TARMAC FLORIDA, INC.

P.O. Box 2998
Hialeah, Florida 33012

August 31, 1989

1989 SEP -5 AM 9:37

DER-MAIL ROOM

Mr. Clair Fancy, P.E.
Division of Air Resources Management
Fla. Department of Environmental Regulation
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

RE: **Application For Major Modification**
Pennsuco Cement & Supply
Permit No. AO13-157297

Dear Mr. Fancy:

Tarmac is pleased to submit an *Application To Operate/Construct Air Pollution Sources* for the modification of Kiln 2 to burn coal as primary fuel. Included as part of the submittal is a PSD application, BACT evaluation, and air quality analysis. Additionally, a check in the amount of $5000.00 is enclosed for the permit processing fee.

Tarmac looks forward to working with you and your staff on this project. Please do not hesitate to contact me or Scott Quaas of this office regarding any questions or further information you may need. The telephone number is (305)823-8800.

Sincerely,

Albert Townsend
Manager
Real Estate & Environmental

cc: K. Riveira
D. Bailey
S. Quaas
D. Buff - KBN Engineering
S. Brooks - FDER, SE Dist.
[illegible] [illegible]
[illegible]
[illegible]
[illegible]

PSD PERMIT APPLICATION
KILN 2 COAL CONVERSION
TARMAC FLORIDA, INC.
AUGUST 1989

$5000 pd.
9-5-89
Rcpt. 117657

STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL REGULATION

TWIN TOWERS OFFICE BUILDING
2600 BLAIR STONE ROAD
TALLAHASSEE, FLORIDA 32301

AC13-169901
PSD-FL-142

BOB GRAHAM
GOVERNOR

VICTORIA J. TSCHINKEL
SECRETARY

APPLICATION TO OPERATE/CONSTRUCT AIR POLLUTION SOURCES

SOURCE TYPE: Portland Cement Mfg. [ ] New[1] [X] Existing[1]

APPLICATION TYPE: [ ] Construction [ ] Operation [X] Modification

COMPANY NAME: TARMAC FLORIDA, INC. COUNTY: Dade

Identify the specific emission point source(s) addressed in this application (i.e. Lime Kiln No. 4 with Venturi Scrubber; Peaking Unit No. 2, Gas Fired) Kiln No. 2

SOURCE LOCATION: Street 11000 NW 121 Way City Medley

UTM: East 17 - 562.8 North 2861.7

Latitude 25 ° 52 ' 30 "N Longitude 80 ° 22 ' 30 "W

APPLICANT NAME AND TITLE: Scott Quaas -- Environmental Specialist

APPLICANT ADDRESS: P.O. Box 2998, Hialeah, Florida 33012

SECTION I: STATEMENTS BY APPLICANT AND ENGINEER

A. APPLICANT

I am the undersigned owner or authorized representative* of TARMAC FLORIDA, INC.

I certify that the statements made in this application for a construction/modification permit are true, correct and complete to the best of my knowledge and belief. Further, I agree to maintain and operate the pollution control source and pollution control facilities in such a manner as to comply with the provision of Chapter 403, Florida Statutes, and all the rules and regulations of the department and revisions thereof. I also understand that a permit, if granted by the department, will be non-transferable and I will promptly notify the department upon sale or legal transfer of the permitted establishment.

*Attach letter of authorization

Signed:

Scott Quaas - Environmental Specialist
Name and Title (Please Type)

Date: 8/31/89 Telephone No. (305)823-8800

B. PROFESSIONAL ENGINEER REGISTERED IN FLORIDA (where required by Chapter 471, F.S.)

This is to certify that the engineering features of this pollution control project have been ~~designed~~/examined by me and found to be in conformity with modern engineering principles applicable to the treatment and disposal of pollutants characterized in the permit application. There is reasonable assurance, in my professional judgment, that

[1] See Florida Administrative Code Rule 17-2.100(57) and (104)

the pollution control facilities, when properly maintained and operated, will discharge an effluent that complies with all applicable statutes of the State of Florida and the rules and regulations of the department. It is also agreed that the undersigned will furnish, if authorized by the owner, the applicant a set of instructions for the proper maintenance and operation of the pollution control facilities and, if applicable, pollution sources.

Signed David A. Buff

David A. Buff
Name (Please Type)

KBN Engineering & Applied Sciences, Inc.
Company Name (Please Type)

P.O. Box 14288, Gainesville, Florida 32604
Mailing Address (Please Type)

Florida Registration No. 19011 Date: 8/31/89 Telephone No. (904) ~~375-8000~~ 331-9000

SECTION II: GENERAL PROJECT INFORMATION

A. Describe the nature and extent of the project. Refer to pollution control equipment, and expected improvements in source performance as a result of installation. State whether the project will result in full compliance. Attach additional sheet if necessary.

Project is for the conversion of the kiln #2 system to coal and will include a 12,000 pound per hour minimum direct fired coal system. No additional control equipment will be required. Oil will remain for startup/backup fuel. Project will result in full compliance.

B. Schedule of project covered in this application (Construction Permit Application Only)

Start of Construction ASAP Completion of Construction 18 months

C. Costs of pollution control system(s): (Note: Show breakdown of estimated costs only for individual components/units of the project serving pollution control purposes. Information on actual costs shall be furnished with the application for operation permit.)

NA - no additional control systems

D. Indicate any previous DER permits, orders and notices associated with the emission point, including permit issuance and expiration dates.

A013-157297 Issued: 2 February 1989 Expires: 15 November 1993

PSD-FL-050 (1983) Kiln conversion for No. 3 Existing in 1971?

Kiln No. 2 - orig. constr. prior to 1977

Expanded 1974

Maule Industries ~ 1975

Lone Star Industries 1977/1978

- Pennsuco.

1977 to 1982 - shut down

Tarmac 1985

E. Requested permitted equipment operating time: hrs/day 24 ; days/wk 7 ; wks/yr 52 ;

if power plant, hrs/yr _____ ; if seasonal, describe: ____________________

F. If this is a new source or major modification, answer the following questions. (Yes or No)

1. Is this source in a non-attainment area for a particular pollutant? YES
   - a. If yes, has "offset" been applied? NO
   - b. If yes, has "Lowest Achievable Emission Rate" been applied? NO
   - c. If yes, list non-attainment pollutants. ozone
2. Does best available control technology (BACT) apply to this source? If yes, see Section VI. YES
3. Does the State "Prevention of Significant Deterioriation" (PSD) requirement apply to this source? If yes, see Sections VI and VII. YES
4. Do "Standards of Performance for New Stationary Sources" (NSPS) apply to this source? NO
5. Do "National Emission Standards for Hazardous Air Pollutants" (NESHAP) apply to this source? NO

H. Do "Reasonably Available Control Technology" (RACT) requirements apply to this source? NO

- a. If yes, for what pollutants? ____________________
- b. If yes, in addition to the information required in this form, any information requested in Rule 17-2.650 must be submitted.

Attach all supportive information related to any answer of "Yes". Attach any justification for any answer of "No" that might be considered questionable.

SECTION III: AIR POLLUTION SOURCES & CONTROL DEVICES (Other than Incinerators)

A. Raw Materials and Chemicals Used in your Process, if applicable:

Description	Contaminants		Utilization Rate - lbs/hr	Relate to Flow Diagram
	Type	% Wt		
limestone	particulates		71,280	1
ash & mineral aggregates	particulates		8,505	1
sand	particulates		1,215	1

B. Process Rate, if applicable: (See Section V, Item 1)

1. Total Process Input Rate (lbs/hr): 81,000

2. Product Weight (lbs/hr): 50,000

C. Airborne Contaminants Emitted: (Information in this table must be submitted for each emission point, use additional sheets as necessary)

Name of Contaminant	Emission[1]		Allowed[2] Emission Rate per Rule 17-2	Allowable[3] Emission lbs/hr	Potential[4] Emission		Relate to Flow Diagram
	Maximum lbs/hr	Actual T/yr			lbs/yr	T/yr	
particulates	31.30	137.10	$E=17.31P^{0.16}$	31.30			2
SO_2	400	1752	16.0 lb/t*	400			2
NO_x	169.25	741.30	6.77 lb/t*	169.25			2

[1] See Section V, Item 2.

[2] Reference applicable emission standards and units (e.g. Rule 17-2.600(5)(b)2. Table II, E. (1) - 0.1 pounds per million BTU heat input)

[3] Calculated from operating rate and applicable standard.

[4] Emission, if source operated without control (See Section V, Item 3).

* - lb/ton clinker produced

D. Control Devices: (See Section V, Item 4)

Name and Type (Model & Serial No.)	Contaminant	Efficiency	Range of Particles Size Collected (in microns) (If applicable)	Basis for Efficiency (Section V Item 5)
Koppers	particulates	±99.8%	5-100	mfg.
Electrostatic				
Precipitator				

E. Fuels

Type (Be Specific)	Consumption*		Maximum Heat Input (MMBTU/hr)
	avg/hr	max./hr	
coal	12,000	13,000	162.5
fuel oil (startup/backup)	1,160	1,170	162.5

*Units: Natural Gas--MMCF/hr; Fuel Oils--gallons/hr; Coal, wood, refuse, other--lbs/hr.

Fuel Analysis: coal

Percent Sulfur: ≤ 2 Percent Ash: 10

Density: NA lbs/gal Typical Percent Nitrogen: ± 1.5

Heat Capacity: 12,500 BTU/lb ______ BTU/gal

Other Fuel Contaminants (which may cause air pollution): ______

F. If applicable, indicate the percent of fuel used for space heating.

Annual Average ______ Maximum ______

G. Indicate liquid or solid wastes generated and method of disposal.

Precipitator dust is insufflated into system

Ash absorbed into clinker

H. Emission Stack Geometry and Flow Characteristics (Provide data for each stack):

Stack Height: 200 ft. Stack Diameter: 8 ft.

Gas Flow Rate: 90,000 ACFM 47,000 DSCFM Gas Exit Temperature: 300 °F.

Water Vapor Content: 23 - 27 % Velocity: 29.8 FPS

SECTION IV: INCINERATOR INFORMATION

Type of Waste	Type O (Plastics)	Type I (Rubbish)	Type II (Refuse)	Type III (Garbage)	Type IV (Pathological)	Type V (Liq.& Gas By-prod.)	Type VI (Solid By-prod.)
Actual lb/hr Incinerated							
Uncontrolled (lbs/hr)							

Description of Waste

Total Weight Incinerated (lbs/hr) Design Capacity (lbs/hr)

Approximate Number of Hours of Operation per day day/wk wks/yr.

Manufacturer

Date Constructed Model No.

	Volume $(ft)^3$	Heat Release (BTU/hr)	Fuel		Temperature (°F)
			Type	BTU/hr	
Primary Chamber					
Secondary Chamber					

Stack Height: ft. Stack Diamter: Stack Temp.

Gas Flow Rate: ACFM DSCFM* Velocity: FPS

*If 50 or more tons per day design capacity, submit the emissions rate in grains per standard cubic foot dry gas corrected to 50% excess air.

Type of pollution control device: [ ] Cyclone [ ] Wet Scrubber [ ] Afterburner

[ ] Other (specify)

Brief description of operating characteristics of control devices:

Ultimate disposal of any effluent other than that emitted from the stack (scrubber water, ash, etc.):

NOTE: Items 2, 3, 4, 6, 7, 8, and 10 in Section V must be included where applicable.

SECTION V: SUPPLEMENTAL REQUIREMENTS

Please provide the following supplements where required for this application.

1. Total process input rate and product weight -- show derivation [Rule 17-2.100(127)]

2. To a construction application, attach basis of emission estimate (e.g., design calculations, design drawings, pertinent manufacturer's test data, etc.) and attach propose methods (e.g., FR Part 60 Methods 1, 2, 3, 4, 5) to show proof of compliance with applicable standards. To an operation application, attach test results or methods use to show proof of compliance. Information provided when applying for an operation permit from a construction permit shall be indicative of the time at which the test wa made.

3. Attach basis of potential discharge (e.g., emission factor, that is, AP42 test).

4. With construction permit application, include design details for all air pollution control systems (e.g., for baghouse include cloth to air ratio; for scrubber include cross-section sketch, design pressure drop, etc.)

5. With construction permit application, attach derivation of control device(s) efficiency. Include test or design data. Items 2, 3 and 5 should be consistent: actual emissions = potential (1-efficiency).

6. An 8 1/2" x 11" flow diagram which will, without revealing trade secrets, identify the individual operations and/or processes. Indicate where raw materials enter, where solid and liquid waste exit, where gaseous emissions and/or airborne particles are evolved and where finished products are obtained.

7. An 8 1/2" x 11" plot plan showing the location of the establishment, and points of airborne emissions, in relation to the surrounding area, residences and other permanent structures and roadways (Example: Copy of relevant portion of USGS topographic map).

8. An 8 1/2" x 11" plot plan of facility showing the location of manufacturing processes and outlets for airborne emissions. Relate all flows to the flow diagram.

9. The appropriate application fee in accordance with Rule 17-4.05. The check should b made payable to the Department of Environmental Regulation.

10. With an application for operation permit, attach a Certificate of Completion of Construction indicating that the source was constructed as shown in the constructio permit.

SECTION VI: BEST AVAILABLE CONTROL TECHNOLOGY

A. Are standards of performance for new stationary sources pursuant to 40 C.F.R. Part 6 applicable to the source?

[ ] Yes [ ] No

Contaminant	Rate or Concentration

B. Has EPA declared the best available control technology for this class of sources (I yes, attach copy)

[ ] Yes [ ] No

Contaminant	Rate or Concentration

C. What emission levels do you propose as best available control technology?

Contaminant	Rate or Concentration

D. Describe the existing control and treatment technology (if any).

1. Control Device/System:
2. Operating Principles: ---
3. Efficiency:*
4. Capital Costs:

*Explain method of determining

5. Useful Life:

6. Operating Costs:

7. Energy:

8. Maintenance Cost:

9. Emissions:

Contaminant	Rate or Concentration

10. Stack Parameters

a. Height: ft.

b. Diameter: ft

c. Flow Rate: ACFM

d. Temperature: °F

e. Velocity: FPS

E. Describe the control and treatment technology available (As many types as applicabl use additional pages if necessary).

1.

a. Control Device:

b. Operating Principles:

c. Efficiency:[1]

d. Capital Cost:

e. Useful Life:

f. Operating Cost:

g. Energy:[2]

h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and opera within proposed levels:

2.

a. Control Device:

b. Operating Principles:

c. Efficiency:[1]

d. Capital Cost:

e. Useful Life:

f. Operating Cost:

g. Energy:[2]

h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

---

[1] Explain method of determining efficiency.

[2] Energy to be reported in units of electrical power - KWH design rate.

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operat
within proposed levels:

3.

a. Control Device: b. Operating Principles:

c. Efficiency:[1] d. Capital Cost:

e. Useful Life: f. Operating Cost:

g. Energy:[2] h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operat
within proposed levels:

4.

a. Control Device: b. Operating Principles:

c. Efficiency:[1] d. Capital Costs:

e. Useful Life: f. Operating Cost:

g. Energy:[2] h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operat
within proposed levels:

F. Describe the control technology selected:

1. Control Device: 2. Efficiency:[1]

3. Capital Cost: 4. Useful Life:

5. Operating Cost: 6. Energy:[2]

7. Maintenance Cost: 8. Manufacturer:

9. Other locations where employed on similar processes:

a. (1) Company:

(2) Mailing Address:

(3) City: (4) State:

[1] Explain method of determining efficiency.
[2] Energy to be reported in units of electrical power - KWH design rate.

(5) Environmental Manager:

(6) Telephone No.:

(7) Emissions:[1]

Contaminant	Rate or Concentration

(8) Process Rate:[1]

b. (1) Company:

(2) Mailing Address:

(3) City: (4) State:

(5) Environmental Manager:

(6) Telephone No.:

(7) Emissions:[1]

Contaminant	Rate or Concentration

(8) Process Rate:[1]

10. Reason for selection and description of systems:

[1] Applicant must provide this information when available. Should this information not b available, applicant must state the reason(s) why.

SECTION VII - PREVENTION OF SIGNIFICANT DETERIORATION

A. Company Monitored Data

1. ____________ no. sites ____________ TSP ____________ ( ) SO^2* ____________ Wind spd/dir

Period of Monitoring ______ / ______ / ______ to ______ / ______ / ______
month day year month day year

Other data recorded ____

Attach all data or statistical summaries to this application.

*Specify bubbler (B) or continuous (C).

2. Instrumentation, Field and Laboratory

a. Was instrumentation EPA referenced or its equivalent? ☐ Yes ☐ No

b. Was instrumentation calibrated in accordance with Department procedures?

☐ Yes ☐ No ☐ Unknown

B. Meteorological Data Used for Air Quality Modeling

1. _____ Year(s) of data from ____/____/____ to ____/____/____
month day year month day year

2. Surface data obtained from (location) ______________________________

3. Upper air (mixing height) data obtained from (location) ______________________________

4. Stability wind rose (STAR) data obtained from (location) ______________________________

C. Computer Models Used

1. ______________________________ Modified? If yes, attach description.

2. ______________________________ Modified? If yes, attach description.

3. ______________________________ Modified? If yes, attach description.

4. ______________________________ Modified? If yes, attach description.

Attach copies of all final model runs showing input data, receptor locations, and principle output tables.

D. Applicants Maximum Allowable Emission Data

Pollutant	Emission Rate	
TSP	______________________________	grams/sec
SO^2	______________________________	grams/sec

E. Emission Data Used in Modeling

Attach list of emission sources. Emission data required is source name, description o point source (on NEDS point number), UTM coordinates, stack data, allowable emissions, and normal operating time.

F. Attach all other information supportive to the PSD review.

G. Discuss the social and economic impact of the selected technology versus other applicable technologies (i.e., jobs, payroll, production, taxes, energy, etc.). include assessment of the environmental impact of the sources.

H. Attach scientific, engineering, and technical material, reports, publications, journals, and other competent relevant information describing the theory and application o the requested best available control technology.

TABLE OF CONTENTS

TABLE OF CONTENTS
Continued

APPENDIX A REFERENCE MATERIALS

APPENDIX B FUGITIVE DUST EMISSION ESTIMATES

1.0 INTRODUCTION

Tarmac Florida, Inc. leases and operates a Portland cement manufacturing plant in northwest Dade County, just east of the Turnpike Extension and south of U.S. 27 (Figure 1-1). Currently, the Tarmac facility consists of three cement kilns which have valid air operating permits issued by the Florida Department of Environmental Regulation (FDER) and Dade County Environmental Resources Management (DERM). Kilns 1 and 2 are permitted to burn natural gas or No. 6 fuel oil, and each have a production capacity of 25.0 tons per hour (TPH) of clinker. Kiln 3 is a larger kiln which is permitted to burn coal, natural gas, or No. 6 fuel oil and has a capacity of 87.5 TPH clinker.

In keeping with Tarmac's longstanding policy of promoting energy efficiency and utilizing domestic fuel sources, Tarmac is now proposing to convert Kiln 2 to coal. Tarmac applied for and received a federal Prevention of Significant Deterioration (PSD) permit to convert Kilns 1, 2, and 3 to coal in 1984. However, this PSD permit was issued 4 years ago and may no longer be considered valid for conversion of Kiln 2 to coal, since this conversion was not accomplished within a reasonable time period after issuance of the permit. Furthermore, this PSD permit limited sulfur dioxide (SO_2) emissions from Kiln 2 to 125 pounds per hour (lb/hr). Based on extensive experience in burning coal in Kiln 3, this emission level is not appropriate. As a result, Tarmac is currently requesting an SO_2 emission limit of 400 lb/hr on Kiln 2 after coal conversion.

The coal conversion will increase actual emissions of certain regulated air pollutants over current emissions from Kiln 2. The U.S. Environmental Protection Agency (USEPA) and FDER have implemented regulations which require a PSD review for new or modified sources which increase air emissions above certain threshold amounts. Because the threshold amounts will be exceeded by the proposed project, the project is subject to PSD review. PSD regulations are promulgated under 40 Code of Federal Regulations (CFR) Part 52.21 and implemented through Florida's

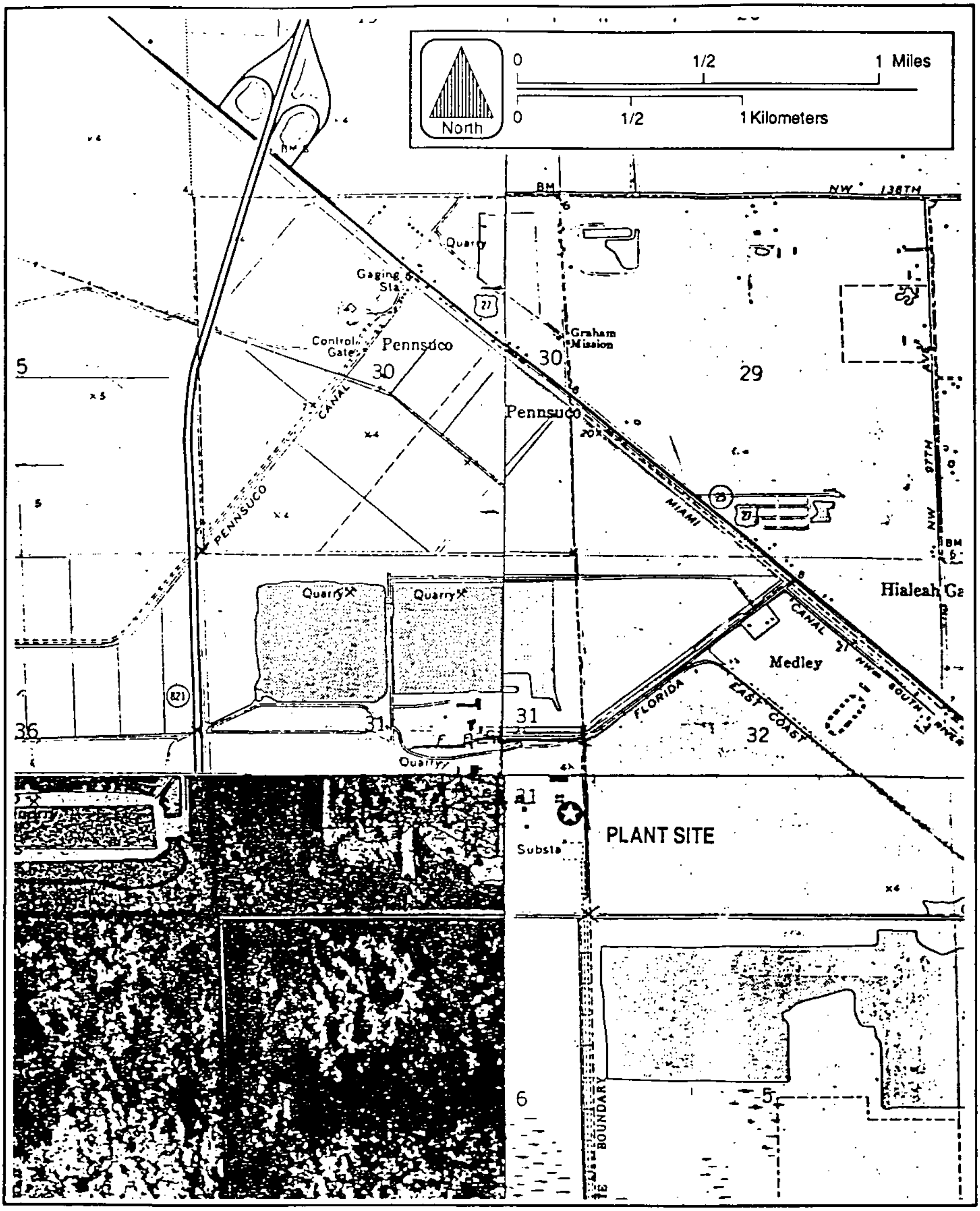

Figure 1-1 LOCATION OF TARMAC FLORIDA FACILITY

State Implementation Plan. FDER's PSD regulations are codified in Chapter 17-2.5~~1~~80, Florida Administrative Code (F.A.C.).

The technical information and analysis required by the federal and state PSD regulations are contained in this PSD application. The application is divided into eight major sections. Presented in Section 2.0 is a description of the facility, including air emissions and stack parameters. PSD review requirements and applicability are presented in Section 3.0. The control technology review, including the Best Available Control Technology (BACT) evaluation, is presented in Section 4.0. Air quality monitoring information is presented in Section 5.0, and the methodology and results of the impact analyses performed for the project are presented in Sections 6.0, 7.0, and 8.0.

2.0 PROJECT DESCRIPTION

2.1 PROCESS DESCRIPTION AND EMISSIONS

Tarmac is proposing to convert the existing Kiln 2 to burn coal. The kiln is currently permitted to burn natural gas and No. 6 fuel oil under FDER operating permit A013-157297. Kiln 2 has been inactive since 1982 due to low demand for cement, but work is underway for startup of the kiln on gas/oil (under the existing permit) for 1/1/90.

A flow diagram of the kiln system after coal conversion is presented in Figure 2-1. The modifications to the kiln will consist of the addition of direct-fired coal burner and the replacement of the chain system to provide better energy efficiency within the kiln. Provisions will also be made to convey raw coal from storage to a new coal mill and then to the kiln. The existing kiln feed system, clinker cooler, clinker cooler electrostatic precipitator (ESP), waste dust storage, dust insufflation system, and kiln ESP will be utilized.

The current production capacity of the kiln of 25 TPH clinker will not increase as a result of this coal conversion. Coal for Kiln 2 will be received, stored, and conveyed through the existing coal handling system for Kiln 3. This system consists of an elevated trestle for unloading bottom dump railcars, a temporary coal storage pile, an active coal storage pile, and a loading hopper for transfer to a screen and coal storage bin. Kiln 2 will have a separate coal mill, which will receive screened coal from the existing coal bin, grind it, and fire it directly into the kiln. Hot air from the existing clinker cooler will be used in the coal mill to dry the coal and pneumatically convey it to the kiln. This direct air-fired system will not have an air emission point, since the coal and air are injected directly into the kiln. Two new conveyor transfer points will be located between the coal storage bin and the new coal mill, but these will be totally enclosed. Therefore, no emissions will result from the new transfer points.

