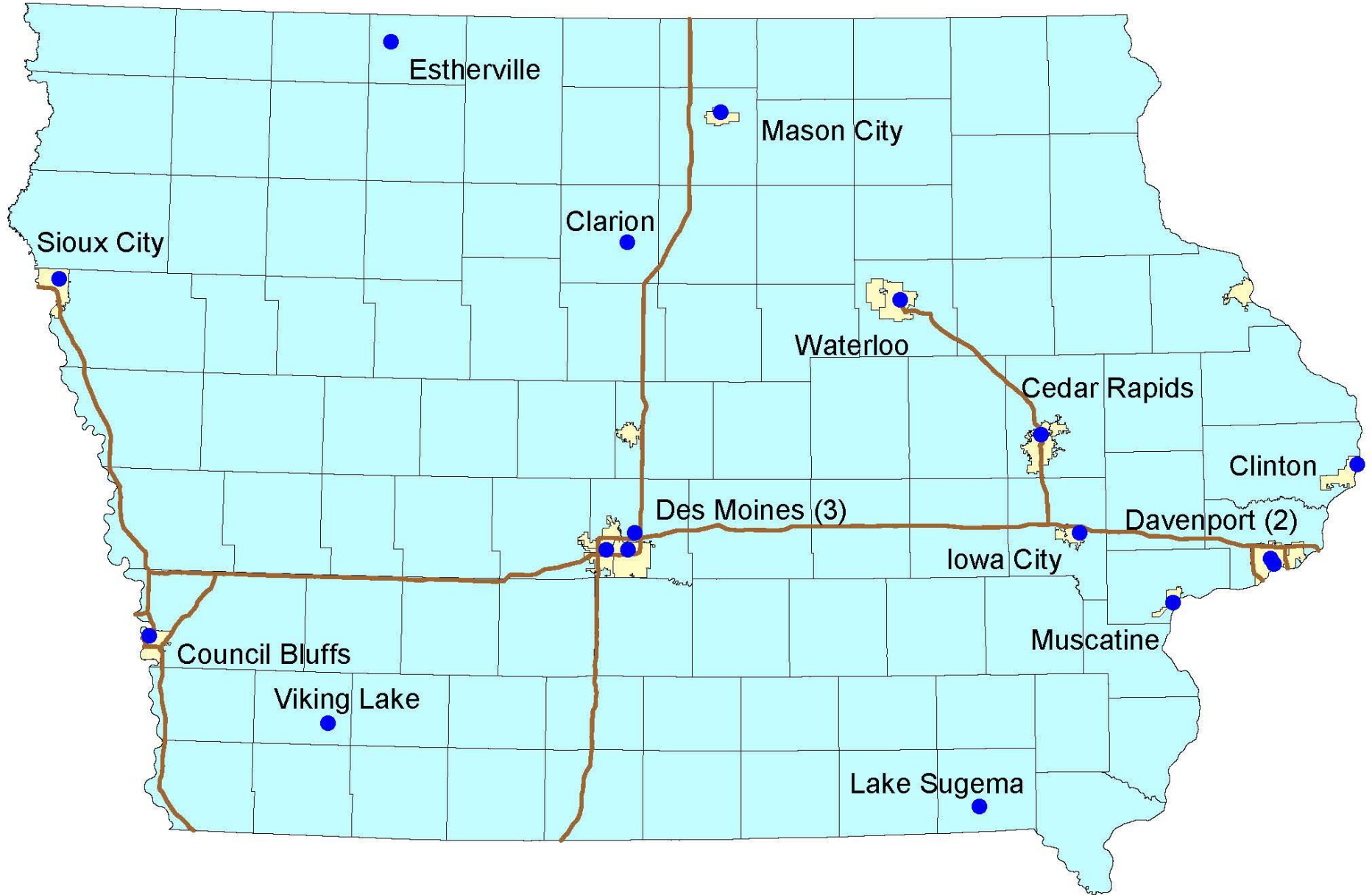
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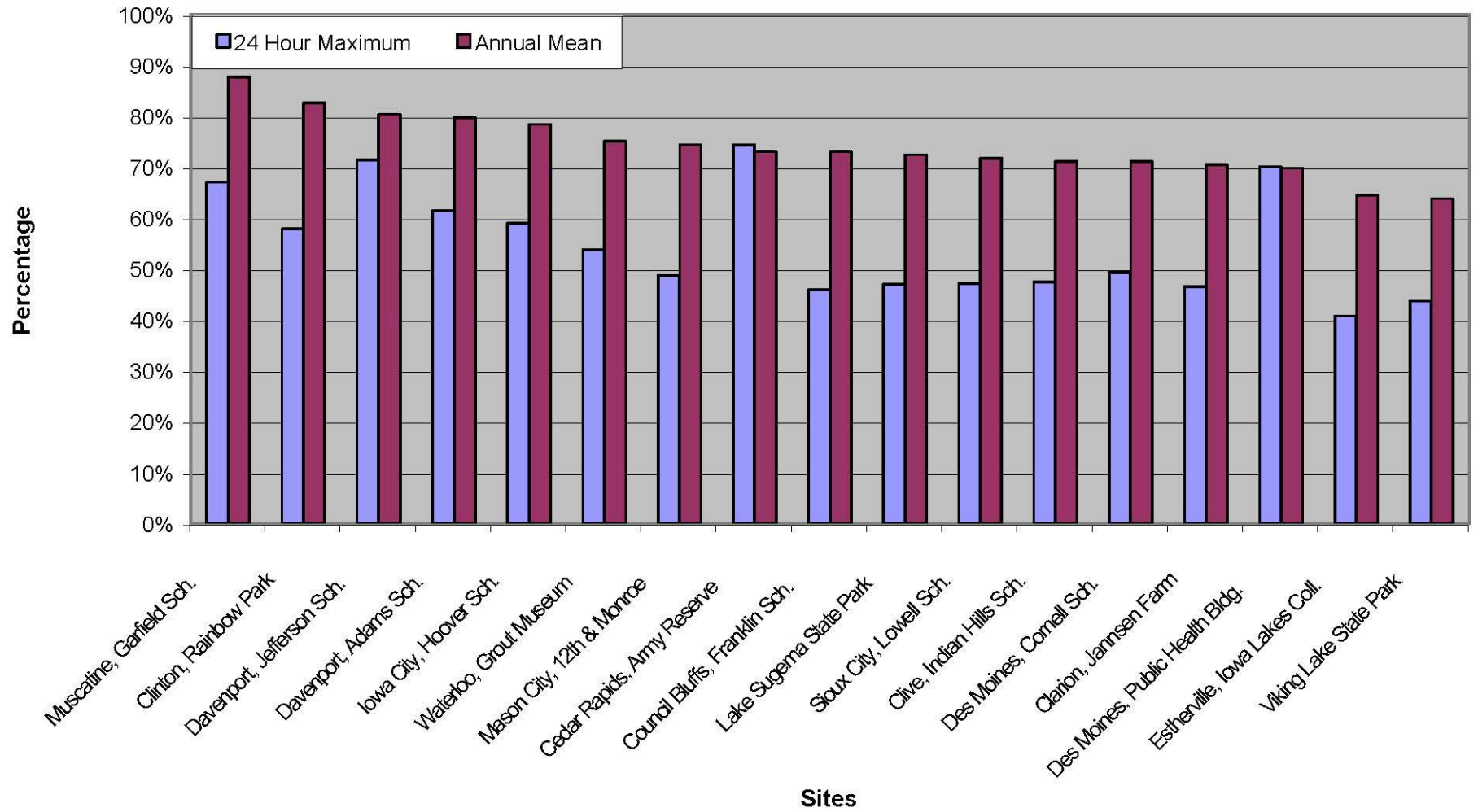
**PM2.5 Monitors
Site Locations**

