Hillsborough County, Florida

Solid Waste Energy Recovery Facility — Application for Power Plant Site Certification

Volume III — Air Quality

Submitted By
The Hillsborough County
Board of County Commissioners

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DER 17-1.202(1)

August, 1984

Prepared by
Camp Dresser & McKee Inc.

Hillsborough County, Florida
Resource Recovery Program
Application for Certification of Resource
Recovery - Electrical Generating Facility

VOLUME III - AIR QUALITY

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DER FORM 17-1.202 (1)

APPLICATION TO OPERATE/CONSTRUCT
AIR POLLUTION SOURCES

*This section also
Scanned 5/1/02.

STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL REGULATION

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

BOB GRAHAM
GOVERNOR

VICTORIA J. TSCHINKEL
SECRETARY

APPLICATION TO OPERATE/CONSTRUCT AIR POLLUTION SOURCES

SOURCE TYPE: Solid Waste Energy Recovery Facility [X] New[1] [ ] Existing[1]

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

COMPANY NAME: County of Hillsborough, Florida COUNTY: Hillsborough

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) Solid Waste Energy Recovery Facility w/Electrostatic Precipitator

SOURCE LOCATION: Street Faulkenburg Rd. Nearest Incorporated City Tampa

UTM: East 03/68/220 M.E. North 30/92/700 M.N.

Latitude 27 ° 57 ' ___ "N Longitude 82 ° 40 ' 22 "W

APPLICANT NAME AND TITLE: Warren N. Smith, Director

APPLICANT ADDRESS: Dept. of Solid Waste, P.O. Box 1110, 925 East Twiggs Street, Tampa Florida 33601

SECTION I: STATEMENTS BY APPLICANT AND ENGINEER

A. APPLICANT

I am the undersigned owner or authorized representative* of Hillsborough County

I certify that the statements made in this application for a construction 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: Warren N. Smith

Warren N. Smith, Director, Dept. of Solid Waste
Name and Title (Please Type)

Date: 7-23-84 Telephone No. (813)272-6674

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 [signature]

Louis Tortora, Jr. PE
Name (Please Type)

Camp Dresser & McKee, Inc.
Company Name (Please Type)

1321 U.S. 19South, Suite 601,Clearwater, Fl. 33546
Mailing Address (Please Type)

LOUIS RICHARD TORTORA JR. CERTIFICATE No. 32073 STATE OF FLORIDA REGISTERED ENGINEER

Florida Registration No. 32073 Date: 7/24/84 Telephone No. (813)530-9984

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 a solid waste energy recovery facility which shall generate electrical power from combustion of municipal refuse. Pollution control device shall be an electrostatic precipitator with an outlet loading of 0.025 grains/dscf corrected to 12% CO_2. Project will be in full compliance with all existing state and federal standards, and the air pollution control device shall meet LAER/BACT for all applicable pollutants.

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

Start of Construction January 1985 Completion of Construction January 1988

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.)

Electrostatic Precipitators (4) $4,500,000 total

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

Not Applicable

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? Will seek offsets

   b. If yes, has "Lowest Achievable Emission Rate" been applied? Yes

   c. If yes, list non-attainment pollutants. Ozone and particulate matter

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? Yes

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		

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

1. Total Process Input Rate (lbs/hr): ____________________

2. Product Weight (lbs/hr): ____________________

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	

[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).

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)

E. Fuels

Type (Be Specific)	Consumption*		Maximum Heat Input (MMBTU/hr)
	avg/hr	max./hr	

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

Fuel Analysis:

Percent Sulfur: ______________________ Percent Ash: ______________________

Density: ______________________ lbs/gal Typical Percent Nitrogen: ______________________

Heat Capacity: ______________________ 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.

____

____

____

____

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

Stack Height: ______ ft. Stack Diameter: ______ ft.

Gas Flow Rate: ______ ACFM ______ DSCFM Gas Exit Temperature: ______ °F.

Water Vapor Content: ______ % Velocity: ______ FPS

SECTION IV: INCINERATOR INFORMATION

Type of Waste	Type O (Plastics)	Type I (Rubbish)	Type II (Refuse)	Type III (Garbage)	Type IV (Patholog-ical)	Type V (Liq.& Gas By-prod.)	Type VI (Solid By-prod.)
Actual lb/hr Inciner-ated	Vendor supplied information						
Uncon-trolled (lbs/hr)	Vendor supplied information.						

Description of Waste Municipal solid waste

Total Weight Incinerated (lbs/hr) 133,333. Design Capacity (lbs/hr) 133,333. (name plate rating

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

Manufacturer Vendor not selected yet.

Date Constructed ______ Model No. ______

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

Stack Height: 220 ft. Stack Diamter: 4 flues, each 5'-9" Diam. Stack Temp. 430°F

Gas Flow Rate: 342,000 ACFM 140,070 @ 50% Ex. Air DSCFM* Velocity: 55 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. 0.027 gr/dscf @ 50% Ex. Air

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

[ ] Other (specify) Electrostatic Precipitator

Brief description of operating characteristics of control devices: Electrostatic precipitator collects particulate matter in flue gas stream by producing an electrical charge on the particles and then attracting them to surfaces of opposite polarity.

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

Hillsborough County's co-located wastewater treatment plant will accept the cooling tower blowdown and ash will be disposed of at Hillsborough County's Southeast County Landfill.

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 proposed 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 used 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 was 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 be 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 construction permit.

SECTION VI: BEST AVAILABLE CONTROL TECHNOLOGY

A. Are standards of performance for new stationary sources pursuant to 40 C.F.R. Part 60 applicable to the source?

[X] Yes [ ] No

Contaminant	Rate or Concentration
Particulate matter	0.08 gr/dscf (grains per dry standard cubic foot) corrected to 12% CO_2

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

[X] Yes [ ] No

Contaminant	Rate or Concentration
Various	See Table 6-2 in the PSD permit application

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

Contaminant	Rate or Concentration
Carbon monoxide, nitrogen oxides, sulfur dioxide, lead, beryllium, mercury. fluorides, and sulfuric acid mist	See PSD permit application Section 6.0

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 applicable, use additional pages if necessary).

1.

a. Control Device: electrostatic precipitator (ESP)

b. Operating Principles: Dry collection of charged particles on oppositely charged surfaces.

c. Efficiency:[1] Outlet Loading 0.025 gr/dscf Corr. to 12% CO_2

d. Capital Cost: $4,500,000

e. Useful Life: 20 yrs.

f. Operating Cost: $556,999./yr

g. Energy:[2] 770 KW

h. Maintenance Cost: $90,000/yr

i. Availability of construction materials and process chemicals: Readily available

j. Applicability to manufacturing processes: Not applicable

k. Ability to construct with control device, install in available space, and operate within proposed levels: ESP has by far the longest history of operation within emission standards on solid waste resource recovery facilities (hundreds of units worldwide).

2.

a. Control Device: fabric filter

b. Operating Principles: Dry collection of particles by filtration through fabrics.

c. Efficiency:[1] Outlet loading 0.025 gr/dscf Corr. to 12% CO_2

d. Capital Cost: $3,694,000

e. Useful Life: 20 yrs. complete bag replacement every 2 years.

f. Operating Cost: $859,000./yr

g. Energy:[2] 218 KW

h. Maintenance Cost: $112,000./yr

i. Availability of construction materials and process chemicals: Readily available

[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 operate within proposed levels: Limited operating experience with fabric filters on solid waste resource recovery facilities (only 3 units on large scale, mass-burn facilities

3.

a. Control Device: Dry Scrubber & ESP Outlet loading 0.025gr/dscf

b. Operating Principles: Alkaline spray neutralizes SO_2 & acid

c. Efficiency:[1] 65% removal eff. for SO_2 & 80% for acid gases

d. Capital Cost: $12,831.000

e. Useful Life: 20 Yr.

f. Operating Cost: $1,387,000/yr.

g. Energy:[2] 1397 KW

h. Maintenance Cost: $336,000/yr

i. Availability of construction materials and process chemicals: Readily available

j. Applicability to manufacturing processes: Not Applicable

k. Ability to construct with control device, install in available space, and operate within proposed levels: Very limited operating experience (only one unit in operation in USA on solid waste service).

4.

a. Control Device: ESP & Wet Scrubber

b. Operating Principles: ESP for dry collection of particulate and alkaline scrubbing for SO_2 & acid gas contr

c. Efficiency:[1] Outlet loading 0.025 gr/dscf 75% removal eff. for SO_2 and 90% for acid gases

d. Capital Costs: $7,810,000.

e. Useful Life: 20 yrs.

f. Operating Cost: $3,310,000/yr

g. Energy:[2]

h. Maintenance Cost: $189,000/yr

i. Availability of construction materials and process chemicals: Expensive corrosion-resistant metals required for quencher and scrubber.

j. Applicability to manufacturing processes: Not Applicable

k. Ability to construct with control device, install in available space, and operate within proposed levels: Very limited operating experience. Problem areas include necessity for stack gas reheat, corrosion of scrubber, and wastewater treatment.

F. Describe the control technology selected:

1. Control Device: ESP

2. Efficiency:[1] Outlet loading controlled to 0.025 gr/dscf corr. to 12% CO_2

3. Capital Cost: $4,500.000

4. Useful Life: 20 yrs.

5. Operating Cost: $556,000/yr

6. Energy:[2] 770 KW

7. Maintenance Cost: $90,000/yr

8. Manufacturer: Not selected yet.

9. Other locations where employed on similar processes: Braintree, MA; Harrisburg, PA; Chicago, NW. IL; Nashville, TN; Norfolk, VA; Saugus, MA; Montreal (Des Carriers), Quebec, and Pinellas County, FL.

a. (1) Company: Not selected yet.

(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
Various	See Table 6-2 in PSD permit application

(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: See Section 6.0 of PSD Permit Application

[1]Applicant must provide this information when available. Should this information not be 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. 5 Year(s) of data from 1 / 1 / 70 (month day year) to 12 / 3 / 74 (month day year)

2. Surface data obtained from (location) Tampa International Airport

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

4. Stability wind rose (STAR) data obtained from (location) Not Used

C. Computer Models Used

1. Industrial Source Complex (ISC), Short-term. 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	4.46	grams/sec
SO^2	23.1	grams/sec

E. Emission Data Used in Modeling

Attach list of emission sources. Emission data required is source name, description of 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 of the requested best available control technology.

State of Florida
DEPARTMENT OF ENVIRONMENTAL REGULATION
Application To Operate/Construct Air Pollutant Sources
Supplemental Information

Section V: Supplemental Requirements

1. Total process input rate at design capacity (i.e. name-plate rating) is 1600 TPD, 4 units each at 400 TPD. Residue amount will be 29.000. lb/hr (dry basis) and is derived as follows:

$$\text{Inert Material} = \left(133{,}333\ \frac{\text{wet lb feed}}{\text{hr}}\right)\left(0.7265\ \frac{\text{dry lb}}{\text{wet lb}}\right)\left(0.289\ \frac{\text{lb inert}}{\text{dry lb}}\right) = 28{,}100\ \frac{\text{dry lb inert}}{\text{hr}}$$

$$\text{Unburned Carbon:} = \left(133{,}333.\ \frac{\text{wet lb feed}}{\text{hr}}\right)\left(0.7265\ \frac{\text{dry lb}}{\text{wet lb}}\right)\left(0.3567\ \frac{\text{lb. Carbon}}{\text{dry lb}}\right)(.025) = 900.\ \frac{\text{dry lb carbon}}{\text{hr}}$$

$$29{,}000.\ \frac{\text{dry lb residue}}{\text{hr}}$$

2. Emission estimates are contained in the Prevention of Significant Deterioration (PSD) Permit Application.

3. Emission factors were derived from AP-42 and from data from recent large-scale, mass burn resource recovery facilities. See PSD Permit Applications.

4-8. These items are not available at this time since a system supplier has not been selected. Once these items have been provided by the vendor they will be transmitted to DER for inclusion in this application.