[1] Kiln Feed
[2] Kiln Stack
[3] Kiln Precipitator
[4] Kiln
[5] Waste Dust Storage
[6] Insufflated Dust
[7] Clinker Cooler
[8] Clinker
[9] Cooler Precipitator
[10] Cooler Stack
[11] Coal Storage
[12] Coal Mill

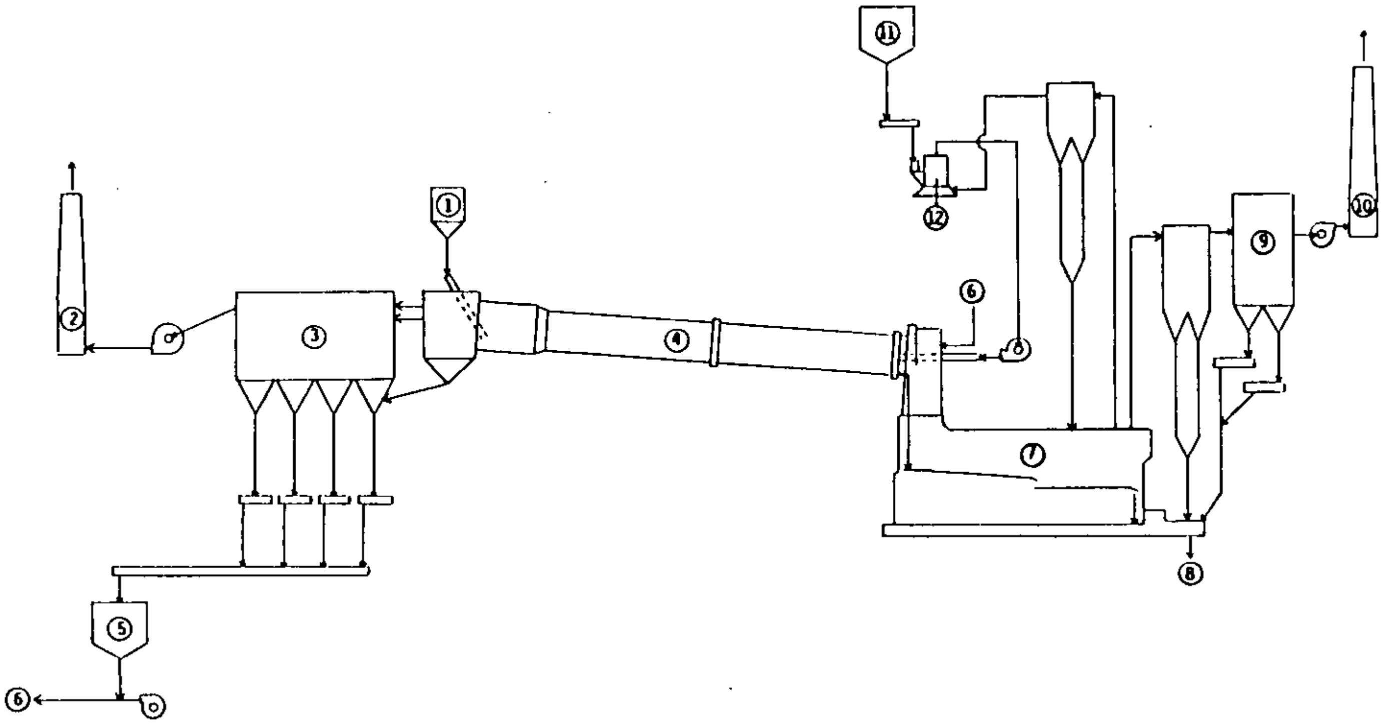

Figure 2-1 FLOW DIAGRAM FOR KILN 2

Current maximum emissions of regulated pollutants from Kiln 2 (based on gas and oil firing) are presented in Table 2-1. Maximum particulate matter-total suspended particulate [PM(TSP)] emissions are based upon the current allowable for the kiln of 31.3 lb/hr (process weight table allowable). PM(TSP) emissions from Kiln 2 have been measured as high as 26.3 lb/hr (March 1982 stack test). Therefore, it is reasonable to assume that the allowable emissions from the kiln represent actual emissions. Emissions of particulate matter with aerodynamic particle size diameter of 10 micrometers (um) or less (PM10) are based upon AP-42 data which indicate that 85 percent of PM(TSP) emissions from Portland cement kilns with ESPs are emitted as PM10 (see Appendix A).

Current SO_2 emissions from Kiln 2 are based upon gas/oil burning. SO_2 emissions tests were conducted on Kilns 1 and 2 when burning fuel oil, and the data were presented in the 1980 application to convert Kiln 2 to coal. SO_2 emissions were stated to be 45.3 lb/hr (refer to Appendix A for supportive information). This emission rate is actually much lower than emissions calculated based upon AP-42 factors for cement kilns.

Current NO_x emissions from Kiln 2 are based upon gas/oil burning. Due to the inactive status of Kiln 2, recent source test data are not available. However, a series of NO_x tests was conducted on the kiln in 1980 while burning both gas and oil (refer to Appendix A). The average of 12 tests burning gas was 4.73 lb/ton clinker, and the average of 12 tests burning oil was 6.71 lb/ton clinker. Based upon these test data, the current NO_x emissions from Kiln 2 are 6.71 lb/ton.

Specific source test data or emission factors are not available concerning carbon monoxide (CO) emissions from cement kilns. However, CO levels in the kiln must be maintained below 0.1 percent in order to eliminate explosion potential in the ESP. CO emissions can therefore be estimated from this CO level and the air flow rate through the kiln. The air flow rate for Kiln 2 when firing oil was approximately 127,000 actual cubic feet per minute (acfm). This equates to 346 lb/hr of CO emissions.

NET EMISSION INCREASE = NEW ALLOWABLE − LOWER OF OLD ACTUAL OR OLD ALLOWABLE

Table 2-1. Baseline and Future Maximum Emissions For Kiln 2 at Tarmac

Pollutant	Baseline Date	Baseline (Gas/Oil) Basis	lb/hr actual	Baseline (Gas/Oil) lb/hr	Revised 11/8 TPY	Future (Coal) Basis	lb/hr	Future (Coal) lb/hr	Revised 11/8/89 TPY	Net Increase (lb/hr)	lb/hr	TPY
Particulate Matter (TSP)	1980	Process weight table allowable	2.4	31.3	10.5	Process weight table allowable	2.9	31.3	12.6	0.0	.9	3.8
Coal Handling (TSP)							.4 3.3		1.7 14.3			
Particulate Matter (PM10)	1980	AP-42: 85% of PM(TSP) emissions	13.6 16.0	26.6	59.6 70.1	AP-42: 85% of PM(TSP) emissions	16.4	26.6	71.9	0.0		
Coal Handling (PM10)							1.6 17.0 20.3		2.6 74.5 88.8		3.4 4.3	14.9 18.7
Sulfur Dioxide		Gas/oil-firing test data	~~45.3~~ 9.5		41.6	Coal firing-16.0 lb/ton clinker use DEM Standard 1.5 lb/10⁶ BTU input		~~400.0~~ 243.8	1752	~~354.7~~	234.3	1,026.2
Nitrogen Oxides		Gas/oil-firing 6.71 lb/ton clinker		167.8		Coal firing-6.77 lb/ton clinker		169.3		1.5		
Carbon Monoxide		0.1% concentration		346.0		No increase over current (<0.1%)		346.0		0.0		
Volatile Organic Compounds		Source testing on Kiln 3		23.1		Coal firing 1.2 lb/ton clinker		30.0		6.9		
Lead		AP-42: 0.10 lb/ton clinker		2.5		AP-42: 0.10 lb/ton clinker		2.5		0.0		
Sulfuric Acid Mist		3% of SO_2 emissions		1.7		3% of SO_2 emissions		12.0		10.3		
Beryllium		0.002 lb/ton clinker		0.05		0.002 lb/ton clinker		0.05		0.0		
Other Regulated Pollutants		No data		--		No data		--		--		

Little information is available regarding emissions of volatile organic compounds (VOCs) from Portland cement kilns. However, Tarmac has recently conducted VOC testing on Kiln 3 as part of testing to burn contaminated soils (July 5, 1988, testing-- refer to Appendix A). The testing showed that the majority of VOC emissions are due to organics in the raw feed. Based upon the coal feed rate during the testing and using AP-42 emission factors for coal combustion in boilers, the contribution of coal burning to the total VOC emissions can be estimated. The emissions due to coal burning can then be subtracted from the total VOC emissions to obtain the VOC emissions due to the raw feed. The resulting VOC emission rate is 0.87 lb/ton clinker (refer to Appendix A). To obtain baseline VOC emissions due to gas/oil burning, the VOC emissions due to the raw feed must be added to VOC emissions due to fuel burning. Burning No. 6 fuel oil results in VOC emissions of 1.3 lb/hr, and total VOC emissions due to the raw feed and fuel oil burning are 23.1 lb/hr.

Baseline emissions of lead (Pb) are based upon the AP-42 factor for cement kilns of 0.10 lb/ton clinker (refer to Appendix A) and the kiln capacity of 25.0 TPH. Emission factors for sulfuric acid mist are not available. Review of the literature concerning oil and coal combustion sources indicates that approximately 3 percent of the SO_2 emissions is sulfuric acid mist. This estimate was used to calculate baseline emissions from Kiln 2.

Baseline emissions of beryllium were based upon USEPA's recent publication entitled Toxic Air Pollutant Emission Factors (USEPA, 1988a). The factor is 0.002 lb/ton clinker. Data are not available concerning the emissions of other regulated pollutants from Portland cement kilns.

Future maximum emissions of regulated pollutants from Kiln 2, after coal conversion, are also shown in Table 2-1. Future PM(TSP) and PM10 emissions will not change as a result of the conversion to coal. The existing ESP is capable of accommodating the small additional dust generated due to the ash in the coal, a majority of which will remain in the clinker and become part of the product.

Future maximum SO_2 emissions will be 400 lb/hr (16.0 lb/ton clinker produced) from Kiln 2 when burning coal with 2.0 percent sulfur content or less. This level of SO_2 emissions is for coal burning and is based upon experience with coal burning in Kiln 3. After considerable difficulty in meeting original SO_2/NO_x emission limits on Kiln 3, the SO_2 emission limit for Kiln 3 was revised to 4.6 lb/ton clinker. This limit can be met simultaneously with NO_x limits by utilizing strict control over process conditions within the kiln (combustion temperature, excess air, and dust insufflation rate). Tarmac is requesting a higher SO_2 limit for Kiln 2 because of the uncertainties associated with operation of this smaller kiln and in achieving simultaneous NO_x control. After source testing is conducted on Kiln 2 for coal burning, test data will be evaluated. Tarmac will be willing to consider a lower SO_2 emission limit at that time if the data support a reduced level.

Use reverse. Set lower limit; amend if test data show higher limit necessary.

Future maximum NO_x emissions when burning coal in Kiln 2 are 6.77 lb/ton clinker, or 169.3 lb/hr. This limit is based upon the current limit on Kiln 3 of 6.77 lb/ton clinker.

Future CO emissions from Kiln 2 when burning coal should not increase over current emissions when burning gas and oil. This is because process conditions within the kiln and ESP demand that CO be held to below 0.1 percent. CO is minimized in the kiln in order to maximize combustion efficiency and promote energy efficiency. Air flow through the Kiln 2 after conversion to coal will decrease compared to previous gas/oil firing, because of the better energy efficiency of the kiln burner and chain system. Based on these considerations, future CO emissions when burning coal are equal to baseline emission levels.

Future maximum VOC emissions from Kiln 2 burning coal are based upon the VOC emissions due to the raw feed, estimated from Kiln 3 data (refer to previous discussion) plus the VOC emissions due to coal burning. Based on the AP-42 factor of 0.10 lb/ton coal and the maximum coal feed rate to Kiln 2 of 6.50 TPH, VOC emissions due to coal burning are 0.7 lb/hr. VOC emissions due to the raw feed are 0.87 lb/ton clinker, or 21.8 lb/hr. Total future VOC emissions are therefore 22.5 lb/hr. Due to the limited database and potential variability in the organic content of the raw feed, Tarmac is requesting a higher future limit of 30.0 lb/hr.

Future maximum emissions of other regulated pollutants were estimated in the same fashion as existing baseline emissions, i.e., by using published emission factors (refer to Appendix A). The emission factors and resulting emissions are presented in Table 2-1.

As described previously, coal for Kiln 2 will be received, stored, and transported using the existing coal handling facilities, with the addition of two new conveyor transfer points and a coal mill. Additional throughput of coal for Kiln 2 will be a maximum of 56,940 TPY. The particulate matter emission sources, emission factors, and resulting emissions are presented in Appendix B. The estimated increase in annual PM(TSP) and PM10 emissions due to operation of Kiln 2 on coal is 12.0 TPY and 5.4 TPY, respectively.

2.2 STACK PARAMETERS

Stack parameters for Kiln 2 after conversion to coal, as well as stack parameters for the other two kilns, are presented in Table 2-2. Also presented are the maximum SO_2 emission rates associated with each kiln. It is noted that Kiln 1 will burn gas as the primary fuel in the future, with oil as backup. There are no plans to convert Kiln 1 to coal. Maximum SO_2 emissions from Kiln 1 are based upon oil firing.

A plot plan of the Tarmac facility is presented in Figure 2-2, with the kiln stacks indicated. The most significant structures at the facility are the finish mill building, the Kiln burner building, the Kiln 1/2 ESP and the Kiln 3/4 ESP.

Table 2-2. TARMAC - K2 Coal Conversion - Stack Parameters and SO_2 Emisssions

Source	Process Rate (TPH Clinker)	SO_2 Emission Rate (lb/hr)	Stack Height		Stack Diameter		Stack Temp.		Stack Velocity		Flow Rate (acfm)
			ft	m	ft	m	°F	°K	ft/min	m/s	
K1 - gas/oil	25.0	4.5/45.3	200	61	8.0	2.44	378	465	2527	12.84	127,000
K2 - coal	25.0	400.0	200	61	8.0	2.44	300	422	1790	9.10	90,000
K3 - coal	87.5	400.0	200	61	15.0	4.57	350	450	2172	11.04	384,000

Source: Tarmac, 1987

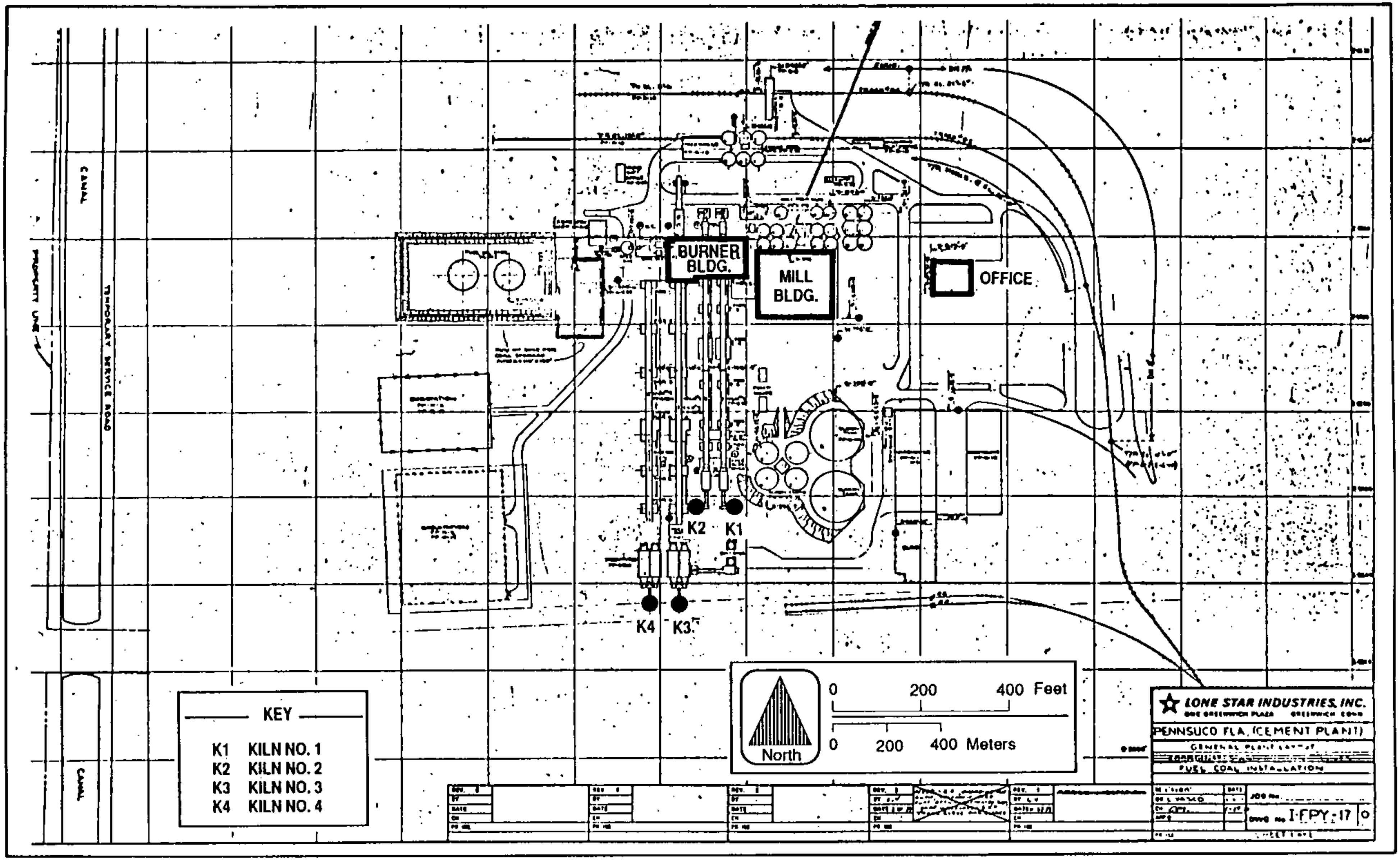

Figure 2-2 PLOT PLAN OF TARMAC FACILITY

The dimensions of these buildings are as follows:

Building	Height	Width	Area of Influence
Finish Mill Building:	106 ft.	260 ft.	530 ft.
Kiln Burner Building:	84 ft.	200 ft.	420 ft.
K1/K2 ESP:	70 ft.	60 ft.	300 ft.
K3/K4 ESP:	90 ft.	130 ft.	450 ft.

The K2 stack is approximately 500 feet from the Finish Mill Building. The K2 stack is just on the edge of the area of influence of the building, and would be affected for only a few specific wind directions when the K2 stack is downwind of the building. The GEP stack height based on this building is 265 feet compared to the K2 stack height of 200 feet.

The K2 stack is outside the area of influence of the burner buildings, and the K2 stack height is more than 2.5 times the width (lesser dimension) of the K1/K2 ESP, and therefore these structures will not cause downwash. The K2 stack is within the area of influence of the K3/K4 ESPs for a few specific wind directions. However, the K3/K4 ESPs are not a solid structure, being open at the bottom. The GEP height of this structure is 225 feet, only slightly greater than the K2 stack height of 200 feet. Based upon these considerations, the downwash potential due to the K3/K4 ESP structures will be minimal.

3.0 AIR QUALITY REVIEW REQUIREMENTS AND APPLICABILITY

The following discussion pertains to the federal and state air regulatory requirements and their applicability to the Tarmac Kiln 2 coal conversion. These regulations must be satisfied before the proposed project can be constructed and operated.

3.1 NATIONAL AND STATE AAQS

The existing applicable National and Florida ambient air quality standards (AAQS) are presented in Table 3-1. Primary National AAQS were promulgated to protect the public health, and secondary National AAQS were promulgated to protect the public welfare from any known or anticipated adverse effects associated with the presence of pollutants in the ambient air. Areas of the country in violation of AAQS are designated as nonattainment areas, and new sources to be located in or near these areas may be subject to more stringent air permitting requirements.

3.2 PSD REQUIREMENTS

3.2.1 General Requirements

Under federal PSD review requirements, all major new or modified sources of air pollutants regulated under the Clean Air Act (CAA) must be reviewed and approved by the USEPA. For sources located in Florida, PSD review and approval has been delegated to FDER.

A "major stationary source" is defined as any one of 28 named source categories which has the potential to emit 100 tons per year (TPY) or more, or any other stationary source which has the potential to emit 250 TPY or more of any pollutant regulated under CAA. "Potential to emit" means the capability, at maximum design capacity, to emit a pollutant after the application of control equipment.

A "major modification" is defined under PSD regulations as a change at an existing major stationary source which increases emissions by greater

Table 3-1. National and State AAQS, Allowable PSD Increments, and Significance Levels (ug/m^3)

Pollutant	Averaging Time	AAQS National Primary Standard	AAQS National Secondary Standard	AAQS State of Florida	PSD Increments Class I	PSD Increments Class II	Significant Impact Levels
Particulate Matter (TSP)	Annual Geometric Mean	NA	NA	NA	5	19	1
	24-Hour Maximum^{+}	NA	NA	NA	10	37	5
Particulate Matter (PM10)	Annual Arithmetic Mean	50	50	50	NA	NA	1
	24-Hour Maximum*	150	150	150	NA	NA	5
Sulfur Dioxide	Annual Arithmetic Mean	80	NA	60	2	20	1
	24-Hour Maximum^{+}	365	NA	260	5	91	5
	3-Hour Maximum^{+}	NA	1,300	1,300	25	512	25
Carbon Monoxide	8-Hour Maximum^{+}	10,000	10,000	10,000	NA	NA	500
	1-Hour Maximum^{+}	40,000	40,000	40,000	NA	NA	2,000
Nitrogen Dioxide	Annual Arithmetic Mean	100	100	100	2.5**	25**	1
Ozone	1-Hour Maximum^{++}	235	235	235	NA	NA	NA
Lead	Calendar Quarter Arithmetic Mean	1.5	1.5	15	NA	NA	NA

$^{+}$ Maximum concentration not to be exceeded more than once per year.

* Achieved when the expected number of exceedances per year is less than 1.

** The State of Florida has not yet adopted the PSD increments for NO_2 concentrations.

$^{++}$ Achieved when the expected number of days per year with concentrations above the standard is less than 1.

NA = Not applicable, i.e., no standard exists.

Note: Particulate matter (TSP) refers to total suspended particulate matter.
Particulate mater (PM10) refers to particulate matter with aerodynamic diameter less than or equal to 10 micrometers (μm).

Sources: Federal Register, Vol. 43, No. 118, June 19, 1978.
40 CFR 50
40 CFR 52.21

than "significant" amounts. PSD significant emission rates are shown in Table 3-2.

PSD review is used to determine whether significant air quality deterioration will result from the new or modified source. PSD requirements are contained in 40 CFR 52.21, Prevention of Significant Deterioration of Air Quality. Major sources and modifications are required to undergo the following analysis related to PSD for each pollutant emitted in "significant" amounts:

1. Control technology review,
2. Source impact analysis,
3. Air quality analysis (monitoring),
4. Additional impact analyses.

In addition to these analyses, a new source must also be reviewed with respect to Good Engineering Practice (GEP) stack height regulations. Discussions concerning each of these requirements are presented in the following sections.

3.2.2 Increments/Classifications

In promulgating the 1977 CAA Amendments, Congress specified that certain increases above an air quality "baseline concentration" level of SO_2 and PM(TSP) concentrations would constitute "significant deterioration." The magnitude of the allowable increment depends on the classification of the area in which a new source (or modification) will be located or have an impact. Three classifications were designated based on criteria established in the CAA Amendments. Initially, Congress promulgated areas as Class I (international parks, national wilderness areas, and memorial parks larger than 5,000 acres, and national parks larger than 6,000 acres) or as Class II (all areas not designated as Class I). No Class III areas, which would be allowed greater deterioration than Class II areas, were designated. USEPA then promulgated as regulations the requirements for classifications and area designations.

Table 3-2. PSD Significant Emission Rates and De Minimis Monitoring Concentrations

Pollutant	Regulated Under	Significant Emission Rate (TPY)	De Minimis Monitoring Concentration ($\mu g/m^3$)
Sulfur Dioxide	NAAQS, NSPS	40	13, 24-hour
Particulate Matter (TSP)	NAAQS, NSPS	25	10, 24-hour
Particulate Matter (PM10)	NAAQS	15	10, 24-hour
Nitrogen Oxides	NAAQS, NSPS	40	14, Annual
Carbon Monoxide	NAAQS, NSPS	100	575, 8-hour
Volatile Organic Compounds (Ozone)	NAAQS, NSPS	40	100 TPY+
Lead	NAAQS	0.6	0.1, 3-month
Sulfuric Acid Mist	NSPS	7	*
Total Fluorides	NSPS	3	0.25, 24-hour
Total Reduced Sulfur	NSPS	10	10, 1-hour
Reduced Sulfur Compounds	NSPS	10	10, 1-hour
Hydrogen Sulfide	NSPS	10	0.2, 1-hour
Asbestos	NESHAP	0.007	*
Beryllium	NESHAP	0.0004	0.001, 24-hour
Mercury	NESHAP	0.1	0.25, 24-hour
Vinyl Chloride	NESHAP	1	15, 24-hour
Benzene	NESHAP	0	*
Radionuclides	NESHAP	0	*
Inorganic Arsenic	NESHAP	0	*

*No ambient measurement method.
+Increases in VOC emissions.

Notes: Ambient monitoring requirements for subject pollutants may be exempted if the impact of the increase in emissions is below air quality impact de minimis levels.
NAAQS = National Ambient Air Quality Standards.
NSPS = New Source Performance Standards.
NESHAP = National Emission Standards for Hazardous Air Pollutants.

Sources: 40 CFR 52.21.
Chapter 17-2, F.A.C.

On October 17, 1988, the USEPA promulgated regulations to prevent significant deterioration due to NO_x emissions and established PSD increments for NO_2 concentrations. The USEPA class designations and allowable PSD increments are presented in Table 3-1. The Florida DER has adopted the USEPA class designations and allowable PSD increments for SO_2 and PM(TSP), but has not yet adopted the NO_2 increments.

The term "baseline concentration" evolves from federal and state PSD regulations and denotes a fictitious concentration level corresponding to a specified baseline date and certain additional baseline sources. By definition in the PSD regulations, as amended August 7, 1980, baseline concentration means the ambient concentration level which exists in the baseline area at the time of the applicable baseline date. A baseline concentration is determined for each pollutant for which a baseline date is established and includes:

1. The actual emissions representative of sources in existence on the applicable baseline date; and
2. The allowable emissions of major stationary sources which commenced construction before January 6, 1975, for SO_2 and PM(TSP) sources, or February 8, 1988, for NO_2 sources, but which were not in operation by the applicable baseline date.

The following emissions are not included in the baseline concentration and therefore affect PSD increment consumption:

1. Actual emissions from any major stationary source on which construction commenced after January 6, 1975, for SO_2 and PM(TSP) sources, and after February 8, 1988, for NO_2 sources; and
2. Actual emission increases and decreases at any stationary source occurring after the baseline date.

The term "baseline date" actually includes three different dates:

1. The major source baseline date, which is January 6, 1975, in the cases of SO_2 and PM(TSP), and February 8, 1988, in the case of NO_2.
2. The minor source baseline date, which is the earliest date after the "trigger date" on which a major stationary source or major modification subject to PSD regulations submits a complete PSD application.
3. The "trigger date", which is August 7, 1977, for SO_2 and PM(TSP), and February 8, 1988, for NO_2.

3.2.3 Control Technology Review

The control technology review requirements of the federal PSD regulations require that all applicable federal and state emission limiting standards be met and that Best Available Control Technology (BACT) be applied to control emissions from the source (40 CFR 52.21). The BACT requirements are applicable to all regulated pollutants for which the increase in emissions from the source or modification exceeds the significant emission rate (see Table 3-2).

BACT is defined in 40 CFR 52.21 as:

> An emissions limitation (including a visible emission standard) based on the maximum degree of reduction for each pollutant subject to regulation under the Act...which the Administrator, on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable ... through application of production processes or available methods, systems, and techniques, including fuel cleaning or treatment or innovative fuel combustion techniques for control of such pollutant.... If the Administrator determines that technological or economic limitations on the application of measurement methodology to a particular emissions unit would make the imposition of an emissions standard infeasible, a design, equipment, work practice, operational standard, or combination thereof, may be prescribed instead to satisfy the requirement for the application of best available control technology.

The requirements for BACT were promulgated within the framework of PSD in the 1977 amendments of the CAA [Public Law 95-95; Part C, Section 165(a)(4)]. The primary purpose of BACT is to optimize consumption of PSD air quality increments and thereby enlarge the potential for future economic growth without significantly degrading air quality (USEPA, 1978; 1980). Guidelines for the evaluation of BACT can be found in USEPA's "Guidelines for Determining Best Available Control Technology (BACT)," (USEPA, 1978) and in the "PSD Workshop Manual" (USEPA, 1980). These guidelines were promulgated by USEPA to provide a consistent approach to BACT and to ensure that the impacts of alternative emission control systems are measured by the same set of parameters. In addition, through implementation of these guidelines, BACT in one area may not be identical to BACT in another area. According to USEPA (1980), "BACT analyses for the same types of emissions unit and the same pollutants in different locations or situations may determine that different control strategies should be applied to the different sites, depending on site-specific factors. Therefore, BACT analyses must be conducted on a case-by-case basis."