Site	Name	City	County	Site Label
191390015	Muscatine, Garfield Sch.	Muscatine	Muscatine	Muscatine, Garfield Sch.
190450021	Clinton, Rainbow Park	Clinton	Clinton	Clinton, Rainbow Park
191630015	Davenport, Jefferson Sch.	Davenport	Scott	Davenport, Jefferson Sch.
191630018	Davenport, Adams Sch.	Davenport	Scott	Davenport, Adams Sch.
191032001	Iowa City, Hoover Sch.	Iowa City	Johnson	Iowa City, Hoover Sch.
190130008	Waterloo, Grout Museum	Waterloo	Black Hawk	Waterloo, Grout Museum
190330019	Mason City, 12th & Monroe	Mason City	Cerro Gordo	Mason City, 12th & Monroe
191130037	Cedar Rapids, Army Reserve	Cedar Rapids	Linn	Cedar Rapids, Army Reserve
191550009	Council Bluffs, Franklin Sch.	Council Bluffs	Pottawattamie	Council Bluffs, Franklin Sch.
191770005	Lake Sugema State Park		Van Buren	Lake Sugema State Park
191930017	Sioux City, Lowell Sch.	Sioux City	Woodbury	Sioux City, Lowell Sch.
191532510	Clive, Indian Hills Sch.	Clive	Polk	Clive, Indian Hills Sch.
191532520	Des Moines, Cornell Sch.	Des Moines	Polk	Des Moines, Cornell Sch.
191970004	Clarion, Jannsen Farm	Clarion	Wright	Clarion, Jannsen Farm
191530030	Des Moines, Public Health Bldg.	Des Moines	Polk	Des Moines, Public Health Bldg.
190630003	Estherville, Iowa Lakes Coll.	Estherville	Emmet	Estherville, Iowa Lakes Coll.
191370002	Viking Lake State Park		Montgomery	Viking Lake State Park