APPENDIX 10.1.5

PREVENTION OF SIGNIFICANT DETERIORATION

Hillsborough County, Florida
Energy Recovery Project
Application for Certification of Resource
Recovery - Electrical Generating Facility

APPENDIX 10.1.5 PREVENTION OF SIGNIFICANT DETERIORATION

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SECTION 1.0

EXECUTIVE SUMMARY

1.0 EXECUTIVE SUMMARY

In recognition of their growing need for solid waste disposal, the Hillsborough County Board of Commissioners has decided to construct a mass-burn solid waste energy recovery facility. In support of this effort, Camp Dresser and McKee Inc. (CDM) has prepared the Prevention of Significant Deterioration (PSD) application and related air quality analyses to meet the requirements of the Clean Air Act. The facility will be constructed and operated by a full service vendor under contract to the County.

This permit application, submitted to the Florida Department of Environmental Regulation (FDER), addresses the specific requirements of the PSD review as well as the new source review for nonattainment areas. The principle components of this review include: projecting facility emissions; performing a Best Available Control Technology (BACT) and Lowest Achievable Emission Rate (LAER) analyses; and an air quality impact analysis. The results of the PSD permitting analysis indicated:

- BACT/LAER for the proposed source is the use of combustion controls inherent to the system design with an ESP designed to meet an outlet grain loading of 0.025 gr/dscf @ 12% CO_2.

- the facility will operate in compliance with the PSD increments and NAAQS for all subject pollutants; and

- the facility is not expected to significantly affect surrounding soils, vegetation or visibility.

This PSD application is comprised of nine major sections. Each of these sections is summarized below.

Section 1.0 - Executive Summary. This section presents the conclusions of the report and provides a description of the report format.

Section 2.0 - Regulatory Overview. This section outlines the PSD process and reviews applicable state and federal regulations. The Prevention of Significant Deterioration and the Non-Attainment Area New Source Review provisions as defined by the Florida Department of Environmental Regulation Air Pollution Administrative Code are the principal regulations which are applicable to this facility.

Section 3.0 - Project Description. Within this section the basic features of the proposed project are described. The proposed facility will incorporate a mass-burn technology with an ultimate generating capacity of approximately 39 megawatts, using 1600 tons per day of solid waste with a heating value of 4000 Btu per pound. Each of the four boilers would be able to handle 400 tons of refuse per day. Each boiler will have an Electrostatic Precipitator (ESP) to remove small particles from the flue gas. The flues from each unit would be encased in a single 67 meter (220 foot) stack.

Section 4.0 - Air Pollutant Emission Projections. Estimates of the facility's emissions are presented in this section. Emission estimates from previously accepted PSD applications and stack test results from mass-burn facilities in Florida and across the country are included. Documentation of all data is provided.

Section 5.0 - Source and Pollutant Applicability. Source applicability under PSD is based on a through-put of over 250 tons of refuse per day and has the potential to emit more than 100 tons per year of certain pollutants. Pollutant applicability is evaluated for each pollutant regulated under PSD. Total Suspended Particulates (TSP) and Ozone (O_3) are not subject to PSD review since the site is located in a non-attainment area but is subject to review under the Non-Attainment area New Source Review provisions.

Section 6.0 BACT/LAER Analysis. This section discusses the application of Best Available Control Technologies (BACT) and Lowest Achievable Emission Rate (LAER) for all applicable pollutants. Each alternative control technology is evaluated with regard to energy, economic, environmental and other issues associated with its implementation. This analysis established that an ESP operating at 0.025 grains per dry standard cubic foot corrected to 12% CO_2 for particulate matter meets the LAER for TSP and, along with other design specifications, is BACT for the other regulated pollutants.

Section 7.0 - Ambient Air Quality PSD Analysis. This section presents the air quality analysis for each subject pollutant demonstrating that its addition to the ambient environment will not violate either applicable National Ambient Air Quality Standards (NAAQS) or the available PSD increment. This analysis included the use of the Industrial Source Complex (ISC) dispersion model and five years of Tampa International Airport data as well as ambient monitoring data from the Hillsborough County Environmental Protection Commission.

Section 8.0 - Additional Air Quality Impact Analysis. This section evaluates the potential impacts on visibility, soils and vegetation and considers any induced growth potential as a result of the proposed facility. No impairment of visibility is predicted with respect to the Chassahowitzka National Wilderness Area, the only Class I area within 100 km. The facility will utilize the local work force so no induced growth is expected. The small contribution the facility may make to the background air quality has no anticipated adverse impact on soils or vegetation.

Section 9.0 - Emission Offsets. The proposed facility's best effort to obtain emission offsets for total suspended particulate matter from existing major facilities is outlined in this section.

SECTION 2.0

REGULATORY REVIEW

2.0 REGULATORY REVIEW

This section summarizes the air quality regulations promulgated by the U.S. Environmental Protection Agency (EPA) and the Florida Department of Environmental Regulation (DER) that define ambient air quality standards and regulate the sources of air contaminants in order to achieve and maintain these ambient standards. The proposed resource recovery facility is subject to the following rules and regulations:

- National Ambient Air Quality Standards (NAAQS)
- Prevention of Significant Deterioration (PSD)
- New Source Performance Standards (NSPS)
- National Emission Standards for Hazardous Air Pollutants (NESHAP)
- Non Attainment Area New Source Review Requirements
- Florida DER Air Pollution Administrative Code

In many cases the Florida DER Air Pollution Administrative Code reflects the standards maintained by the EPA. For those cases where the Florida code represents a more restrictive ambient impact requirement, the Florida regulation has been applied.

2.1 NATIONAL AMBIENT AIR QUALITY STANDARDS

The EPA has established ambient ceilings for certain criteria pollutants as mandated by the Clean Air Amendments of 1970 (P.L. 91-604). These standards, known as the National Ambient Air Quality Standards (NAAQS), were set at two levels. The primary standards define levels which are necessary to protect the public health. The secondary standards define levels which protect the public welfare. The criteria pollutants regulated under NAAQS are sulfur dioxide (SO_2), total suspended particulates (TSP), carbon monoxide (CO), ozone (O_3), nitrogen dioxide (NO_2) and lead (Pb). Further amendments to the Clean Air Act have rescinded the hydrocarbon (HC) standard and revised the standard for O_3. The NAAQS and the corresponding Florida Ambient Air Quality Standards (FAAQS) as adopted by the DER are presented in Table 2-1.

TABLE 2-1

SUMMARY OF AMBIENT AIR STANDARDS -
FEDERAL (40 CFR 50) AND FLORIDA STATE (17-2.300)

Contaminant[1]	Averaging Period	Florida Conc.	Florida Units	Florida Statistic[2]	Federal Primary Conc.	Federal Primary Units[2]	Federal Primary Stat.	Federal Secondary Conc.	Federal Secondary Units[2]	Federal Secondary Stat.
SULFUR DIOXIDE (SO_2)	12 Consecutive Mos.	60 (0.02)	ug/m^3 (PPM)	A.M. (Arith. Mean of 24 hr. avg. concern)	80 (0.03)	ug/m^3 (PPM)	A.M.			
	24-HR.	260 (0.1)	ug/m^3 (PPM)	MAX.	365 (0.14)	ug/m^3 (PPM)	MAX.			
	3-HR.	1300 (0.5)	ug/m^3 (PPM)	MAX.				1300 (0.5)	ug/m^3 (PPM)	MAX.
CARBON MONOXIDE (CO)	8-HR.	10 (9)	mg/m^3 (PPM)	MAX.	10 (a)	mg/m^3 (PPM)	MAX.			
	1-HR.	40 (35)	mg/m^3 (PPM)	MAX.	40 (35)	mg/m^3 (PPM)	MAX.			
OZONE (PHOTOCHEMICAL OXIDANTS)	1-HR.	0.12 (235)	PPM (ug/m^3)	MAX.	0.12 (235)	PPM (ug/m^3)	MAX.	235	ug/m^3	MAX.
NITROGEN DIOXIDE (NO_2)	12-Consecutive Mos.	100 (0.05)	ug/m^3 (PPM)	A.M.	100 (0.05)	ug/m^3 (PPM)	A.M.	100	ug/m^3	A.M.
TOTAL SUSPENDED PARTICULATES	12 Consecutive Mos.	60	ug/m^3	G.M. (Geometric mean of 24 hr. average concentrations)	75	ug/m^3	G.M.	60[4]	ug/m^3	G.M.
	24-HR.	150	ug/m^3	Maximum	260	ug/m^3	MAX.	150	ug/m^3	MAX.
Lead	Maximum Calendar	1.5	ug/m^3	A.M.	1.5	ug/m^3	MAX.			

(1) Gaseous concentrations are corrected to a reference temperature of 25°C and to a reference pressure of 760 millimeters of Mercury.

(2) All maximum values are values not to be exceeded more than once a year (Ozone Std. not to be exceeded more than one day per year).

(4) To be used as a guide in assessing implementation plans to achieve 24-hour standard.

Each state was given the primary responsibility for assuring air quality by submitting a State Implementation Plan (SIP). The state then defined all geographic areas as attainment or non-attainment depending on whether the NAAQS were met. Areas which could not be so defined due to the lack of ambient air data were defined as unclassifiable. Areas designated unclassifiable may be treated as attainment until further information becomes available.

2.2 PREVENTION OF SIGNIFICANT DETERIORATION

A new resource recovery facility which locates in an attainment or unclassified area and emits 250 tons per year or more of a particular pollutant is considered to be major stationary source and therefore subject to a PSD review (17-2.500) before a permit to construct can be issued. The applicability of the specific requirements of PSD to the proposed Hillsborough County resource recovery facility is contained in Section 5.0.

In general, a PSD permit application must contain the following basic components:

- A Best Available Control Technology (BACT) review and application
- An analysis of existing ambient air quality
- An impact assessment demonstrating that emissions from the new source will not cause a violation of ambient air quality standards or PSD increments.
- An assessment of the source's impact on air quality related values including soils, vegetation, and visibility
- A complete description of the nature and operation of the source.

<u>Best Available Control Technology</u>

The control technology review is required for new sources to evaluate and apply BACT, defined as follows:

" An emission limitation, including a visible emission standard, based on the maximum degree of reduction of each pollutant emitted which the Department, on a case-by-case basis, taking into account energy, environment, and economic impacts, and other costs, determines is achievable through application of production processes and available methods, systems, and techniques for control of each pollutant." (17-2.100(22)).

According to the FDER, BACT should be applied for each pollutant subject to New Source Review (NSR) requirements. Pollutants subject to (NSR) are those that are designated attainment or unclassified for the area of construction proposed by the new facility and would have potential emissions equal to or greater than those defined by the de minimis emission rates listed in Table 2-2.

The application of BACT may result in emission rates equal to or less than the New Source Performance Standards (NSPS). In establishing BACT the emission limiting standards proposed by other states shall be considered. All scientific, engineering, and technical material and the social and economic impact of the application of such technology must be included in a BACT evaluation.