The BACT requirements are intended to ensure that the control systems incorporated in the design of a proposed facility reflect the latest in control technologies used in a particular industry and take into consideration existing and future air quality in the vicinity of the proposed facility. BACT must, as a minimum, demonstrate compliance with NSPS for a source (if applicable). An evaluation of the air pollution control techniques and systems, including a cost-benefit analysis of alternative control technologies capable of achieving a higher degree of emission reduction than the proposed control technology, is required. The cost-benefit analysis requires the documentation of the materials, energy, and economic penalties associated with the proposed and alternative control systems, as well as the environmental benefits derived from these systems. A decision on BACT is to be based on sound judgement, balancing environmental benefits with energy, economic, and other impacts (USEPA, 1978).

Historically, a "bottom-up" approach consistent with the BACT Guidelines and Workshop Manual has been used. With this approach, an initial control level, which is usually NSPS, is evaluated against successively more stringent controls until a BACT level is selected. However, USEPA developed a concern that the bottom-up approach was not providing the level of BACT decisions originally intended. As a result, in December 1987 the USEPA Assistant Administrator for Air and Radiation mandated changes in the implementation of the PSD program including the adoption of a new "top-down" approach to BACT decision making.

The top-down approach requires an applicant to start with the most stringent control alternative, usually Lowest Achievable Emission Rate (LAER), and either provide an analysis that justifies its rejection based on technical or economic infeasibility, or propose it as BACT.

The top-down BACT approach essentially starts with the most stringent (or top) technology and emissions limit that have been applied elsewhere to the same source category. The applicant must next provide a basis for rejecting this technology in favor of the next most stringent technology or propose to use it.

Rejection of control alternatives may be based on technical or economical infeasibility. Such decisions are made on the basis of physical differences (e.g., fuel type), locational differences (e.g., availability of water), or significant differences that may exist in the environmental, economic or energy impacts. The differences between the proposed facility and the facility on which the control technique was applied previously must be justified.

3.2.4 Air Quality Analysis

In accordance with requirements of 40 CFR 52.21(m), any application for a PSD permit must contain an analysis of continuous ambient air quality data in the area affected by the proposed major stationary source or major modification. For a new major source, the affected pollutants are those that the source would potentially emit in significant amounts. For a major modification, the pollutants are those for which the net emissions increase exceeds the significant emission rate (see Table 3-2).

According to CAA, ambient air monitoring for a period of up to 1 year is generally appropriate to satisfy the PSD monitoring requirements. A minimum of four (4) months of data is required. Existing data from the vicinity of the proposed source may be utilized if the data meet certain quality assurance requirements; otherwise, additional data may need to be gathered. Guidance in designing a PSD monitoring network is provided in USEPA's "Ambient Monitoring Guidelines for Prevention of Significant Deterioration" (USEPA, 1987a).

The regulations include an exemption which excludes or limits the pollutants for which an air quality analysis must be conducted. This exemption states that the Administrator may exempt a proposed major stationary source or major modification from the monitoring requirements of 40 CFR 52.21(m) with respect to a particular pollutant if the emissions increase of the pollutant from the source or modification would cause, in any area, air quality impacts less than the de minimis levels presented in Table 3-2.

3.2.5 Source Impact Analysis

A source impact analysis must be performed by a proposed major source subject to PSD for each pollutant for which the increase in emissions exceeds the significant emission rate (Table 3-2). The PSD regulations specifically require the use of atmospheric dispersion models in performing impact analysis, estimating baseline and future air quality levels, and determining compliance with AAQS and allowable PSD increments. Designated USEPA models must normally be used in performing the impact analysis. Specific applications for other than USEPA-approved models require USEPA's consultation and prior approval. Guidance for the use and application of dispersion models is presented in the USEPA publication "Guideline on Air Quality Models (Revised)" (USEPA, 1987b).

The source impact analysis for criteria pollutants may be limited to only the new or modified source if the net increase in impacts due to the new or modified source is below significance levels, as presented in Table 3-1.

Various lengths of record for meteorological data can be utilized for impact analysis. A 5-year period can be used with corresponding evaluation of highest, second-highest short-term concentrations for comparison to AAQS or PSD increments. The term "highest, second-highest" (HSH) refers to the highest of the second-highest concentrations at all receptors (i.e., the highest concentration at each receptor is discarded). The second-highest concentration is significant because short-term AAQS specify that the standard should not be exceeded at any location more than once a year. If less than 5 years of meteorological data are used in the modeling analysis, the highest concentration at each receptor must normally be used for comparison to air quality standards.

3.2.6 Additional Impact Analysis

In addition to air quality impact analyses, federal PSD regulations require analyses of the impairment to visibility and the impacts on soils and vegetation that would occur as a result of the proposed source. These analyses are to be conducted primarily for PSD Class I areas. Impacts due to general commercial, residential, industrial, and other growth associated with the source must also be addressed. These analyses are required for each pollutant emitted in significant amounts (Table 3-2).

3.2.7 Good Engineering Practice Stack Height

The 1977 CAA Amendments require that the degree of emission limitation required for control of any pollutant not be affected by a stack height that exceeds GEP, or any other dispersion technique. On July 8, 1985, USEPA promulgated final stack height regulations (USEPA, 1985). GEP stack height is defined as the highest of:

1. 65 meters (m), or
2. A height established by applying the formula:

   Hg = H + 1.5L

   where: H_g = GEP stack height,

   H = Height of the structure or nearby structure, and

   L = Lesser dimension (height or projected width) of nearby structure(s), or
3. A height demonstrated by a fluid model or field study.

"Nearby" is defined as a distance up to five times the lesser of the height or width dimensions of a structure or terrain feature, but not greater than 0.8 km. Although GEP stack height regulations require that the stack height used in modeling for determining compliance with AAQS and PSD increments not exceed the GEP stack height, the actual stack height may be greater.

The stack height regulations also allow increased GEP stack height beyond that resulting from the above formula in cases where "plume impaction" occurs. Plume impaction is defined as concentrations measured or predicted to occur when the plume interacts with "elevated terrain." "Elevated terrain" is defined as terrain which exceeds the height calculated by the GEP stack height formula. Because the terrain in the vicinity of the Tarmac plant is flat, plume impaction was not considered in determining the GEP stack height.

3.3 NONATTAINMENT RULES

The Emission Offset Interpretative Ruling (40 CFR 51, Appendix S) applies to new and modified major sources affecting nonattainment areas. Under Section IV.A of the Ruling, such sources are required to: (1) meet an emission limitation which specifies the lowest achievable emission rate for such sources, (2) certify that all existing major sources owned or operated by the applicant in the same state are in compliance with all applicable emission limitations and standards under the Act, (3) obtain emission offsets such that there will be reasonable progress toward attainment of the applicable national AAQS, and (4) demonstrate that the emission offsets would provide a positive net air quality benefit in the affected area [not applicable for VOC or NO_x].

Based on the current nonattainment provisions, all major new sources and modifications to existing major sources located in a nonattainment area must undergo nonattainment review if the proposed pieces of equipment have the potential to emit 100 TPY or more of the nonattainment pollutant, or if the major modification results in a significant net emission increase of the nonattainment pollutant.

3.4 SOURCE APPLICABILITY

3.4.1 PSD Review

3.4.1.1 Pollutant Applicability

The Tarmac plant is located in Dade County, which has been designated by USEPA and FDER as an attainment area for all criteria pollutants except ozone. Because of the ozone nonattainment designation, emissions of VOC from the Tarmac plant will not be subject to PSD review. Dade County is designated as a PSD Class II area for SO_2, PM(TSP), and NO_x. The Tarmac site is located approximately 30 km northeast of the Everglades National Park, the nearest PSD Class I area.

The existing Tarmac plant is considered to be an existing "major stationary source" because current emissions of regulated pollutants exceed 100 TPY. Since the source is an existing major source, PSD review is required for any pollutant for which the net increase in emissions due to the proposed project exceeds the PSD significant emission rates presented in Table 3-2 (i.e., major modification).

Presented in Table 3-3 is the maximum net increase in emissions for each regulated pollutant due to the Kiln 2 coal conversion, based upon the maximum hourly change in emissions presented in Table 2-1, and assuming 8,760 hr/yr operation. Also included is the estimated increase in PM(TSP) and PM10 emissions due to increased coal handling for Kiln 2. As

Table 3-3. Net Increase in Emissions Due to the Kiln 2 Coal Conversion Compared to the PSD Significant Emission Rates

Pollutant	Increase in Emissions Due to Kiln 2 Coal Conversion lb/hr	TPY	Significant Emission Rate (TPY)	PSD Review Applies?
Particulate Matter (TSP)	--	12.0	25	No
Particulate Matter (PM10)	--	5.4	15	No
Sulfur Dioxide	354.7	1,553	40	Yes
Nitrogen Dioxide	1.5	6.6	40	No
Carbon Monoxide	0.0	0.0	100	No
Votatile Organic Compounds*	6.9	30.2	40	No*
Lead	0.0	0.0	0.6	No
Sulfuric Acid Mist	10.3	45.1	7	Yes
Beryllium	0.0	0.0	0.0004	No

* Nonattainment pollutant; PSD review does not apply.

shown, potential emissions from the proposed project will exceed the PSD significant emission rate for only SO_2 and sulfuric acid mist. The proposed modification is subject to PSD review for these pollutants.

3.4.1.2 Ambient Monitoring

Based upon the net increase in emissions from the proposed coal conversion, presented in Table 3-3, a PSD preconstruction ambient monitoring analysis is required for SO_2 and sulfuric acid mist. However, if the net increase in impact of a pollutant is less than the de minimis monitoring concentration, then an exemption from the preconstruction ambient monitoring requirement may be granted for that pollutant. In addition, if an acceptable ambient monitoring method for the pollutant has not been established by USEPA, monitoring is not required.

The maximum predicted 24-hour SO_2 impact due to the net increase in SO_2 emissions associated with the Kiln 2 coal conversion is 21 ug/m^3. The methodology used to predict maximum impacts and the impact analysis results are presented in Sections 6.0 and 7.0. This maximum 24-hour impact is above the de minimis monitoring concentration for SO_2 of 13 ug/m^3. There is no acceptable ambient monitoring method for sulfuric acid mist, and therefore monitoring is not required for this pollutant. As a result, the proposed project is subject to preconstruction ambient monitoring analysis for SO_2 only. The air quality analysis for SO_2 is presented in Section 5.0.

3.4.1.3 GEP Stack Height

The GEP stack height regulations allow any stack to be at least 65 meters high. The existing stack for the Kiln 2 is 200 ft in height (61.0 meters) and, therefore, does not exceed the GEP stack height.

3.4.2 Nonattainment Review

Nonattainment review is required for ozone if the net increase in VOC emissions due to the proposed modification exceeds the significant emission rate of 40 TPY. As shown in Table 3-3, the maximum potential increase in VOC emissions due to the project is less than 40 TPY. As a result, nonattainment review for VOC emissions is not required.

4.0 CONTROL TECHNOLOGY EVALUATION

As discussed in the PSD source applicability section (Section 3.4), only SO_2 and sulfuric acid mist emissions require a BACT evaluation. Since sulfuric acid mist emissions are a direct result of sulfur emissions, sulfuric acid mist will be controlled by controlling SO_2. As a result, only SO_2 will be discussed in this section. The BACT evaluation is presented in this section.

Kiln 2 at Tarmac is an existing cement kiln equipped with an ESP for particulate control. The existing kiln already provides SO_2 removal due to the alkaline nature of the kiln dust. The ESP provides some additional SO_2 removal as a result of contact of the flue gases with the kiln dust. A baghouse used for particulate control would inherently provide greater SO_2 removal (in the range of 20 to 45 percent) than the ESP due to the filter cake formed on the bags. However, the use of a baghouse at Tarmac would require complete replacement of the existing ESP, and would be economically prohibitive.

Based upon the sulfur in the coal (2.0 percent sulfur maximum) and the sulfur in the raw feed to the kiln (0.16 percent SO_3 ~~sulfur~~), total potential SO_2 emissions from the kiln are 623.7 lb/hr. To achieve the requested 400 lb/hr SO_2 emission rate, an inherent SO_2 removal efficiency of 36 percent is required. At this level of SO_2 emissions, the flue gases would contain approximately 650 parts per milliion by volume (ppmv) (wet) SO_2. This concentration of SO_2 is approximately equivalent to that concentration in the exhaust gases of a power plant burning 0.9% S coal.

Tarmac's proposed BACT for SO_2 is the inherent control within the kiln/ESP system to achieve an emission rate of 400 lb/hr or less. Based upon experience with Kiln 3 burning coal, regulating conditions within the kiln (i.e., temperature, excess air, etc.) to control SO_2 emissions affects NO_x emissions. After startup of Kiln 2 on coal, Tarmac will conduct performance tests to determine the lowest routinely achievable SO_2 emission rate while at the same time complying with the maximum NO_x emission rate of 169.3 lb/hr (6.77 lb/ton clinker). Based upon this testing, Tarmac is willing to re-evaluate the SO_2 emission limit and accept a lower limit if justified by the test results. Tarmac is fully committed to minimizing SO_2 emissions from the kiln by optimizing kiln operating parameters, while maintaining clinker quality.

There are considered no feasible alternatives to SO_2 control on Kiln 2. Review of the EPA BACT/LAER Clearinghouse documents revealed that no existing or permitted cement kiln employs an add-on SO_2 control system. All cement kilns employ the inherent removal of SO_2 in the kiln and a particulate control device as the SO_2 control method. This is the method proposed by Tarmac, with the commitment to re-evaluating the SO_2 emission limit based upon stack test results.

The proposed BACT for the kiln is the existing kiln/ESP system and operation of the kiln to minimize SO_2 while maintaining compliance with the NO_x on the kiln. This is based upon the consideration of the existing kiln/ESP system and the inherent minimum 36 percent removal efficiency of the existing system, Tarmac's commitment to minimize SO_2 emissions from the kiln, and with the commitment to re-evaluate the SO_2 emission limit for Kiln 2, after test data is obtained.

5.0 AIR QUALITY ANALYSIS

5.1 PROJECT MONITORING APPLICABILITY

As determined by the source applicability analysis described in Section 3.4, an ambient monitoring analysis is required by PSD regulations for SO_2 only. In order to satisfy these requirements, Tarmac proposes to use existing ambient SO_2 data collected by FDER at a site near to the Tarmac facility. The available SO_2 monitoring data are described in Section 5.2.

5.2 AMBIENT SULFUR DIOXIDE DATA

Ambient SO_2 monitoring data from Dade County are available from a FDER operated monitoring station located within 3 km of the Tarmac facility. The monitoring site is located at the intersection of SR 821 (Turnpike Extension) and US 27. Ambient SO_2 data collected at this site for the period 1987 through 1988 are presented in Table 5-1. The monitor actually operated at the site during the period August 1987 through October 1988. The data were collected using a continuous monitor, and since the site is operated by FDER, the data are gathered by required quality assurance procedures for PSD networks.

As indicated in the table, all recorded SO_2 concentrations are low and well below the AAQS. The highest measured 3-hour concentration during the monitoring period was 15 ug/m^3, and the highest measured 24-hour concentration was 8 ug/m^3. These values are well below the AAQS of 1,300 ug/m^3, 3-hour average, and 260 ug/m^3, 24-hour average. The recorded mean SO_2 concentration at the site was 3 ug/m^3. This concentration is well below the AAQS of 60 ug/m^3 for the annual averaging period.

Background SO_2 concentrations for use in the impact analysis are based upon the maximum 3-hour, 24-hour and annual average concentrations measured at the monitoring site. This was assumed since the observed values were low compared to AAQS. The resulting background concentrations are: 15 ug/m^3, 3-hour; 8 ug/m^3, 24-hour; and 3 ug/m^3, background levels are considered conservative since they reflect current operation of the Tarmac facility, and the Tarmac facility will be included specifically in the modeling analysis.

Table 5-1. Summary of Ambient Sulfur Dioxide Data, Dade County, 1987-1988

				Sulfur Dixide Concentration ($\mu g/m^3$)				
Site No.	Site Name	Time Period	No. Obs.	Max. 3-hr	2nd Max. 3-hr	Max. 24-hr	2nd Max. 24-hr	Arithmetic Mean
0860-019	Miami-- US 27 & SR 821	1987[*]	3,049	9	8	4	4	3
		1988[+]	6,605	15	13	8	5	3
Federal Primary AAQS				-	-	-	365	80
Federal Secondary AAQS				-	1,300	-	-	-
Florida AAQS				-	1,300	-	260	60

[*] Data cover period Aug - Dec 1987.
[+] Data cover period Jan - Oct 1988.

6.0 AIR QUALITY MODELING APPROACH

6.1 GENERAL MODELING APPROACH

The general modeling approach followed USEPA and FDER modeling guidelines for determining compliance with AAQS and PSD increments. In general, when model predictions are used to determine compliance with AAQS and PSD increments, current policies stipulate that the highest annual average and highest, second-highest short-term (i.e., 24 hours or less) concentrations be compared to the applicable standard when 5 years of meteorological data are used. The highest, second-highest concentration (HSH) is calculated for a receptor field by:

1. Eliminating the highest concentration predicted at each receptor,
2. Identifying the second-highest concentration at each receptor, and
3. Selecting the highest concentration among these second-highest concentrations.

This approach is consistent with the air quality standards, which permit a short-term average concentration to be exceeded once per year at each receptor.

To develop the maximum short-term concentrations for the proposed facility, the general modeling approach was divided into screening and refined phases to reduce the computation time required to perform the modeling analysis. The basic difference between the two phases is the receptor grid used when predicting concentrations, the number of emission points, and the number of meteorological periods evaluated. In general, concentrations for the screening phase were predicted using a coarse receptor grid, limited number of major sources, and a 5-year meteorological record.

After a final list of HSH short-term concentrations was developed, the refined phase of the analysis was conducted by predicting concentrations for a refined receptor grid centered on the receptor at which the HSH concentration was produced from the screening phase. The air dispersion model was executed for the meteorological periods during which both the highest and second-highest concentrations were predicted to occur at that receptor, based on the screening phase results. This approach was used to ensure that valid HSH concentrations were obtained. More detailed descriptions of the emission inventory and receptor grids used in the screening and refined phases of the analysis are presented in the following sections.

6.2 MODEL SELECTION

The selection of an appropriate air dispersion model was based on the model's ability to simulate impacts in areas surrounding the Tarmac facility. Within 50.0 km of the facility, the terrain can be described as simple, i.e., flat to gently rolling. As defined in the USEPA modeling guidelines, simple terrain is considered to be an area where the terrain features are all lower in elevation than the top of the stack(s) under evaluation. Therefore, a simple terrain model was selected to predict maximum ground-level concentrations.

The Industrial Source Complex (ISC) dispersion model (USEPA, 1988a) was used to evaluate the pollutant emissions from the Tarmac facility and other existing major facilities. This model is contained in USEPA's User's Network for Applied Modeling of Air Pollution (UNAMAP), Version 6 (USEPA, 1988b). The ISC model is applicable to sources located in either flat or rolling terrain where terrain heights do not exceed stack heights.

The ISC model consists of two sets of computer codes which are used to calculate short- and long-term ground level concentrations. The main differences between the two codes are the input format of the meteorological data and the method of estimating the plume's horizontal dispersion.

The first model code, the ISCST model, is designed to calculate hourly concentrations based on hourly meteorological parameters (i.e., wind direction, wind speed, atmospheric stability, ambient temperature, and mixing heights). The hourly concentrations are processed into non-overlapping, short-term and annual averaging periods. For example, a 24-hour average concentration is based on 24 1-hour averages calculated from midnight to midnight of each day. For each short-term averaging period selected, the highest and second-highest average concentrations are calculated for each receptor. As an option, a table of the 50 highest concentrations over the entire field of receptors can be produced.

The second model code within the ISC model is the ISC long-term (ISCLT) model. The ISCLT model uses joint frequencies of wind direction, wind speed, and atmospheric stability to calculate seasonal and/or annual average ground-level concentrations. Because the input wind directions are for 16 sectors, with each sector defined as 22.5 degrees, the model calculates concentrations by assuming that the pollutant is uniformly distributed in the horizontal plane within a 22.5 degree sector.

In this analysis, the ISCST model was used to calculate both short-term and annual average concentrations because these concentrations are readily obtainable from the model output. In general, the ISCST model will produce higher annual average concentrations as compared to the ISCLT model.

Major features of the ISCST model are presented in Table 6-1. Concentrations due to stack and volume sources are calculated by the ISCST model using the steady-state Gaussian plume equation for a continuous source. The area source equation in the ISCST model is based on the equation for a continuous and finite crosswind line source. The ISC model has rural and urban options which affect the wind speed profile exponent law, dispersion rates, and mixing-height formulations used in calculating ground level concentrations. The criteria used to determine when the rural or urban mode is appropriate are based on land use near the proposed plant's surroundings (Auer, 1978). If the land use is classified as heavy industrial, light-moderate industrial, commercial, or compact residential for more than 50 percent of the area within a 3 km radius circle centered

Table 6-1. Major Features of the ISCST Model

ISCST Model Features
o Polar or Cartesian coordinate systems for receptor locations
o Rural or one of three urban options which affect wind speed profile exponent, dispersion rates, and mixing height calculations
o Plume rise due to momentum and buoyancy as a function of downwind distance for stack emissions (Briggs, 1969, 1971, 1972, and 1975)
o Procedures suggested by Huber and Snyder (1976); Huber (1977); and Schulmann and Hanna (1986) and Schulmann and Scire (1980) for evaluating building wake effects
o Procedures suggested by Briggs (1974) for evaluating stack-tip downwash
o Separation of multiple point sources
o Consideration of the effects of gravitational settling and dry deposition on ambient particulate concentrations
o Capability of simulating point, line, volume and area sources
o Capability to calculate dry deposition
o Variation with height of wind speed (wind speed-profile exponent law)
o Concentration estimates for 1-hour to annual average
o Terrain-adjustment procedures for elevated terrain including a terrain truncation algorithm
o Receptors located above local terrain, i.e., "flagpole" receptors
o Consideration of time-dependent exponential decay of pollutants
o The method of Pasquill (1976) to account for buoyancy-induced dispersion
o A regulatory default option to set various model options and parameters to EPA recommended values (see text for regulatory options used)
o Procedure for calm-wind processing

Source: USEPA, 1988b

on the proposed source, the urban option should be selected. Otherwise, the rural option is more appropriate.

For modeling analyses that will undergo regulatory review, such as PSD permit applications, the following model features are recommended by USEPA (1987a) and are referred to as the regulatory options in the ISCST model:

1. Final plume rise at all receptor locations,
2. Stack-tip downwash,
3. Buoyancy-induced dispersion,
4. Default wind speed profile coefficients for rural or urban option,
5. Default vertical potential temperature gradients,
6. Calm wind processing, and
7. Reducing calculated SO_2 concentrations in urban areas by using a decay half-life of 4 hours (i.e., reduce the SO_2 concentration emitted by 50% for every 4 hours of plume travel time).

In this analysis, the USEPA regulatory options were used to address maximum impacts. Based on a review of the land use around the Tarmac facility, the rural mode was selected based on the degree of residential, industrial, and commercial development within 3 km of the site.

6.3 METEOROLOGICAL DATA

Meteorological data used in the ISCST model to determine air quality impacts consisted of a concurrent 5-year period of hourly surface weather observations and twice-daily upper air soundings from the National Weather Service (NWS) stations at Miami International Airport and West Palm Beach, respectively. The 5-year period of meteorological data was from 1982 through 1986. The NWS station in Miami, located approximately 10 km to the southeast of the Tarmac site, was selected for use in the study because it is the closest primary weather station to the study area with similar surrounding topographical features. This station also has the most readily available and complete database which is representative of the plant site.

The surface observations included wind direction, wind speed, temperature, cloud cover, and cloud ceiling. The wind speed, cloud cover, and cloud ceiling values were used in the ISCST meteorological preprocessor program to determine atmospheric stability using the Turner stability scheme. Based on the temperature measurements at morning and afternoon, mixing heights were calculated with the radiosonde data at West Palm Beach International Airport using the Holzworth approach (1972). The West Palm Beach International Airport is located about 100 km north-northeast of the site. Hourly mixing heights were derived from the morning and afternoon mixing heights using the interpolation method developed by USEPA (Holzworth, 1972). The hourly surface data and mixing heights were used to develop a sequential series of hourly meteorological data (i.e., wind direction, wind speed, temperature, stability, and mixing heights). Because the observed hourly wind directions were randomized within each sector to account for the expected variability in air flow. These calculations were performed by using the USEPA RAMMET meteorological preprocessor program.

6.4 EMISSION INVENTORY

6.4.1 Tarmac Facility

Stack operating parameters and SO_2 emission rates for the kilns at Tarmac are presented in Section 2.0, Table 2-2. For determining PSD increment consumption for SO_2, only Kilns 2 and 3 are increment-consuming sources due to their conversion or proposed conversion to coal. The PSD baseline SO_2 emissions for Kilns 2 and 3 are 45.1 lb/hr and 21.9 lb/hr, respectively, based upon oil burning (emission rates documented in 1980 coal conversion application). Thus, increment-consuming emissions for the two kilns are the post-coal conversion emission rate (400 lb/hr each kiln) minus the baseline emission rate, or 354.9 lb/hr for Kiln 2 and 378.1 lb/hr for Kiln 3.

For Kiln 1, a conservatively estimated gas flow rate of 87,000 acfm was used instead of the higher flow rate shown in Table 2-2. This equates to a stack exit velocity of 1,731 ft/min or 8.79 m/s.

6.4.2 Other Air Emission Sources

SO_2 is the only pollutant required to be addressed in the impact analysis. Therefore, an emission inventory for SO_2 was developed from available databases.

FDER provided KBN with AIR 10 reports and APIS inventories for Broward, Dade, and Palm Beach counties. Using this information, supplemented with data from permits, PSD applications, and previous modeling analyses, the SO_2 emitting facilities within 50 km of the location of the Tarmac site were identified and are presented in the attached tables.

All facilities located within 15 km of the Tarmac site with SO_2 emissions greater than 25 TPY were included in the modeling analysis. Facilities located 15 to 50 km from the proposed units with SO_2 emissions greater than 100 TPY were subject to further screening to determine the potential of significant interaction with the proposed sources. An additional source, North Broward Resource Recovery, was also included in the modeling analysis because it is a PSD increment-consuming source, although this is slightly more than 50 km from the Tarmac facility. A list of facilities considered in the modeling analysis is presented in Table 6-2. UTM coordinates of the Tarmac site are 583.2 km east, 2881.3 km north.