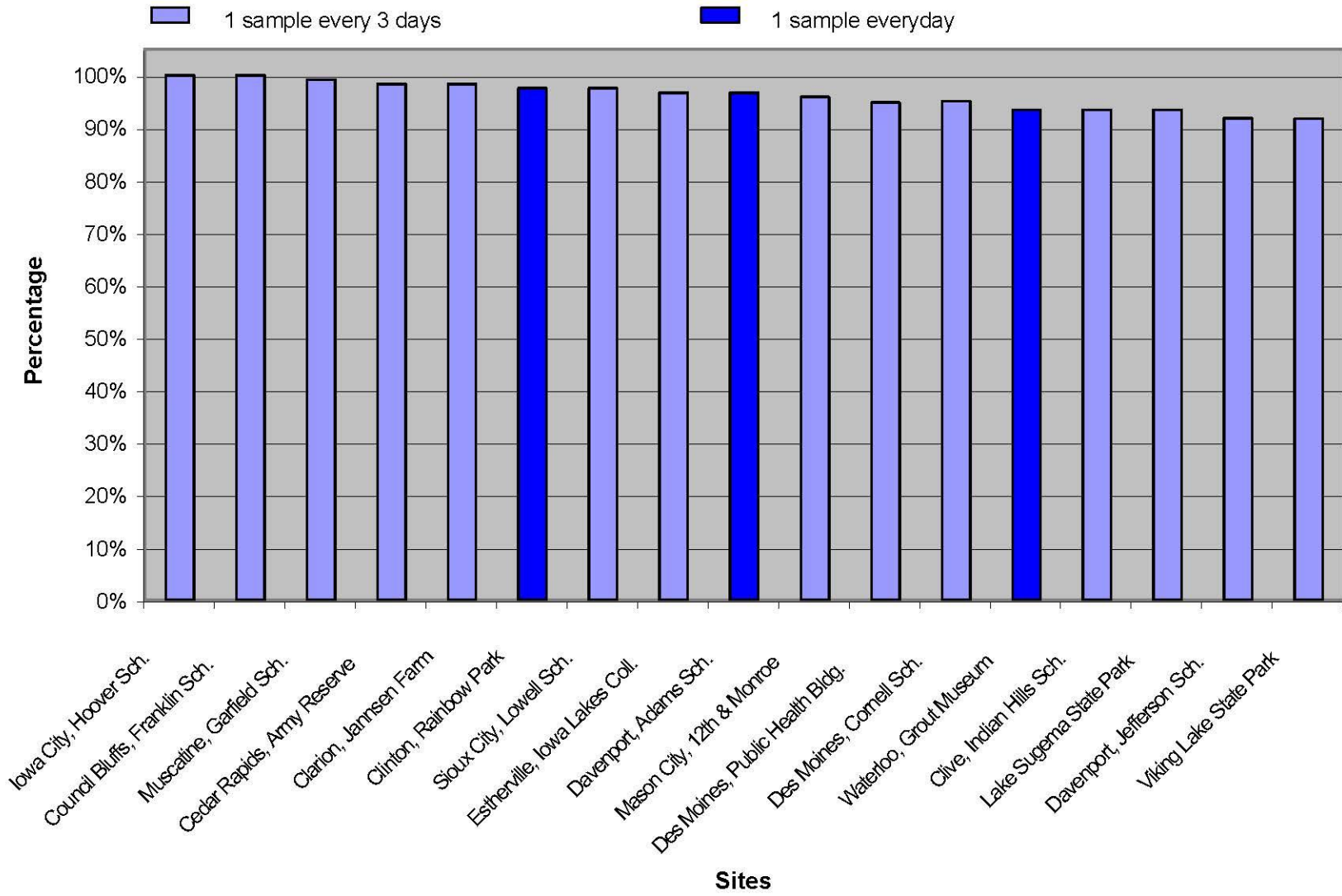
PM2.5 Monitors



Comparison of 2003 PM2.5 Data with National Ambient Air Quality Standards



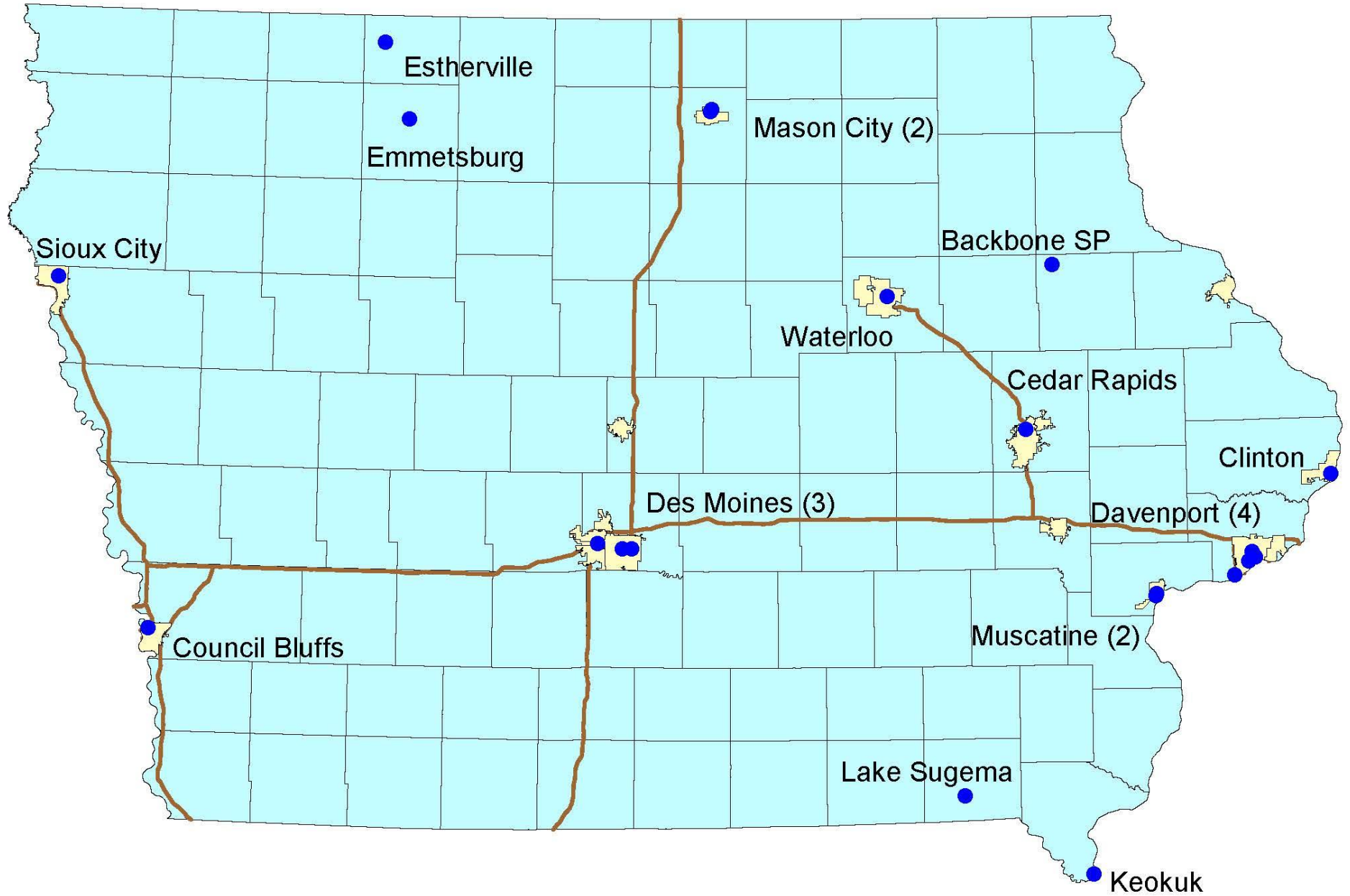
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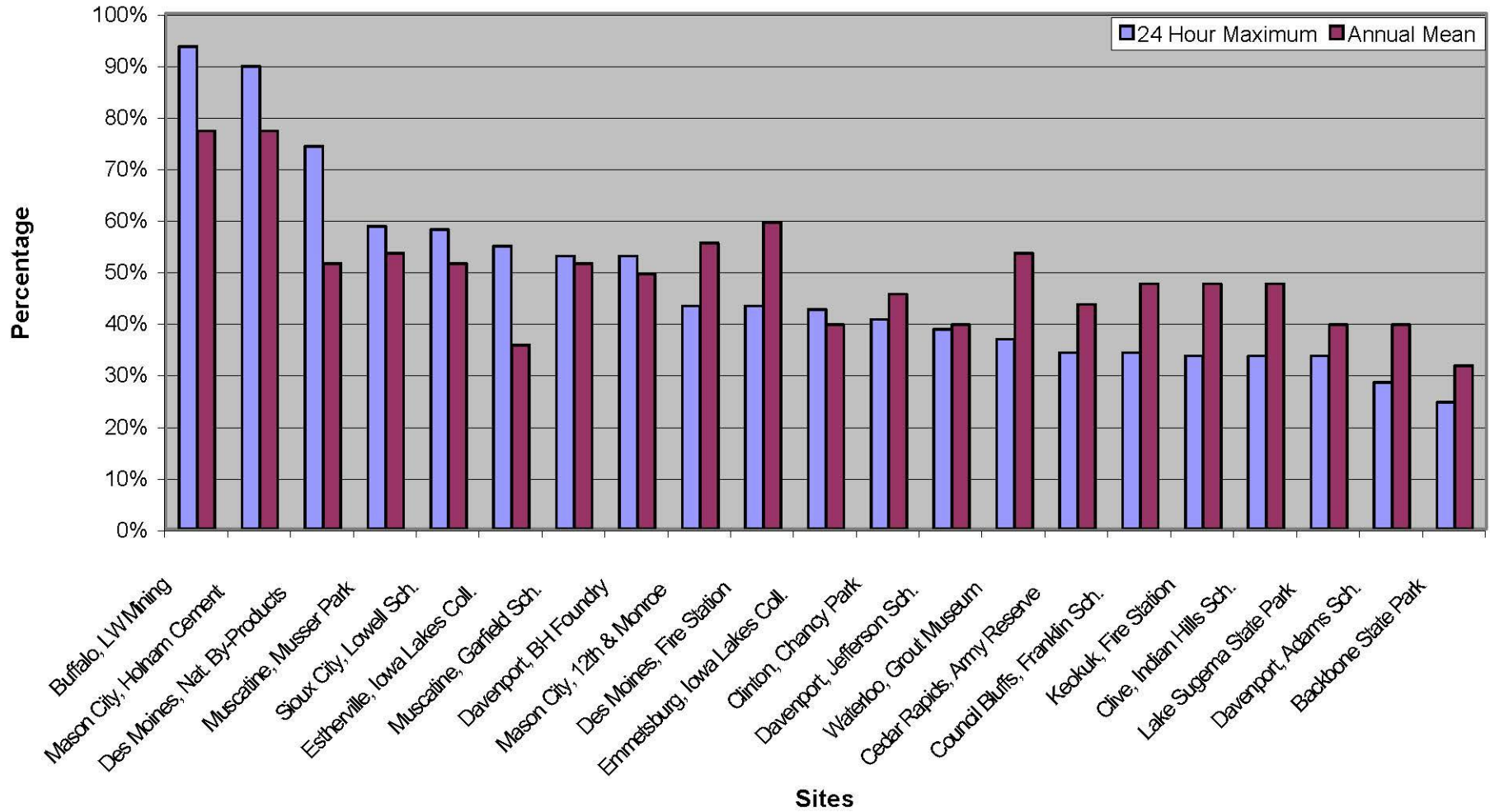
**PM10 Monitors
Site Locations**

Site	Name	City	County	Site Label
191532510	Clive, Indian Hills Sch.	Clive	Polk	Clive, Indian Hills Sch.
191630017	Buffalo, LW Mining	Buffalo	Scott	Buffalo, LW Mining
190330018	Mason City, Holnam Cement	Mason City	Cerro Gordo	Mason City, Holnam Cement
190450019	Clinton, Chancy Park	Clinton	Clinton	Clinton, Chancy Park
191471002	Emmetsburg, Iowa Lakes Coll.	Emmetsburg	Palo Alto	Emmetsburg, Iowa Lakes Coll.
191630019	Davenport, BH Foundry	Davenport	Scott	Davenport, BH Foundry
191550009	Council Bluffs, Franklin Sch.	Council Bluffs	Pottawattamie	Council Bluffs, Franklin Sch.
191770005	Lake Sugema State Park		Van Buren	Lake Sugema State Park
191390020	Muscatine, Musser Park	Muscatine	Muscatine	Muscatine, Musser Park
190630003	Estherville, Iowa Lakes Coll.	Estherville	Emmet	Estherville, Iowa Lakes Coll.
191130037	Cedar Rapids, Army Reserve	Cedar Rapids	Linn	Cedar Rapids, Army Reserve
191532001	Des Moines, Fire Station	Des Moines	Polk	Des Moines, Fire Station
191630018	Davenport, Adams Sch.	Davenport	Scott	Davenport, Adams Sch.
191390015	Muscatine, Garfield Sch.	Muscatine	Muscatine	Muscatine, Garfield Sch.
190130008	Waterloo, Grout Museum	Waterloo	Black Hawk	Waterloo, Grout Museum
191110008	Keokuk, Fire Station	Keokuk	Lee	Keokuk, Fire Station
191930017	Sioux City, Lowell Sch.	Sioux City	Woodbury	Sioux City, Lowell Sch.
191530059	Des Moines, Nat. By-Products	Des Moines	Polk	Des Moines, Nat. By-Products
190550001	Backbone State Park		Delaware	Backbone State Park
191630015	Davenport, Jefferson Sch.	Davenport	Scott	Davenport, Jefferson Sch.
190330019	Mason City, 12th & Monroe	Mason City	Cerro Gordo	Mason City, 12th & Monroe