Existing Air Quality Analysis

Sources subject to NSR requirements must provide an analysis of ambient air quality in the vicinity of the proposed facility. Pollutants that do not have established ambient air quality standards are subject to monitoring sufficient to determine ambient levels. Pollutants with established state or national ambient air quality standards (FAAQS or NAAQS) are subject to monitoring to determine whether emissions would violate those standards or any PSD increment. The monitoring data is usually gathered over a twelve month period but shorter periods of no less than four months may be allowed. Sources may be exempt from the monitoring requirements if representative data exist or ambient impacts are below de minimis monitoring concentrations listed in Table 2-3. Typically, existing air quality monitoring data may be used instead of preconstruction monitoring if:

TABLE 2-2

SIGNIFICANT (De Minimis) EMISSION RATES

Pollutant	Emission Rate (tons/year)
Carbon monoxide	100
Nitrogen oxides	40
Sulfur dioxide	40
Total suspended particulate	25
Ozone (volatile organic compounds)	40
Lead	0.6
Beryllium	0.004
Mercury	0.1
Vinyl chloride	1
Fluorides	3
Sulfuric acid mist	7
Total reduced sulfur (including H_2S)	10
Reduced sulfur (including H_2S)	10
Hydrogen sulfide	10

SOURCE: Table 500-2 in Florida's Air Pollution Administrative Code

TABLE 2-3

SIGNIFICANT (De Minimis) MONITORING CONCENTRATIONS

Pollutant	Air Quality Concentrations (ug/m^3) and Averaging Time
Carbon Monoxide	575 (eight-hour)
Nitrogen dioxide	14 (annual)
Sulfur dioxide	13 (24-hour)
Total Suspended Particulates	10 (24-hour)
Ozone	**
Lead	0.1 (24-hour)
Beryllium	0.0005 (24-hour)
Mercury	0.25 (24-hour)
Vinyl Chloride	15 (24-hour)
Fluorides	0.25 (24-hour)
Total reduced sulfur (including H_2S)	10.0 (one-hour)
Reduced sulfur (including H_2S)	10.0 (one-hour)
Hydrogen sulfide	0.04 (one-hour)

** No specific air quality concentration for ozone is prescribed. Exemptions are granted when a source's VOC emissions are <100 tons/year.

SOURCE: Table 500-3 in Florida's Air Pollution Administrative Code

- the data are representative of the impact from the proposed facility;
- the data would meet PSD quality assurance requirements; and
- the data are current

Air Quality Impact Analysis

The source must demonstrate that the proposed emissions will not violate Florida or National standards or PSD maximum allowable increases (increments). The estimates of ambient air quality impact from the proposed source must be based on the models and meteorological data acceptable to the DER and EPA.

The PSD regulations set maximum allowable increases above ambient concentrations for SO_2 and TSP (Table 2-4). These incremental concentrations are categorized depending on the degree of industrial development desired. Class I areas have the smallest increments and include international parks, national wilderness areas, national parks, and other areas where air quality deterioration is undesirable. Class II areas allow for moderate industrial development. Class III areas allow for substantial industrial development. The increments associated with each class are listed in Table 2-4. No Class III areas currently exist in Florida. The nearest Class I area to the proposed facility is the Chassahowitzka Wilderness Area located approximately 45 miles to the northeast. A source impact analysis must show that the PSD increments are not violated. This is done by modeling the potential emissions from the proposed facility along with the actual emissions from those sources which have:

- Emission increases and decreases at major stationary sources resulting from construction that began after January 6, 1975; and
- Emission increases and decreases at all stationary sources occurring after the baseline data.

The baseline date is the earliest date after August 7, 1977 on which a complete application under PSD requirements was submitted.

TABLE 2-4
PSD AIR QUALITY INCREMENTS

Class I*

Pollutant	Maximum Allowable Increase (micrograms per cubic meter)
Particulate Matter:	
Annual Geometric mean	5
24-hour maximum	10
Sulfur Dioxide:	
Annual arithmetic mean	2
24-hour maximum	5
Three-hour maximum	25

Class II**

Pollutant	Maximum Allowable Increase (micrograms per cubic meter)
Particulate Matter:	
Annual Geometric mean	19
24-hour maximum	37
Sulfur Dioxide:	
Annual arithmetic mean	20
24-hour maximum	91
Three-hour maximum	512

Class III***

Pollutant	Maximum Allowable Increase (micrograms per cubic meter)
Particulate Matter:	
Annual Geometric mean	37
24-hour maximum	75
Sulfur Dioxide:	
Annual arithmetic mean	40
24-hour maximum	182
Three-hour maximum	700

* Nearest Class I area is the Chassahowitzka National Wilderness Area located approximately 45 miles NE of the facility.
** Hillsborough County is designated as Class II.
*** No Class III areas currently exist in Florida.

The PSD regulations also provide for an ambient ceiling concentration which cannot be exceeded as defined by the FAAQS and NAAQS. An impact analysis of the proposed source is done by modeling. Resulting air quality levels are then determined by adding the facility's impacts to background pollutant levels. Background pollutant levels are established by monitoring data, modeling existing sources, or a combination of both.

The reviewing agency may request additional impact estimates such as the impact on Class I areas, or the impact on neighboring attainment and non-attainment areas. In some cases, special receptor locations may be specified but in general an impact analysis does not extend beyond the point where concentrations fall below the significance limits listed in Table 2-5.

2.3 NEW SOURCE PERFORMANCE STANDARDS

The EPA under the New Source Performance Standards (NSPS) listed in Section 40 CFR Part 60 and Florida under Section 17-2 Part VI have promulgated source specific and general emissions limitations applicable to new and modified sources. These NSPS represent the maximum degree of emission control using available technology.

For new incinerators with a charging rate of greater than 50 tons per day of refuse, a limit for particulate matter of 0.08 gr/dcsf corrected to 12% CO_2 is established. This is almost identical to the Florida particulate matter limit of 0.08 gr/dscf corrected to 50% excess air. Florida further sets a specific limitation that incinerators emit no objectionable odor. The general opacity rule found in Florida. Administrative Code (FAC) rule 17-2.610 does not apply to a source for which either a specific particulate standard or specific opacity standard is provided elsewhere in the rules. Because the resource recovery facility is subject to the specific particulate standard in Rule 17-2.600(1)(c), the general opacity standard does not apply.

TABLE 2-5

SIGNIFICANCE LEVELS

Pollutant	Averaging Time				
	Annual	24-Hour	8-Hour	3-Hour	1-Hour
SO_2	1.0 ug/m^3	5 ug/m^3		25 ug/m^3	
TSP	1.0 ug/m^3	5 ug/m^3			
NO_2	1.0 ug/m^3				
CO			0.5 mg/m^3		2 mg/m^3

[FAC 17-2.100(147)]

2.4 NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS

The EPA has promulgated standards for certain hazardous air pollutants in 40 CFR Part 61. These pollutants currently listed are asbestos, beryllium, mercury and vinyl chloride. Currently the National Emission Standards for Hazardous Air Pollutants (NESHAP) do not effect the design or operation of a resource recovery facility which utilizes municipal solid waste.

2.5 NON ATTAINMENT NEW SOURCE REVIEW REQUIREMENTS

A proposed facility locating in a non-attainment area and emitting more than 100 tons per year of the affected pollutant is subject to the review requirements contained in 17-2.510(4) of the Florida Administrative Code. For that pollutant designated as non-attainment, the source must show that the proposed emissions plus existing emissions plus any required emission offsets do not interfere with reasonable further progress toward achieving compliance with ambient air quality standards. Sources outside a non-attainment area but within the area of influence must show a less than significant impact within the non-attainment area without the use of offsets. The preconstruction review requirements include the application and employment of Lowest Achievable Emission Rate (LAER) emission control technology, the acquisition of a sufficient new source allowance or emission offset, and the demonstration of a net air quality improvement.

LAER is defined in the DER nonattainment regulations as "the most stringent limitation which is contained in the implementation plan of any state for such class or category of source or the most stringent emission limitation which is achieved in practice, whichever is more stringent". In support of a LAER determination all scientific, engineering, and technical material must be made available. In no case shall a LAER determination result in an emission rate greater than the NSPS.

For non-attainment areas with an approved SIP the source must either obtain a new source allowance or offsets greater than the proposed emissions or demonstrate a net air quality improvement. New source allowance is available for VOC but not for other pollutants. A resource recovery facility is exempt from securing all the necessary offsets prior to issuance of an operating permit if 1) the best efforts to obtain such offsets were unsuccessful, 2) emission offsets will be sought and applied as they become available, and 3) all available offsets have been secured.

2.6 FDER AIR POLLUTION CONTROL REGULATIONS

The Florida Administrative Code, Chapter 17-2, for the most part has incorporated the federal code for each of the air programs previously discussed. Some slight differences do exist, however, which are important to this study.

Ambient Air Quality Standards

Unlike the NAAQS for the criteria pollutants, Florida has adopted a single set of standards which incorporates both primary and secondary standards. This is the case for the 24-hour and annual TSP standards as well as the 3-hour SO_2 standard. For the 24-hour and annual SO_2 standards, Florida has adopted values which are lower than the NAAQS. Thus, references to the impact of the facility on ambient air quality are made relative to the Florida standards since they are the most restrictive set of ambient standards.

Emission Limitations

The DER emission limitations that apply to this mass-burn facility are contained in FAC 17.2.600(1)(c) for sources with a charging rate equal to or greater than 50 tons per day. This regulation restricts particulate matter emissions to 0.08 grains per dry standard cubic foot of exhaust gas corrected to 50 percent of excess air. This is very nearly identical to the NSPS found in the federal code. In developing BACT or LAER, however, emission limitations more restrictive than this may be required. The Florida regulation further requires that no objectionable odors be emitted from the facility.

Permit Requirements

Any source which emits air pollutants must obtain an Application to Operate/Construct Air Pollution Sources, as specified by 17-2.210(1). This permit requires such information necessary to meet the requirements of the appropriate regulations. Florida has been delegated complete authority for sources subject to a PSD review, except for the way increment consumption is calculated. EPA's review authority extends only to that area where the calculation of increment differs from EPA's approach.

SECTION 3.0
PROJECT OVERVIEW

3.0 PROJECT OVERVIEW

3.1 OBJECTIVES

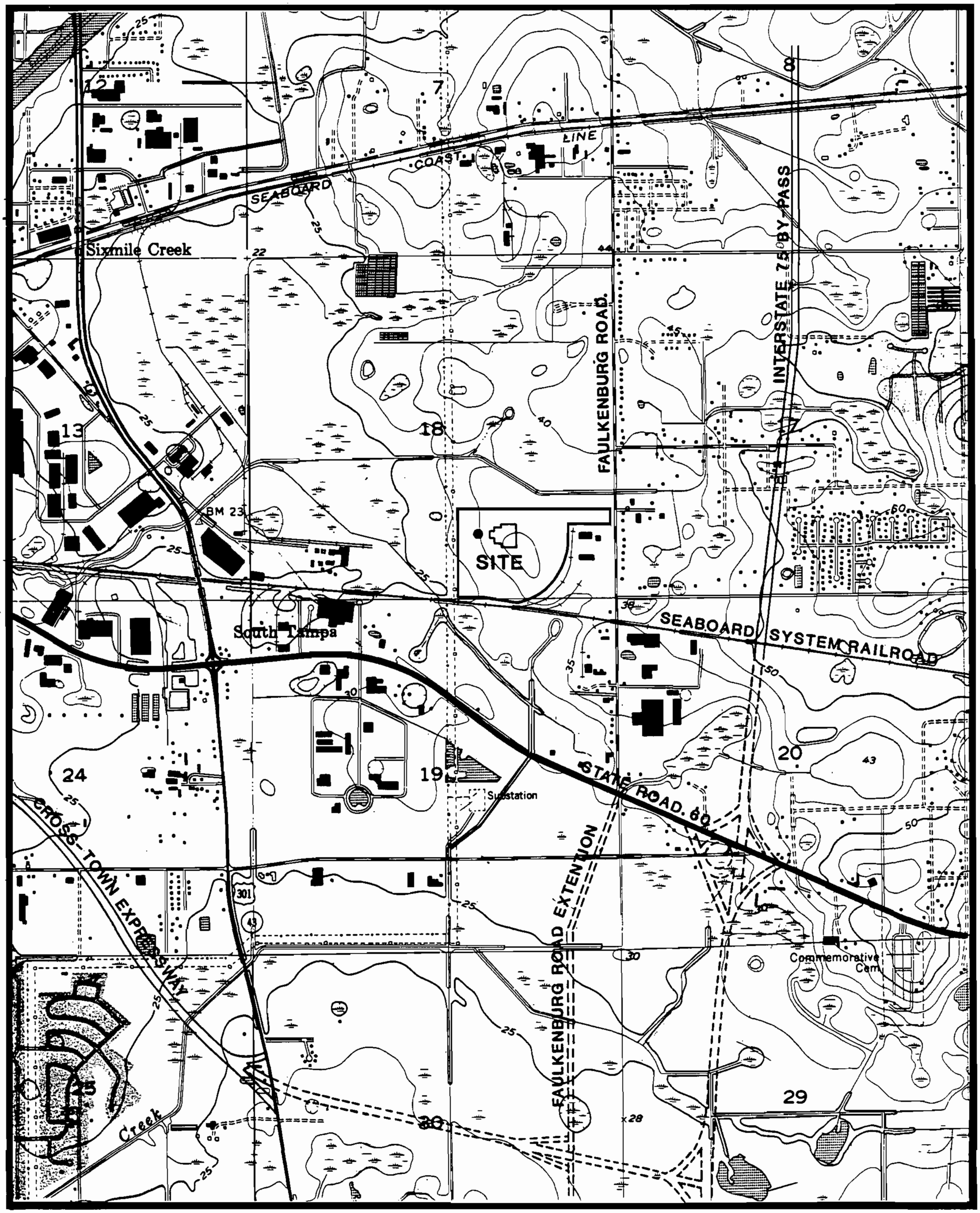
In Hillsborough County, there is an increasing interest in solid waste disposal and in the concept of resource recovery from solid wastes. Interest has been stimulated by an increased awareness associated with landfill disposal methods and of the value of energy and recyclable materials. The solid waste generated in Hillsborough County is currently disposed of in the Hillsborough Heights Landfill. Because of landfill capacity limitations and legal restrictions concerning the Hillsborough Heights Landfill, it is mandated to close by 31 October 1984.