As described above, each facility between 15 and 50 km from the Tarmac site was further screened to determine the probability of source interaction. The recommended screening technique is the "Screening Threshold" method developed by the North Carolina Department of Natural Resources and Community Development, and approved by the USEPA. The method is designed to objectively eliminate from the emission inventory those facilities which are not likely to have significant interaction with the source undergoing evaluation. In general, facilities that should be considered in the modeling analyses are those with emissions greater than Q (in TPY), which is calculated by the following criterion:

Table 6-2. Source Inventory Considered in the Modeling Analysis

APIS Facility Identification Number	Facility	County	UTM Coordinates (km) East	UTM Coordinates (km) North	Relative Location (km) to Tarmac Facility[+] X	Relative Location (km) to Tarmac Facility[+] Y	Distance From Proposed Site (km)	Direction From Proposed Site (degrees)	Maximum Allowable SO$_2$ Emissions[*] (TPY)
50BRO060036	FPL -Port Everglades	Broward	587.4	2885.3	24.5	23.6	34.0	46	76,239
50BRO060037	FPL -Fort Lauderdale	Broward	580.3	2883.3	17.4	21.6	27.7	39	63,964
50DAD130003	FPL -Turkey Point	Dade	567.2	2813.2	4.3	-48.5	48.7	175	36,192
50DAD130004	General Portland	Dade	551.7	2843.4	-11.2	-18.3	21.5	211	10,546
50DAD130348	Metro Dade Resource Recovery	Dade	564.3	2857.4	1.4	-4.3	4.5	162	2,996 T
50BRO06????	South Broward County Resource Recovery	Broward	579.6	2883.3	16.7	21.6	27.3	38	1,318
50BRO06????	North Broward County Resource Recovery	Broward	583.6	2907.6	20.7	45.9	50.4	24	896
50DAD130001	FPL -Cutler	Dade	570.4	2834.9	7.5	-26.8	27.8	164	488
50BRO060015	East Coast Asphalt	Broward	584.9	2902.2	22.0	40.5	46.1	29	230
50DAD130015	Rinker Materials	Dade	558.2	2851.3	-4.7	-10.4	11.4	204	218 A
50BRO062094	Waste Management	Broward	583.2	2908.0	20.3	46.3	50.6	24	187
50DAD130483	General Asphalt Portable Plant	Dade	561.5	2853.2	-1.4	-8.5	8.6	189	103
50DAD130053	Brewer Company of Florida	Dade	551.0	2816.8	-11.9	-44.9	46.5	195	85
50DAD130013	Homestead City Utilities	Dade	552.5	2817.6	-10.4	-44.1	45.3	193	77
50BRO060046	Weekly Asphalt Paving	Broward	576.9	2886.1	14.0	24.4	28.1	30	39

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[*] Maximum facility emissions are based on emissions found in APIS, or specific operation permits and PSD application.

[+] The Tarmac facility is located at UTM coordinates of 583.2 km east and 2881.3 km north.

Note: T = Emission rate based on Emission Testing emission information, because no information was available on allowable emissions.

A = Emission rate based on ACTUAL emission information, because no information was available on allowable emissions.

$$Q = 20 \times D$$

where D is the distance (km) from the particular source to the source undergoing evaluation.

A listing of the SO_2 facilities in the inventory with associated maximum allowable emissions, distance from the proposed site, and associated Q is presented in Table 6-3. Those facilities with maximum allowable emissions which are below the calculated "screening threshold" were eliminated from further consideration in the modeling analysis. The remaining facilities, along with all facilities greater than 25 TPY emissions and located within 15 km of the Tarmac site, comprise the facility list to be used in the modeling.

Two different source inventories for the FPL-Fort Lauderdale facility were considered for the PSD increment consumption modeling analysis. The first source inventory did not include the proposed FPL Combined Cycle Units and the subsequent retirement of Units 4 and 5. The second source inventory included the increment consumption of the proposed Combined Cycle Units and the increment expansion due to the retirement of Units 4 and 5. The PSD modeling analysis was conducted in this manner to demonstrate the impacts, if the proposed FPL Combined Cycle Units are permitted as planned. Impacts with and without contributions from the FPL-Fort Lauderdale facility will be presented in Section 7.0.

A summary of the SO_2 sources used in the modeling is presented in Table 6-4. PSD increment-affecting sources are noted and were used in the PSD analysis.

6.5 RECEPTOR LOCATIONS

As discussed in Section 6.1, the general modeling approach considered screening and refined phases to address compliance with maximum allowable PSD Class I and Class II increments and AAQS. In the ISCST modeling,

Table 6-3. Summary of SO2 Facilities Considered in the Modeling Analysis Using the "Screening Threshold" Technique

APIS Facility Identification Number	Facility	Distance From Proposed Site (km)	Direction From Proposed Site (degrees)	Maximum SO2 * Emissions (TPY)	Q, Emission Threshold (TPY) (20 x Distance)	Included in Modeling
50BR0060036	FPL - Port Everglades	34.0	46	76,239	680	YES
50BR0060037	FPL -Fort Lauderdale	27.7	39	65,964	555	YES
50DAD130003	FPL -Turkey Point	48.7	175	36,192	974	YES
50DAD130004	General Portland	21.5	211	10,546	429	YES
50DAD130348	Metro Dade Resource Recovery	4.5	162	2,996	90	YES
50BRO06????	South Broward County Res. Rec.	27.3	38	1,318	546	YES
50BRO06????	North Broward County Res. Rec.	50.4	24	896	1,007	YES
50DAD130001	FPL -Cutler	27.8	164	488	557	NO
50BRO060015	East Coast Asphalt	46.1	29	230	922	NO
50DAD130015	Rinker Mat	11.4	204	218	228	YES
50BRO062094	Waste Management	50.6	24	187	1,011	NO
50DAD130483	General Asphalt Portable Plant	8.6	189	103	172	YES
50DAD130053	Brewer Company of Florida	46.5	195	85	929	NO
50DAD130013	Homestead City Utilities	45.3	193	77	906	NO
50BRO060046	Weekly Asphalt Paving	28.1	30	39	563	NO

* Maximum facility emissions determined from APIS or other available information on facility.

Note: All facilities within 15 km of Tarmac with SO_2 emissions greater than 25 TPY were modeled.

Table 6-4. Summary of SO_2 Emission Sources To Be Used in the Modeling Analysis

APIS Facility Number	Facility	Coordinates Relative To Proposed Unit (km)		Source Description	Stack Data (ft)		Operating Data		Modeled Emissions (lb/hr)	Annual Emissions (TPY)	PSD Sources
		X	Y		Height	Diameter	Temperature (degrees F)	Velocity (ft/sec)			
50BR0060036	FPL - Port Everglades	24.5	23.6	Units 1 and 2	344	14.0	289	68.0	5,060	22,163 *	No
				Units 3 and 4	343	18.1	275	68.0	8,470	37,098 *	No
				Gas Turbines 1-12	51	18.0**	860	70.0	3,876	16,978 *	No
50BR0060037	FPL - Fort Lauderdale	17.4	21.6	Proposed CT/HRSG	150	16.0	280	36.2	3,678	16,109	Yes
				Units 4 and 5	151	14.0	300	57.8	3,630	15,900	No
				Gas Turbines 1-12	51	18.0**	860	70.0	3,876	16,978	No
				Gas Turbines 13-24	44	18.0**	860	70.0	3,876	16,978	No
50AD13003	FPL - Turkey Point	4.3	-48.5	Unit 1 and 2	400	18.1	275	63.0	19,800	36,192	No
50BR006????	South Broward County Resource Revovery	16.7	21.6	Units 1-3	195	7.5	226	59.1	303	1,318	Yes
50BR006????	North Broward County Resource Recovery	20.7	45.9	Units 1-3	200	7.5	226	59.1	281	896	Yes
50DAD130004	General Portland	-11.2	-18.3	Cement Kilns 1 and 2	225	14.8	475	15.0	2,408+	10,546	No
50DAD130348	Metro Dade Resource Recovery	1.4	-4.3	Boilers 1-4	151	9.0	390	40.0	418	1,832	Yes
50DAD130015	Rinker Materials	-4.7	-10.4	Concrete Batch Plant	137	15.0	260	25.0	111	218	No
50DAD130483	General Asphalt	-1.4	-8.5	Concrete Batch Plant	23	3.8	300	76.0	23	103	No

* Annual emissions are based on the assumption of 8,760 hours of operation at the modeled emission rate.

+ Short-term emissions are based on the assumption of 8,760 hours of operation at the annual emission rate.

** Effective diameter based on the rectangular area of the stack.

concentrations were predicted for the screening phase using several receptor grids. The locations of the receptors were based on identifying the areas in which maximum concentrations would be expected due to the proposed units.

A description of the receptor locations for determining compliance with PSD Class II increments and AAQS is as follows:

1. 360 receptors located at distances of 100, 300, 500, 800, 1100, 1,500, 2,000, 2,500, 3,200 and 4,000 m along 36 radials with each radial spaced at 10-degree increments.

2. 24 receptors located along the north and east boundaries of the Everglades National Park for the PSD Class I analysis. The locations of these receptors are presented in Table 6-5.

After the screening modeling was completed to determine impacts for comparison to PSD Class II increments and AAQS, refined short-term modeling was conducted using a receptor grid centered on the receptor which had the highest, second-highest short-term concentrations. The receptors were located at intervals of 100 m between the distances considered in the screening phase along 9 radials, at 2-degree increments, centered on the radial along which the maximum concentration was produced. For example, if the maximum concentration was produced along the 90-degree radial at a distance of 1.75 km, the refined receptor grid would consist of receptors at the following locations:

<u>Directions (degrees)</u>	<u>Distance (km)</u>
82, 84, 86, 88, 90, 92, 94, 96, 98	1.35, 1.45, 1.55, 1.65, 1.75, 1.85, 1.95, 2.05, and 2.15 per direction

To ensure that a valid HSH concentration was calculated, concentrations were predicted for the refined grid for the periods that produced both the highest and HSH concentrations from the screening receptor grid.

Table 6-5. Receptors Used in the PSD Class I Modeling Analysis To Address Predicted Impacts on the Everglades National Park

Receptor No.	UTM Coordinates (km) East	UTM Coordinates (km) North	Relative Position to Proposed Site (km)* East	Relative Position to Proposed Site (km)* North	Relative Position to Proposed Site (km)* Distance
1	515.0	2848.0	-47.9	-13.7	49.8
2	520.0	2848.0	-42.9	-13.7	45.0
3	525.0	2848.0	-37.9	-13.7	40.3
4	530.0	2848.0	-32.9	-13.7	35.6
5	533.5	2848.0	-29.4	-13.7	32.4
6	533.5	2843.0	-29.4	-18.7	34.8
7	533.5	2838.0	-29.4	-23.7	37.8
8	533.5	2833.0	-29.4	-28.7	41.1
9	533.5	2828.0	-29.4	-33.7	44.7
10	533.5	2823.0	-29.4	-38.7	48.6
11	533.5	2818.0	-29.4	-43.7	52.7
12	533.5	2815.3	-29.4	-46.4	54.9
13	538.0	2815.3	-24.9	-46.4	52.7
14	541.3	2814.0	-21.6	-47.7	52.3
15	542.0	2811.0	-20.9	-50.7	54.8
16	543.0	2810.0	-19.9	-51.7	55.4
17	543.0	2805.0	-19.9	-56.7	60.0
18	543.0	2800.0	-19.9	-61.7	64.8
19	543.0	2796.5	-19.9	-65.2	68.2
20	548.0	2796.5	-14.9	-65.2	66.9
21	553.0	2796.5	- 9.9	-65.2	65.9
22	556.0	2796.0	- 6.9	-65.7	66.1
23	556.6	2792.0	- 6.3	-69.7	70.0
24	557.0	2789.0	- 5.9	-72.7	72.9

* The UTM coordinates of the Tarmac facility are 562.9 km east and 2861.7 north.

6.6 BACKGROUND CONCENTRATIONS

Background concentrations used in the air quality impact analysis are discussed in Section 5.0. The SO_2 background concentrations used in the AAQS analysis were 15 $\mu g/m^3$, 8 $\mu g/m^3$ and 3 $\mu g/m^3$ for averaging times of 3-hour, 24-hour, and annual, respectively.

6.7 BUILDING DOWNWASH EFFECTS

Based on the building dimensions associated with buildings or structures at the Tarmac facility, stacks for Kilns 1, 2, and 3 are within 10% of GEP based on the K3/K4 ESP. In addition, the K3/K4 ESP is not a solid structure, being open at the bottom and allowing air flow under the ESPs. Therefore, no potential building downwash or wake effects were considered in the modeling analysis due to this structure.

The K1 and K2 stacks are marginally within the area of influence of the Finish Mill Building, and the stacks are near the GEP height for this building of 265 feet. Therefore downwash due to this structure will not be significant. The K3 stack is not in the influence of the Finish Mill Building or any other buildings other than the K3/K4 ESP.

Building downwash was simulated for the FPL-Fort Lauderdale facility. The parameters used for model simulation of downwash can be found in the model printouts.

7.0 AIR QUALITY MODELING RESULTS

7.1 KILN 2 ONLY

A summary of the maximum predicted SO_2 impacts due to Kiln 2 only burning coal, based on the screening analysis, is presented in Table 7-1. The results reflected the proposed SO_2 emissions of 400 lb/hr. The maximum predicted 3-hour, 24-hour and annual SO_2 concentrations are 90, 24 and 3.4 $\mu g/m^3$, respectively. These maximum impacts are all above the significance levels established by USEPA and FDER, and therefore further modeling analysis is required for SO_2 to demonstrate compliance with PSD increments and AAQS.

The maximum predicted impacts due to the <u>increase</u> in SO_2 emissions due to Kiln 2 Coal Conversion can be obtained by ratioing the above results. The increase in SO_2 emissions, from Table 2-1, is 354.7 lb/hr. The maximum impacts due to this increase are as follows: 80 $\mu g/m^3$, 3-hour; 21 $\mu g/m^3$, 24-hour; and 3.1 $\mu g/m^3$, annual average.

7.2 PSD CLASS II INCREMENT ANALYSIS

Maximum SO_2 concentrations predicted from the screening analysis for comparison to the PSD Class II increments are presented in Table 7-2. The results reflect impacts due to all increment consuming sources, which include Kiln 2 and Kiln 3 at Tarmac. The maximum PSD increment consumption values were well below the allowable increments. The 24-hour increment consumption was predicted from the screening analysis to be about 30 percent of the allowable increment, and therefore this impact was further refined (1985, Day 244 and 32). A summary of the maximum SO_2 PSD Class II increment consumption concentrations predicted in the analysis are presented in Table 7-3.

The maximum 3-hour average SO_2 PSD Class II increment consumption due to all increment consuming sources is predicted to be 103 $\mu g/m^3$, which is

Table 7-1. Maximum Predicted SO$_2$ Concentrations from the Screening Analysis Due to Kiln 2 Only

Averaging Period	Maximum Concentration (ug/m^3)	Receptor Location+		Period		
		Direction (°)	Distance (km)	Julian Day	Hour Ending	Year
3-Hour*	89	330	0.800	239	12	1982
	90	340	1.100	149	15	1983
	84	300	0.800	245	15	1984
	78	250	0.800	148	15	1985
	74	10	1.100	70	12	1986
24-Hour*	20	320	1.500	201	-	1982
	24	280	1.500	185	-	1983
	22	310	1.100	122	-	1984
	20	290	2.000	237	-	1985
	19	330	1.500	48	-	1986
Annual	3.3	320	1.500	-	-	1982
	3.4	300	1.100	-	-	1983
	2.9	300	1.500	-	-	1984
	2.1	230	1.500	-	-	1985
	2.3	270	2.000	-	-	1986

\+ Relative to the location of the Kiln 2.

* Highest, second-highest concentrations predicted for this averaging period.

Table 7-2. Maximum Predicted SO_2 Concentrations from the Screening Analysis for Comparison to PSD Class II Increments

Averaging Period	Maximum Concentration (ug/m³)	Receptor Location+ Direction (°)	Receptor Location+ Distance (km)	Period Julian Day	Period Hour Ending	Period Year
3-Hour*	97	330	0.800	204	12	1982
	103	300	0.800	200	12	1983
	94	330	0.800	182	12	1984
	83	250	0.800	148	15	1985
	81	340	1.500	48	12	1986
24-Hour*	23.5	320	1.500	177	-	1982
	25.7	280	1.500	212	-	1983
	23.6	310	1.100	122	-	1984
	26.1	340	2.000	244	-	1985
	23.1	330	1.500	169	-	1986
Annual	4.5	320	1.500	-	-	1982
	4.6	300	1.500	-	-	1983
	3.9	300	1.500	-	-	1984
	3.3	280	2.000	-	-	1985
	3.6	270	2.000	-	-	1986

\+ Relative to the location of the Kiln 2.

* Highest, second-highest concentrations predicted for this averaging period.

Note: 3-and 24-hour average concentrations remain unchanged if the impacts of the proposed combined cycle units and Units 4 and 5 at FPL Fort Lauderdale are not considered in the modeling analysis. Annual concentrations are reduced by 0.1 ug/m³ if impacts from these sources are not considered.

Table 7-3. Maximum Predicted SO_2 Concentrations for Comparison to PSD Class II Increments

Averaging Period	Maximum Concentration (ug/m^3)	Receptor Location[+] Direction (°)	Receptor Location[+] Distance (km)	Period Julian Day	Period Hour Ending	Period Year	PSD Class II Increment
SO_2 Concentrations							
3-Hour[•]	103	300	0.800	204	12	1982	512
24-Hour[•]	26.3	338	1.900	244	--	1985	91
Annual	4.6	300	1.500	--	--	1983	20

[+] Relative to the location of the Kiln 2.

[•] Highest, second-highest concentrations predicted for this averaging period.

20 percent of the maximum allowable PSD Class II increment of 512 $\mu g/m^3$, not to be exceeded more than once per year.

The maximum 24-hour average SO_2 PSD Class II increment consumption due to all sources is predicted to be 26.3 ug/m^3, which is 29 percent of the maximum allowable PSD Class II increment of 91 ug/m^3, not to be exceeded more than once per year.

The maximum annual average SO_2 PSD Class II increment consumption is predicted to be 4.6 $\mu g/m^3$, which is 23 percent of the maximum allowable PSD Class II increment of 20 $\mu g/m^3$.

Based upon these results, operation of Kiln 2 on coal, in conjunction with all other PSD increment consuming sources, will consume less than 30 percent of the allowable Class II increments. Thus, there is increment available for significant future growth in the area. As discussed in Section 6.0, the PSD Class II analysis was conducted both with and without the planned FPL Lauderdale Repowering Project. Maximum increment consumption values near Tarmac did not change as a result of the planned FPL facility. This indicates that other nearby sources (i.e., Tarmac and Dade County Resource Recovery) are the primary contributors to the Class II increment consumption values.

7.3 AAQS ANALYSIS

The maximum 3-hour, 24-hour, and annual average total SO_2 concentrations predicted from the screening analysis are presented in Table 7-4. The total concentrations were determined from the impacts of the modeled sources added to the background concentration determined from monitoring data. These results show that the maximum SO_2 concentrations due to all sources are well below the AAQS for all averaging periods.

Table 7-4. Maximum Predicted Total SO$_2$ Concentrations from the Screening Analysis for Comparison to AAQS

	Concentration (ug/m^3)							
		Total Due To		Receptor Location[++]		Period		
Averaging Period	Total	Modeled Sources	Background	Direction (°)	Distance (km)	Julian Day	Hour Ending	Year
3-hour	239	224	15	20	3.2	28	24	1982
	225	210	15	320	4.0	263	24	1983
	244	229	15	330	4.0	74	24	1984
	217	202	15	10	3.2	156	24	1985
	246	231	15	10	4.0	130	21	1986
24-hour[•]	76	68	8	340	4.0	314	--	1982
	65	57	8	320	4.0	303	--	1983
	72	64	8	330	4.0	269	--	1984
	67	59	8	10	4.0	337	--	1985
	60	52	8	230	3.2	155	--	1986
Annual	13	10	3	320	1.5	--	--	1982
	12	9	3	300	1.5	--	--	1983
	12	9	3	300	1.5	--	--	1984
	12	9	3	320	4.0	--	--	1985
	12	9	3	270	3.2	--	--	1986

[•] Highest, second-highest concentrations predicted for this averaging period.
[++] Relative to the location of Kiln 2.

Note: AAQS are 1,300 ug/m^3, 3-hour
260 ug/m^3, 24-hour
60 ug/m^3, annual

Based upon the low predicted values, no refinements of these concentrations were performed. Review of the model printouts indicated fairly uniform concentrations across the receptor grid, indicating a distant source is causing the maximum impacts.

The maximum 3-hour average SO_2 concentration due to all sources is predicted to be 246 $\mu g/m^3$, which is 19 percent of the Florida AAQS of 1300 $\mu g/m^3$, not to be exceeded more than once per year. The maximum 24-hour average SO_2 concentration due to all sources is predicted to be 76 $\mu g/m^3$, which is 29 percent of the Florida AAQS of 260 $\mu g/m^3$, not to be exceeded more than once per year. The maximum annual average SO_2 concentration due to all sources is predicted to be 13 $\mu g/m^3$, which is 22 percent of the Florida AAQS of 60 $\mu g/m^3$.

The Dade County Department of Environmental Resources Management, Environmental Planning Division has developed the following AAQS for SO_2 that must not be exceeded in any part of Dade County:

3-Hour Average - 350 $\mu g/m^3$
24-Hour Average - 110 $\mu g/m^3$
Annual Average - 25 $\mu g/m^3$

The 3- and 24-hour average AAQS may be exceeded once per year. As shown in Table 7-4, none of the predicted concentrations exceed the Dade County AAQS.

7.4 CLASS I AREA ANALYSIS

The results of the PSD Class I area modeling analysis for the Everglades National Park are presented in Table 7-5. The modeling analysis evaluated a number of receptors along the boundary of the Class I area.

Table 7-5. Maximum Predicted SO_2 Concentrations for Comparison to PSD Class I Increments

Averaging Period	Maximum Concentration (ug/m^3)	Period			PSD Class I Increment
		Julian Day	Hour Ending	Year	
3-Hour*	15	317	12	1982	25
	16	266	9	1983	
	16	56	12	1984	
	19	150	9	1985	
	12	257	24	1986	
24-Hour*	3.9	291	--	1982	5
	4.5	303	--	1983	
	3.9	268	--	1984	
	3.7	256	--	1985	
	4.1	124	--	1986	
Annual	0.56	--	--	1982	2
	0.53	--	--	1983	
	0.52	--	--	1984	
	0.49	--	--	1985	
	0.54	--	--	1986	

* Highest, second-highest concentrations predicted for this averaging period.

As shown in Table 7-5, total Class I PSD increment consumption concentrations for SO_2 are below the Class I increments for all averaging times. The maximum 3-hour increment consumption is predicted to be 19 $\mu g/m^3$, compared to the Class I increment of 25 $\mu g/m^3$. The maximum predicted 24-hour increment consumption for SO_2 is 4.5 $\mu g/m^3$, which is below the allowable increment of 5 $\mu g/m^3$. These maximum increment consumption values are due to the effects of two increment consuming sources located in Dade County: Tarmac Florida (cement plant) and Dade County Resource Recovery (MSW incinerator). The proposed Lauderdale Repowering Project does not contribute to these maximum increment consumption values. This value was further refined using a refined receptor grid with 100 m spacing along the boundary of the Class I area. The resulting 24-hour increment consumption was 4.7 $\mu g/m^3$ (1983, Day 303).

The maximum predicted annual SO_2 increment consumption concentration in the Class I area is predicted to be 0.56 $\mu g/m^3$. This value is well below the allowable Class I increment of 2 $\mu g/m^3$ for SO_2.

To demonstrate the effects the proposed Kiln 2 Coal Conversion will have on the Class I area, the modeling analysis evaluated the impacts of Kiln 2 only. The results of this analysis are presented in Table 7-6. As shown, the maximum Class I impacts due to Kiln 2 only are 7.2 $\mu g/m^3$, 3-hour, 1.8 $\mu g/m^3$, 24-hour, and 0.16 $\mu g/m^3$, annual average. These values are less than 40 percent of the Class I increments.

Maximum total SO_2 concentrations predicted in the Class I area due to all sources are presented in Table 7-7. These concentrations include the estimated background concentration for the Tarmac area. As shown, the maximum concentrations are predicted to be: 193 $\mu g/m^3$, 3-hour average; 52 $\mu g/m^3$, 24-hour average; and 9.9 $\mu g/m^3$, annual average. These maximum impacts are 20 percent of the AAQS or less.

Table 7-6. Maximum Predicted SO_2 Concentrations for Comparison to PSD Class I Increments Due to Kiln 2 Only

Averaging Period	Maximum Concentration (ug/m^3)	Period			PSD Class I Increment
		Julian Day	Hour Ending	Year	
3-Hour*	6.9	206	3	1982	25
	7.2	138	6	1983	
	6.8	260	24	1984	
	6.6	149	3	1985	
	6.2	221	3	1986	
24-Hour*	1.4	292	--	1982	5
	1.8	290	--	1983	
	1.4	78	--	1984	
	1.2	343	--	1985	
	1.2	295	--	1986	
Annual	0.16	--	--	1982	2
	0.14	--	--	1983	
	0.15	--	--	1984	
	0.13	--	--	1985	
	0.15	--	--	1986	

---

* Highest, second-highest concentrations predicted for this averaging period.

Table 7-7. Maximum Total Predicted SO_2 Concentrations for the Everglades NP Class I Area

	Concentration (ug/m^3)				
		Total due to			
Averaging Period	Total	Modeled Sources	Background	Year	AAQS
3-Hour*	159	144	15	1982	1,300
	193	178	15	1983	
	181	166	15	1984	
	167	152	15	1985	
	163	148	15	1986	
24-Hour*	48	40	8	1982	260
	50	42	8	1983	
	50	42	8	1984	
	52	44	8	1985	
	44	36	8	1986	
Annual	9.9	6.9	3	1982	60
	9.2	6.2	3	1983	
	9.9	6.9	3	1984	
	9.0	6.0	3	1985	
	9.1	6.1	3	1986	

8.0 IMPACTS TO AIR QUALITY RELATED VALUES, VEGETATION, SOILS AND VISIBILITY

8.1 AIR QUALITY RELATED VALUES

The impacts of the proposed Kiln 2 coal conversion on Air Quality Related Values (AQRV), in the Everglades National Park are addressed in this section. The AQRVs are defined under PSD regulations as being: "All those values possessed by an area except those that are not affected by changes in air quality and include all those assets of an area whose vitality, significance, or integrity is dependent in some way upon the air environment. These values include visibility and those scenic, cultural, biological, and recreational resources of an area that are affected by air quality. Important attributes of an area are those values or assets that make an area significant as a monument, preserve, or primitive area. They are the assets that are to be preserved if the area is to achieve the purposes for which it was set aside" (Federal Register, 1978).

Freshwater and coastal wetlands, dominant plant communities, unique and rare plant communities, soils and associated periphyton, and the wildlife dependent upon these communities for habitat are considered part of the AQRVs. Rare, endemic, threatened, and endangered species of the national park and bioindicators of air pollution (e.g., lichens) are also AQRVs and are evaluated in this section.

8.1.1 General Description

The Everglades National Park is a subtropical preserve located on the southern tip of Florida. The park comprises about 715,000 acres including an estimated 330,000 acres of mangrove and saltmarsh, 366,000 acres of prairie, and 20,000 acres of pineland (Taylor and Herndon, 1981). Small islands of tropical hardwood hammock, evergreen temperate swamp ("bayheads") and cypress swamp are present and are interspersed among the larger vegetation communities.

Most of the coastline is occupied by mangroves. Species present include red mangrove (Rhizophora mangle), black mangrove (Avicennia germinans), and white mangrove (Laguncularia racemosa).

Prairies which are seasonally inundated are the largest vegetation communities in the national park. These wetlands are dominated by sawgrass (Cladium jamaicense), muhlygrass (Muhlenbergia filipes), and/or little bluestem (Schizachyrium rhizomatum). Muhlygrass dominates the drier prairies; sawgrass occurs where the hydroperiod is longer than 5-months. Algal periphyton mats are usually present in these prairies. The predominant soil in the prairies is Marl. Marl is a calcareous substance precipitated by the blue-green algae of the periphyton mats. The algae comprising the periphyton are important primary producers and are dependent upon calcium-rich waters (Gleason and Spackman, 1973). Sawgrass sometimes occurs on pockets of peat within the marl-limestone substrate.