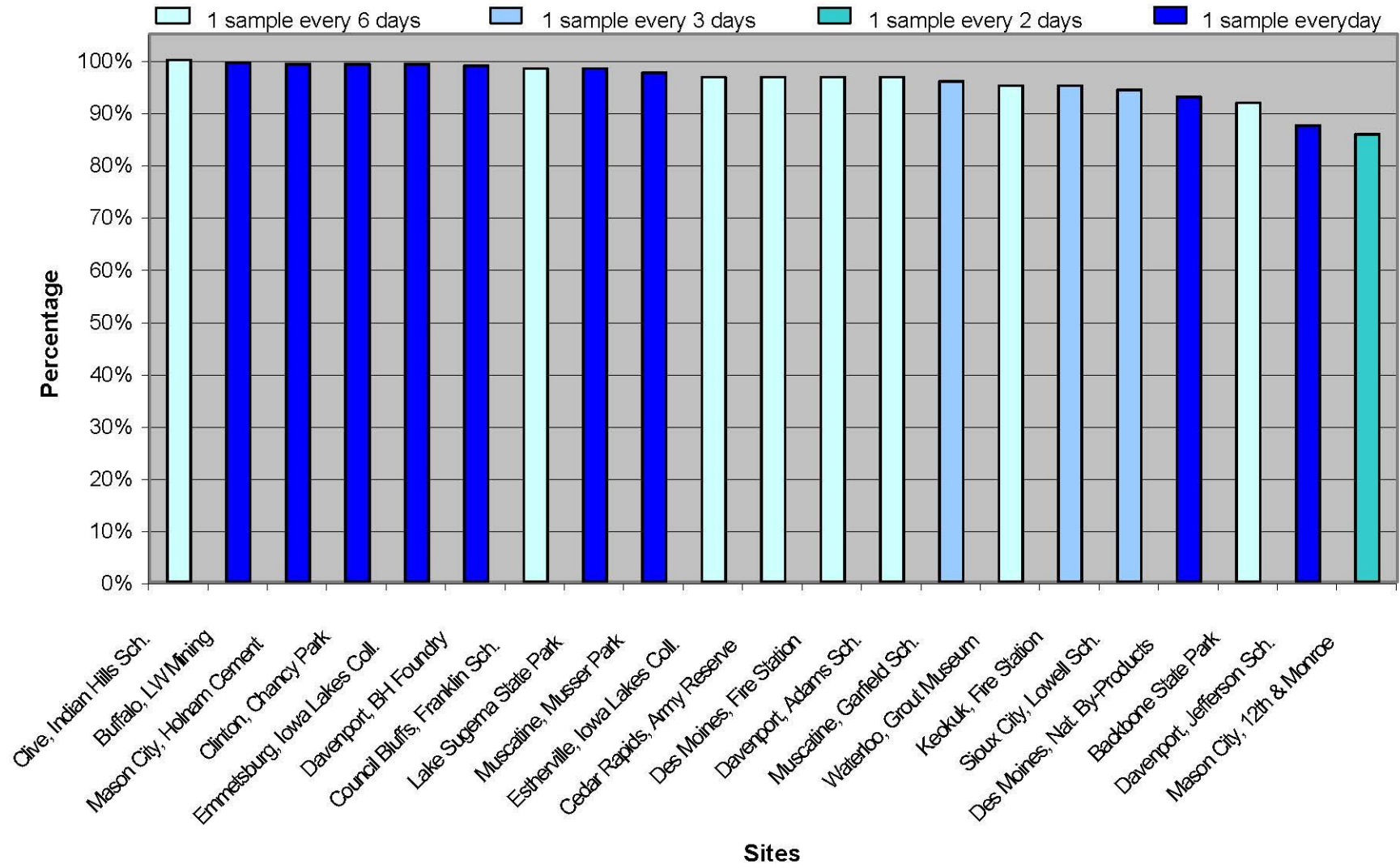
PM10 Monitors



Comparison of 2003 PM10 Data with National Ambient Air Quality Standards



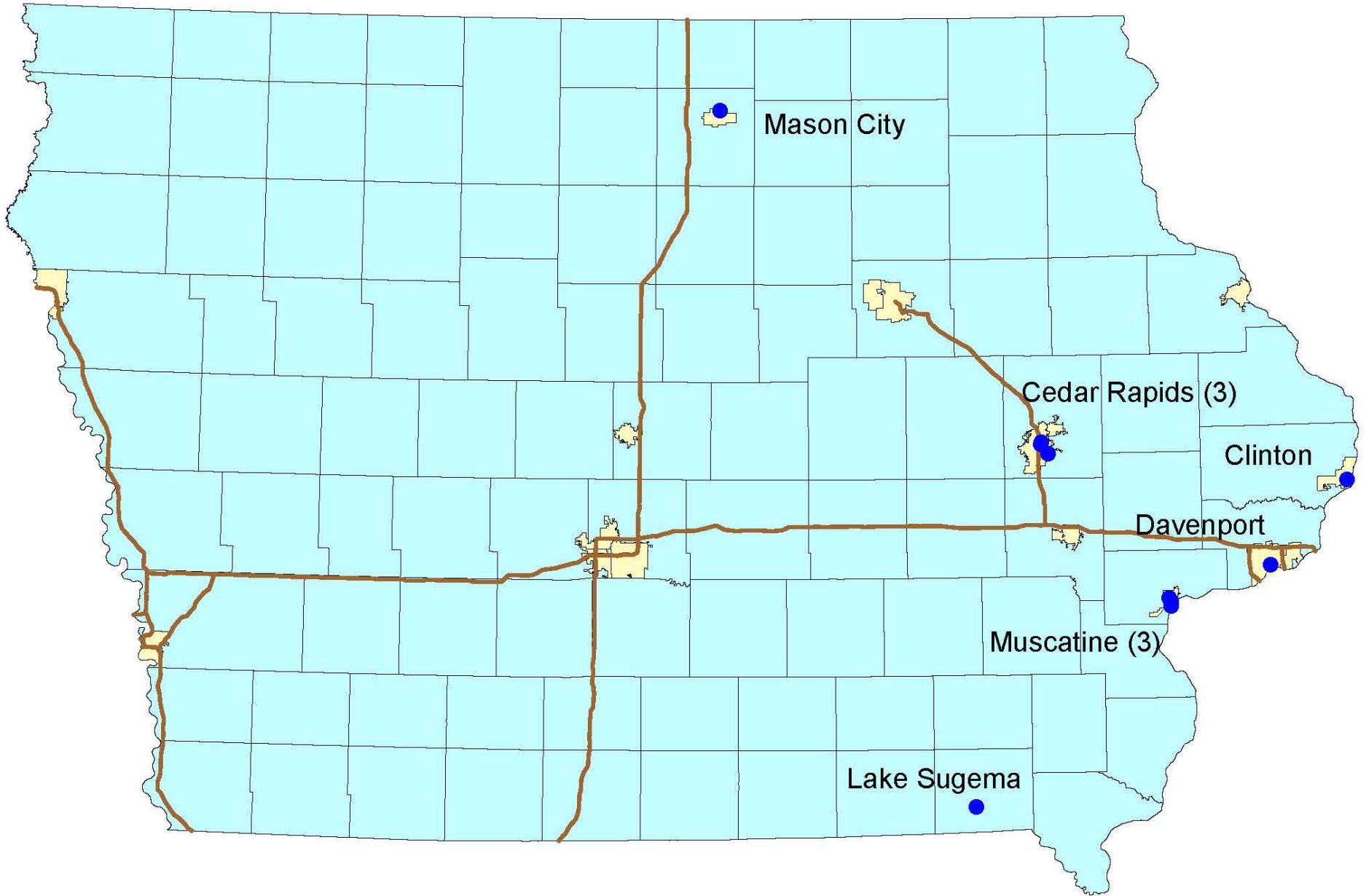
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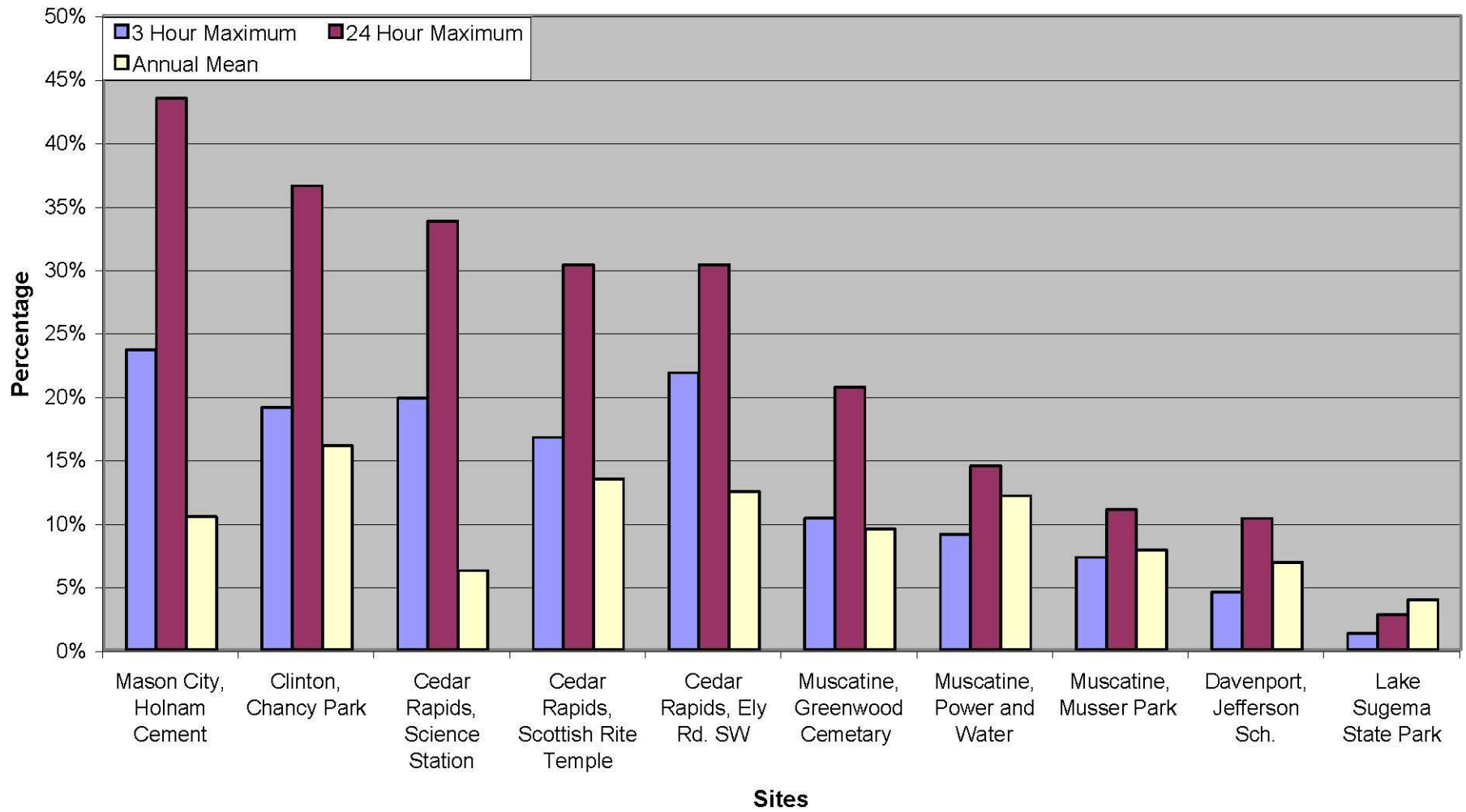
Sulfur Dioxide Monitors**Site Locations**