On 15 April 1982, the Hillsborough County Board of County Commissioners authorized establishment of the County Resource Recovery Program. The purpose of this program is to evaluate, plan, and implement a resource recovery facility to serve the unincorporated areas of the County. The project is based on combusting the refuse using mass-burn technology, recovering the heat energy, and converting the energy to electricity for sale. The design, construction, and operation of the facility will be by a full-service contractor under a long-term contract with the County. The contractor will be selected through a Request for Proposal (RFP) procurement process.

The facility will be located on a 50.4 acre site located on Faulkenburg Road. The location of this site is identified in Figure 3-1.

3.2 FACILITY DESCRIPTION

After evaluating several technologies, the County has found that the proposed resource recovery facility incorporating a mass-burn technology, operated by a full-service vendor under contract to the County (the owner of the plant would be the County), would best fit its present and foreseeable needs. The energy recovery facility is anticipated to have a



HILLSBOROUGH COUNTY
ENERGY RECOVERY PROJECT

FIGURE 3-1

LOCATION OF SITE

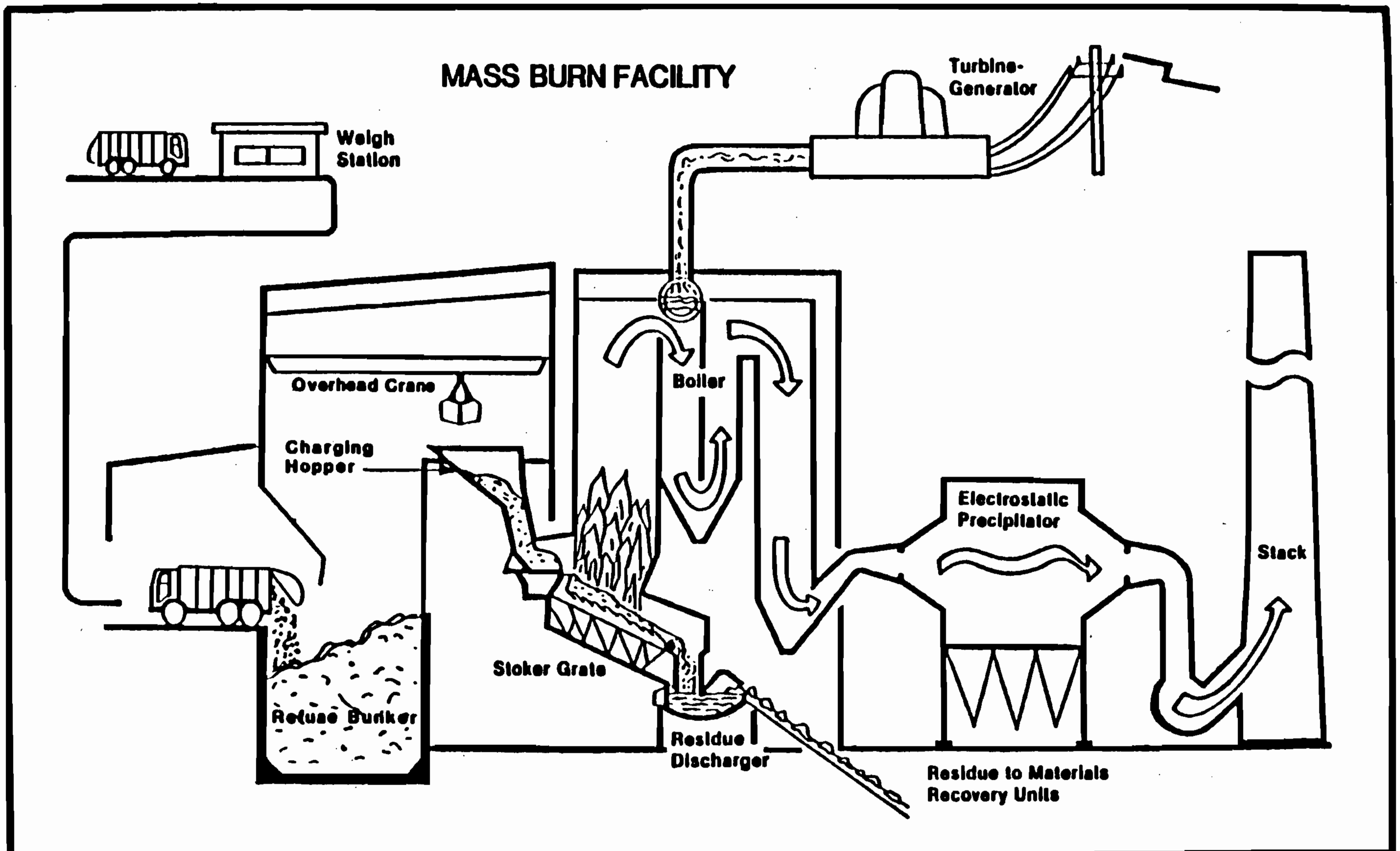
FEET
1000 0 1000 2000 3000

nameplate generating capacity of approximately 29 megawatts, using 1,200 tons per day (tpd) of solid waste as fuel. However, certification for an ultimate site capacity of about 39 megawatts, capable of processing 1,600 tons of solid waste per day, is being sought in anticipation of future solid waste disposal requirements. The energy produced would be used to satisfy internal power demands and the surplus would be sold directly to the Tampa Electric Company (TECO).

Since the proposed facility will utilize mass-burn technology, there will be no complex preprocessing of wastes at the facility prior to combustion. However, identifiable quantities of sludge from wastewater treatment plants, asbestos containing construction waste, or other hazardous waste will not be accepted at the facility. Oversized items would be separated from the incoming refuse by an overhead crane. A roto-shear (shredder) may be utilized to reduce the size of this material. After size reduction, this material would either be landfilled, sold as scrap, or charged into the furnace.

A conceptual schematic diagram of the recovery facility is presented in Figure 3-2. Truck transport will be used to deliver MSW to the facility and to remove ash residue from the facility. Under a 1600 tpd configuration, four 400-tpd units would be used in the facility. MSW would be dumped into the refuse bunker directly from packer trucks inside the building. All waste will be stored inside the building and kept under negative pressure, so no waste will be visible from the outside and odors and fugitive emission will be controlled. The overhead cranes mix MSW in the bunker and load the four charging hoppers as required.

Each boiler will be equipped with an electrostatic precipitator (ESP) for particulate air emission control. An electrostatic precipitator is a pollution control device that removes small particles from exhaust gases. The gases pass through a strong electric field where the particles are charged and attracted to the electrically charged collecting plates. The dust is then removed mechanically from these plates. The efficiency of the ESP has been established as achieving an emission limitation for particulate matter of 0.025 gr/dscf corrected to 12% CO_2. A complete analysis, demonstrating



HILLSBOROUGH COUNTY
ENERGY RECOVERY PROJECT

FIGURE 3-2
SCHEMATIC OF TYPICAL RESOURCE RECOVERY FACILITY

the ESP as LAER for particulate matter and BACT for the other criteria pollutants is contained in Chapter 6.0. The flue gas will be drawn through the ESPs by an induced draft fan which would be located between the stack and the ESPs.

Bottom ash from the furnace and flyash from the precipitator will be mixed prior to removal from the facility. Ash will comprise 10 percent of the volume and 25 percent of the weight of the MSW processed by the facility. The ash will be quenched with water to about 30 percent moisture prior to transport to a landfill.

As noted above, while the proposed facility will have a maximum design rated capacity of 1600 tpd, its initial throughput will be about 1200 tpd (comprised of three 400 tpd units). Each boiler unit operates independently from the others. It would, therefore, be possible to routinely shut down one unit for periods of maintenance and inspection.

3.3 GOOD ENGINEERING PRACTICE STACK HEIGHT EVALUATION

The 1977 Clean Air Act Amendments sought to require that emission limitations used for control of any pollutant were not affected by the stack height which exceeds good engineering practice (GEP), or any other dispersion technique. The GEP stack height was that "height necessary to insure that emissions from the stack do not result in excessive concentrations of any air pollutant in the immediate vicinity of the source as a result of atmospheric downwash, eddies, and wakes which may be created by the source itself, nearby structures, or nearby terrain obstacles." The Act did not seek to restrict the actual height of any stack, only to limit the theoretical stack height used in determining a source's allowable emission rate. This section of the Clean Air Act does not apply to stacks in existence before December 31, 1970.

The EPA proposed regulations to implement Section 123 on January 12, 1979 (44 FR 2608). Based on the responses received during the extended period for public comments, the EPA issued a final rulemaking regarding stack height regulations on February 8, 1982 (47 FR 5864). This final version incorporated many changes received during the comment period. The stack height regulations became effective March 10, 1982. On October 11, 1983, the EPA was ordered by the U.S. Court of Appeals (Sierra Club and NRDC versus EPA, et al.) to review and revise certain sections of their stack height regulations. However, none of the contested sections is expected to affect the determination of the GEP stack height for the proposed facility.