Pinelands occur on limestone (Miami oolite),and have many crevices and solution holes but very little soil development (Loope, et al., 1979). South Florida slash pine (Pinus elliottii var. densa) is the single canopy tree in this vegetation type. The understory, which is diverse, includes tropical hardwoods and herbaceous species endemic to South Florida. Pinelands were once the dominant upland community in South Florida, but very little of this community type remains outside of the national park boundaries.

Hardwood hammocks in the park range up to a few acres in size and number in the thousands. They occur on small areas of ground higher than the surrounding prairie. Dominant species include gumbo-limbo (Bursera simaruba), poisonwood (Metopium toxiferum), buckthorn (Bumelia salicifolia), strangler fig (Ficus aurea), and pigeon-plum (Coccoloba diversifolia). Other important trees and shrubs include myrsine (Myrsine floridana), wild tamarind (Lysiloma latisiliquum), white stopper (Eugenia axillaris), wild coffee (Psychotria nervosa), and marlberry (Ardisia escallonioides). The hardwood hammocks contain numerous tropical plant species not found anywhere else in the United States (Loope and Urban, 1980). Epiphytic orchids and bromeliads are frequent. The hammocks grow on eroded limestone which is covered with a shallow layer of organic soil (Olmsted, et al., 1980).

Temperate swamp hardwoods are found in the areas which are inundated seasonally. These areas are dominated by redbay (Persea borbonia), wax myrtle (Myrica cerifera), sweetbay (Magnolia virigniana), and dahoon (Ilex cassine). Pond apple (Annona glabra), cocoplum Chrysobalanus icaco), and buttonbush (Caphalanthus occidentalis) are in the shrub layer. Ferns are common in the ground layer. Epiphytes include Tillandsia spp. and Encyclia tampensis. Peat forms the substrate which varies in depth from 30 to 200 cm over limestone.

Two types of cyprss, bald cypress (Taxodium distichum) and pond cypress (Taxodium ascendens), occur in the national park. The understory of cypress-dominated communities is typically open and contains many of the same species that are present in the temperate swamp hardwood communities. Ferns usually dominate the groundlayer. Epiphytic vascular plants and lichens are abundant. Again, in these areas peat or peaty marls form the substrate.

Lichens are abundant on the bark of hardwood trees and cypress hammocks, as well as on ornamental trees planted at visitor centers within the park. Lichens are important for their intrinsic functions in the park ecosystem and for their use as bioindicators based on their sensitivity to air pollution. They provide a germination substrate for vascular epiphytes, and serve as food for invertebrates. Some species fix nitrogen. Because lichens are sensitive to air pollution, potential impacts of air pollution on the national park vegetation can be evaluated by comparing predicted pollutant levels in the park to the threshold levels of pollutants known to be injurious to lichens. If projected pollutant levels are below amounts known to adversely impact lichens, then less sensitive vascular plants are very unlikely to be affected.

Vascular epiphytes, many of them threatened or endangered species, are common in tree hammocks. Most of these are orchids (Epidendrum spp., Oncidium spp.) and bromeliads (Catopsis beteroniana, Catopsis nutans, Tillandsia balbisiana eg.). These plants obtain water and essential elements from precipitation and much of their surface area is exposed to airborne contaminants. Therefore, vascular epiphytes may potentially be sensitive to air pollutants.

No plant species in the park are listed by the U.S. Fish and Wildlife Service as threatened or endangered. However, certain species that are either under review for listing by the Fish and Wildlife Service or protected by the State of Florida under the Preservation of Native Flora of Florida Act (Table 8-1) could be present in the park.

Major soil associations found within the national park and their characteristics are summarized in Table 8-2. The soils consist primarily of histosols and shallow entisols over limestone substrate.

Threatened and endangered wildlife species found in the national park are listed in Table 8-3. The primary habitats for each of these species are shown in Table 8-4.

8.1.2 Impacts to Vegetation

One essential plant nutrient is sulfur. Sulfur is usually taken up as sulfate ions from the soil solution through the roots. When sulfur dioxide in the atmosphere enters the foliage through pores in the leaves, it reacts with water in the leaf interior to form sulfite ions. Sulfite ions are highly toxic. They interact with enzymes, compete with normal metabolites, and interfere with a variety of cellular functions (Horsman and Wellburn, 1976). However, sulfite is oxidized to sulfate ions within the leaf, which can then be used by the plant as a nutrient. Small amounts of sulfite may be oxidized before they become toxic to the plant.

Table 8-1. Rare Plants Found to Occur in South Florida Area

SCIENTIFIC NAME	COMMON NAME	USFWS STATUS	FDA STATUS
SPECIAL PLANT			
Asclepias curtissii	Curtiss' milkweed		T
Conradina grandiflora	large-flowered rosemary	UR2	
Ernodea littoralis	beach-creeper		T
Jacquemontia reclinata	beach jacquemontia	UR2	E
Lechea cernua	nodding pinweed	UR2	
Myrcianthes fragrans var simponii	twinberry	UR2	
Okenia hypogaea	burrowing four-o'clock		E
Coccothrinax argentata	silver palm		C
Digitaria gracillima	longleaf crabgrass	UR2	
Epidendrum nocturnum	night-scented orchid		T
Hymenocallis latifolia	broad-leaved spiderlily	UR5	
Remirea maritima	beach-star		E
Tillandsia flexuosa	banded wild-pine		T
Acrostichum aureum	golden leather fern		E
Asplenium dentatum	slender spleenwort		T
Asplenium serratum	bird's nest spleenwort		E
Ophioglossum palmatum	hand fern	UR5	E

Source: Wood, 1988

Table 8-2. Summary of Characteristics of Major Soil Associations Found Within Everglades National Park

Soil Type/Association	Characteristics
Broward-Parkwood-Keri Association	Derived from moderately thin beds of sand over marl or relatively hard limestone. Parkwood soils are underlain by soft marl at somewhat deeper depths; the Keri series is typically comprised of layers of sand and marl within 100 cm from the surface.
Perrine-Ochopee Association	The Perrine series are poorly drained from recent unconsolidated, finely divided calcareous sediments and are generally associated with tidal swamps and marshes. Depth to underlying limestone is 20 to 91 cm. The Ochopee soils are poorly drained and originated from calcareous sands and marl.
Everglades-Brighton-Pamlico Association	Highly organic muck or peat soils formed from decomposition of emergent vegetation that overlie nearly neutral or alkaline sands and sandy clays. Underlain by marl or limestone. Everglades soils are slightly acid to alkaline; Brighton and Pamlico soils tend to be more acidic.
Tidal Marsh-Coastal Beach-Coastal Dunes	Restricted to the periphery of the coast and consists of nearly level salt marshes, coastal beach, and coastal dunes. Tidal exchange and sea salt deposition dominate the ionic balance and pH regime of these systems.
Rockland	Porous limestone through which water flows freely.

Source: Smith, et al., 1973.

Table 8-3. Federal and State Listed Endangered and Threatened Animals in the Everglades National Park

Animals	State	Federal
<u>Mammals</u>		
Florida Panther	End.	End.
Mangrove Fox Squirrel	End.	-
Florida Black Bear	Thr.	-
Everglades Mink	Thr.	-
Manatee	Thr.	End.
<u>Birds</u>		
Wood Stork	End.	-
Everglade Kite	End.	End.
Cape Sable Seaside Sparrow	End.	End.
Peregrine Falcon	End.	End.
Southern Bald Eagle	Thr.	End.
Osprey	Thr.	-
Florida Sandhill Crane	Thr.	-
Brown Pelican	Thr.	End.
Great White Heron	Thr.	-
Southeastern American Kestrel	Thr.	-
<u>Reptiles</u>		
American Crocodile	End.	End.
American Alligator	Thr.	Thr.
Eastern Indigo Snake	Thr.	Thr.

End. = endangered; Thr. = threatened

Table 8-4. Habitat of Federal and State Listed Endangered and Threatened Animals in the Everglades National Park

	HABITAT							
Species	Pine Forest	Tropical Hardwood Forest	Cypress Forest	Evergreen Swamp Forest	Inland Marshes, Ponds, Sloughs	Wet Prairies	Mangrove Forest	Coastal Marshes
<u>Mammals</u>								
Florida Panther	X	X	X	X		X	X	X
Mangrove Fox Squirrel	X	X	X	X		X		
Florida Black Bear	X	X	X	X		X	X	X
Everglades Mink			X	X	X	X		
Manatee							X	
<u>Birds</u>								
Wood Stork			X	X	X	X	X	X
Everglade Kite					X	X		
Cape Sable Seaside Sparrow					X	X		X
Peregrine Falcon	X				X	X	X	X
Southern Bald Eagle	X		X		X		X	X
Osprey	X		X			X	X	X
Florida Sandhill Crane					X	X		X
Brown Pelican							X	X
Great White Heron				X			X	X
Southeastern American Kestrel	X				X	X		
<u>Reptiles</u>								
American Crocodile							X	
American Alligator			X	X	X	X	X	
Eastern Indigo Snake	X	X	X			X	X	

Source: Duever, *et al.*, 1979.

If a plant is subject to long-term exposure to sulfur dioxide, sulfate may accumulate in the leaves because more sulfate is produced than can be utilized by the plant. Reduced yield and other impacts on growth and vigor may result from these chronic, long-term exposures. Frequency of exposure is important. Low doses of sulfur dioxide, followed by long periods of very low or no exposure, may be less damaging than the same total dose received continuously. This is because plants can utilize the accumulated sulfate during the period of no exposure.

Plant species vary widely with regard to the threshold level of pollutants which cause injury or growth reduction. Plant response to sulfur dioxide emissions from the proposed facility will depend upon the concentration of the gas, the duration of each exposure, and the frequency of exposures. Near the Tarmac facility (i.e., within 4 km), the pattern of exposure will consist of a few episodes of relatively high concentration for a short duration interspersed with long periods of extremely low concentrations. At longer distances from the facility, such as within the Class I area, concentrations are generally low for long periods of time.

The maximum predicted 3-hour average SO_2 concentration in the Class I area due to all sources is 193 ug/m^3, (see Table 7-8). The total maximum predicted 24-hour average concentration is 52 ug/m^3, and the annual average concentration is 9.9 ug/m^3. Concentrations which are at or near the maximum levels will occur infrequently during the year and will occur at the eastern border of the national park. Maximum concentrations will decrease with distance to the west of the eastern boundary, since emissions sources lie to the east of the park.

The maximum contribution of Kiln 2 to concentrations in the Class I area are 7.2 ug/m^3, 3-hour, 1.8 ug/m^3, 24-hour, and 0.16 ug/m^3 annual average. These maximum contributions are less than 1 percent of the AAQS for SO_2.

Exposures to SO_2 that have been shown by laboratory tests or field observations to adversely affect plant species that occur, or are similar to those that occur, in the national park are presented in Table 8-5. The most sensitive species are two lichen species that are common in the park, but less abundant in urban areas east of the national park (Ramalina denticulata and Parmotrema tinctorum). Exposures that affect these lichens are much higher than the concentrations and frequencies of SO_2 that will result from the proposed Kiln 2 Coal Conversion. Therefore, no adverse impact to vegetative resources in the national park is expected to result from the coal conversion.

In conclusion, the predicted concentrations of sulfur dioxide resulting from the proposed coal conversion will have no impact on the vegetation of the national park.

8.1.3 Impacts to Soils

Potential and hypothesized effects of atmospheric deposition on soils include: increased soil acidification; alteration in cation exchange; loss of base cations; and mobilization of trace metals. The potential sensitivity of specific soils to atmospheric inputs is related to two factors. First, the physical ability of a soil to conduct water vertically through the soil profile is important. Second, the ability of the soil to resist chemical changes, as measured in terms of pH and soil cation exchange capacity (CEC), is important in determining how a soil responds to atmospheric inputs.

The soils of the national park are generally classified as histosols or entisols. Histosols (or peat soils) are organic and have extremely high buffering capacities based on CEC, base saturation, and bulk density. Therefore, they will be relatively insensitive to atmospheric inputs. The entisols are shallow sandy soils overlying limestone, such as the soils found in the pinelands. The direct connection of these soils with subsurface limestone tends to neutralize any acidic inputs. In addition, the groundwater table is highly buffered due to the interaction with subsurface limestone formations, which results in high alkalinity (as Calcium Carbonate).

Table 8-5. Lowest Doses of SO_2 Reported to Affect Plant Species Common to Site Region

Species	Lowest SO_2 Concentration (ug/m^3) Known to Affect Species	Reference
Parmotrema tinctorum	200, for 6 hours/week for 10 weeks. Increased percent electrolyte leakage. (240, for 3 hours/week for 6 weeks showed no effect on leakage, biomass gain, or photosynthetic rate.	Hart et al., 1988
Ramalina denticulata	400, for 6 hours/week for 10 weeks. Reduced biomass gain, lowered photosyntheitic rate, and increased percent electrolyte leakage in comparison to effects of lower SO_2 concentrations	Hart et al., 1988
Taxodium distichum (bald cypress)	1300, for 48 hours did not affect dry weight gain	Shanklin and Kozlowski; 1985
Pinus elliottii (slash pine)	650, for 2 hours - Reduced needle growth	Berry 1974
Lycopersicon (tomato) escoulentum	1258, for 5 hours on each of 57 days reduced growth	Kohut et al., 1982
C_4 species - Amaranthus retroflexus, Setaria faberii, Setaria lutescens (pigweed) (foxtail grasses)	650 ug/m^3, 8 hours/day for 5 days during 2 weeks. Increased weight at normal CO_2 concentrations	Carlson and Bazzaz, 1982
Lemna spp (duckweed)	390 for 6 weeks reduced growth	Fankhauser et. al., 1976
Orange (citrus)	2,080 for 23 days with 10 day interruption reduced leaf area.	Matsushima and Brewer 1972

The relatively low sensitivity of the soils in the park to acidic deposition, coupled with the extremely low ground-level SO_2 concentrations predicted for the national park, will result in no significant impact on soils in the park.

8.1.4 Impacts to Wildlife

Both physiological and ecological effects to fauna due to gaseous and particulate pollutants have been reported (Newman, 1980; Newman and Schreiber, 1988). The most severe of these effects have been observed at concentrations above the secondary national ambient air quality standards. Physiological and/or behavioral effects have also been observed in experimental animals at concentrations below these standards (see Table 8-6).

The major air quality risk to wildlife in the United States is from continuous exposure to pollutants above the national ambient air quality standards. Risks also occur for wildlife living in the vicinity of an emission source which experiences frequent "upset" or episodic conditions that occur because of malfunctioning of equipment, unique meteorological conditions or during start up emission sources (Newman and Schreiber, 1988). Under these conditions, chronic effects, e.g., particulate contamination or acute effects, such as injury to health, have been observed (Newman, 1980).

The lowest threshold values of SO_2 reported to cause physiological changes in wildlife are shown in Table 8-6. These values are well below the maximum predicted 3-hour and annual average concentrations in the National Park of 193 $\mu g/m^3$, and 9.9 $\mu g/m^3$, respectively. As a result, no significant effects on terrestrial wildlife AQRVs from SO_2 are expected.

No impacts to the Everglades National Park's wildlife or wildlife habitats, including threatened and endangered species, nor to wildlife resources in the vicinity of the Tarmac plant, are expected.

Table 8-6. Examples of Lowest Observed Effect Levels of Air Pollutants on Wildlife

Pollutant	Reported Effect	Concentration (ug/m^3)	Exposure
Sulfur Dioxide	respiratory stress in guinea pigs	427 to 854	1 hour
	respiratory stress in rats	267	7 hours/day;* 5 day/week for 10 weeks
	decreased abundance deer mice	13-157	continually for 5 months**

Source: Adapted from Newman (1981) and Newman and Schreiber (1988).

* Used to compare as a range between 3 hour and 24 hour averaging times.
** Used to compare with annual averaging times.

8.2 IMPACTS TO VISIBILITY

The Clean Air Act Amendments of 1977 provide for implementation of guidelines to prevent visibility impairment in mandatory Class I areas. The guidelines are intended to protect the aesthetic quality of these pristine areas from reduction in visual range and atmospheric discoloration due to various pollutants.

The nearest Class I area is the Everglades National Park, located about 30 km from the Tarmac site. A Level-1 visibility screening analysis was performed to determine the potential adverse visibility effects using the approach suggested in the Workbook for Plume Visual Impact Screening and Analysis (USEPA, 1988). The Level-1 screening model has been computerized by EPA. The user inputs emissions of particulates, NO_x (as NO_2), primary NO_2, soot, and primary SO_4 from the proposed source, along with transport specifications for the particular case (i.e. distance to Class I area, background visual range, meteorological conditions, etc.). Visibility impacts are determined for two parameters:

1) Contrast of a plume against a viewing background such as the sky or a terrain feature.
2) Perceptibility of a plume on the basis of the color difference between the plume and the viewing background (Delta E).

Results are provided by the model for several scenarios based on the background view, the viewing angle, visibility impairment due to plumes located both inside and outside the Class I area, and the sun angle. The critical value for contrast is 0.05 while that for Delta E is 2.00. If these levels are not exceeded by the proposed source, the source passes the Level-1 visibility analysis, and the source will not have a significant impact on the Class I area.

Input parameters and results of the Level-1 analysis for the proposed Lauderdale units are presented in Figure 8-1. As shown, Kiln 2 will emit particulates, NO_x and primary SO_4 (sulfuric acid mist). Emission rates are

```
              Visual Effects Screening Analysis for
                Source: Tarmac Kiln 2
                Class I Area: Everglades NP

                *** Level-1 Screening ***
Input Emissions for

   Particulates    31.30  LB /HR
   NOx (as NO2)   169.30  LB /HR
   Primary NO2       .00  LB /HR
   Soot              .00  LB /HR
   Primary SO4     12.00  LB /HR


     **** Default Particle Characteristics Assumed

              Transport Scenario Specifications:

    Background Ozone:                  .04 ppm
    Background Visual Range:         25.00 km
    Source-Observer Distance:        30.00 km
    Min. Source-Class I Distance:    30.00 km
    Max. Source-Class I Distance:    50.00 km
    Plume-Source-Observer Angle:     11.25 degrees
    Stability:   6
    Wind Speed:   1.00 m/s

                         R E S U L T S

Asterisks (*) indicate plume impacts that exceed screening criteria

         Maximum Visual Impacts INSIDE  Class I Area
          Screening Criteria ARE NOT Exceeded
                                     Delta E      Contrast
                                   ===========  ============
Backgrnd Theta Azi Distance Alpha Crit  Plume   Crit  Plume
======== ===== === ======== ===== ====  =====   ====  =====
 SKY       10.  84.    30.0   84.  2.00  1.500   .05   .004
 SKY      140.  84.    30.0   84.  2.00   .641   .05  -.014
 TERRAIN   10.  84.    30.0   84.  2.00   .896   .05   .012
 TERRAIN  140.  84.    30.0   84.  2.00   .209   .05   .010


         Maximum Visual Impacts OUTSIDE Class I Area
          Screening Criteria ARE NOT Exceeded
                                     Delta E      Contrast
                                   ===========  ============
Backgrnd Theta Azi Distance Alpha Crit  Plume   Crit  Plume
======== ===== === ======== ===== ====  =====   ====  =====
 SKY       10.  65.    28.0  104.  2.00  1.521   .05   .004
 SKY      140.  65.    28.0  104.  2.00   .647   .05  -.015
 TERRAIN   10.  50.    26.2  119.  2.00  1.036   .05   .014
 TERRAIN  140.  50.    26.2  119.  2.00   .250   .05   .012
```

Figure 8-1 VISIBILITY SCREENING RESULTS, TARMAC KILN 2

the same as presented in Table 2-1 for Kiln 2 after conversion to cool. Primary NO_2 and soot are not emitted in significant quantities by fossil fuel combustion sources, and therefore these emissions were set to zero.

The background visual range, as determined for southeast Florida from the Workbook manual, is 25 km. Other parameters input to the model were based upon default values given in the Workbook and incorporated into the computer model.

The values of Delta E and contrast are all less than the screening criteria of 2.00 and 0.05, respectively. As a result, it is highly unlikely that emissions from the proposed coal conversion will cause adverse visibility impairment in the Everglades National Park.

8.3 IMPACTS DUE TO ASSOCIATED GROWTH

Air quality impacts due to general commercial, residential, industrial and other growth associated with the Kiln 2 Coal Conversion would potentially occur during the construction and operational phases. Since Kiln 2 is already in place, construction activities and employment will generate relatively small quantities of air pollutants that can affect air quality. The emissions from construction will be minor, since major earthworks are not necessary. Construction employment requirements are expected to be filled by existing construction and manufacturing workers that would supply the materials necessary for the conversion. The impact of this growth is insignificant relative to the existing population base in the area.

Operational employment would be about 16 personnel added to the current plant staff of 93. The additional employment is expected to originate primarily from the general population growth in the area, which would not be a direct result of the project. Based upon the above considerations, the air quality impact of the proposed project due to additional growth will be minimal.

REFERENCES

Berry, C.R. 1974. Age of pine seedlings with primary needles affects sensitivity to ozone and sulfur dioxide. Phytopathology 64: 207-209.

Carlson, R. W. and E. A. Bazzaz, 1982. Photosynthesis and growth response to fumigation with SO_2 at elevated CO_2 for C_3 and C_4 plants. Oecologia 54: 50-54.

Duever, M.J., J.E. Carlson, J.F. Meeder, L.C. Duever, L.H. Gunderson, L.A. Riopelle, T.R. Alexander, R.L. Myers, and D.P. Spangler, 1979. The Big Cypress National Preserve, Research Report No. 8 of the National Audubon Society, 2nd Printing.

Fankhauser, H., C. Brunold, and K.H. Erismann. 1976. The influence of sublethal concentrations of sulfur dioxide on morphology, growth and product yield of the duckweed Lemna minor L. Oecologia 23: 201-209.

Gleason, P. J. and W. Spackman, Jr., 1974. Calcareous Periphyton and Water Chemistry in the Everglades in Environments of South Florida: Present and Past. ed. Patrick J. Gleason. Miami Geological Society. Miami, Florida. pp.146-181.

Hart, R., P. G. Webb, R. H. Biggs, and K. M. Portier, 1988. The use of lichen fumigation studies to evaluate the effects of new emission sources on Class I areas. Journal Air Pollution Control Association 38: 144-147.

Holzworth, G.C. 1972. Mixing Heights, Wind Speeds and Potential for Urban Air Pollution Throughout the Contiguous United States. Publication No. AP-101. U.S. Environmental Protection Agency.

Kohut, R. J. et al., 1982. The National Crop Loss Assessment Network: A Summary of Field Studies. Paper 82-69.5. Session 69. Presentation at the 75th Annual Meeting of the Air Pollution Control Association.

Loope, L. L. , D. W. Black, S. Black, and G. N. Avery, 1979. Distribution and Abundance of Flora in Limestone Rockland Pine Forests of Southeastern Florida. Report T-547. South Florida Research Center. Everglades National Park, Homestead, Florida.

Matsushima, J. and R.F. Brewer. 1972. Influence of sulfur dioxide and hydrogen fluoride as a mix or reciprocal exposure on citrus growth and development. Journal Air Pollution Control Association 22: 710-713.

Olmsted, I.C., L.L. Loope, and R.E. Rintz, 1980. A Survey and Baseline Analysis of Aspects of the Vegetation of Taylor Slough, Everglades National Park. Report T-586. South Florida Research Center. Everglades National Park. Homestead, Florida 33030.

Shanklin, J. and T. T. Kozlowski, 1985. Effect of flooding of soil on growth and subsequent responses of Taxodium distichum seedlings to SO_2. Environmental Pollution (Series A) 38: 199-212 Smith, 1973.

Taylor, D. L. and A. Herndon, 1981. Impact of 22 Years of Fire on Understory Hardwood Shrubs in Slash Pine Communities within Everglades National Park. Report T-640. South Florida Research Center. Everglades National Park, Homestead, Florida.

Wood, D. A., July, 1987. Official Lists of Endangered and Potentially Endangered Fauna and Flora in Florida. Florida Game and Fresh Water Fish Commission, Tallahassee, Florida.

Appendix A
Reference Materials

EXERPT FROM 1980 PERMIT APPLICATION

KILN 2 COAL CONVERSION

Section V, Item 2 Emission Estimates (continued)

Sulfur Dioxide

Calculations based upon 0.08% SO_3 in raw feed, 2.0% S coal, and 91.3% SO_2 removal inherent in process based upon stack test results.

Coal:

Feed: 81,000 #/hr. x 0.0008 x $\frac{32}{80}$ = 25.92 #S/hr.

Fuel: 15,000 #/hr. x 0.02 = 300.0 #S/hr.

Total Input SO_2: = x 2

651.84 $\#SO_2$/hr.

Maximum emitted = 651.84 x (1 - 0.913) = 56.7 $\#SO_2$/hr.
Annual & Potential = 56.7 #/hr x 8760 hr/yr ÷ 2000 #/ton
= 248.4 TPY

Gas:

Feed: 81,000 #/hr x 0.0008 x $\frac{32}{80}$ = 25.92 #S/hr.
x2
Total Input = 51.84 $\#SO_2$/hr.

Maximum Emitted = 51.84 #/hr x (1 - 0.913) = 4.5 $\#SO_2$/hr.
Annual & Potential = 4.5#/hr x 8760 ÷ 2000 = 19.7 TPY

Oil: Base on recent stack test (June, 1979)

Maximum emitted = 0.2519 #/MM BTu x 180 MM BTu/hr = 45.3 # SO_2/hr
Annual & Potential = 45.3 #/hr x 8760 ÷ 2000 = 198.6 TPY

EXCERPT FROM 1980 PERMIT APPLICATION

KILN 3 COAL CONVERSION

Section V, Item #2: Emission Estimates

Sulfur Dioxide:

Calculation based upon 0.08% SO_3 in raw feed, 2.0% coal and 98.7% SO_2 removal inherent inprocess based upon stack test results.