Site ID	Name	City	County	Site Label
190330018	Mason City, Holnam Cement	Mason City	Cerro Gordo	Mason City, Holnam Cement
190450019	Clinton, Chancy Park	Clinton	Clinton	Clinton, Chancy Park
191130029	Cedar Rapids, Science Station	Cedar Rapids	Linn	Cedar Rapids, Science Station
191130031	Cedar Rapids, Scottish Rite Temple	Cedar Rapids	Linn	Cedar Rapids, Scottish Rite Temple
191130038	Cedar Rapids, Ely Rd. SW	Cedar Rapids	Linn	Cedar Rapids, Ely Rd. SW
191390016	Muscatine, Greenwood Cemetery	Muscatine	Muscatine	Muscatine, Greenwood Cemetery
191390017	Muscatine, Power and Water	Muscatine	Muscatine	Muscatine, Power and Water
191390020	Muscatine, Musser Park	Muscatine	Muscatine	Muscatine, Musser Park
191630015	Davenport, Jefferson Sch.	Davenport	Scott	Davenport, Jefferson Sch.
191770005	Lake Sugema State Park		Van Buren	Lake Sugema State Park

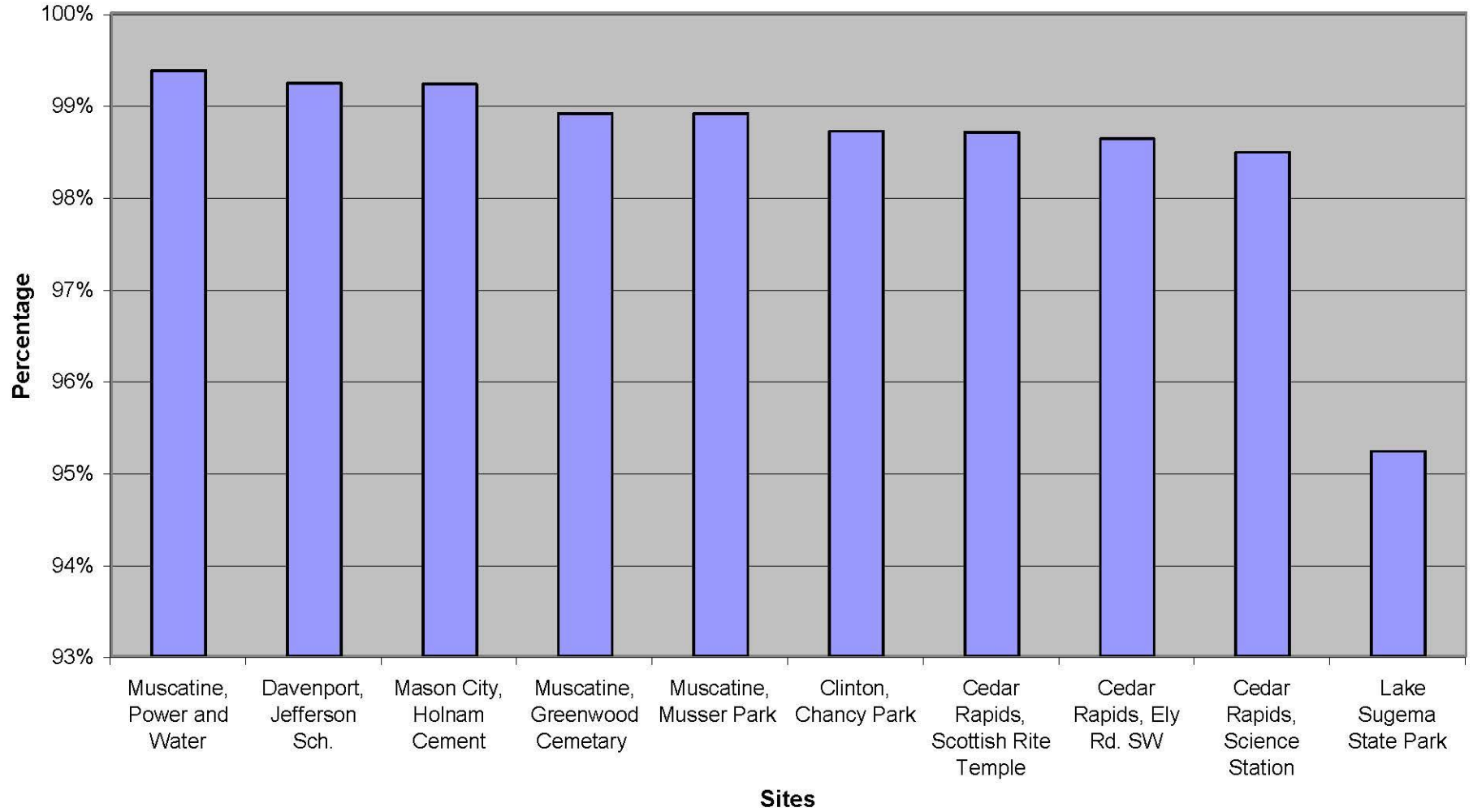
Sulfur Dioxide Monitors



Comparison of 2003 Sulfur Dioxide Data with National Ambient Air Quality Standards