The GEP stack height is the greater of 65 meters or the height calculated from:

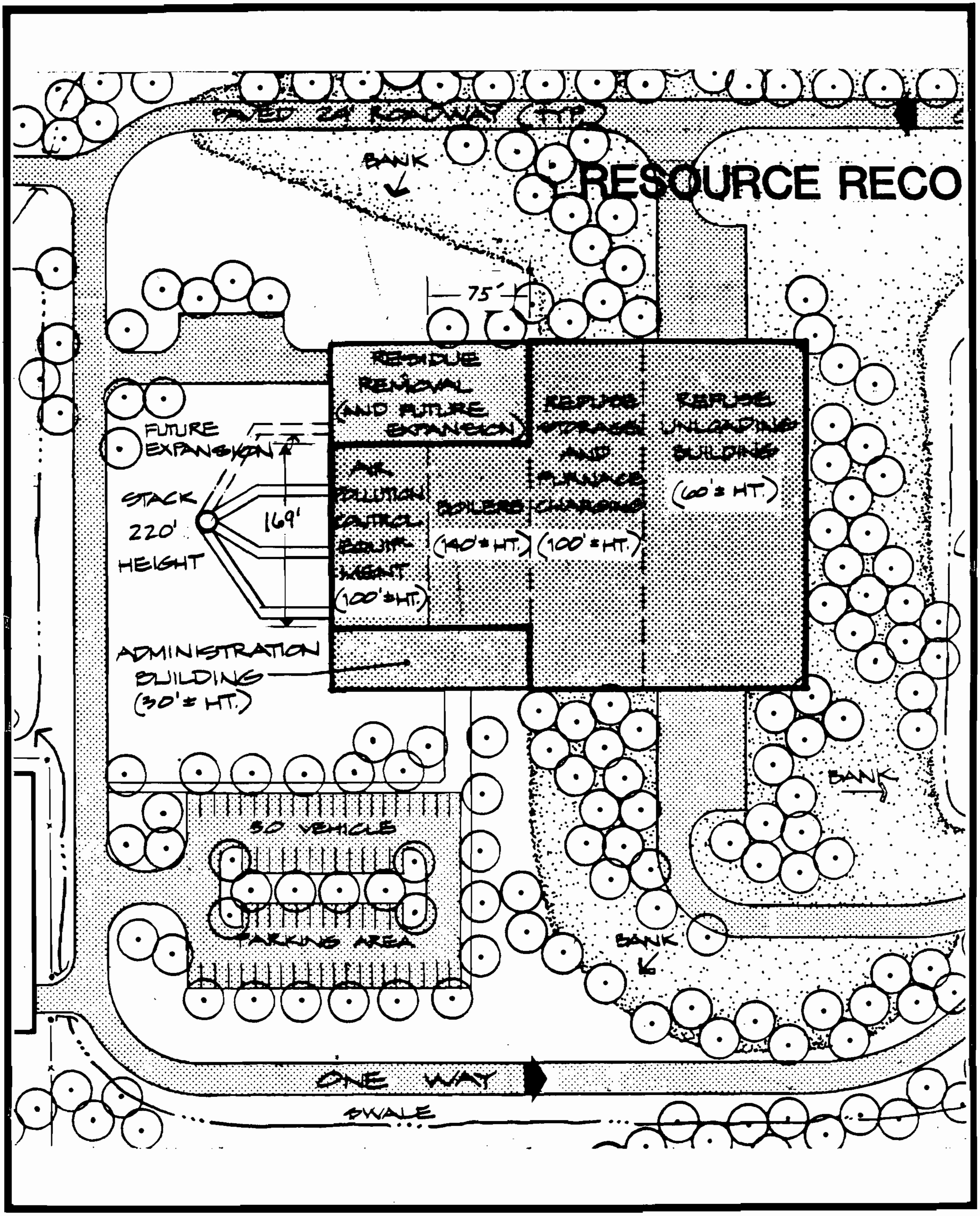
$$H_G = H + 1.5L$$

where:

H_G = the maximum GEP stack height
H = the height of the structure
L = the lesser dimension (height or width) of the structure.

This formula is applicable to any structure located within five times dimension "L" but not exceeding 0.8 km of the proposed stack. The height and width of a structure is based on the frontal area of the structure projected onto a plane perpendicular to a line originating from the stack and following the direction of the wind. The stack height may be less than the maximum GEP if excess concentrations do not result due to aerodynamic downwash.

The dimensions of the powerhouse and ancillary structures are shown in Figure 3-3. The proposed facility is located in relatively flat rural environment; thus the powerhouse structure is within the area of influence of the plume. The projected area dimensions of the powerhouse for use in the maximum GEP stack height calculation are listed in Table 3-1. Based on these dimensions the building height is a lesser dimension than the building width. The equation is then simplified to two and one half times the building height and the maximum GEP stack height is calculated to be



HILLSBOROUGH COUNTY
ENERGY RECOVERY PROJECT

FIGURE 3-3
STACK AND BUILDING CONFIGURATION

TABLE 3-1

PROJECTED AREA DIMENSIONS OF POWER HOUSE

Building Height	42.7 meters
Building Width	51.5 meters
Building Length	22.9 meters
Max. Projected Width	56.4 meters

106.8m. Since the proposed stack height of 67m is less than the maximum GEP stack height, the effects of downwash must be considered in predicting ground level concentrations. For a further discussion regarding the proposed stack height, see Appendix 10.16 "Stack Height Analysis and Recommendations".

3.4 BOILER OPERATING CONDITIONS

The resource recovery facility will consist of four boilers each capable of firing 400 tpd of reference waste (see Section 3.3 of Volume I) at its maximum continuous rating (MCR). This firing rate will be adjusted as the waste quality changes, i.e. changes in the higher heating value (HHV). This is because one of the objectives of plant operation is to maintain the heat load to the boiler by maintaining the heat release on the grate. When the HHV is low (higher moisture and ash fractions, lower combustibles fraction) more waste will be processed, up to 440 tpd per boiler. Likewise, when the HHV is high, less waste will be processed.

A screening analysis was run to assess the potential air quality impact of various operating loads. A total of four different operating load extremes were selected for review. The boiler operating conditions selected for modeling were based on identifying minimum, maximum, and typical load conditions as well as identifying high and low values of the HHV. The boiler conditions associated with each case are listed in Table 3-2.

The maximum load condition with a heating value of 4,000 Btu/lb resulted in the highest pollutant impacts and therefore this condition is used throughout the modeling assessment (see Section 7.1). This provides for a conservative analysis as the facility is expected to operate, over the long-term, at its maximum continuous rating (MCR) of 400 TPD of reference solid waste subject to an availability of 85 percent. A detailed discussion of the modeling methodology and results of the screening analysis are described in Exhibit A.

TABLE 3-2

BOILER OPERATING CONDITIONS

Boiler Exit		Refuse Fired		Flue Exit (from all 4 boilers)		
°F	ACFM*	Heat Content Btu/lb	Rate* (TPD)	Temp. °F(°K)	Flow Rt ACFM	Exit Vel. fps (mps)**
450	87,840	4,000	440	430 (494)	343,600	55.2 (16.82)
475	89,675	4,500	400	455 (508)	351,000	56.4 (17.19)
450	39,925	4,000	200	430 (494)	156,200	25.1 (7.65)
450	79,855	4,000	400	430 (494)	312,400	50.3 (15.32)

* Per boiler (4 boilers total).
** Flue diameter = 5'9" (1.75 m) for an effective diameter of 3.5m.

SECTION 4.0

AIR POLLUTANT EMISSIONS

4.0 AIR POLLUTANT EMISSIONS

The combustion of refuse to produce energy in the boilers of resource recovery facilities results in the emission of various air pollutants through several formation mechanisms. The generation of pollutants at the furnaces, eventually delivered to an air pollution control device are of two types: those over which the system operator has control through the technology utilized, and those which are a function of the composition of the waste stream, hence, essentially uncontrollable in a mass-burn system.

Emissions of particulate matter ~~is~~ are primarily a function of the efficiency of the control device(s) to provide for compliance with required emission limitations. Emissions of pollutants such as carbon monoxide, oxides of nitrogen, hydrocarbons, and hydrogen sulfide are principally influenced by the quality of combustion.

Emissions of other pollutants such as fluorides, hydrogen chloride, sulfur dioxide, mercury, lead, beryllium, and asbestos, are principally influenced by the composition of the as-received waste stream, over which there is normally only limited operator control. Identifiable contaminants such as those found in sludge from wastewater treatment plants, asbestos containing construction material, and other hazardous waste are not accepted at the facility. Some control of those composition-dependent pollutants such as lead, beryllium, asbestos, and other trace metals which adhere to particles is provided by the electrostatic precipitator, a post-furnace pollution control device which traps and removes these pollutants.

The emission factors for all these pollutants are summarized on Table 4-1, and discussed individually below. Projected emission estimates are based on preliminary combustion calculations using waste characterization data and preliminary design information along with stack test data from other operating mass-burn facilities as compared with recent EPA-approved emission levels for the PSD permits of proposed similar units. Also, listed on this table are emission factors for the major mass-burn resource recovery facilities in the west central Florida area.

TABLE 4-1

EMISSION FACTORS FOR FLORIDA RESOURCE RECOVERY FACILITIES
(pounds per ton of MSW)

Hydrocarbons	Hillsborough (proposed)	Pinellas 1 & 2[1]	Pinellas 3[2]	McKay Bay[3]
Particular matter	0.48*	1.6	0.5	0.67*
Sulfur dioxide	2.5	3.0	1.9	4.1
Nitrogen oxides	3.0	---	3.0	7.2
Carbon monoxide	1.8	---	1.5	0.4
Hydrocarbons	0.2	---	0.3	0.2
Lead	0.048	---	0.03	0.074
Mercury	0.0052	---	0.01	0.0996
Beryllium	13.1×10^{-6}	---	1.3×10^{-6}	6.2×10^{-6}
Fluorides	0.06	---	0.1	0.10
Sulfuric acid	7.68×10^{-2}	---	---	---
Hydrogen chloride	4.0	---	4.0	4.51

* Required LAER due to non-attainment area

Source: 1) HDR, 1978
2) HDR, 1983
3) Florida Permit AC 29-47277

Particulate Matter. The particulate emission limit being proposed to meet LAER is 0.025 grains per dry standard cubic foot adjusted to 12% CO_2 (0.025 gr/dscf @ 12% CO_2).

Based on preliminary design data, a particulate emission factor can be developed as follows:

$$135{,}270\ \frac{\text{dscf @ 12\% } CO_2}{\text{ton refuse}} \times 0.025\ \frac{\text{gr PM}}{\text{dscf @ 12\% } CO_2} \times \frac{\text{lb}}{7000\ \text{gr}} = 0.48\ \frac{\text{lb PM}}{\text{ton refuse}}$$

Carbon Monoxide. Carbon monoxide (CO) emission is primarily a function of combustion conditions, rather than solid waste composition as it is a product of incomplete combustion. The quantity of CO produced is dependent upon the design and operation of the furnace. Historically, there has been a downward trend in CO emissions as advancements in combustion technology have been realized.

Formation of CO in the furnace results from failure of the combustion system to complete the burnout of the combustible gases rising from the burning refuse bed. The injection of sufficient air and its proper mixing with the combustible gases are critical factors in reducing CO emission. Even when operated at high excess air levels, unburned CO can be generated from local areas of the burning refuse bed due to solid waste heterogeneity or grate overloading which creates deficiencies in available oxygen necessary for proper combustion.

Modern furnaces are designed to maximize air and fuel mixing effectiveness and combustion completion through proper grate design and the ability to control refuse feed. Optimization of the fuel mixing and the fuel feed rate through the system is done by controlling the grate speed which determines the rate at which refuse travels as it burns. Mixing of the refuse in the storage bunker prior to burning also helps homogenize the fuel. Proper design of the overfire air jets, combustion temperature, and overfire air ratio promotes oxidation of remaining carbon monoxide gases to CO_2. When all of these design features and operation practices are employed, CO production is minimized.

A review of CO emission data from the major mass-burn facilities in the U.S. are presented below:

Facility	Emission Factor (lb/ton)	Reference
Nashville, TN	1.77	(Rigo, 1982)
North Andover, MA (NESWC)*	0.64	(EPA, 1983)
Westchester County, NY*	0.62	(EPA, 1983)
VARIOUS	1.9	(O'Connell, 1982)
Chicago (Northwest), IL	0.672	(Cooper Engineers, 1983)
N. Little Rock	1.0	(EPA, 1980a)
Braintree, MA	4.3	(EPA, 1980a)
Pinellas Unit 3	~~1.5~~ 0.8	(HDR, 1983)

*From Accepted PSD permit applications

Based on information presented above, a CO emission factor of 1.8 lb/ton appears to be a representative number for a modern properly operated mass-burn facility.

Hydrocarbons. Like CO, gaseous hydrocarbon (HC) emissions are also a function of combustion conditions rather than the composition of the solid waste. Larger amounts of HC result from poor combustion at low temperatures with insufficient oxygen. Adequate emission control of HC is provided by the system design, that is employing a well designed furnace system which maintains certain minimum temperature levels.

The HC emissions can be held to very low levels with proper furnace controls, such as providing adequate oxygen in the refuse bed, agitating the input refuse, and ensuring sufficient dwell time, all of which will contribute to burnout of combustible matter and resulting gases.

Hydrocarbons are initially released from the refuse in the furnace bed where they are oxidized to CO and then to CO_2. Achievement of full hydrocarbon combustion within the furnace chamber requires proper mixing of the excess air and retention of resulting gases, at high temperature (>1,400°F) for an adequate retention time (typically >0.5 sec). Once combusted at a high combustion chamber temperature, hydrocarbons do not re-form upon cooling to the lower exit temperatures found in the cold side ESP and associated ductwork.