Coal: based on recent stack test on similar sulfur content oil

Sulfur input:
feed: 283,500 lbs/hr x 0.0008 x 32/80 = 90.72 #/hr
fuel: 46,000 lbs/hr x 0.02 = 920,00 #/hr

1010.72 #/hr. sulfur
Total input: x2
=2021.44 #/hr SO_2

Maximum emitted=2021.44 #/hr x (1-.987) = 26.28 #/hr.
Annual & Potential=26.28 #/hr x 8760 ÷ 2000 = 115.1 TPY

Gas: 283,500 lbs/hr x 0.0008 x 32/80 x 2 x (1-.987) = 2/36 #/hr SO_2
Annual & Potential =2.36 #/hr x 8760 ÷ 2000 = 10.3 TPY

Oil: Based on recent stack test at 2.37% sulfur, #6 fuel oil
0.0397 #/MMBTU x 552 MMBTU/hr. (max.) = 21.9 #/hr
Annual & Potential = 21.9 #/hr x 8760 ÷ 2000 = 95.9 TPY

NO_x TEST DATA

KILN 2 - GAS & OIL

1980

TABLE T-2

MIAMI STACK EMISSION SURVEY
NOX EMISSION RATE - EPA METHOD 7

1980

Run No.	Sample No.	Kiln No.	Fuel Type	Date 1980	Lbs. NO_2 Hr.	Lbs. NO_2 Ton Clnk.	Lbs. NO_2 LB.F.Gas	PPM*
1	1	2	Gas	3-20	211.5	9.95	9.45	435
1	2	2	Gas	3-20	109.1	5.13	4.88	224
1	3	2	Gas	3-20	107.4	5.05	4.80	221
1	4	2	Gas	3-20	101.8	4.79	4.55	209
1	5	2	Gas	3-20	96.7	4.55	4.32	199
1	6	2	Gas	3-20	95.4	4.49	4.26	196
1	7	2	Gas	3-20	91.2	4.29	4.08	188
1	8	2	Gas	3-20	57.1	2.69	2.55	117
1	9	2	Gas	3-20	86.5	4.07	3.87	178
1	10	2	Gas	3-20	89.1	4.19	3.98	183
[illegible]	11	2	Gas	3-20	124.5	5.86	5.56	256
1	12	2	Gas	3-20	35.6	1.68	1.59	73
	AVE.				100.5	4.73	4.49	207
2	1	2	Oil	3-21	148.0	5.92	7.64	353
2	2	2	Oil	3-21	125.8	5.03	6.50	300
2	3	2	Oil	3-21	147.7	5.91	7.63	352
2	4	2	Oil	3-21	140.8	5.63	7.27	336
2	5	2	Oil	3-21	143.7	5.75	7.42	343
2	6	2	Oil	3-21	267.6	10.70	13.82	638
2	7	2	Oil	3-21	252.6	10.10	13.05	602
2	8	2	Oil	3-21	114.1	4.56	5.89	272
2	9	2	Oil	3-21	81.4	3.26	4.20	194
2	10	2	Oil	3-21	141.3	5.65	7.30	337
2	11	2	Oil	3-21	217.8	8.71	11.25	519
2	12	2	Oil	3-21	233.5	9.34	12.00	557
	AVE				167.9	6.71	8.66	400

VOC TESTING

KILN 3

JULY, 1988

Tarmac

TARMAC FLORIDA, INC.
EMISSION TESTS -- KILN NO. 3

< VOC's >

	July 5, 1988 [Background]	August 9, 1988 [Burning Soils]	October 4, 1988 [Burning RDF]
1	59.21	92.04	50.99
2	59.90	72.68	60.28
3	108.50	72.91	35.29
AVERAGE	75.87	79.21	48.85

Tarmac

** PROCESS DATA **

REPORT NO: ____________

COMPANY: Tarmac Florida, Inc. DATE: 7/05/88

SOURCE: Kiln # 3 PERMIT NO: A013-144183

TYPE OF INSTALLATION: Cement Production Plant

TYPE OF MATERIAL PROCESSED: limestone, mineral aggregates

TYPE(s) OF FUEL USED: coal

TYPE OF POLLUTION CONTROL SYSTEM: electrostatic precipitator

GENERAL CONDITION OF CONTROL EQUIPMENT: normal

	RUN 1	RUN 2	RUN 3
FEED RATE (tons/hr):	133.5	133.5	133.5
PRODUCTION RATE (tons/hr):	85.1	85.1	85.1
FUEL RATE (tons/hr):	18.2	18.1	17.9

OPERATING CURRENT: see attached sheet

COMPANY REPRESENTATIVE: Scott Quams

TITLE: Environmental Specialist

SIGNATURE: ____________________

VOC Emission Estimates

1. Baseline Emissions, Kiln 2, gas/oil:

From VOC test on Kiln 3 (7/5/88)

Average VOC emissions = 75.9 lb/hr
Clinker produced = 85.1 TPH
Fuel rate = 18.07 TPH coal

VOC due to coal burning (total organics):

AP-42 factor = 0.10 lb/ton
18.07 TPH x 0.1 lb/ton = 1.81 lb/hr

VOC due to organics in raw feed = 75.9 lb/hr - 1.8 lb/hr
= 74.1 lb/hr

74.1 lb/hr / 85.1 TPH clinker = 0.87 lb/ton clinker

VOC from Kiln 2 due to organics:

25 TPH clinker x 0.87 lb/ton = 21.8 lb/hr

VOC from Kiln 2 due to fuel oil burning:

AP-42 factor = 1.04 lb/1,000 gal
Maximum heat input to Kiln 2 (existing) = 180 x 10^6 Btu/hr
180 x 10^6 Btu/hr / 145,000 Btu/gal = 1,241 gal/hr
1,241 gal/hr x 1.04 lb/1,000 gal = 1.3 lb/hr

Total VOC emissions from Kiln 2 when burning oil:

21.8 lb/hr + 1.3 lb/hr = 23.1 lb/hr

2. Future Emissions, Kiln 2, coal:

VOC due to organics in raw feed:

25 TPH x 0.87 lb/ton = 21.8 lb/hr

VOC due to coal burning:

6.5 TPH coal x 0.10 lb/ton = 0.7 lb/hr

Total VOC:

21.8 lb/hr + 0.7 lb/hr = 22.5 lb/hr
To allow margin of safety, estimate maximum VOC emissions to be 30 lb/hr.
Equivalent lb/ton clinker -
30 lb/hr / 25 TPH = 1.2 lb/ton clinker

EXCERPTS FROM

"AP-42"

AND

"TOXIC AIR POLLUTANT EMISSION FACTORS"

TABLE 8.6-1. UNCONTROLLED EMISSION FACTORS FOR CEMENT MANUFACTURING[a]

EMISSION FACTOR RATING: E

Process	Particulate[b]		Sulfur dioxide[c]								Nitrogen oxides		Lead	
			Mineral source[d]		Gas combustion		Oil combustion		Coal combustion					
	kg/Mg	lb/ton	kg/Mg	lb/ton	kg/Mg	lb/ton	kg/Mg	lb/ton	kg/Mg	lb/ton	kg/Mg	lb/ton	kg/Mg	lb/ton
Dry process kiln	128	256	5.4	10.8	Neg	Neg	2.2S	4.4S	3.6S	7.2S	1.4	2.8	0.06	0.12
Wet process kiln	120	240	5.4	10.8	Neg	Neg	2.2S	4.4S	3.6S	7.2S	1.4	2.8	0.05	0.10
Clinker cooler[e]	4.6	9.2	-	-	-	-	-	-	-	-	-	-	-	-
Dryers, grinders, etc.[f]														
Wet process	16.0	32.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.01	0.02
Dry process	48.0	96.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.02	0.04

[a] References 1-2. Expressed in terms of units of clinker produced, assuming 5% gypsum in finished cement. Includes fuel combustion emissions, which should not be calculated separately. Neg = negligible. S = % sulfur in fuel. Dash = no data. NA = not applicable.

[b] Emission Factor Rating: B

[c] Factors account for reactions with alkaline dust, with no controls. One test series for gas and oil fired wet process kilns, with limited data, suggests that 21-45% of SO_2 can be removed by reactions with the alkaline filter cake, if baghouses are used.

[d] From sulfur in raw materials, which varies with their sources. Factors account for some residual sulfur, because of its alkalinity and affinity for SO_2.

[e] Reference 8. Emission Factor Rating: D.

[f] Expressed in terms of units of cement produced.

TABLE 8.6-3. SIZE SPECIFIC PARTICULATE EMISSION FACTORS FOR CEMENT KILNS[a]

EMISSION FACTOR RATING: D

Particle size (um)	Cumulative mass % < stated size[b]						Cumulative emission factor < stated size[c]											
	Uncontrolled		Dry process kiln with multiclone[d]	Wet process kiln with ESP	Baghouse		Uncontrolled				Dry process with multiclone[d]		Wet process with ESP		Baghouse			
	Wet process kiln	Dry process kiln			Wet process kiln	Dry process kiln	Wet Process		Dry Process						Wet process		Dry process	
							kg/Mg	lb/ton	kg/Mg	lb/ton	kg/Mg	lb/ton	kg/Mg	lb/ton	kg/Mg	lb/ton	kg/Mg	lb/ton
2.5	7.0	18	3.8	64	NA	45	8.4	17	23	46	5.0	10	0.25	0.50	NA	NA	0.073	0.15
5.0	20	NA	14	83	NA	77	24	48	-	-	19	38	0.32	0.64	NA	NA	0.13	0.26
10.0	24	42	24	85	NA	84	29	58	54	108	32	64	0.33	0.66	NA	NA	0.14	0.28
15.0	35	44	31	91	NA	89	43	86	57	114	41	82	0.36	0.72	NA	NA	0.15	0.30
20.0	57	NA	38	98	NA	100	68	136	-	-	49	98	0.39	0.78	NA	NA	0.16	0.32
Total mass emission factor							120[e]	240[e]	128[e]	256[e]	130[f]	260[f]	0.39[f]	0.78[f]	0.57[f]	1.1[f]	0.16[f]	0.32[f]

[a] Reference 8. ESP = electrostatic precipitator. NA = not available. Dash = no data.

[b] Aerodynamic diameter. Percentages rounded to two significant figures.

[c] Expressed as unit weight of particulate/unit weight of clinker produced, assuming 5% gypsum in finished cement. Rounded to two significant figures.

[d] Based on a single test, and should be used with caution.

[e] From Table 8.6-1.

[f] From Table 8.6-2.

TABLE 1.4-1. UNCONTROLLED EMISSION FACTORS FOR NATURAL GAS COMBUSTION[a]

Furnace size & type (10^6 Btu/hr heat input)	Particulate[h]		Sulfur dioxide[c]		Nitrogen oxides[d]		Carbon monoxide[e]		Volatile organics			
									Nonmethane		Methane	
	kg/10^6m^3	lb/10^6 ft^3	kg/10^6m^3	lb/10^6 ft^3	kg/10^6m^3	lb/10^6 ft^3	kg/10^6m^3	lb/10^6 ft^3	kg/10^6m^3	lb/10^6 ft^3	kg/10^6m^3	lb/10^6 ft^3
Utility boilers (> 100)	16 - 80	1 - 5	9.6	0.6	8800[h]	550[h]	640	40	23	1.4	4.8	0.3
Industrial boilers (10 - 100)	16 - 80	1 - 5	9.6	0.6	2240	140	560	35	44	2.8	48	3
Domestic and commercial boilers (< 10)	16 - 80	1 - 5	9.6	0.6	1600	100	320	20	84	5.3	43	2.7

[a] Expressed as weight/volume fuel fired.

[b] References 15-18.

[c] Reference 4. Based on avg. sulfur content of natural gas, 4600 g/10^6 Nm^3 (2000 gr/10^6 scf).

[d] References 4-5, 7-8, 11, 14, 18-19, 21.

[e] Expressed as NO_2. Tests indicate about 95 weight % NO_x is NO_2.

[f] References 4, 7-8, 16, 18, 22-25.

[g] References 16, 18. May increase 10 - 100 times with improper operation or maintenance.

[h] For tangentially fired units, use 4400 kg/10^6 m^3 (275 lb/10^6 ft^3). At reduced loads, multiply factor by load reduction coefficient in Figure 1.4-1. For potential NO_x reductions by combustion modification, see text. Note that NO_x reduction from these modifications will also occur at reduced load conditions.

TABLE 1.3-1. UNCONTROLLED EMISSION FACTORS FOR FUEL OIL COMBUSTION

EMISSION FACTOR RATING: A

Boiler Type[a]	Particulate Matter[b]		Sulfur Dioxide[c]		Sulfur Trioxide		Carbon Monoxide[d]		Nitrogen Oxide[e]		Volatile Organics[f] Nonmethane		Volatile Organics[f] Methane	
	$kg/10^3 l$	$lb/10^3 gal$	$kg/10^3 l$	$lb/10^3 gal$	$kg/10^3 l$	$lb/10^3 gal$	$kg/10^3 l$	$lb/10^3 gal$	$kg/10^3 l$	$lb/10^3 gal$	$kg/10^3 l$	$lb/10^3 gal$	$kg/10^3 l$	$lb/10^3 gal$
Utility Boilers														
Residual Oil	[g]	[g]	19S	157S	0.34S[h]	2.9S[h]	0.6	5	8.0 (12.6)(5)[i]	67 (105)(42)[i]	0.09	0.76	0.03	0.28
Industrial Boilers														
Residual Oil	[g]	[g]	19S	157S	0.24S	2S	0.6	5	6.6[j]	55[j]	0.034	0.28	0.12	1.0
Distillate Oil	0.24	2	17S	142S	0.24S	2S	0.6	5	2.4	20	0.024	0.2	0.006	0.052
Commercial Boilers														
Residual Oil	[g]	[g]	19S	157S	0.24S	2S	0.6	5	6.6	55	0.14	1.13	0.057	0.475
Distillate Oil	0.24	2	17S	142S	0.24S	2S	0.6	5	2.4	20	0.04	0.34	0.026	0.216
Residential Furnaces														
Distillate Oil	0.3	2.5	17S	142S	0.24S	2S	0.6	5	2.2	18	0.085	0.713	0.214	1.78

[a] Boilers can be approximately classified according to their gross (higher) heat rate as shown below:
Utility (power plant) boilers: $>106 \times 10^9$ J/hr ($>100 \times 10^6$ Btu/hr)
Industrial boilers: 10.6×10^9 to 106×10^9 J/hr (10×10^6 to 100×10^6 Btu/hr)
Commercial boilers: 0.5×10^9 to 10.6×10^9 J/hr (0.5×10^6 to 10×10^6 Btu/hr)
Residential furnaces: $<0.5 \times 10^9$ J/hr ($<0.5 \times 10^6$ Btu/hr)

[b] References 3-7 and 24-25. Particulate matter is defined in this section as that material collected by EPA Method 5 (front half catch).

[c] References 1-5. S indicates that the weight % of sulfur in the oil should be multiplied by the value given.

[d] References 3-5 and 8-10. Carbon monoxide emissions may increase by factors of 10 to 100 if the unit is improperly operated or not well maintained.

[e] Expressed as NO_2. References 1-5, 8-11, 17 and 26. Test results indicate that at least 95% by weight of NO_x is NO for all boiler types except residential furnaces, where about 75% is NO.

[f] References 18-21. Volatile organic compound emissions are generally negligible unless boiler is improperly operated or not well maintained, in which case emissions may increase by several orders of magnitude.

[g] Particulate emission factors for residual oil combustion are, on average, a function of fuel oil grade and sulfur content:
Grade 6 oil: 1.25(S) + 0.38 $kg/10^3$ liter [10(S) + 3 $lb/10^3$ gal] where S is the weight % of sulfur in the oil. This relationship is based on 81 individual tests and has a correlation coefficient of 0.65.
Grade 5 oil: 1.25 $kg/10^3$ liter (10 $lb/10^3$ gal)
Grade 4 oil: 0.88 $kg/10^3$ liter (7 $lb/10^3$ gal)

[h] Reference 25.

[i] Use 5 $kg/10^3$ liters (42 $lb/10^3$ gal) for tangentially fired boilers, 12.6 $kg/10^3$ liters (105 $lb/10^3$gal) for vertical fired boilers, and 8.0 $kg/10^3$ liters (67 $lb/10^3$ gal) for all others, at full load and normal (>15%) excess air. Several combustion modifications can be employed for NO_x reduction: (1) limited excess air can reduce NO_x emissions 5-20%, (2) staged combustion 20-40%, (3) using low NO_x burners 20-50%, and (4) ammonia injection can reduce NO_x emissions 40-70% but may increase emissions of ammonia. Combinations of these modifications have been employed for further reductions in certain boilers. See Reference 23 for a discussion of these and other NO_x reducing techniques and their operational and environmental impacts.

[j] Nitrogen oxides emissions from residual oil combustion in industrial and commercial boilers are strongly related to fuel nitrogen content, estimated more accurately by the empirical relationship:
kg $NO_2/10^3$ liters = 2.75 + $50(N)^2$ [lb $NO_2/10^3$gal = 22 + $400(N)^2$] where N is the weight % of nitrogen in the oil. For residual oils having high (>0.5 weight %) nitrogen content, use 15 kg $NO_2/10^3$ liter (120 lb $NO_2/10^3$gal) as an emission factor.

TABLE 1.1-1. EMISSION FACTORS FOR EXTERNAL BITUMINOUS AND SUBBITUMINOUS COAL COMBUSTION[a]

Firing Configuration	Particulate[b]		Sulfur Oxides[c]		Nitrogen Oxides[d]		Carbon Monoxide[e]		Nonmethane VOC[e,f]		Methane[e]	
	kg/Mg	lb/ton	kg/Mg	lb/ton	kg/Mg	lb/ton	kg/Mg	lb/ton	kg/Mg	lb/ton	kg/Mg	lb/ton
Pulverized coal fired												
Dry bottom	5A	10A	19.5S(17.5S)	39S(35S)	10.5(7.5)[g]	21(15)[g]	0.3	0.6	0.04	0.07	0.015	0.03
Wet bottom	3.5A[h]	7A[h]	19.5S(17.5S)	39S(35S)	17	34	0.3	0.6	0.04	0.07	0.015	0.03
Cyclone furnace	1A[h]	2A[h]	19.5S(17.5S)	39S(35S)	18.5	37	0.3	0.6	0.04	0.07	0.015	0.03
Spreader stoker												
Uncontrolled	30[j]	60[j]	19.5S(17.5S)	39S(35S)	7	14	2.5	5	0.04	0.07	0.015	0.03
After multiple cyclone												
With fly ash reinjection from multiple cyclone	8.5	17	19.5S(17.5S)	39S(35S)	7	14	2.5	5	0.04	0.07	0.015	0.03
No fly ash reinjection from multiple cyclone	6	12	19.5S(17.5S)	39S(35S)	7	14	2.5	5	0.04	0.07	0.015	0.03
Overfeed stoker[k]												
Uncontrolled	8[m]	16[m]	19.5S(17.5S)	39S(35S)	3.25	7.5	3	6	0.04	0.07	0.015	0.03
After multiple cyclone	4.5[n]	9[n]	19.5S(17.5S)	39S(35S)	3.25	7.5	3	6	0.04	0.07	0.015	0.03
Underfeed stoker												
Uncontrolled	7.5[p]	15[p]	15.5S	31S	4.75	9.5	5.5	11	0.65	1.3	0.4	0.8
After multiple cyclone	5.5[n]	11[n]	15.5S	31S	4.75	9.5	5.5	11	0.65	1.3	0.4	0.8
Handfired units	7.5	15	15.5S	31S	1.5	3	45	90	5	10	4	8

[a] Factors represent uncontrolled emissions unless otherwise specified and should be applied to coal consumption as fired.

[b] Based on EPA Method 5 (front half catch) as described in Reference 12. Where particulate is expressed in terms of coal ash content, A, factor is determined by multiplying weight % ash content of coal (as fired) by the numerical value preceding the "A". For example, if coal having 8% ash is fired in a dry bottom unit, the particulate emission factor would be 5 x 8, or 40 kg/Mg (80 lb/ton). The "condensible" matter collected in back half catch of EPA Method 5 averages <5% of front half, or "filterable", catch for pulverized coal and cyclone furnaces; 10% for spreader stokers; 15% for other stokers; and 50% for handfired units (References 6, 19, 49).

[c] Expressed as SO_2, including SO_2, SO_3 and gaseous sulfates. Factors in parentheses should be used to estimate gaseous SO_x emissions for subbituminous coal. In all cases, "S" is weight % sulfur content of coal as fired. See Footnote b for example calculation. On average for bituminous coal, 97% of fuel sulfur is emitted as SO_2, and only about 0.7% of fuel sulfur is emitted as SO_3 and gaseous sulfate. An equally small percent of fuel sulfur is emitted as particulate sulfate (References 9, 13). Small quantities of sulfur are also retained in bottom ash. With subbituminous coal generally about 10% more fuel sulfur is retained in the bottom ash and particulate because of the more alkaline nature of the coal ash. Conversion to gaseous sulfate appears about the same as for bituminous coal.

[d] Expressed as NO_2. Generally, 95 - 99 volume % of nitrogen oxides present in combustion exhaust will be in the form of NO, the rest NO_2 (Reference 11). To express factors as NO, multiply by factor of 0.66. All factors represent emission at baseline operation (i.e., 60 - 110% load and no NO_x control measures, as discussed in text).

[e] Nominal values achieveable under normal operating conditions. Values one or two orders of magnitude higher can occur when combustion is not complete.

[f] Nonmethane volatile organic compounds (VOC), expressed as C_2 to C_{16} n-alkane equivalents (Reference 58). Because of limited data on NMVOC available to distinguish the effects of firing configuration, all data were averaged collectively to develop a single average for pulverized coal units, cyclones, spreaders and overfeed stokers.

[g] Parenthetic value is for tangentially fired boilers.

[h] Uncontrolled particulate emissions, when no fly ash reinjection is employed. When control device is installed, and collected fly ash is reinjected to boiler, particulate from boiler reaching control equipment can increase by up to a factor of two.

[j] Accounts for fly ash settling in an economizer, air heater or breeching upstream of control device or stack. (Particulate directly at boiler outlet typically will be twice this level.) Factor should be applied even when fly ash is reinjected to boiler from boiler, air heater or economizer dust hoppers.

[k] Includes traveling grate, vibrating grate and chain grate stokers.

[m] Accounts for fly ash settling in breeching or stack base. Particulate loadings directly at boiler outlet typically can be 50% higher.

[n] See text for discussion of apparently low multiple cyclone control efficiencies, regarding uncontrolled emissions.

[p] Accounts for fly ash settling in breeching downstream of boiler outlet.

11.2.1 UNPAVED ROADS

11.2.1.1 General

Dust plumes trailing behind vehicles traveling on unpaved roads are a familiar sight in rural areas of the United States. When a vehicle travels an unpaved road, the force of the wheels on the road surface causes pulverization of surface material. Particles are lifted and dropped from the rolling wheels, and the road surface is exposed to strong air currents in turbulent shear with the surface. The turbulent wake behind the vehicle continues to act on the road surface after the vehicle has passed.

11.2.1.2 Emissions And Correction Parameters

The quantity of dust emissions from a given segment of unpaved road varies linearly with the volume of traffic. Also, field investigations have shown that emissions depend on correction parameters (average vehicle speed, average vehicle weight, average number of wheels per vehicle, road surface texture and road surface moisture) that characterize the condition of a particular road and the associated vehicle traffic.[1-4]

Dust emissions from unpaved roads have been found to vary in direct proportion to the fraction of silt (particles smaller than 75 micrometers in diameter) in the road surface materials.[1] The silt fraction is determined by measuring the proportion of loose dry surface dust that passes a 200 mesh screen, using the ASTM-C-136 method. Table 11.2.1-1 summarizes measured silt values for industrial and rural unpaved roads.

The silt content of a rural dirt road will vary with location, and it should be measured. As a conservative approximation, the silt content of the parent soil in the area can be used. However, tests show that road silt content is normally lower than in the surrounding parent soil, because the fines are continually removed by the vehicle traffic, leaving a higher percentage of coarse particles.

Unpaved roads have a hard nonporous surface that usually dries quickly after a rainfall. The temporary reduction in emissions because of precipitation may be accounted for by not considering emissions on "wet" days (more than 0.254 millimeters [0.01 inches] of precipitation).

The following empirical expression may be used to estimate the quantity of size specific particulate emissions from an unpaved road, per vehicle kilometer traveled (VKT) or vehicle mile traveled (VMT), with a rating of A:

$$E = k(1.7)\left(\frac{s}{12}\right)\left(\frac{S}{48}\right)\left(\frac{W}{2.7}\right)^{0.7}\left(\frac{w}{4}\right)^{0.5}\left(\frac{365-p}{365}\right) \quad \text{(kg/VKT)} \qquad (1)$$

$$E = k(5.9)\left(\frac{s}{12}\right)\left(\frac{S}{30}\right)\left(\frac{W}{3}\right)^{0.7}\left(\frac{w}{4}\right)^{0.5}\left(\frac{365-p}{365}\right) \quad \text{(lb/VMT)}$$

TABLE 11.2.1-1. TYPICAL SILT CONTENT VALUES OF SURFACE MATERIALS ON INDUSTRIAL AND RURAL UNPAVED ROADS[a]

Industry	Road Use Or Surface Material	Plant Sites	Test Samples	Silt (%, w/w)	
				Range	Mean
Copper smelting	Plant road	1	3	[15.9 - 19.1]	[17.0]
Iron and steel production	Plant road	9	20	4.0 - 16.0	8.0
Sand and gravel processing	Plant road	1	3	[4.1 - 6.0]	[4.8]
Stone quarrying and processing	Plant road	1	5	[10.5 - 15.6]	[14.1]
Taconite mining and processing	Haul road	1	12	[3.7 - 9.7]	[5.8]
	Service road	1	8	[2.4 - 7.1]	[4.3]
Western surface coal mining	Access road	2	2	4.9 - 5.3	5.1
	Haul road	3	21	2.8 - 18	8.4
	Scraper road	3	10	7.2 - 25	17
	Haul road (freshly graded)	2	5	18 - 29	24
Rural roads	Gravel	1	1	NA	[5.0]
	Dirt	2	5	5.8 - 68	28.5
	Crushed limestone	2	8	7.7 - 13	9.6

[a] References 4 - 11. Brackets indicate silt values based on samples from only one plant site. NA = Not available.

where: E = emission factor
k = particle size multiplier (dimensionless)
s = silt content of road surface material (%)
S = mean vehicle speed, km/hr (mph)
W = mean vehicle weight, Mg (ton)
w = mean number of wheels
p = number of days with at least 0.254 mm (0.01 in.) of precipitation per year

The particle size multiplier, k, in Equation 1 varies with aerodynamic particle size range as follows:

Aerodynamic Particle Size Multiplier For Equation 1

$\leq$30 μm	$\leq$15 μm	$\leq$10 μm	$\leq$5 μm	$\leq$2.5 μm
0.80	0.50	0.36	0.20	0.095

The number of wet days per year, p, for the geographical area of interest should be determined from local climatic data. Figure 11.2.1-1 gives the geographical distribution of the mean annual number of wet days per year in the United States.

Equation 1 retains the assigned quality rating if applied within the ranges of source conditions that were tested in developing the equation, as follows:

RANGES OF SOURCE CONDITIONS FOR EQUATION 1

Equation	Road silt content (%, w/w)	Mean vehicle weight		Mean vehicle speed		Mean no. of wheels
		Mg	ton	km/hr	mph	
1	4.3 - 20	2.7 - 142	3 - 157	21 - 64	13 - 40	4 - 13

Also, to retain the quality rating of the equation applied to a specific unpaved road, it is necessary that reliable correction parameter values for the specific road in question be determined. The field and laboratory procedures for determining road surface silt content are given in Reference 4. In the event that site specific values for correction parameters cannot be obtained, the appropriate mean values from Table 11.2.1-1 may be used, but the quality rating of the equation is reduced to B.