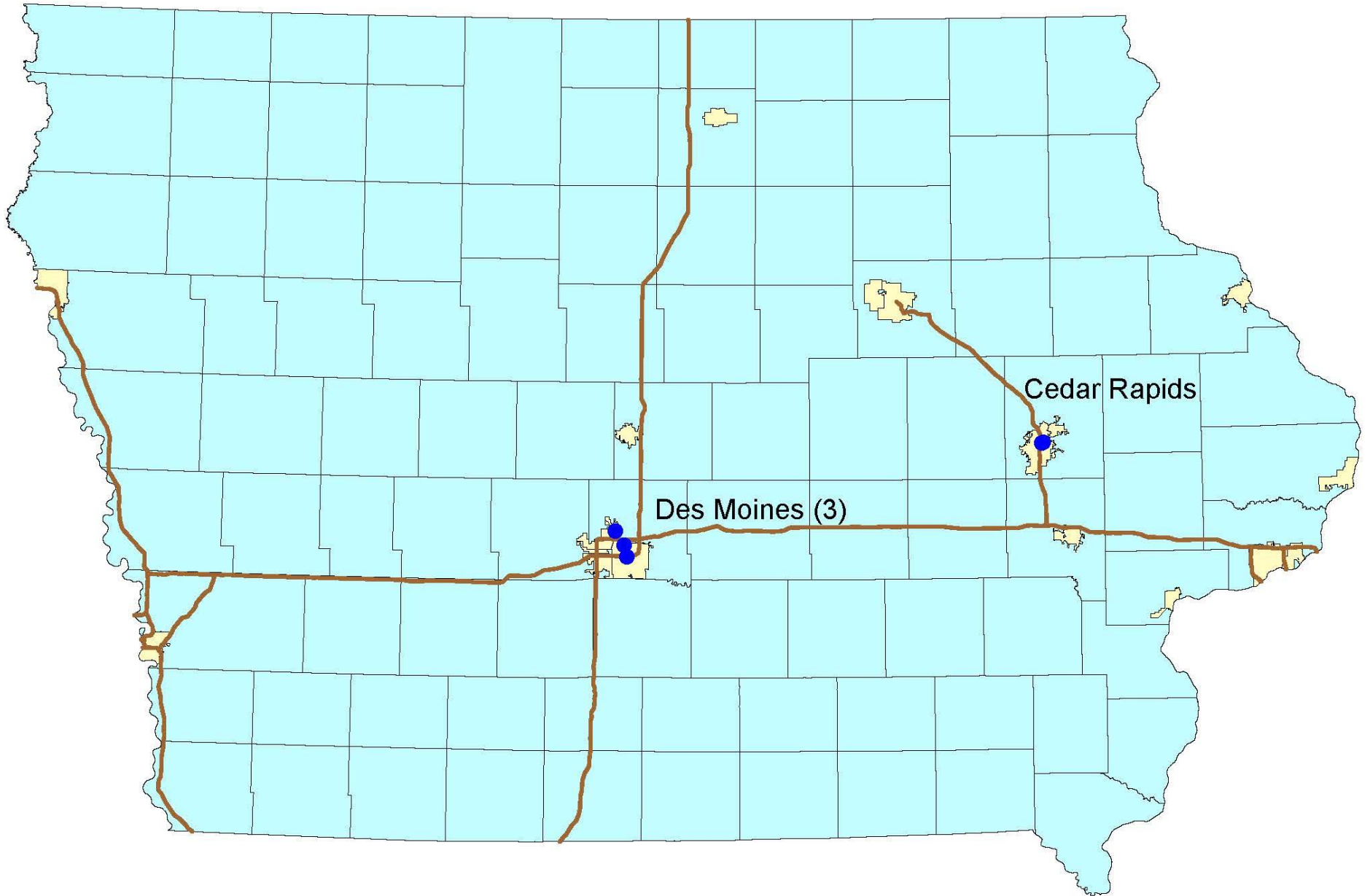
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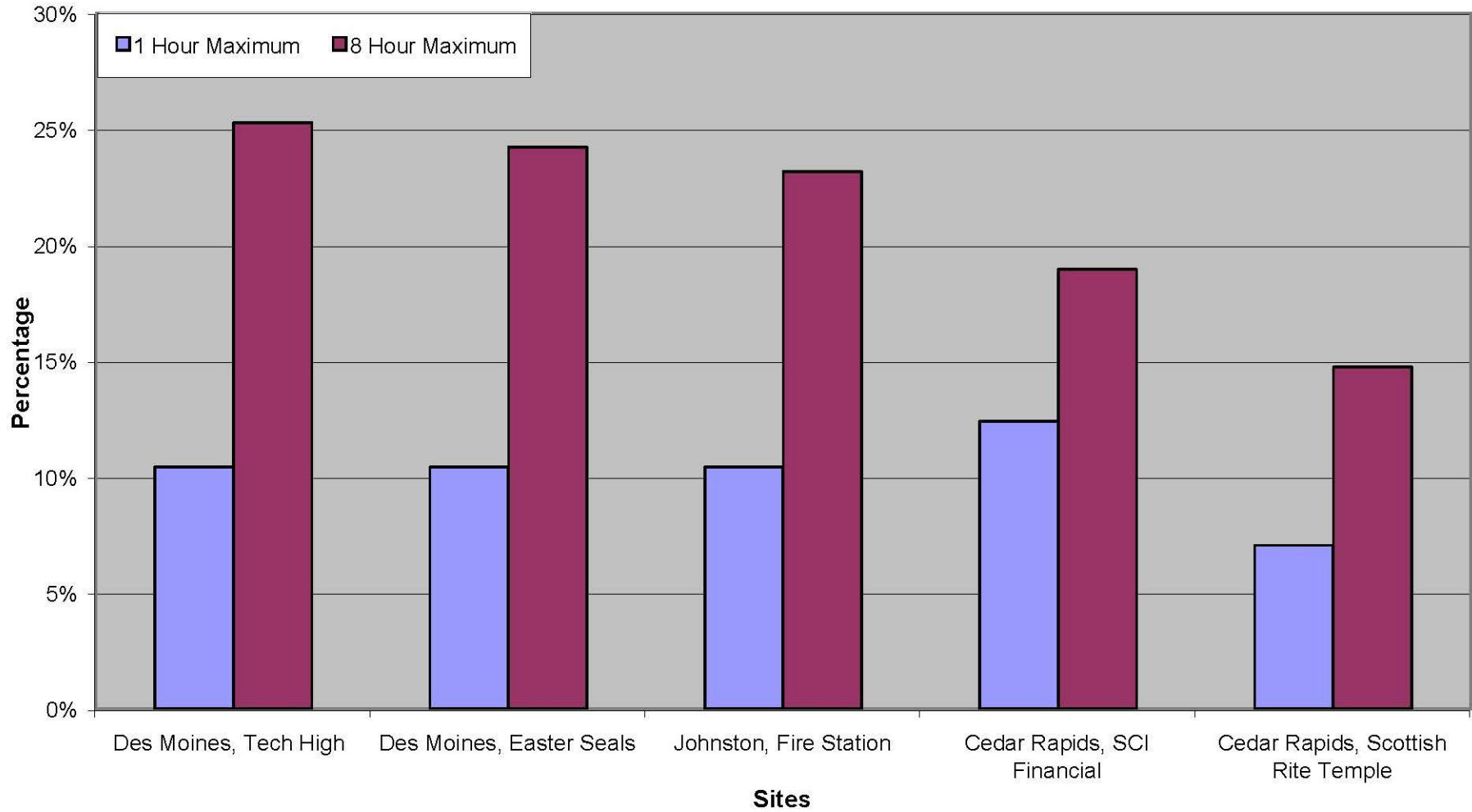
**Carbon Monoxide Monitors
Site Locations**

Site	Name	City	County	Site Label
191130030	Cedar Rapids, SCI Financial	Cedar Rapids	Linn	Cedar Rapids, SCI Financial
191130031	Cedar Rapids, Scottish Rite Temple	Cedar Rapids	Linn	Cedar Rapids, Scottish Rite Temple
191530052	Des Moines, Tech High	Des Moines	Polk	Des Moines, Tech High
191530061	Des Moines, Easter Seals	Des Moines	Polk	Des Moines, Easter Seals
191530062	Johnston, Fire Station	Johnston	Polk	Johnston, Fire Station

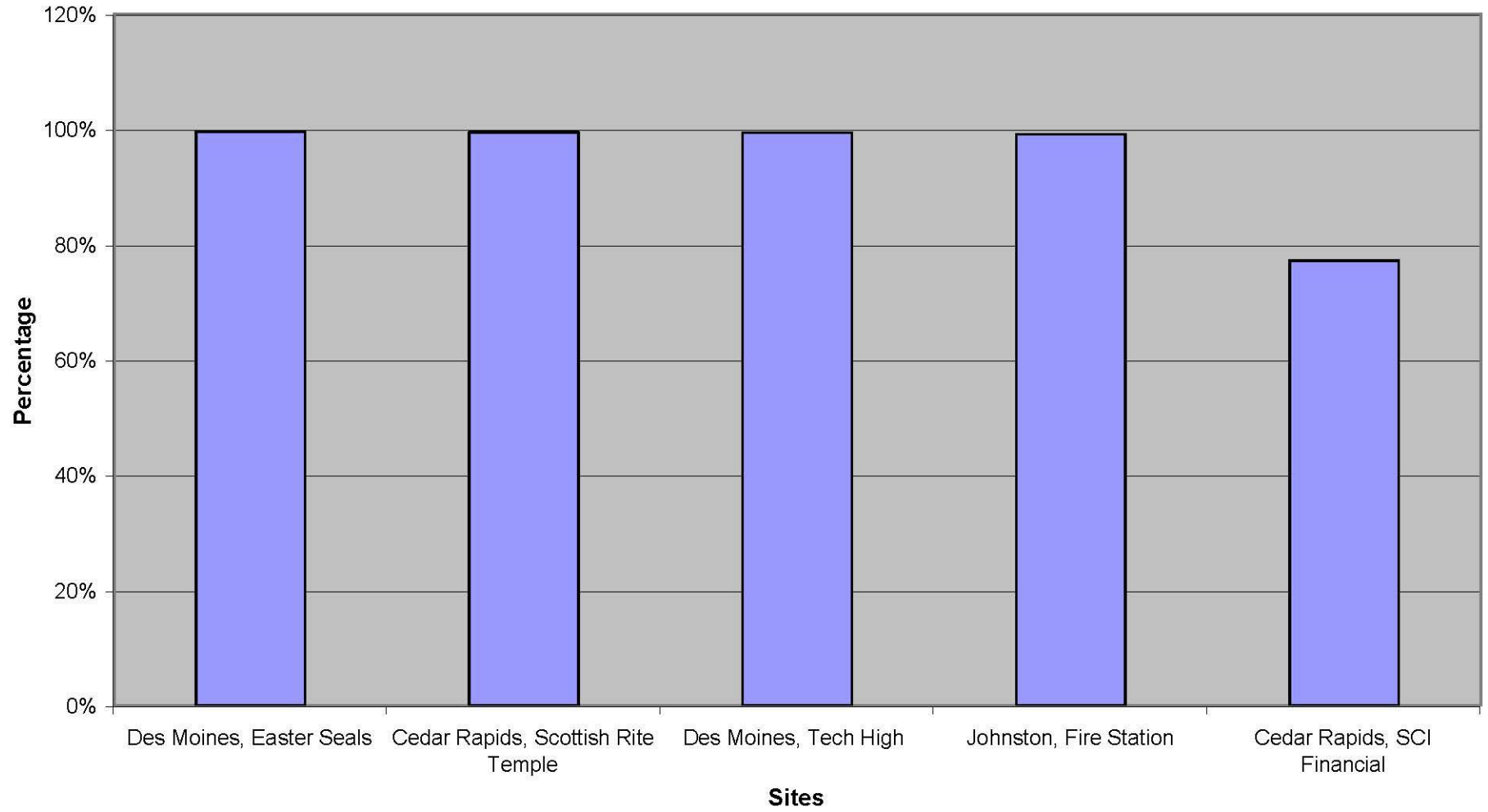
Carbon Monoxide Monitors



Comparison of 2003 Carbon Monoxide Data with National Ambient Air Quality Standards