HC emissions have typically not been quantified at resource recovery facilities. In the past, CO emissions rather than HC emissions have been relied upon exclusively as indicators of combustion efficiency. Of the limited published data available, higher emission rates have been recorded at older, less efficient facilities than at newer modern facilities with effective combustion controls. Based upon the data available and values used in recent PSD permit applications, an expected emission rate of 0.2 lb HC/ton of refuse was selected for this analysis and appears reasonable for a modern mass-burn facility.

This proposed emission factor is higher than stack test data results from the Braintree, MA of 0.12 lb non-methane hydrocarbon (NMHC)/ton refuse, but is within the range referenced by EPA (EPA, 1980b) for waste-to-energy systems of 0.027-0.24 lb NMHC/ton solid waste. HC emission estimates for other facilities are not generally available from the literature.

<u>Nitrogen Oxides</u>. Formation of nitrogen oxides (NO_x) is comprised of two major mechanisms; thermal NO_x formation and fuel NO_x formation. The NO_x produced by exposing the nitrogen contained in the ambient air to the high temperatures of combustion is referred to as thermal NO_x. This is an inevitable result at high temperatures as ambient air contains approxiately 78 percent nitrogen (by volume). Fuel NO_x is formed when the nitrogen

contained in the fuel is oxidized to NO and then further oxidized to NO_2. According to a recently published review of NO_x formation (Russell et al, 1984), fuel NO_x appears most likely to be the dominant formation mechanism. The levels of NO_x produced, therefore, is a function of temperature and excess air (oxygen availability). While NO_x formation does occur in modern mass-burn facilities, it is generated in significant quantities only at temperature in excess of 2,000°F. Typical design value flue gas temperatures for modern combustion units are approximately 1400-1800°F.

The control of NO_x is provided primarily by furnace temperature control. there are higher instantaneous local temperatures within the combustion zone, but NO_x formation has relatively slow kinetics requiring a certain residence time. For this same reason, once NO_x is formed, significant disassociation of NO_x does not occur since the disassociation process like the formation process is kinetically slow, so that the NO_x formed in the furnace is essentially "frozen".

Older, less thermally-efficient furnaces have demonstrated relatively low NO_x emissions indicative of poor low-temperature combustion quality rather than adequate emissions control. Effective temperature control means lowering furnace temperatures to minimize NO_x formation without inordinately increasing the emissions of other pollutants such as CO, HC, and odors. Based on a review of data quantifying NO_x emissions, an emission factor of 3.0 lb NO_x/ton was chosen as representative of the proposed facility.

For the five operating mass-burn facilities shown below, an average of 2.88 lb NO_x per ton (expressed as lb NO_2/ton) of refuse can be calculated.

Facility	Average NO_x Emission Factors (lb/ton)	
Oceanside, NY	4.59	
Braintree, MA	2.58	average
Harrisburg, PA	2.13	
Chicago NW, IL	2.51	
Nashville, TN	2.59	
AVERAGE	2.88	too high

The proposed emission factor is also consistent with emission estimates from other similar facilities' PSD permits recently approved by the U.S. EPA (EPA, 1983) shown below:

Facility	PSD Permit Emission Estimate lbs NO_x/ton refuse
Baltimore, MD (Northeast MD Waste Disposal Authority)	3.19
North Andover, MA	2.92
Westchester CO, NY	3.00

The chosen value of 3.0 lb NO_2/ton is also suggested by EPA (EPA, 1977) in its AP-42 air pollution emission guidelines.

Sulfur Dioxide. Sulfur dioxide (SO_2) formation in the furnace is a function of the sulfur content of the fuel and the chemical form in which it occurs. Sulfur in refuse occurs in several forms, as organic sulfur chiefly in coated papers as sulfides (S_2-), sulfate (SO_4^{2-}) and sulfite (SO_3^{2-}). All of these compounds except sulfate, which typically accounts for 2-3 percent of the fuel sulfur content, can be converted to SO_2 during combustion. Analysis has suggested that one half of the total sulfur in the fuel is retained in the grate residue, one-quarter is absorbed by flyash, and one-quarter is emitted in the flue gas (Kaiser 1968). Since over 99 percent of flyash produced can be retained by an electrostatic precipitator, it can be assumed from this analysis that about one-quarter of the refuse sulfur is emitted from a facility. Based on observations of coal-fired facilities, it has been suggested that only 30 percent of the non-residue sulfur is absorbed by flyash, hence 35 percent of the refuse sulfur would be emitted in the flue gas (Niessen 1978).

The form of the sulfur emitted would be predominantly SO_2, with 1-2 percent of the sulfur in the flue gas as gaseous SO_3 (sulfur trioxide) and sulfuric acid mist. The very small amount of the flyash (<1 percent) not captured by the electrostatic precipitator would contain sulfur, where present, in the form of SO_3. Non-SO_2 emissions are discussed separately below.

The SO_2 emissions generated from waste-to-energy conversions have not been considered by regulatory agencies to be a significant environmental problem because resource recovery facility emissions have been well below EPA established levels for fossil fuel facilities. The lower SO_2 emissions observed for resource recovery facilities appear to correspond to the lower sulfur content in its fuel.

It is most appropriate to estimate SO_2 emissions from a waste-to-energy facility based on empirical data. An SO_2 emission factor of 2.5 lb/ton is proposed for the facility based on published EPA emission factors contained in EPA publication AP-42 (EPA, 1977).

This estimate agrees well with stack test results from other mass-burn facilities. Data compiled by Rigo, et al (1982), for six mass-burn units, as presented below, has a weighted average of 2.25 lbs SO_2/ton refuse.

Facility	No. of Samples	Sample Average, lbs SO_2/ton refuse
Oceanside, NY	2	3.03
Braintree, MA	3	3.24
Harrisburg, PA	9	1.09
Chicago NW, IL	8	3.99
Saugus, MA	2	2.0
Nashville, TN	6	0.99

The estimate derived above is consistent with EPA's (1977) emission factor of 2.5 lbs SO_2/ton refuse for these types of facilities and with other emission estimates from mass-burn facilities' PSD permits recently approved by the U.S. EPA:

Facility	PSD Permit Emission Estimate lbs SO_2/ton refuse
Baltimore, MD	4.00
North Andover, MA	2.50
Westchester CO, NY	2.00

From studies completed to date, it is clear that refuse is a non-homogeneous fuel, and that sulfur content of refuse burned can, and will, vary even when the refuse is consistently from the same source. This fact, in combination with the other factors cited earlier, can interact and result in complex sulfur variability patterns which are difficult for plant operators to manage and predict on a short-term basis. Therefore, the estimate of 2.5 lbs SO_2/ton of refuse can be considered to be a reasonable, appropriate estimate of achievable long-term SO_2 emissions from the facility.

Sulfuric Acid Mist. Small quantities of gaseous SO_3 emissions are associated with emissions of SO_2. In the flue gas stream and in the emitted vapor plume, the dry gaseous SO_3 reacts with the water droplets to produce sulfuric acid mist, H_2SO_4. The H_2SO_4 emission is a function of the quantity of SO_2 generation and degree of successive oxidation of SO_2 to SO_3 to H_2SO_4. The H_2SO_4 emission for a resource recovery facility is best estimated as equal to 1.5 to 2 percent of the SO_2 emission rate by volume. Theoretical SO_3 emissions derived from published ASME data (Combustion Fundamentals of Waste Incineration), as a function of furnace temperature and excess air and fuel sulfur content, are 1.5% to 2.0% by volume of projected total SO_x. When calculating the potential H_2SO_4 emission as 2.0 percent by volume of SO_2 emission factor estimated above, then 7.68×10^{-2} lb H_2SO_4/ton refuse can be expected as an emission rate from the proposed facility.

Hydrogen Sulfide, Reduced Sulfur Compounds, and Total Reduced Sulfur. No measurable emissions of hydrogen sulfide (H_2S) or total reduced sulfur compounds are expected from modern resource recovery facilities.

The H_2S is formed when organic matter containing sulfur is decomposed in the absence of air. The H_2S is relatively unstable and, in the presence of air, burns to form H_2O and SO_2. The H_2S also reacts with SO_2 in the presence of moisture, to form H_2O and S. The S may be deposited as pure sulfur or may become re-oxidized to SO_2, if there is adequate air supply and mixing.

Emission control of these other sulfur compounds is exercised by providing adequate oxygen and a high furnace temperature to ensure full oxidation.

Fluoride. Fluoride furnace emissions are a function of the fluorine (F) content of the solid waste combusted. The fluorine content of refuse in the U.S. has been subject to recent change due to restrictions upon the production of certain fluorine-containing products (aerosol propellents formerly used in spray containers). Emissions of fluorides result primarily from the combustion of fluorinated plastics and other fluorocarbon products.

Fluorine combustion products occur as gaseous fluorides in the flue gas and as solid compounds in the ash. In moist air, liquid droplets of hydrofluoric acid (HF) are found.

Test data from operating facilities, and projected emissions estimates from PSD permits for recent EPA-approved facilities, generally do not include emission factors for HF, except for the Baltimore, Maryland facility, which projects 0.05 lb HF/ton refuse will result. In an EPA memo (EPA, 1980a) an emission factor of 0.045-0.06 lb HF per ton of refuse was indicated as a reasonable estimate. A conservative projection of 0.06 lb HF/ton refuse has been identified for use in this analysis.

Hydrogen Chloride. Hydrogen chloride (HCl) emission is primarily a function of the chlorine content of the fuel. The emission of HCl depends both on the quantity of chlorine in the solid waste and on the species of chlorine present because not all of the chlorine content of the combusted solid waste exits the stack as gaseous HCl. Chlorine occurs in the waste stream as organic chlorine (chlorinated organic combustibles) and as inorganic chlorine; e.g., NaCl. Organic chlorine has generally been held to be the main source of stack HCl emissions (Hollander et al. 1980), but in the last decade, inorganic chlorine volatilization and/or conversion to HCl has been suggested (Altar 1979; Krause et al. 1974; Robertson 1974). Chlorine that is not volatilized or converted to HCl remains in the grate residue; some stack HCl may precipitate out in the flyash also.

Organic chlorine is found in chlorinated plastics (e.g., polyvinyl chloride, PVC), rubber (5 percent chlorine by weight), paper, and textiles in refuse. Inorganic chlorine occurs in solid waste chiefly as sodium and potassium salts (NaCl, KCl).

Emission factors from stack test data obtained from other mass-burn waste-to-energy facilities (Rigo et al, 1982) are reported as:

Facility	Number of Samples	Average lb HCl/Ton Refuse
Harrisburg, PA	6	3.84
Chicago NW, IL	27	4.49
Saugus, MA	29	3.78
Nashville, TN	4	1.60

The average emission factor for these faciilties is 3.43 lb HCl/ton refuse, with a weighted average of 3.94 HCl/ton. Therefore, based on these data, a value of 4.0 lb HCl/ton of refuse is considered a reasonable emission level.

Vinyl Chloride, Other Chlorinated Organics and Free CL_2. No measurable/significant emissions of gaseous vinyl chloride (H_2CHCl) are expected from the proposed resource recovery facilities. This also applies to other chlorinated organics such as phosgene ($COCl_2$), as well as to free gaseous CL_2. Most of the chlorine released in the combustion is converted to gaseous HCl before exiting the furnace.

Lead. Lead (Pb) emission from the combustion of solid waste is primarily a function of the solid waste composition. Lead is widespread as a trace metal in most components of the combustible faction of solid waste, and also appears in more concentrated metallic forms in the metals fraction, particularly in ferrous cans and general solderings. The Pb associates with particles in the stack upon volatilization which allows for its control by ESP's.

Lead is melted and volatilized in the combustion process and then retained in, or redeposited onto, the bottom ash and flyash, but some will reach the ESP as submicron fumes and droplets.