Equation 1 was developed for calculation of annual average emissions, and thus, is to be multiplied by annual vehicle distance traveled (VDT). Annual average values for each of the correction parameters are to be substituted into

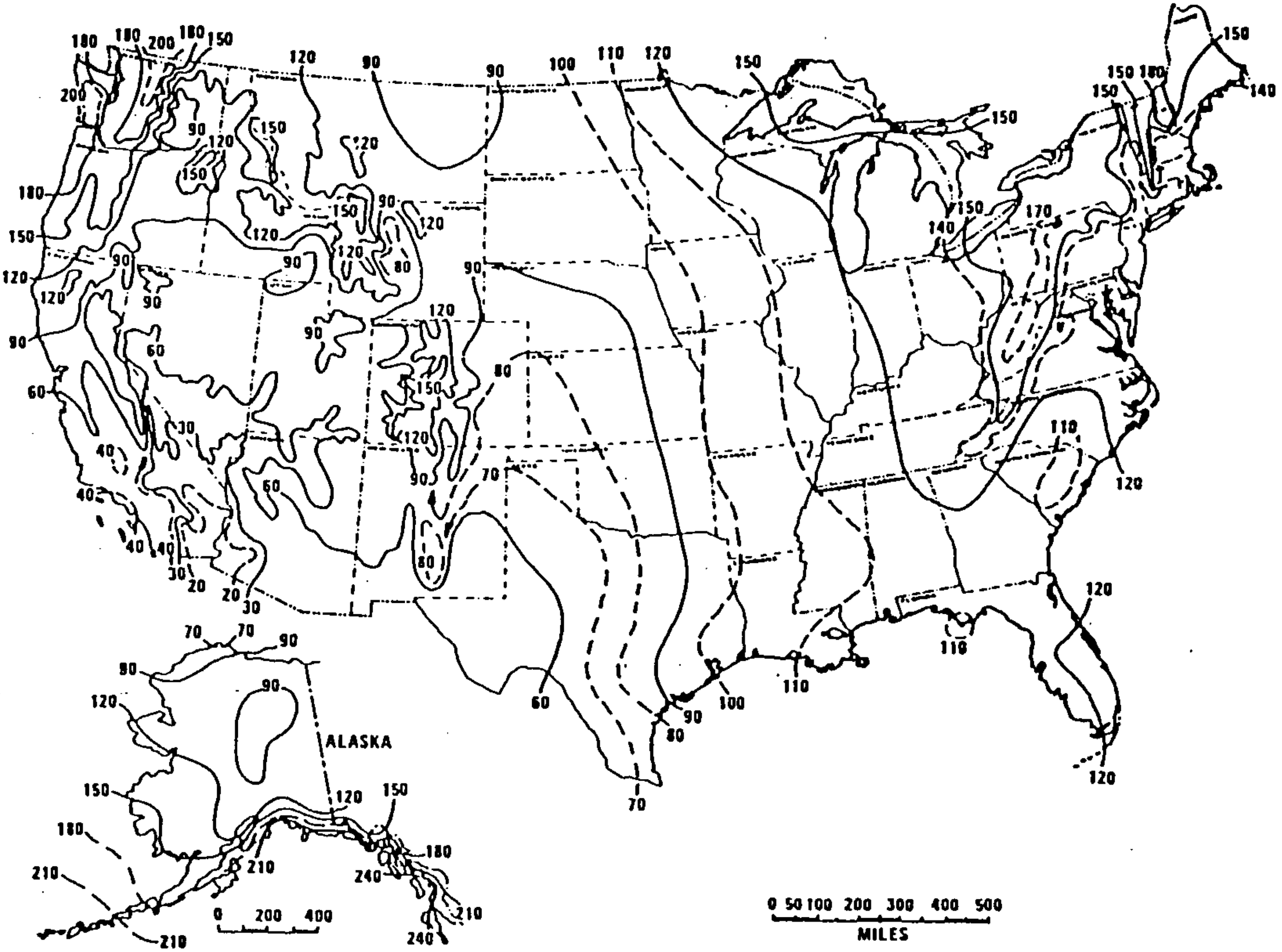

Figure 11.2.1-1. Mean number of days with 0.01 inch or more of precipitation in United States.[10]

the equation. Worst case emissions, corresponding to dry road conditions, may be calculated by setting p = 0 in the equation (which is equivalent to dropping the last term from the equation). A separate set of nonclimatic correction parameters and a higher than normal VDT value may also be justified for the worst case averaging period (usually 24 hours). Similarly, to calculate emissions for a 91 day season of the year using Equation 1, replace the term (365-p)/365 with the term (91-p)/91, and set p equal to the number of wet days in the 91 day period. Also, use appropriate seasonal values for the nonclimatic correction parameters and for VDT.

11.2.1.3 Control Methods

Common control techniques for unpaved roads are paving, surface treating with penetration chemicals, working into the roadbed of chemical stabilization chemicals, watering, and traffic control regulations. Chemical stabilizers work either by binding the surface material or by enhancing moisture retention. Paving, as a control technique, is often not economically practical. Surface chemical treatment and watering can be accomplished with moderate to low costs, but frequent retreatments are required. Traffic controls, such as speed limits and traffic volume restrictions, provide moderate emission reductions but may be difficult to enforce. The control efficiency obtained by speed reduction can be calculated using the predictive emission factor equation given above.

The control efficiencies achievable by paving can be estimated by comparing emission factors for unpaved and paved road conditions, relative to airborne particle size range of interest. The predictive emission factor equation for paved roads, given in Section 11.2.6, requires estimation of the silt loading on the traveled portion of the paved surface, which in turn depends on whether the pavement is periodically cleaned. Unless curbing is to be installed, the effects of vehicle excursion onto shoulders (berms) also must be taken into account in estimating control efficiency.

The control efficiencies afforded by the periodic use of road stabilization chemicals are much more difficult to estimate. The application parameters which determine control efficiency include dilution ratio, application intensity (mass of diluted chemical per road area) and application frequency. Between applications, the control efficiency is usually found to decay at a rate which is proportional to the traffic count. Therefore, for a specific chemical application program, the average efficiency is inversely proportional to the average daily traffic count. Other factors that affect the performance of chemical stabilizers include vehicle characteristics (e. g., average weight) and road characteristics (e. g., bearing strength).

Water acts as a road dust suppressant by forming cohesive moisture films among the discrete grains of road surface material. The average moisture level in the road surface material depends on the moisture added by watering and natural precipitation and on the moisture removed by evaporation. The natural evaporative forces, which vary with geographic location, are enhanced by the movement of traffic over the road surface. Watering, because of the frequency of treatments required, is generally not feasible for public roads and is used effectively only where water and watering equipment are available and where roads are confined to a single site, such as a construction location.

References for Section 11.2.1

1. C. Cowherd, Jr., et al., Development of Emission Factors for Fugitive Dust Sources, EPA-450/3-74-037, U. S. Environmental Protection Agency, Research Triangle Park, NC, June 1974.

2. R. J. Dyck and J. J. Stukel, "Fugitive Dust Emissions from Trucks on Unpaved Roads", Environmental Science and Technology, 10(10):1046-1048, October 1976.

3. R. O. McCaldin and K. J. Heidel, "Particulate Emissions from Vehicle Travel over Unpaved Roads", Presented at the 71st Annual Meeting of the Air Pollution Control Association, Houston, TX, June 1978.

4. C. Cowherd, Jr., et al., Iron and Steel Plant Open Dust Source Fugitive Emission Evaluation, EPA-600/2-79-103, U. S. Environmental Protection Agency, Research Triangle Park, NC, May 1979.

5. R. Bohn, et al., Fugitive Emissions from Integrated Iron and Steel Plants, EPA-600/2-78-050, U. S. Environmental Protection Agency, Research Triangle Park, NC, March 1978.

6. R. Bohn, Evaluation of Open Dust Sources in the Vicinity of Buffalo, New York, U. S. Environmental Protection Agency, New York, NY, March 1979.

7. C. Cowherd, Jr., and T. Cuscino, Jr., Fugitive Emissions Evaluation, Equitable Environmental Health, Inc., Elmhurst, IL, February 1977.

8. T. Cuscino, Jr., et al., Taconite Mining Fugitive Emissions Study, Minnesota Pollution Control Agency, Roseville, MN, June 1979.

9. K. Axetell and C. Cowherd, Jr., Improved Emission Factors for Fugitive Dust from Western Surface Coal Mining Sources, 2 Volumes, EPA Contract No. 68-03-2924, PEDCo Environmental, Inc., Kansas City, MO, July 1981.

10. T. Cuscino, Jr., et al., Iron and Steel Plant Open Source Fugitive Emission Control Evaluation, EPA-600/2-83-110, U. S. Environmental Protection Agency, Research Triangle Park, NC, October 1983.

11. J. Patrick Reider, Size Specific Emission Factors for Uncontrolled Industrial and Rural Roads, EPA Contract No. 68-02-3158, Midwest Research Institute, Kansas City, MO, September 1983.

12. C. Cowherd, Jr., and P. Englehart, Size Specific Particulate Emission Factors for Industrial and Rural Roads, EPA-600/7-85-038, U. S. Environmental Protection Agency, Research Triangle Park, NC, September 1985.

13. Climatic Atlas of the United States, U. S. Department of Commerce, Washington, DC, June 1968.

11.2.3 AGGREGATE HANDLING AND STORAGE PILES

11.2.3.1 General

Inherent in operations that use minerals in aggregate form is the maintenance of outdoor storage piles. Storage piles are usually left uncovered, partially because of the need for frequent material transfer into or out of storage.

Dust emissions occur at several points in the storage cycle, during material loading onto the pile, during disturbances by strong wind currents, and during loadout from the pile. The movement of trucks and loading equipment in the storage pile area is also a substantial source of dust.

11.2.3.2 Emissions and Correction Parameters

The quantity of dust emissions from aggregate storage operations varies with the volume of aggregate passing through the storage cycle. Also, emissions depend on three correction parameters that characterize the condition of a particular storage pile: age of the pile, moisture content and proportion of aggregate fines.

When freshly processed aggregate is loaded onto a storage pile, its potential for dust emissions is at a maximum. Fines are easily disaggregated and released to the atmosphere upon exposure to air currents from aggregate transfer itself or high winds. As the aggregate weathers, however, potential for dust emissions is greatly reduced. Moisture causes aggregation and cementation of fines to the surfaces of larger particles. Any significant rainfall soaks the interior of the pile, and the drying process is very slow.

Field investigations have shown that emissions from aggregate storage operations vary in direct proportion to the percentage of silt (particles < 75 μm in diameter) in the aggregate material.[1 3] The silt content is determined by measuring the proportion of dry aggregate material that passes through a 200 mesh screen, using ASTM-C-136 method. Table 11.2.3-1 summarizes measured silt and moisture values for industrial aggregate materials.

11.2.3.3 Predictive Emission Factor Equations

Total dust emissions from aggregate storage piles are contributions of several distinct source activities within the storage cycle:

1. Loading of aggregate onto storage piles (batch or continuous drop operations).
2. Equipment traffic in storage area.
3. Wind erosion of pile surfaces and ground areas around piles.
4. Loadout of aggregate for shipment or for return to the process stream (batch or continuous drop operations).

TABLE 11.2.3-1. TYPICAL SILT AND MOISTURE CONTENT VALUES OF MATERIALS AT VARIOUS INDUSTRIES

Industry	Material	Silt (%)			Moisture (%)		
		No. of test samples	Range	Mean	No. of test samples	Range	Mean
Iron and steel production[a]	Pellet ore	10	1.4 - 13	4.9	8	0.64 - 3.5	2.1
	Lump ore	9	2.8 - 19	9.5	6	1.6 - 8.1	5.4
	Coal	7	2 - 7.7	5	6	2.8 - 11	4.8
	Slag	3	3 - 7.3	5.3	3	0.25 - 2.2	0.92
	Flue dust	2	14 - 23	18.0	0	NA	NA
	Coke breeze	1		5.4	1		6.4
	Blended ore	1		15.0	1		6.6
	Sinter	1		0.7	0	NA	NA
	Limestone	1		0.4	0	NA	NA
Stone quarrying and processing[b]	Crushed limestone	2	1.3 - 1.9	1.6	2	0.3 - 1.1	0.7
Taconite mining and processing[c]	Pellets	9	2.2 - 5.4	3.4	7	0.05 - 2.3	0.96
	Tailings	2	NA	11.0	1		0.35
Western surface coal mining[d]	Coal	15	3.4 - 16	6.2	7	2.8 - 20	6.9
	Overburden	15	3.8 - 15	7.5	0	NA	NA
	Exposed ground	3	5.1 - 21	15.0	3	0.8 - 6.4	3.4

[a] References 2-5. NA = not applicable.
[b] Reference 1.
[c] Reference 6.
[d] Reference 7.

Adding aggregate material to a storage pile or removing it usually involves dropping the material onto a receiving surface. Truck dumping on the pile or loading out from the pile to a truck with a front end loader are examples of batch drop operations. Adding material to the pile by a conveyor stacker is an example of a continuous drop operation.

The quantity of particulate emissions generated by a batch drop operation, per ton of material transferred, may be estimated, with a rating of C, using the following empirical expression[2]:

$$E = k(0.00090)\ \frac{\left(\frac{s}{5}\right)\left(\frac{U}{2.2}\right)\left(\frac{H}{1.5}\right)}{\left(\frac{M}{2}\right)^2\left(\frac{Y}{4.6}\right)^{0.33}}\quad (\text{kg/Mg}) \qquad (1)$$

$$E = k(0.0018)\ \frac{\left(\frac{s}{5}\right)\left(\frac{U}{5}\right)\left(\frac{H}{5}\right)}{\left(\frac{M}{2}\right)^2\left(\frac{Y}{6}\right)^{0.33}}\quad (\text{lb/ton})$$

where: E = emission factor
k = particle size multipler (dimensionless)
s = material silt content (%)
U = mean wind speed, m/s (mph)
H = drop height, m (ft)
M = material moisture content (%)
Y = dumping device capacity, m^3 (yd^3)

The particle size multipler (k) for Equation 1 varies with aerodynamic particle size, shown in Table 11.2.3-2.

TABLE 11.2.3-2. AERODYNAMIC PARTICLE SIZE MULTIPLIER (k) FOR EQUATIONS 1 AND 2

Equation	< 30 µm	< 15 µm	< 10 µm	< 5 µm	< 2.5 µm
Batch drop	0.73	0.48	0.36	0.23	0.13
Continuous drop	0.77	0.49	0.37	0.21	0.11

The quantity of particulate emissions generated by a continuous drop operation, per ton of material transferred, may be estimated, with a rating of C, using the following empirical expression[3]:

TABLE 11.2.3-1. TYPICAL SILT AND MOISTURE CONTENT VALUES OF MATERIALS AT VARIOUS INDUSTRIES

Industry	Material	Silt (%)			Moisture (%)		
		No. of test samples	Range	Mean	No. of test samples	Range	Mean
Iron and steel production[a]	Pellet ore	10	1.4 - 13	4.9	8	0.64 - 3.5	2.1
	Lump ore	9	2.8 - 19	9.5	6	1.6 - 8.1	5.4
	Coal	7	2 - 7.7	5	6	2.8 - 11	4.8
	Slag	3	3 - 7.3	5.3	3	0.25 - 2.2	0.92
	Flue dust	2	14 - 23	18.0	0	NA	NA
	Coke breeze	1		5.4	1		6.4
	Blended ore	1		15.0	1		6.6
	Sinter	1		0.7	0	NA	NA
	Limestone	1		0.4	0	NA	NA
Stone quarrying and processing[b]	Crushed limestone	2	1.3 - 1.9	1.6	2	0.3 - 1.1	0.7
Taconite mining and processing[c]	Pellets	9	2.2 - 5.4	3.4	7	0.05 - 2.3	0.96
	Tailings	2	NA	11.0	1		0.35
Western surface coal mining[d]	Coal	15	3.4 - 16	6.2	7	2.8 - 20	6.9
	Overburden	15	3.8 - 15	7.5	0	NA	NA
	Exposed ground	3	5.1 - 21	15.0	3	0.8 - 6.4	3.4

[a] References 2-5. NA = not applicable.
[b] Reference 1.
[c] Reference 6.
[d] Reference 7.

$$E = k(0.00090)\,\frac{\left(\frac{s}{5}\right)\left(\frac{U}{2.2}\right)\left(\frac{H}{3.0}\right)}{\left(\frac{M}{2}\right)^2}\quad (\text{kg/Mg}) \qquad (2)$$

$$E = k(0.0018)\,\frac{\left(\frac{s}{5}\right)\left(\frac{U}{5}\right)\left(\frac{H}{10}\right)}{\left(\frac{M}{2}\right)^2}\quad (\text{lb/ton})$$

where: E = emission factor
k = particle size multiplier (dimensionless)
s = material silt content (%)
U = mean wind speed, m/s (mph)
H = drop height, m (ft)
M = material moisture content (%)

The particle size multiplier (k) for Equation 2 varies with aerodynamic particle size, as shown in Table 11.2.3-2.

Equations 1 and 2 retain the assigned quality rating if applied within the ranges of source conditions that were tested in developing the equations, as given in Table 11.2.3-3. Also, to retain the quality ratings of Equations 1 or 2 applied to a specific facility, it is necessary that reliable correction parameters be determined for the specific sources of interest. The field and laboratory procedures for aggregate sampling are given in Reference 3. In the event that site specific values for correction parameters cannot be obtained, the appropriate mean values from Table 11.2.3-1 may be used, but in that case, the quality ratings of the equations are reduced by one level.

TABLE 11.2.3-3. RANGES OF SOURCE CONDITIONS FOR EQUATIONS 1 AND 2[a]

Equation	Silt content (%)	Moisture content (%)	Dumping capacity		Drop height	
			m^3	yd^3	m	ft
Batch drop	1.3 - 7.3	0.25 - 0.70	2.10 - 7.6	2.75 - 10	NA	NA
Continuous drop	1.4 - 19	0.64 - 4.8	NA	NA	1.5 - 12	4.8 - 39

[a] NA = not applicable.

For emissions from equipment traffic (trucks, front end loaders, dozers, etc.) traveling between or on piles, it is recommended that the equations for vehicle traffic on unpaved surfaces be used (see Section 11.2.1). For vehicle travel between storage piles, the silt value(s) for the areas among the piles (which may differ from the silt values for the stored materials) should be used.

For emissions from wind erosion of active storage piles, the following total suspended particulate (TSP) emission factor equation is recommended:

$$E = 1.9 \left(\frac{s}{1.5}\right) \left(\frac{365-p}{235}\right) \left(\frac{f}{15}\right) \text{ (kg/day/hectare)} \qquad (3)$$

$$E = 1.7 \left(\frac{s}{1.5}\right) \left(\frac{365-p}{235}\right) \left(\frac{f}{15}\right) \text{ (lb/day/acre)}$$

where: E = total suspended particulate emission factor
s = silt content of aggregate (%)
p = number of days with $\geqq 0.25$ mm (0.01 in.) of precipitation per year
f = percentage of time that the unobstructed wind speed exceeds 5.4 m/s (12 mph) at the mean pile height

The coefficient in Equation 3 is taken from Reference 1, based on sampling of emissions from a sand and gravel storage pile area during periods when transfer and maintenance equipment was not operating. The factor from Test Report 1, expressed in mass per unit area per day, is more reliable than the factor expressed in mass per unit mass of material placed in storage, for reasons stated in that report. Note that the coefficient has been halved to adjust for the estimate that the wind speed through the emission layer at the test site was one half of the value measured above the top of the piles. The other terms in this equation were added to correct for silt, precipitation and frequency of high winds, as discussed in Reference 2. Equation 3 is rated C for application in the sand and gravel industry and D for other industries.

Worst case emissions from storage pile areas occur under dry windy conditions. Worst case emissions from materials handling (batch and continuous drop) operations may be calculated by substituting into Equations 1 and 2 appropriate values for aggregate material moisture content and for anticipated wind speeds during the worst case averaging period, usually 24 hours. The treatment of dry conditions for vehicle traffic (Section 11.2.1) and for wind erosion (Equation 3), centering around parameter p, follows the methodology described in Section 11.2.1. Also, a separate set of nonclimatic correction parameters and source extent values corresponding to higher than normal storage pile activity may be justified for the worst case averaging period.

11.2.3.4 Control Methods

Watering and chemical wetting agents are the principal means for control of aggregate storage pile emissions. Enclosure or covering of inactive piles to reduce wind erosion can also reduce emissions. Watering is useful mainly to reduce emissions from vehicle traffic in the storage pile area. Watering of the storage piles themselves typically has only a very temporary slight effect on total emissions. A much more effective technique is to apply chemical wetting agents for better wetting of fines and longer retention of the moisture film. Continuous chemical treatment of material loaded onto piles, coupled with watering or treatment of roadways, can reduce total particulate emissions from aggregate storage operations by up to 90 percent.[8]

References for Section 11.2.3

1. C. Cowherd, Jr., et al., Development of Emission Factors for Fugitive Dust Sources, EPA-450/3-74-037, U. S. Environmental Protection Agency, Research Triangle Park, NC, June 1974.

2. R. Bohn, et al., Fugitive Emissions from Integrated Iron and Steel Plants, EPA-600/2-78-050, U. S. Environmental Protection Agency, Research Triangle Park, NC, March 1978.

3. C. Cowherd, Jr., et al., Iron and Steel Plant Open Dust Source Fugitive Emission Evaluation, EPA-600/2-79-103, U. S. Environmental Protection Agency, Research Triangle Park, NC, May 1979.

4. R. Bohn, Evaluation of Open Dust Sources in the Vicinity of Buffalo, New York, U. S. Environmental Protection Agency, New York, NY, March 1979.

5. C. Cowherd, Jr., and T. Cuscino, Jr., Fugitive Emissions Evaluation, Equitable Environmental Health, Inc., Elmhurst, IL, February 1977.

6. T. Cuscino, et al., Taconite Mining Fugitive Emissions Study, Minnesota Pollution Control Agency, Roseville, MN, June 1979.

7. K. Axetell and C. Cowherd, Jr., Improved Emission Factors for Fugitive Dust from Western Surface Coal Mining Sources, 2 Volumes, EPA Contract No. 68-03-2924, PEDCo Environmental, Inc., Kansas City, MO, July 1981.

8. G. A. Jutze, et al., Investigation of Fugitive Dust Sources Emissions and Control, EPA-450/3-74-036a, U. S. Environmental Protection Agency, Research Triangle Park, NC, June 1974.

CLIMATES OF THE STATES

National Oceanic and Atmospheric Administration
Narrative Summaries, Tables, and Maps
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Second Edition

New Material by
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Volume 1

Alabama — North Dakota

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TABLE 2.2-1

ANNUAL PERCENTAGE FREQUENCY OF WIND BY SPEED GROUPS AND THE MEAN SPEED

STATE AND STATION	0 - 3 m.p.h.	4 - 7 m.p.h.	8 - 12 m.p.h.	13 - 18 m.p.h.	19 - 24 m.p.h.	25 - 31 m.p.h.	32 - 38 m.p.h.	39 - 46 m.p.h.	47 m.p.h. and over	Mean speed m.p.h.
ALA. Birmingham	27	22	30	17	3	1	•	•	•	7.9
Mobile	7	28	38	20	6	1	•	•	•	10.0
Montgomery	31	29	27	12	2	•	•			6.9
ALASKA, Anchorage	28	35	25	11	2	•	•	•		6.8
Cold Bay	4	9	18	27	21	14	5	2	•	17.4
Fairbanks	40	35	19	5	1	•	•	•		5.2
King Salmon	11	20	30	24	10	4	1	•	•	11.4
ARIZ. Phoenix	38	36	20	5	1	•	•	•		5.4
Tucson	18	35	30	14	3	1	•	•		8.1
ARK. Little Rock	12	30	39	16	2	•	•	•		8.7
CALIF. Bakersfield	35	30	24	10	1	•	•			5.8
Burbank	52	26	18	4	1	•	•	•		4.5
Fresno	30	41	22	7	1	•	•			6.1
Los Angeles	28	33	27	11	1	•	•			6.8
Oakland	26	28	28	16	2	1	•	•	•	7.5
Sacramento	15	28	31	16	5	1	•	•	•	9.3
San Diego	28	38	28	6	•	•	•			8.3
San Francisco	16	21	26	22	11	3	•	•	•	10.6
COLO. Colorado Springs	9	27	38	19	6	2	•	•	•	10.0
Denver	11	27	34	22	5	2	•	•	•	10.0
CONN. Hartford	13	26	32	24	6	1	•	•	•	9.8
D.C. Washington	11	26	35	22	5	1	•	•	•	9.7
DEL. Wilmington	15	31	30	19	4	1	•	•	•	8.8
FLA. Jacksonville	10	33	35	18	3	•	•	•		8.9
Miami	14	30	34	20	2	•	•	•	•	8.8
Orlando	18	28	32	17	4	•	•	•		8.6
Tallahassee	33	36	23	7	•	•				6.1
Tampa	9	31	40	16	2	•	•	•	•	8.8
West Palm Beach	9	22	36	27	6	1	•	•		10.5
GA. Atlanta	13	24	36	21	6	1	•	•		9.7
Augusta	36	29	25	9	1	•	•			6.3
Macon	10	26	46	16	2	•	•	•	•	8.9
Savannah	12	34	37	14	3	•	•	•	•	8.4
HAWAII, Hilo	7	34	43	15	2	•	•			8.7
Honolulu	9	17	27	32	12	2	•	•	•	12.1
IDAHO, Boise	15	30	32	18	4	1	•	•		8.9
ILL. Chicago (O'Hare)	8	22	33	27	8	2	•	•	•	11.2
Chicago (Midway)	7	26	36	25	5	1	•	•	•	10.2
Moline	14	23	32	24	7	2	•	•	•	10.0
Springfield	7	22	28	27	12	3	1	•	•	12.0
IND. Evansville	19	23	32	21	5	1	•	•		9.1
Fort Wayne	9	23	33	25	8	2	•	•	•	10.9
Indianapolis	9	22	34	26	7	2	•	•	•	10.8
South Bend	7	21	35	30	7	1	•	•		10.9
IOWA, Des Moines	3	17	38	29	10	3	1	•	•	12.1
Sioux City	10	20	31	25	10	4	1	•	•	11.7

STATE AND STATION	0 - 3 m.p.h.	4 - 7 m.p.h.	8 - 12 m.p.h.	13 - 18 m.p.h.	19 - 24 m.p.h.	26 - 31 m.p.h.	32 - 38 m.p.h.	39 - 46 m.p.h.	47 m.p.h. and over	Mean speed m.p.h.
KANS. Topeka	11	19	30	27	10	2	•	•	•	11.2
Wichita	4	12	30	31	16	5	1	•	•	13.7
KY. Lexington	8	25	39	22	6	1	•	•		10.1
Louisville	17	28	31	20	3	1	•	•		8.8
LA. Baton Rouge	17	29	34	17	3	•	•	•		8.3
Lake Charles	19	31	29	17	4	1	•	•	•	8.5
New Orleans	16	27	32	19	5	1	•	•	•	9.0
Shreveport	12	26	37	21	4	1	•	•	•	9.5
MAINE, Portland	10	30	33	22	4	1	•	•	•	9.6
MD. Baltimore	7	24	39	22	6	2	•	•	•	10.4
MASS. Boston	3	12	33	35	12	4	1	•	•	13.3
MICH. Detroit (City AP)	8	23	37	26	5	1	•	•	•	10.3
Flint	16	26	32	22	3	1	•	•	•	9.0
Grand Rapids	14	23	32	25	5	1	•	•	•	9.8
MINN. Duluth	6	15	33	31	11	4	1	•	•	12.6
Minneapolis	8	21	34	28	9	2	•	•	•	11.2
MISS. Jackson	33	25	26	14	2	•	•	•		7.1
MO. Kansas City	9	29	35	23	5	1	•			9.8
St. Louis	10	29	36	21	3	1	•	•	•	9.3
Springfield	4	13	34	32	13	3	1	•	•	12.9
MONT. Great Falls	7	19	24	24	15	9	3	1	•	13.9
NEBR. Omaha	12	17	29	28	11	3	•	•		11.6
NEV. Las Vegas	18	28	25	20	8	3	1	•	•	9.7
Reno	52	20	13	10	4	1	•	•	•	5.9
N. J. Newark	11	25	34	24	5	1	•	•	•	9.8
N. MEX. Albuquerque	17	36	28	13	5	2	•	•	•	8.6
N. Y. Albany	23	24	27	21	4	1	•	•		8.6
Binghamton	11	23	33	25	5	1	•	•	•	10.0
Buffalo	5	17	34	27	13	3	1	•	•	12.4
New York (Kennedy)	6	17	35	28	10	3	•	•	•	12.0
New York (La Guardia)	6	15	30	31	12	4	1	•	•	12.9
Rochester	8	22	34	25	9	2	1	•	•	11.2
Syracuse	14	27	30	23	5	1	•	•	•	9.7
N. C. Charlotte	20	32	31	14	2	•	•	•		7.9
Greensboro	20	32	31	14	2	•	•	•	•	8.0
Raleigh	18	33	34	14	2	•	•	•	•	7.7
Winston-Salem	19	22	33	21	4	1	•	•		9.0
N. DAK. Bismarck	14	20	27	24	12	3	1	•	•	11.2
Fargo	4	13	28	31	15	7	2	•	•	14.4
OHIO, Akron-Canton	7	25	35	26	5	1	•	•	•	10.4
Cincinnati	11	27	36	22	4	1	•	•	•	9.6
Cleveland	7	18	35	29	9	2	•	•	•	11.6
Columbus	26	23	29	18	4	1	•	•	•	8.2
Dayton	8	25	36	23	6	2	•	•	•	10.3
Youngstown	7	28	36	24	6	1	•	•	•	10.3
OKLA. Oklahoma City	2	11	34	34	13	6	1	•	•	14.0