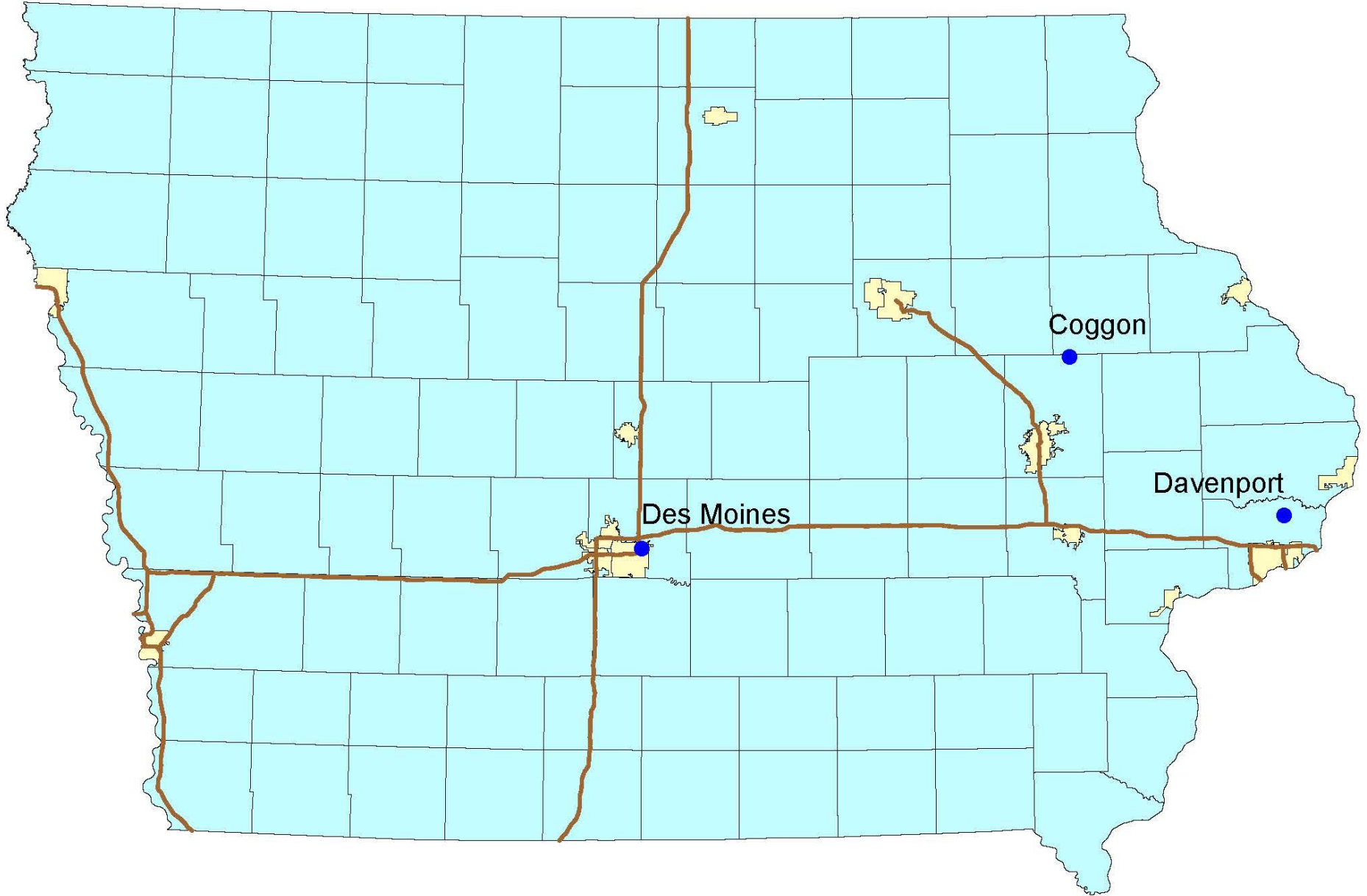
Data Capture



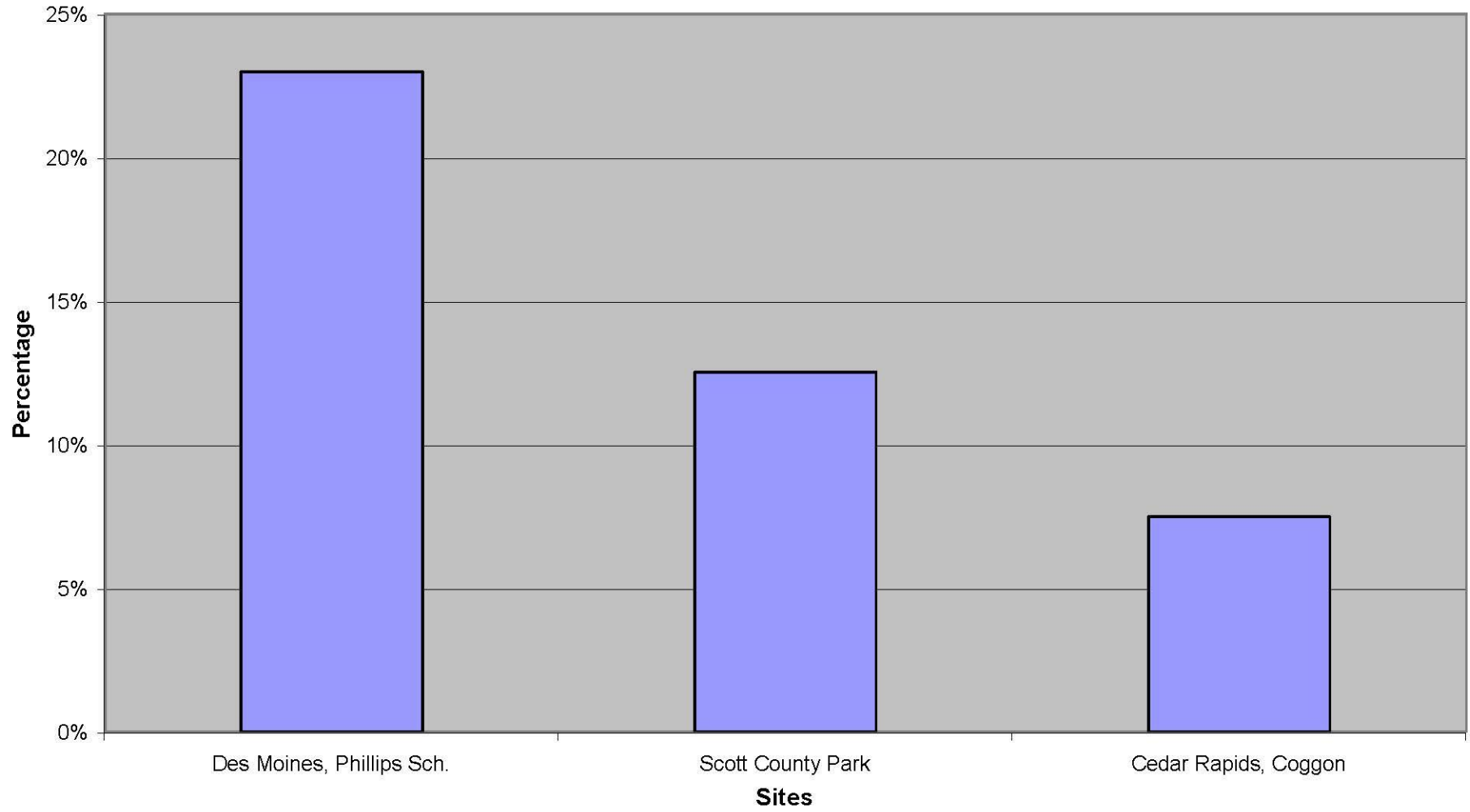
**Nitrogen Dioxide Monitors
Site Locations**