Emission estimates for lead presented in recent PSD applications and published literature have been derived from actual measured lead concentrations in the flue gas particles or have been proposed as a percentage/ratio of total flue gas particles. EPA, 1980a, suggested that based on combustion testing, the lead emission factor would be 8 to 10 percent of the particulate emissions. This would amount to 9 percent by weight stack test. Using a reasonable value of 10%, the Pb emission factor would be .048 lb/ton of refuse.

Mercury. Mercury (Hg) (and mercury compounds) is capable of passing through an ESP without collection because of its volatility. Mercury and its compounds evident in solid waste are typically found in trace quantities. Usually, only a minor portion of Hg is retained in the grate residue as the Hg volatilized into the flue gas tends to condense into particles as it travels through the decreasing temperature of the system towards exit.

Emission measurements for Hg are generally not readily available for operating resource recovery facilities. Based upon the estimates used in PSD permit applications and presented in literature for similar facilities (O'Connell et al., 1982), a value of 5.2×10^{-3} lb Hg/ton of refuse was selected as an emission factor for this facility.

Beryllium. Beryllium (Be) emissions are functions of the solid waste composition and the particulate removal efficiency of the ESP for small beryllium containing particles. Beryllium is contained in solid waste in trace quantities, therefore, beryllium emissions are expected to be minimal.

Beryllium in refuse combustion systems is associated with ash and airborne particles. The Be in refuse will be retained in the ash during combustion, so resultant stack emissions can be effectively reduced by a high ESP particulate collection efficiency. The Be is generally well-distributed among the ash particles but does appear to be somewhat more concentrated among smaller particles. As with other trace components, there are minimal data available on the emissions of beryllium from mass-burn facilities similar to that proposed. Based upon values used in other PSD applications, an emission factor of 13.1×10^{-6} lb Be/ton of refuse has been selected for this analysis (ADL, 1981 and CDM,1984).

Reference	Permitted Emission Estimate lbs BE/ton refuse
CDM, 1984	13.2×10^{-6}
ADL, 1981	13.0×10^{-6}

Asbestos. Measurable stack emissions of free asbestos fibers are not expected for resource recovery facilities. Furnace emission of asbestos is a function of asbestos in the solid waste. The emission control procedure for this material is to keep it out of the furnace. Demolition waste and any other identifiable asbestos-contaminated waste are generally not accepted at resource recovery facilities.

SECTION 5.0

SOURCE AND POLLUTANT APPLICABILITY

5.0 SOURCE AND POLLUTANT APPLICABILITY

Source Applicability

The proposed resource recovery facility would burn over 250 tons of refuse per day and has the potential to emit greater than 100 tons per year of certain pollutants. Therefore, it is considered a major stationary source, and is subject to PSD review.

Emission Unit Applicability

The proposed facility will contain 4 mass-burn furnaces equipped with steam generating boilers capable of charging 400 tpd of refuse. The combustion gases will be exhausted through individual flues contained in a single 220-foot stack. No significant quantifiable fugitive emissions will be generated from this facility. The tipping area and refuse storage bunker will be totally enclosed and kept under negative pressure. The air exhausted from this area will be drawn into the furnaces as combustion air supply.

Pollutant Applicability

The PSD regulations state that if the proposed source emits pollutants for which the site area is designated as attainment or unclassifiable (or any other PSD regulated pollutants that are not subject to ambient air quality standards), and it emits these pollutants at a rate greater than the significant emission rate, the source is subject to PSD review for those pollutants. A source is exempt from PSD review and subject to New Source Review for Nonattainment Areas for those pollutants designated as non-attainment in the siting area. Table 5-1 compares the PSD significant emission rates with the potential source emissions.

The Faulkenburg Road site is located in the federally- and state-designated West Central Florida Intrastate Air Quality Control Region (AQCR). The proposed site and impact areas located in Hillsborough County are designated as attainment with respect to the NAAQS for carbon monoxide, nitrogen

TABLE 5-1

SIGNIFICANT EMISSION RATES AND FACILITY POTENTIAL TO EMIT VALUES FOR PSD REGULATED POLLUTANTS

Pollutants	Significant[a] Emission Rates (tons/year)	Potential[b] to Emit (tons/year)
Particulate matter	25	140
Carbon monoxide	100	526
Nitrogen oxides	40	876
Sulfur dioxide	40	730
Ozone (VOCs)	40	58
Lead	0.6	14
Asbestos	0.007	---
Beryllium	0.0004	3.83×10^{-3}
Mercury	0.1	1.52
Vinyl chloride	1.0	---
Fluorides	3	17.5
Sulfuric acid mist	7	22.4
Total reduced sulfur (including H_2S)	10	---
Reduced sulfur (including H_2S)	10	---
Hydrogen sulfide	10	---
Hydrogen chloride	---	1168

SOURCE:

[a]FAC 17.2 Part V Table 500.2.

[b]Emission estimates at 100 percent system capacity for Baseline Control Alternative - ESP 0.025 gr/dscf @ 12 percent CO_2.

dioxide, and lead; unclassifiable for sulfur dioxide; and is nonattainment with respect to the NAAQS for total suspended particulates and ozone. Areas designated as unclassifiable are areas where insufficient or unrepresentative monitoring data exist to warrant an attainment designation, but these are areas treated as attainment until proven otherwise. Based on the pollutant emission rates and the attainment status of the area, the proposed source is subject to PSD review for the pollutants listed on Table 5-1 with the exception of total suspended particulates, ozone, asbestos, vinyl chloride, hydrogen sulfide, total reduced sulfur, and reduced sulfur compounds. The remaining pollutants subject to PSD Review include carbon monoxide, nitrogen oxides, sulfur dioxide, lead, beryllium, mercury, fluorides, and sulfuric acid mist. Hydrogen chloride was also added to this list, as requested by DER. Total suspended particulates and ozone are subject to review under the New Source Review for Nonattainment Areas (FAC 17-2.510).

SECTION 6.0

BEST AVAILABLE CONTROL TECHNOLOGY/
LOWEST ACHIEVABLE EMISSION RATE ANALYSIS

6.0 BEST AVAILABLE CONTROL TECHNOLOGY/LOWEST ACHIEVABLE EMISSION RATE ANALYSIS

The evaluation of the emission control technology proposed for a new source is to be contained within the Best Available Control Technology (BACT) and Lowest Achievable Emission Rate (LAER) analyses which are integral portions of the PSD and NSR processes. The BACT analysis is required under the PSD review process, and the LAER analysis is required under New Source Review (NSR) for Non-Attainment Areas, Florida Administrative Code 17-2.510. For purposes of consistency and continuity, both analyses have been incorporated into this section. The BACT/LAER analysis provides the rationale for selecting the control strategy to best satisfy the individual constraints of the area surrounding the site and to minimize the impacts on energy, economic and environmental issues.

A BACT/LAER analysis involves: the review of pollutant applicability, the identification of sensitive concerns, and the selection of control strategy alternatives. These elements are further evaluated using energy, economic and environmental criteria. It is assumed for this analysis that the facility will operate at 100% availability at the maximum firing rate of 110% of the nameplate rating (equal to 1760 TPD). This will provide for worst-case analysis in terms of emissions (both short- and long-term) and their environmental impacts, energy consumption, and economic (operations and maintenance) considerations. Finally, the BACT/LAER decision-making process culminates in a preferred control strategy for minimizing the emission of regulated pollutants from the proposed source within the above constraints. The control option finally selected as LAER for particulate matter is the electrostatic precipitator designed to limit particulate emissions to 0.025 gr/dscf corrected to 12% CO_2, and along with other design specifications is BACT for other regulated pollutants.

Potential sensitive concerns to be included in the BACT/LAER analysis can be addressed on the basis of energy, economic and environmental issues. Relative to energy supply, the project will have a positive effect. The facility is designed to produce steam and electricity during the combustion process. This generation will help satisfy an existing energy demand that would otherwise be supplied by existing fossil-fuel combustion units. Furthermore, no direct energy is recovered from the landfilling of MSW, but fugitive emissions and odor are generated from that disposal method.

The economic impacts analysis of the alternative air pollutant control strategies is based on the following factors: capital cost (debt service), maintenance costs (including supplies and labor), and operations cost (cost of power, chemicals, water, waste disposal). Facility design features that affect air pollutant emissions but which are primarily related to the furnace design and operational parameters (i.e. grate design, excess air level, etc.) are not included in the economic analysis. With this data the total annual cost (economic impact) of each control strategy for each pollutant can be assessed and comparisons made in terms of cost effectiveness.

In general, the positive environmental impacts of the facility would include the reduction of landfilling activities and a resultant reduction in fugitive dust emissions, vehicular emissions (carbon monoxide, hydrocarbons, and nitrogen oxides), odor problems, potential groundwater pollution, and a reduction in the consumption of land resources for landfilling activities. However, the facility would directly impact air quality by releasing atmospheric pollutants as identified in Section 4.0. The level of degradation is assessed on a comparative basis for both the individual control technology considered and the relative impact on the environment.

The environmental impact analysis was performed by calculating incremental ground-level air pollutant impacts of the various control alternatives. The EPA-approved short-term version of the Industrial Source Complex Model (ISCST) model was chosen due to its capability to analyze the aerodynamic affects of the buildings comprising the facility on plume dispersion (downwash). This is required since the proposed stack height is less than the calculated GEP requirements. The modeling methodology and protocol that is followed to calculate facility impacts in Section 7.0 was also used in the BACT/LAER analysis. The stack parameters that were used in the modeling exercise simulated worst-case conditions. That is, recently cleaned boilers operating at maximum load conditions (1760 tpd or 110 percent of the nameplate rating) and firing a waste with a low HHV (4000 BTU/lb). The boiler tubes, being recently cleaned, allow for maximum heat transfer which therefore reduces flue gas temperature; hence, reduces plume rise and pollutant dispersion. This particular condition will occur only briefly. As the units are operated, the boiler tubes become fouled, thereby reducing heat transfer and increasing the flue gas temperature which aids pollutant dispersion. Although worst-case conditions should be used to calculate maximum short-term pollutant concentrations, annual average conditions would be used to calculate maximum long-term concentrations. However, to minimize the computer time involved with the modeling activities, all impacts, both short and long-term were predicted based on worst-case stack gas exit conditions. This would therefore overpredict the long-term concentrations providing a degree of conservatism. Also, this assumption of worst-case conditions holds true even under conditions of changing waste throughput due to variations in waste quality (i.e. HHV). The operating characteristics of the system were discussed earlier in Sections 2 and 4. Worst-case conditions at maximum load corresponds to firing 1760 tpd of solid waste with an HHV of 4,000 BTU/lb and a stack gas exit temperature of 430 deg. F (ESP Case). The modeling data base and options used in the analysis are summarized in Section 7. Source operating data used as input to the model for all control alternatives are listed in Table 6-1. None of the control options studied resulted in pollutant impact projections in violation of the NAAQS or PSD increments (a detailed NAAQS analysis is contained in Section 7.0).

Although BACT determinations are made on a case-by-case basis, EPA pursues a program to disseminate information on control technology determinations. This is done in a nationally consistent manner through the BACT/LAER Clearinghouse (EPA, 1982 and EPA, 1983). The basic purposes of the BACT/LAER Clearinghouse are to: (1) provide state and local agencies with current control technology determinations, (2) summarize recent determinations for sources of similar size and nature, and (3) provide data on the emission limits imposed on new or modified sources.

TABLE 6-1

Source Operating Data

	Stack Height (m)	Exit Gas Temperature (°K)	Exit Gas[1] Velocity (m/s)	Effective Stack Internal diameter (m)[2]
ESP (at 0.025 gr/dscf @ 12% CO_2)	67	494	16.8	3.5
Fabric Filter	67	494	16.8	3.5
Dry Scrubber/ESP and Dry Scrubber/Fabric Filter	67	416	16.8	3.22
ESP/Wet Scrubber	67	400	16.8	3.15

Building Dimensions

Height (m)	Width (m)	Length (m)	Maximum Projected width (m)	Width/Length[3] Dimension used in the Model (m)
42.7	51.5	22.9	56.4	49.9

[1] Exit velocity for all alternatives were set equal to that of the baseline modeling case (i.e. that condition modeled in the worst-case analysis) so as not to bias modeling results.