STATE AND STATION	0 - 3 m.p.h.	4 - 7 m.p.h.	8 - 12 m.p.h.	13 - 18 m.p.h.	19 - 24 m.p.h.	25 - 31 m.p.h.	32 - 38 m.p.h.	39 - 46 m.p.h.	47 m.p.h. and over	Mean speed m.p.h.
OKLA. (Cont.) Tulsa	9	24	34	28	7	1	•	•	•	10.6
OREG. Medford	47	31	14	6	2	•	•	•	•	4.6
Portland	28	27	25	16	4	1	•	•	•	7.7
Salem	25	32	28	13	2	•	•			7.1
PA. Harrisburg	28	31	25	13	3	1	•	•		7.3
Philadelphia	11	27	35	21	5	1	•	•	•	9.6
Pittsburgh	12	26	34	22	4	1	•	•		9.4
Scranton	11	33	35	18	2	•	•	•		8.8
R. I. Providence	11	20	32	28	7	2	•	•	•	10.7
S. C. Charleston	12	28	35	19	4	1	•	•		9.2
Columbia	25	35	26	12	2	•	•			7.0
S. DAK. Huron	10	18	29	29	10	3	1	•	•	11.9
Rapid City	15	22	28	21	10	4	1	•	•	11.0
TENN. Chattanooga	39	25	24	11	1	•	•			6.1
Knoxville	29	29	25	12	4	1	•	•	•	7.5
Memphis	14	26	34	20	5	1	•	•		9.4
Nashville	27	31	25	14	2	•	•	•	•	7.2
TEX. Amarillo	5	15	32	32	12	4	1	•	•	12.9
Austin	13	25	34	23	5	1	•	•		9.7
Brownsville	10	17	25	30	14	3	•	•	•	12.3
Corpus Christi	11	16	26	33	12	2	•	•		11.9
Dallas	9	21	32	28	9	1	•	•		11.0
El Paso	10	22	32	22	9	4	1	•	•	11.3
Ft. Worth	4	14	34	34	10	3	•	•	•	12.5
Galveston	4	13	39	33	10	2	1	•	•	12.5
Houston	6	18	36	28	10	2	•	•	•	11.8
Laredo	6	15	32	34	12	1	•	•		12.3
Lubbock	4	11	33	34	13	5	1	•	•	13.6
Midland	9	22	38	26	4	1	•	•		10.1
San Antonio	18	23	32	22	4	1	•	•		9.3
Waco	3	14	36	35	10	2	•	•		12.5
Wichita Falls	5	22	41	27	5	1	•	•	•	10.5
UTAH, Salt Lake City	12	33	36	14	4	1	•	•	•	8.7
VT. Burlington	24	24	28	22	2	•	•			8.3
VA. Norfolk	14	23	30	25	6	1	•	•	•	10.2
Richmond	14	37	36	11	1	•	•	•		7.8
Roanoke	31	22	23	17	5	2	•	•		8.3
WASH. Seattle-Tacoma AP	13	16	35	26	8	2	•	•	•	10.7
Spokane	17	38	27	14	3	1	•	•		8.1
W. VA. Charleston	29	37	25	8	1	•	•			6.2
WIS. Green Bay	8	22	32	26	10	2	•	•	•	11.2
Madison	15	22	30	23	7	2	•	•	•	10.1
Milwaukee	8	17	31	30	11	3	1	•	•	12.1
WYO. Casper	8	16	27	27	13	7	2	•	•	13.3
PACIFIC, Wake Island	1	6	27	48	17	2	•	•		14.6
P. R. San Juan	13	28	27	25	4	•	•	•	•	9.1

Source: Climatography of the United States Series 82; Decennial Census of the United States Climate -- Summary of Hourly Observations, 1951-60 (Table B)

PB89-135644

Toxic Air Pollutant Emission Factors
A Compilation for Selected Air Toxic Compounds and Sources

Radian Corp., Research Triangle Park, NC

Prepared for

Environmental Protection Agency
Research Triangle Park, NC

Oct 88

U.S. DEPARTMENT OF COMMERCE
National Technical Information Service
NTIS

INDUSTRIAL PROCESS	SIC CODE	EMISSION SOURCE	SCC	POLLUTANT	CAS NUMBER	EMISSION FACTOR	NOTES	REFERENCE
process								
Cement manufacture - wet process	3241	Raw mill	305006	Cadmium	7440439	2 x 10E-5 lb/ton feed	Controlled with baghouse	38
Cement manufacture - wet process	3241	Clinker cooler	305006	Cadmium	7440439	1 x 10E-5 lb/ton feed	Controlled with ESP or baghouse	38
Cement manufacture - wet process	3241	Dryers and grinders	305007	Manganese	7439965	16 lb/10E3 tons cement produced	Uncontrolled, calculated based on engineering judgement	107
Cement manufacture - wet process	3241	Kilns	30500706	Manganese	7439965	114 lb/10E3 tons cement produced	Uncontrolled, calculated based on engineering judgement	107
Cement manufacture - wet process	3241	Kilns	30500706	Manganese	7439965	0.02-0.142 lb/10E3 tons cement produced	Controlled by ESP, calculated based on engineering judgement	107
Cement manufacture - wet process	3241	Kilns	30500706	Manganese	7439965	0.049-0.132 lb/10E3 tons cement produced	Controlled by fabric filter, calculated based on engineering judgement	107
Cement manufacture - wet process	3241	Kiln	30500706	Nickel	7440020	0.2-2 lb/1000 tons raw mater. feed input	Controlled by fabric filter, based on source tests	110
Cement manufacture - wet process	3241	Kiln	30500706	Beryllium	7440417	0.002 lb/ton produced	Engineering judgement	113
Cement manufacture - wet process	3241	Kiln	30500706	Chromium	7440473	12 kg/1000 Mg cement produced	Uncontrolled, includes fuel emissions, as total chromium	161
Cement manufacture - wet process	3241	Kiln	30500706	Chromium	7440473	0.011 kg/1000 Mg cement produced	ESP, includes fuel emissions, as total chromium	161
Cement manufacture - wet process	3241	Kiln	30500706	Chromium	7440473	0.008 kg/1000 Mg cement produced	Fabric filter, includes fuel emissions, as total chromium	161
Cement manufacture - wet process	3241	Clinker cooler	30500714	Nickel	7440020	0.004 lb/1000 tons raw mater. feed input	Controlled by fabric filter, based on source tests	110
Cement manufacture - wet process	3241	Clinker cooler	30500714	Nickel	7440020	0.1 lb/1000 tons raw mater. feed input	Controlled by ESP, based on source tests	110
Cement manufacture - wet process	3241	Clinker cooler	30500714	Nickel	7440020	0.2 lb/1000 tons raw mater. feed input	Controlled by two fabric filters in parallel, based on source tests	110
Cement manufacture - wet process	3241	Clinker cooler	30500714	Beryllium	7440417	0.0008 lb/ton produced	ESP control	113

APPENDIX B

FUGITIVE DUST EMISSION ESTIMATES

B.1 DESCRIPTION OF COAL HANDLING SYSTEM

B.1.1 EXISTING COAL HANDLING SYSTEM

At the existing coal handling facilities at Tarmac, coal is received via 100-ton railcars and bottom-dumped onto the ground from an elevated trestle. A temporary storage pile is formed under the trestle unloading area. A front-end loader (FEL) of 7 yd^3 capacity is used to move coal from temporary storage to the active coal storage pile for the facility. Current active storage amounts to approximately 1.0 acres. From the active storage pile, a FEL of 7 yd^3 capacity is used to move coal from the active storage pile to the loading hopper.

From the loading hopper onward, all conveyor transfer points, the bucket elevator, the storage bin, the coal mills and other equipment are enclosed and controlled by baghouses. These baghouses are permitted under the current operating permit (A013-157297). A flow diagram of the existing coal preparation facilities is presented in Figure B-1.

B.1.2 PROPOSED FACILITIES FOR KILN 2

No changes will be made in the existing coal receiving and storage facilities to accommodate Kiln 2. The Kiln 2 coal conversion will result in a maximum increase of 56,940 TPY of coal processed through the facilities. This will result in increased tonnage moved by the FELs, and will increase storage pile size by approximately 0.3 acres.

From the existing loading hopper through to the existing coal bin, increased throughput.will occur, which will increase the annual operating hours of three baghouses controlling these points (G-509, G-521 and G-527). Operating hours will increase from about 10 hr/day to a maximum of 16 hr/day (increase of 2,040 hr/yr at 340 day/yr operation). The maximum particulate emissions from the three baghouses, based upon the air flow rates of 4,000, 6000, and 4,000 acfm, respectively, and 0.01 gr/dscf particulate loading, are 0.34 lb/hr, 0.51 lb/hr, and 0.34 lb/hr, respectively. This results in an increase in particulate emissions of

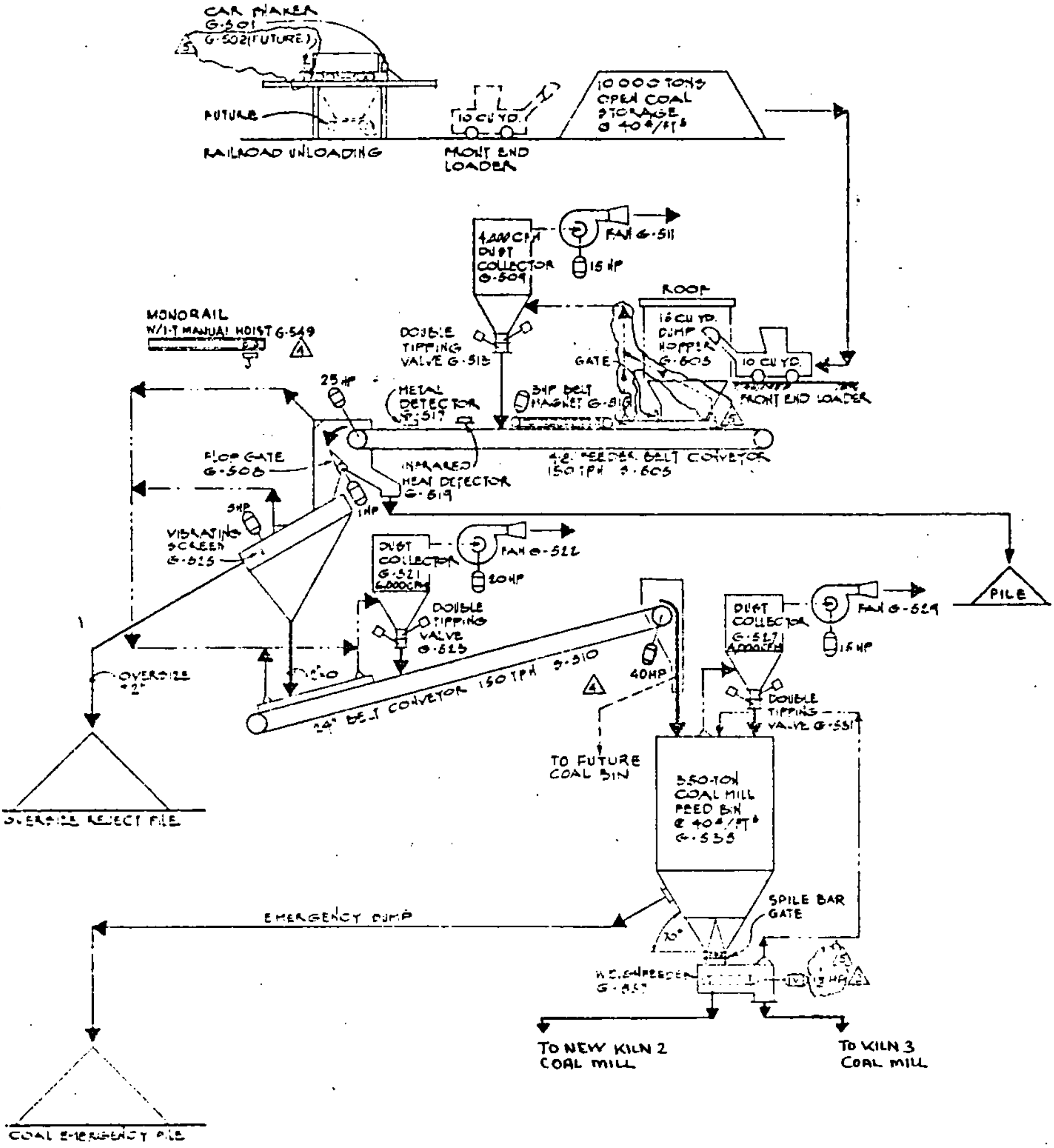

Figure B-1 FLOW DIAGRAM OF COAL PREPARATION SYSTEM

0.35 TPY , 0.52 TPY, and 0.35 TPY for the three baghouses (total increase of 1.21 TPY). These particulate emissions are assumed to be all PM10.

A new rotary conveyor will be constructed to convey coal for Kiln 2 from the existing coal bin to the new coal mill. This will be a totally enclosed conveyor, and no emissions will result. Hot air from the clinker cooler will provide drying of the coal in the mill, and will also convey the coal to the kiln. Thus, there will be no particulate emissions from the new coal mill.

B.2 FUGITIVE DUST EMISSION ESTIMATES

Fugitive dust emissions from the coal handling operations at Tarmac were estimated using the generalized fugitive dust emission factor equations contained in USEPA Publication AP-42, Section 11.2.3, Aggregate Handling and Storage Piles (10/86), and Section 11.2.1, Unpaved Roads (9/85). These sections contain emission factors for the following types of emission sources associated with the Tarmac operations:

- Batch drop operation
- Wind erosion from storage piles
- Vehicular traffic in the storage pile area

A. COAL TRANSFER OPERATIONS

The coal transfer operations at Tarmac consist of the railcar dump; transfer from the temporary storage pile to the active storage pile and; transfer from active storage pile to the loading hopper. These operations are all batch drop operations. The AP-42 factor for a batch drop operation is as follows:

$$E = k\,(0.0018)\ \frac{\left(\frac{s}{5}\right)\left(\frac{U}{5}\right)\left(\frac{H}{5}\right)}{\left(\frac{M}{2}\right)^{2}\left(\frac{Y}{6}\right)^{0.33}}\ \text{lb/ton}$$

where,
E - emission factor
k - particle size multiplier
s - material silt content (%)
U - mean wind speed (mph)
H - drop height (ft)
M - material moisture content (%)
Y - dumping device capacity (yd^3)

The particle size multiplier, k, is 1.0 for total suspended particulate [PM(TSP)]. The coal moisture content (M) was based on periodic sampling by Tarmac which shows an average moisture content of 7.2 percent. The silt content (s) of coal was obtained from Section 11.2.3 of AP-42, which showed an average of 5% for silt. The mean wind speed, U, in Miami is 8.8 mph, based upon a 9-year average. This average wind speed was used in the annual emission estimates. A higher wind speed of 18 mph was used for worst case daily emission estimates. This wind speed is exceeded only 2% of the time in Miami. The drop height varies for the transfer points, resulting in different emission factors. The resulting emission factors for each operation, and annual and worst case daily emission rates, are presented in Tables B-1 and B-2.

The current maximum daily delivery of coal to the site is 2,000 tons (20 rail cars). After conversion of Kiln 2 to coal, this maximum daily tonnage will not increase. Only the frequency of coal deliveries to the site will increase.

B. WIND EROSION

The recommended AP-42 emission factor equation for wind erosion from active storage piles is as follows:

$$E = 1.7\ (s/1.5)\ [(365-p)/235]\ (f/15)$$

where, E - total suspended particulate emission factor (lb/acre/day)
s - silt content (%)
p - number of days with precipitation greater than 0.01 inches
f - percentage of time that winds exceed 12 mph

Table B-1. Tarmac Kiln 2 Annual Particulate Matter (TSP) Emissions Increase

SOURCE	TYPE	s SILT CONTENT (%)	M MOISTURE CONTENT (%)	U WIND SPEED (MPH)	H DROP HEIGHT (FT)	Y DEVICE CAPACITY (YD**3)	E EMISSION FACTOR (LB/TON)
1) RAILCAR UNLOADING	BATCH DROP	5	7.2	8.8	20	87.0	0.00040
2) FEL-TO-PILE	BATCH DROP	5	7.2	8.8	10	7.0	0.00046
3) FEL-TO-LOADING HOPPER	BATCH DROP	5	7.2	8.8	10	7.0	0.00046
4) ACTIVE COAL PILE	WIND EROSION	5	-	-	-	-	*
5) ACTIVE COAL PILE	VEHICULAR TRAFFIC	5	-	-	-	-	*
6) BAGHOUSE G-509	BAGHOUSE	-	-	-	-	-	*
7) BAGHOUSE G-521	BAGHOUSE	-	-	-	-	-	*
8) BAGHOUSE G-527	BAGHOUSE	-	-	-	-	-	*

ANNUAL EMISSION ESTIMATES

SOURCE	UNCONTROLLED EMISSION FACTOR (LB/TON)	ANNUAL THRUPUT (TPY)	ANNUAL EMISSIONS (TPY)
1) RAILCAR UNLOADING	0.00040	56,940	0.012
2) FEL-TO-PILE	0.00046	56,940	0.013
3) FEL-TO-LOADING HOPPER	0.00046	56,940	0.013
4) ACTIVE COAL PILE (WIND)	*	*	0.480
5) ACTIVE COAL PILE (TRAFFIC)	*	56,940	10.230
6) BAGHOUSE G-509	*	56,940	0.35
7) BAGHOUSE G-521	*	56,940	0.52
8) BAGHOUSE G-527	*	56,940	0.35

		TOTAL ANNUAL EMISSIONS =	11.97

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* REFER TO TEXT FOR EMISSION FACTORS OR BASIS OF EMISSIONS

Table B-2. Tarmac Kiln 2 Maximum 24-Hour Particulate Matter (TSP) Emission Increases

SOURCE	TYPE	s SILT CONTENT (%)	M MOISTURE CONTENT (%)	U WIND SPEED (MPH)	H DROP HEIGHT (FT)	Y DEVICE CAPACITY (YD**3)	E EMISSION FACTOR (LB/TON)
1) RAILCAR UNLOADING	BATCH DROP	5	7.2	18	20	87.0	0.00083
2) FEL-TO-PILE	BATCH DROP	5	7.2	18	10	7.0	0.00095
3) FEL-TO-LOADING HOPPER	BATCH DROP	5	7.2	18	10	7.0	0.00095
4) ACTIVE COAL PILE	WIND EROSION	5	-	-	-	-	*
5) ACTIVE COAL PILE	VEHICULAR TRAFFIC	5	-	-	-	-	*
6) BAGHOUSE G-509	BAGHOUSE	-	-	-	-	-	*
7) BAGHOUSE G-521	BAGHOUSE	-	-	-	-	-	*
8) BAGHOUSE G-527	BAGHOUSE	-	-	-	-	-	*

24-HOUR EMISSION ESTIMATES

SOURCE	UNCONTROLLED EMISSION FACTOR (LB/TON)	MAXIMUM 24-HOUR THRUPUT (TONS/DAY)	MAXIMUM 24-HOUR EMISSIONS (LB/DAY)
1) RAILCAR UNLOADING	0.00083	+	+
2) FEL-TO-PILE	0.00095	+	+
3) FEL-TO-LOADING HOPPER	0.00095	156	0.15
4) ACTIVE COAL PILE (WIND)	*	*	8.80
5) ACTIVE COAL PILE (TRAFFIC)	*	156	46.50
6) BAGHOUSE G-509	*	6 HR/DAY	2.04
7) BAGHOUSE G-521	*	6 HR/DAY	3.06
8) BAGHOUSE G-527	*	6 HR/DAY	2.04

		TOTAL 24-HOUR EMISSIONS =	62.59

* REFER TO TEXT FOR EMISSION FACTORS

\+ THERE WILL BE NO INCREASE IN MAXIMUM DAILY COAL UNLOADING RATE

As described above, the silt content of coal is taken to be 5%. The number of days in Miami with precipitation greater than 0.01 inches is approximately 120, and the percentage of time that the winds exceed 12 mph is 22%. Substituting these values into the above equation yields the following:

$$E = 1.7 \times (5/1.5) \times [(365-120)/235] \times (22/15) = 8.7 \text{ lb/acre/day}$$

The active coal pile at Tarmac will increase by approximately 0.3 acres. This results in the following annual average PM(TSP) emissions due to the increased storage pile area:

$$0.3 \text{ acres} \times 8.7 \text{ lb/acre/day} \times 365 \text{ days/yr} / 2{,}000 \text{ lb/ton} = 0.48 \text{ TPY}$$

For a worst case daily estimation, no precipitation was assumed, and the frequency of high winds greater than 12 mph was assumed to be 50% (i.e. half of the day). This yields the following emission factor and worst case daily emission rate:

$$E = 1.7 \times (5/1.5) \times [(365-0)/235] \times (50/15) = 29.3 \text{ lb/acre/day}$$

$$0.3 \text{ acres} \times 29.3 \text{ lb/acre/day} = 8.8 \text{ lb/day}$$

These emission rates are summarized in Tables B-1 and B-2.

C. VEHICULAR TRAFFIC

AP-42 recommends the use of the emission factor for unpaved roads (Section 11.2.1) for estimating fugitive emissions due to vehicular traffic in and around storage piles. The equation is as follows:

$$E = k\ (5.9)\ (s/12)\ S/30)\ (W/3)^{0.7}\ (w/4)^{0.5}\ [(365-p)/365]$$

where, E = particulate emission factor (lb/mile)
k = 1.0 for total suspended particulate matter
s = silt content of road surface material (%)
S = mean vehicle speed (mph)
W = mean vehicle weight (tons)
w = mean number of wheels
p = number of days with precipitation greater than 0.01 inches

For the Tarmac operation,

s = 15% (assumed to be three times that of coal silt content)
S = 10 mph
W = 55.0 tons (loaded weight)
= 47.5 tons (empty weight)
w = 4
p = 120

Substituting these values into the emission factor equation yields the following:

$$E = 1.0\ (5.9)\ (15/12)\ (10/30)\ (55/3)^{0.7}\ (4/4)^{0.5}\ [(365-120)/365]$$

$$= 12.6 \text{ lb/mile (loaded)}$$

$$E = 1.0\ (5.9)\ (15/12)\ (10/30)\ (47.5/3)^{0.7}\ (4/4)^{0.5}\ [(365-120)/365]$$

$$= 11.4 \text{ lb/mile (empty)}$$

For worst case daily conditions, the emission factor was adjusted for no precipitation:

$$E = 1.0\ (5.9)\ (15/12)\ (10/30)\ (55/3)^{0.7}\ (4/4)^{0.5}\ [(365-0)/365]$$

$$= 18.8 \text{ lb/mile (loaded)}$$

$$E = 1.0\ (5.9)\ (15/12)\ (10/30)\ (47.5/3)^{0.7}\ (4/4)^{0.5}\ [(365-120)/365]$$

$$= 17.0 \text{ lb/mile (empty)}$$

The frontend loader has a payload capacity of 8 tons. In order to load the maximum annual coal thruput of 56,940 tons for Kiln 2 would require 7,118 trips. The travel distance from the rail car unloading area to the coal pile is about 250 feet, and from the coal pile to the unloading hopper is about 300 feet. Total one-way distance is 550 feet or 741 miles annually. This annual mileage was increased by 15% to account for additional travel due to pile maintenance activities, i.e., 852 mi/yr. Resulting annual emissions are as follows:

Loaded: 852 mi/yr x 12.6 lb/mile / 2,000 lb/ton = 5.37 TPY
Empty: 852 mi/hr x 11.4 lb/mile / 2,000 lb/ton = 4.86 TPY

As described previously, the maximum daily amount of coal delivered to the site will not increase. However, additional loading of coal from the coal pile to the loading hopper will increase by 6.5 TPH or 156 tons per day. This rate requires 23 trips per day, or 1.3 miles one-way travel distance.

Worst case daily emissions are:

Loaded: 1.3 miles x 18.8 lb/mile = 24.4 lb/day
Empty: 1.3 miles x 17.0 lb/mile = 22.1 lb/day

D. PARTICULATE EMISSION SUMMARY

Particulate emission estimates for the Tarmac coal handling operations are summarized in Tables B-1, B-2 and B-3. These emissions represent the increase in particulate emissions due to the Kiln 2 coal conversion. As shown in Tables B-1 and B-2, annual emissions of PM(TSP) are estimated at 11.97 TPY, and worst case daily emissions are 62.6 lb/day. Based on particle site data developed by EPA, PM10 particle size multipliers and PM(TSP) estimates are shown in Table B-3. The PM10 emissions increase is 5.40 TPY annually, and 32.7 lb/day, maximum.

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8/28/89

Table B-3. Tarmac Kiln 2 PM10 Emissions Increase

ANNUAL PM10 EMISSION ESTIMATES

SOURCE	TYPE OPERATION	ANNUAL PM(TSP) EMISSIONS (TPY)	PM10 PARTICLE SIZE MULTIPLIER	ANNUAL PM10 EMISSIONS (TPY)
1) RAILCAR UNLOADING	BATCH DROP	0.012	0.36	0.0043
2) FEL-TO-PILE	BATCH DROP	0.013	0.36	0.0047
3) FEL-TO-LOADING HOPPER	BATCH DROP	0.013	0.36	0.0047
4) ACTIVE COAL PILE	WIND EROSION	0.480	1.00	0.4800
5) ACTIVE COAL PILE	VEHICULAR TRAFFIC	10.230	0.36	3.6828
6) BAGHOUSE G-509	BAGHOUSE	0.35	1.00	0.3500
7) BAGHOUSE G-521	BAGHOUSE	0.52	1.00	0.5200
8) BAGHOUSE G-527	BAGHOUSE	0.35	1.00	0.3500
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	TOTAL ANNUAL EMISSIONS =	11.97		5.40

24-HOUR PM10 EMISSION ESTIMATES

SOURCE	TYPE OPERATION	MAXIMUM 24-HOUR PM EMISSIONS (lb/day)	PM10 PARTICLE SIZE MULTIPLIER	MAXIMUM 24-HOUR PM10 EMISSIONS (lb/day)
1) RAILCAR UNLOADING	BATCH DROP	0.00	0.36	0.00
2) FEL-TO-PILE	BATCH DROP	0.00	0.36	0.00
3) FEL-TO-LOADING HOPPER	BATCH DROP	0.15	0.36	0.05
4) ACTIVE COAL PILE	WIND EROSION	8.80	1.00	8.80
5) ACTIVE COAL PILE	VEHICULAR TRAFFIC	46.50	0.36	16.74
6) BAGHOUSE G-509	BAGHOUSE	2.04	1.00	2.04
7) BAGHOUSE G-521	BAGHOUSE	3.06	1.00	3.06
8) BAGHOUSE G-527	BAGHOUSE	2.04	1.00	2.04
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	TOTAL 24-HOUR EMISSIONS =	62.59		32.73