Site	Name	City	County	Site Label
191130033	Cedar Rapids, Coggon	Cedar Rapids	Linn	Cedar Rapids, Coggon
191530058	Des Moines, Phillips Sch.	Des Moines	Polk	Des Moines, Phillips Sch.
191630014	Scott County Park	Davenport	Scott	Scott County Park

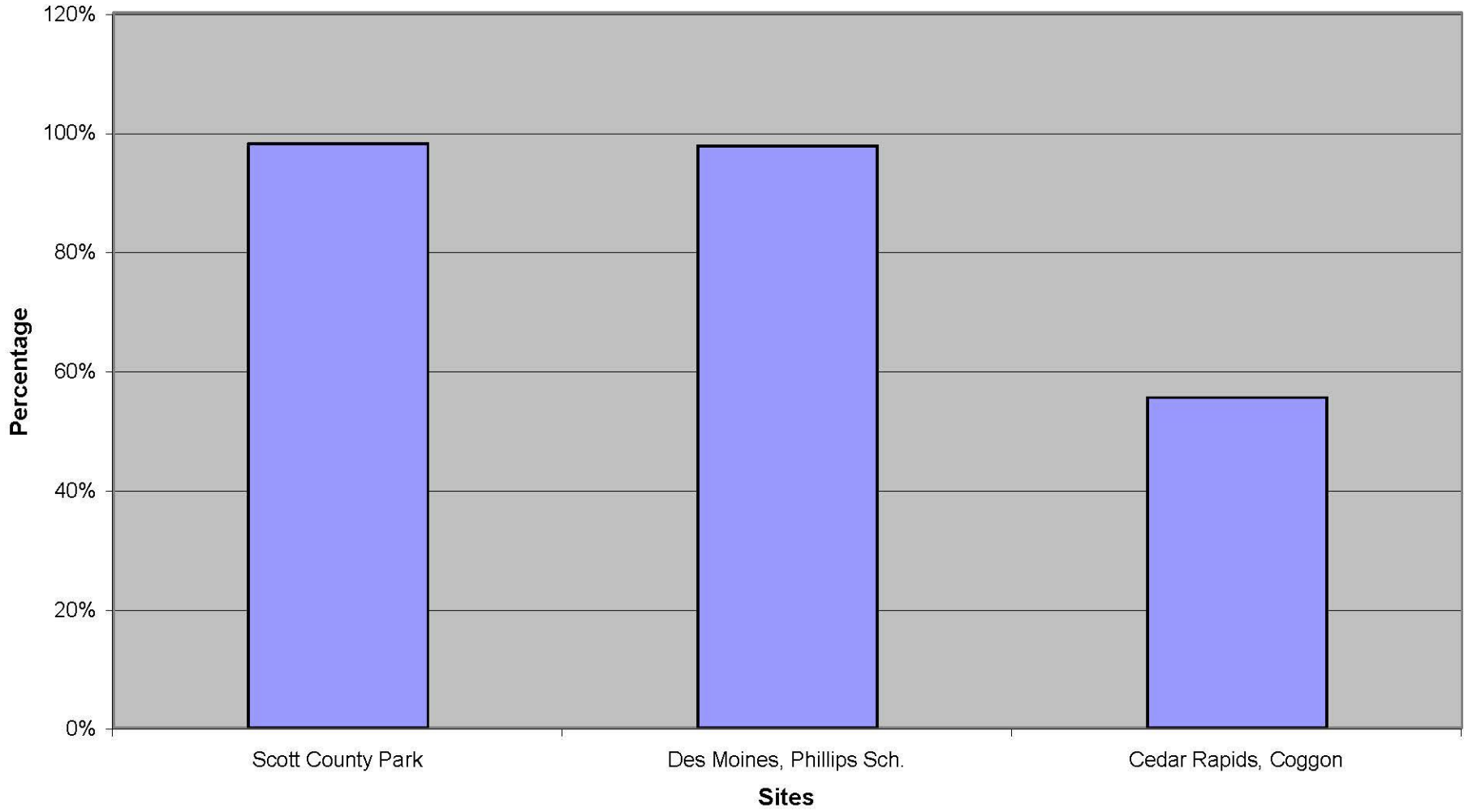
Nitrogen Dioxide Monitors



Comparison of 2003 Nitrogen Dioxide Data with National Ambient Air Quality Standards



Data Capture



Additional Chart Information

Listed below is additional information that may be useful in interpreting the charts contained in this review

Ozone

Comparison of 2003 Ozone Data with National Ambient Air Quality Standards

This graph shows the highest hourly ozone average (expressed as a percentage of the 0.125 ppm one-hour NAAQS) and highest eight-hour ozone average (expressed as a percentage of the 0.085 ppm eight-hour NAAQS) for each ozone monitor operated in 2003.

Data Capture

This graph shows the total number of hourly ozone values (expressed as a percentage of the total number of hours in the ozone season) for each ozone monitor operated in 2003. Ozone season runs from April through October; this amounts to 214 days or 5136 hours. An ozone monitor that recorded data for all 5136 hours of the ozone season would have a data capture rate of 100%.

PM2.5

Comparison of 2003 PM2.5 Data with National Ambient Air Quality Standards

This graph shows the highest 24-hour value (expressed as a percentage of the 65.5 $\mu\text{g}/\text{m}^3$ 24-hour NAAQS), and the annual average (expressed as a percentage of the 15.05 $\mu\text{g}/\text{m}^3$ annual NAAQS) for each PM2.5 monitor operated in 2003.

Data Capture

For each PM2.5 monitor operated in 2003, this graph shows the fraction of scheduled sampling days in 2003 where a PM2.5 sample was actually collected. During 2003, PM2.5 samplers in Iowa were scheduled to operate at a sampling frequency of either one sample every third day (121 scheduled samples) or one sample each day (365 scheduled samples). The sampling frequency of each monitor is indicated in the legend of the graph.

PM10

Comparison of 2003 PM10 Data with National Ambient Air Quality Standards

This graph shows the highest 24-hour value (expressed as a percentage of the 155 $\mu\text{g}/\text{m}^3$ 24-hour NAAQS), and the annual average (expressed as a percentage of the 50.0 $\mu\text{g}/\text{m}^3$ annual NAAQS) for each PM10 monitor operated in 2003.

Data Capture

For each PM10 monitor operated in 2003, this graph shows the fraction of scheduled sampling days in 2003 where a PM10 sample was actually collected. During 2003, PM10 samplers in Iowa were scheduled to operate at a frequency of one sample every sixth day (61 scheduled samples), one sample every third day (121 scheduled samples), one sample every other day (183 scheduled samples) or one sample each day (365 scheduled samples). The sampling frequency of each monitor is indicated in the legend of the graph.

Sulfur Dioxide

Comparison of 2003 Sulfur dioxide Data with National Ambient Air Quality Standards

This graph shows the highest 3-hour value (expressed as a percentage of the 0.55 ppm 3-hour NAAQS), the highest 24-hour value (expressed as a percentage of the 0.145 ppm 24-hour NAAQS), and the annual average (expressed as a percentage of the 0.0305 ppm annual NAAQS) for each sulfur dioxide monitor operated in 2003.

Data Capture

This graph shows total number of hourly sulfur dioxide values (expressed as a percentage of the total number of hours in 2003) for each sulfur dioxide monitor that operated in 2003. A sulfur dioxide monitor that recorded data for all 8760 hours during 2003 would have a data capture rate of 100%.

Carbon Monoxide

Comparison of 2003 Carbon Monoxide Data with National Ambient Air Quality Standards

This graph shows the highest 1-hour value (expressed as a percentage of the 35.5 ppm 1-hour NAAQS), the highest 8-

hour values (expressed as a percentage of the 9.5 ppm 8- hour NAAQS) for each carbon monoxide monitor operated in 2003.

Data Capture

This graph shows total number of hourly carbon monoxide values (expressed as a percentage of the total number of hours in 2003. A carbon monoxide monitor that recorded data for all 8760 hours during 2003 would have a data capture rate of 100%.

Nitrogen Dioxide

Comparison of 2003 Nitrogen Dioxide Data with National Ambient Air Quality Standards

This graph shows the annual average (expressed as a percentage of the 0.0535 ppm annual NAAQS) for each monitoring site that operated in 2003.

Data Capture

This graph shows total number of hourly nitrogen dioxide values, expressed as a percentage of the total number of hours in 2003. A nitrogen dioxide monitor that recorded data for all 8760 hours during 2003 would have a data capture rate of 100%.