[2] Effective internal diameter is the diameter necessary to maintain an exit gas velocity of 16.8 m/s under maximum load conditions.

[3] The width/length dimension is the dimension of the width and length of a fictitious building whose area is equal to that of a circle whose diameter is the maximum projected width listed above.

Table 6-2 contains a list of BACT determinations made nationwide and is intended as a reference. Again, no two BACT determinations are exactly alike due to the case-by-case decision method stipulated by EPA.

The data presented in the following analysis are primarily based on information collected from various equipment vendors. The relative values have been reviewed by CDM and appear to be in general agreement with current established practices and experience.

This section presents the BACT/LAER analysis for each pollutant subject to PSD and NSR reviews and thereby identifies the control alternatives, the process leading to the proposed strategy, the selected control strategy and the level of control proposed for each applicable pollutant. The control alternatives for each pollutant have been selected from a longer list of potential control alternatives. Those analyzed below appear to be the best suited for this application.

6.1 PARTICULATE MATTER

The control of particulate matter from refuse combustion is regulated under New Source Performance Standards (NSPS) (40 CFR 60). The Federal NSPS standard for a Municipal Solid Waste (MSW) combustion facility is 0.08 grains of particulate per dry standard cubic foot (gr/dscf) of exhaust gas corrected to 12 percent CO_2. Based on preliminary design data, this emission rate would correspond to approximately 0.48 pounds of particulate per ton of refuse burned.

Resource recovery facilities operating in Florida are also subject to the DER regulation, Specific Source Emission Limiting Standards for Incinerators (17-2.600(1)(c)). Particulate emissions for sources greater than 50 tons per day are limited to 0.08 gr/dscf corrected to 50 percent excess air. This standard is essentially the same as the federal NSPS Standard. The design emission rate proposed for the facility is 0.025 grains of particulate per dry standard cubic foot of exhaust gas, corrected to 12 percent carbon dioxide (0.025 gr/dscf at 12% CO_2), which is well below the aforementioned emission standards.

TABLE 6-2

RECENT BACT DETERMINATIONS FOR FACILITIES BURNING REFUSE

SOURCE TYPE/COMPANY NAME LOCATION/PERMIT NUMBER DATE OF ISSUE	SOURCE SIZE PROCESS DESCRIPTION	PROPOSED CONTROL TECHNOLOGY	BACT EMISSION LIMITATION DETERMINATION
Refuse Combustion/Energy Answers Corp. Rochester, MA 025-120MA14 3/15/82	3 new waterwall boilers rated at 600 tpd each firing refuse derived fuel	o 3 stage ESP with overall PM collection efficiency of 96%	PM: 0.05 gr/dscf @ 12% CO_2
		o low sulfur refuse	SO_2: 0.23 lb/MMBTU
		o boiler design for NO_x	NO_x: 0.5 lb/MMBTU
Refuse Combustion/Municipal Incinerator Pulaski Hwy. Baltimore, MD 78MD-09 1/25/80	600 tpd municipal incinerator	o ESP with an overall PM collection efficiency of 98%	PM: subject to LAER not BACT (0.03 gr/dscf @ 12% CO_2)
		o proper combustion techniques for SO_2, CO, VOC, NO_x	SO_2: 35.1 lb/hr CO: 30 lb/hr VOC: 1.3 lb/hr NO_x: 2.6 lb/hr
Refuse Combustion/NE MD Waste Disposal Authority Baltimore, MD 81MD-01 9/10/81	3 new mass-burning waterwall boilers with a total capacity of 2010 tpd	NOT SPECIFIED	SO_2: 335 lb/hr CO: 109 lb/hr NO_x: 267 lb/hr F: 4.2 lb/hr
Refuse Combustion/Refuse Fuels Inc. Lawrence, MA 023-121MA12 3/23/81	new waterwall furnace with a total capacity of 960 tpd, firing refuse derived fuel	o 5 field ESP with an overall PM collection efficiency of 98%	PM: Subject to LAER not BACT (0.025 gr/dscr @ 12% CO_2)
		o low S RDF	SO_2: 1.2 lb/MMBTU
		o boiler design for NO_x control	NO_2: 0.7 lb/MMBTU
Refuse Combustion/Resource Authority Gallatin, TN 8/1/80	2 new refuse mass-burning waterwall boilers at 75 tpd each	o Scrubber and fabric filters with an overall PM collection efficiency of 99%	PM: 0.04 gr/dscf
		NOTE: due to problems encountered with the existing scrubber/fabric filter system, they are being replaced with ESP's.	

TABLE 6-2 (Continued)

RECENT BACT DETERMINATIONS FOR FACILITIES BURNING REFUSE

SOURCE TYPE/COMPANY NAME LOCATION/PERMIT NUMBER DATE OF ISSUE	SOURCE SIZE PROCESS DESCRIPTION	PROPOSED CONTROL TECHNOLOGY	BACT EMISSION LIMITATION DETERMINATION
Refuse Combustion/NESWC North Andover, MA 029-121-MA16 5/27/82	2 new mass-burn water-wall refuse fired boilers with a total capacity of 1607 tpd	o ESP designed to meet approved BACT determination	PM: 0.05 gr/dscf @ 12% CO_2 CO: 0.07 lb/MMBTU H_2SO_4: 0.02 lb/MMBTU
		o low S fuel	SO_2: 0.27 lb/MMBTU NO_x: 0.32 lb/MMBTU
Refuse Combustion/McKay Bay Tampa, FL PSD-FL-086 7/2/82	new refuse fired mass-burn furnaces with a total capacity of 1000 tpd	o ESP designed to comply with LAER	PM: Subject to LAER not BACT (0.025 gr/dscf @ 12% CO_2)
		o low S fuel	SO_2: 170 lb/hr
		o boiler design and operating procedures for NO_x control	NO_x: 300 lb/hr VOC: 9 lb/hr Be: 5.0 gr/day F: 6.0 lb/hr Hg: 0.6 lb/hr Pb: 3.1 lb/hr
Refuse Combustion/Westchester County, NY 2/22/82	new mass-burn waterwall refuse fired boilers with a total capacity of 2250 tpd.	o ESP designed to comply with approved BACT determination	PM 0.03 gr/dscf NO_x: 3.0 lb/ton CO: 0.62 lb/ton
Refuse Combustion/Pinellas County, FL Pinellas Park, FL 8/31/83	additional mass-burn waterwall refuse fired boiler with a total capacity of 1,050 tpd	o ESP designed to comply with approved BACT determination	PM: 0.03 gr/dscf @ 12% CO_2 SO_2: 1.0 lb/ton NO_x: 3.0 lb/ton CO: 1.5 lb/ton

SOURCES: (EPA, 1982) and (EPA, 1983)
NESWC PSD permit, #023-121-MA16
McKay Bay PSD permit, #PSD-FL-086
(HDR, 1983)

As mentioned in Section 5.0, the source is located in an area designated as non-attainment for particulate matter, and therefore subject to New Source Review and LAER. A particulate matter emission rate of 0.025 gr/dscf at 12% CO_2 is considered to represent LAER for this source based on a review of the most stringent emission limitation contained in any State Implementation Plan (Maryland and the District of Columbia). Since LAER for particulate matter is proposed at 0.025 gr/dscf at 12% CO_2, no control efficiency was considered that would result in a higher particulate matter emission rate.

The alternative particulate control systems capable of meeting the particulate limitation of 0.025 gr/dscf at 12% CO_2 have been considered for review include:

1. Electrostatic precipitator (ESP).
2. High energy wet venturi scrubber.
3. Fabric filtration system (or baghouse).

The individual control efficiencies of the systems presented above can be compared based on actual operating experience and/or theoretical design values. These control systems are all capable of meeting the emission requirements as established by State and Federal source performance guidelines. Any of the particulate control systems presented in this section could, if properly designed and operated, meet this emission level.

The following factors were considered in selecting LAER at 0.025 gr/dscf:

- Maryland's air code (and others), the most stringent state emission standard in the U.S., at 0.03 gr/dscf at 12% CO_2.

- Recent LAER determinations for Refuse Fuels Inc. in Lawrence, Massachusetts and the McKay Bay facility in Tampa, Florida both at 0.025 gr/dscf at 12% CO_2, utilizing electrostatic precipitators (See Table 6-2).

- Recent BACT determination for the resource recovery facility in Westchester County, New York at 0.03 gr/dscf at 12% CO_2, utilizing an electrostatic precipitator.

The recent LAER determinations for Lawrence, Massachusetts and Tampa, Florida suggest that a LAER of 0.025 gr/dscf at 12% CO_2 represents the lowest emission level that can be reliably obtained by a state-of-the-art electrostatic precipitator over the long-term. The fact that vendors are now willing to guarantee to 0.020 gr/dscf at 12% CO_2 should be qualified by the fact that vendors tend to overstate their product's capabilities particularly in a competitive bid situation and also that manufacturer's guarantees at these low levels usually extend to the initial compliance test only, whereas the LAER standard would be applicable for the entire 20 to 30 year project life. Furthermore, it has been noted that ESP performance has a tendency to deteriorate slightly with time (O'Connell, 1982). In light of the above discussion, it would be prudent to set LAER at 0.025 gr/dscf at 12% CO_2 knowing that this proposed emission rate must be maintained over the 20-30 year project life.

Several alternative particulate control systems have been considered for review under LAER including: an electrostatic precipitator (ESP), a wet venturi scrubber, and a fabric filter (FF). The electrostatic precipitator is the standard customary flue gas cleaning device historically applied to municipal solid waste (MSW) combustion facilities and utility boilers for particulate control. Fabric filters have been used on utility boilers on a limited basis and to an even lesser degree on MSW combustion facilities and can still be considered in the developmental stage from a long-term operations point of view. Use of wet scrubbing systems on utility and industrial boilers are not uncommon. However, their application on MSW combustion facilities has been very limited. Operating experience with wet scrubbing systems on MSW plants has been largely unsuccessful due to the corrosion problems from the saturated flue gas, the need for stack gas reheat, and costs associated with wastewater disposal.

The air pollution control devices mentioned above have historically been applied to various combustion processes and all systems have either demonstrated, or can be designed to achieve control efficiencies in compliance with the proposed LAER particulate emission rate of 0.025 gr/dscf at 12% CO_2.

Description of Alternative Control Systems

Electrostatic Precipitators. Collection of particles is accomplished by producing an electrical charge on the particle and attracting the particle to collecting surfaces of opposite polarity. The collected dry particles are mechanically removed from the collecting surfaces and fall to the bottom hopper of the ESP for removal and transportation to landfill. Some major MSW resource recovery facilities equipped with ESPs are located in Braintree, MA; Harrisburg, PA; Chicago NW, IL; Nashville, TN; Norfolk, VA; Saugus, MA; Montreal (Des Carriers); Ouebec, and Pinellas County, FL. MSW combustion facilities throughout the U.S. and the world, are successfully utilizing ESPs for the efficient control of particulate matter.

The use of ESPs to control particulate emissions from utility boilers and MSW combustion facilities has proven to be acceptable based on many years of operating experience. Also, ESPs when compared to the other control technologies discussed hereafter have, in general, proven to be the most cost-effective, reliable, and most frequently applied technology available for controlling particulates from major combustion sources, especially MSW resource recovery facilities.

Several factors affect the collection efficiency of an ESP system. These include:

- Collection plate area per unit gas flow rate (specific collection area - "SCA").
- Gas velocity through collectors.
- Size distribution and properties of the particles.

- Number, width and length of gas passages.

- Electrical field strength.

- Particle in-field residence time.

It is possible to attain the desired control efficiency by altering the design specification for each of the above parameters. Furthermore, several positive characteristics of an ESP are important when considering their use in controlling combustion emissions. These include:

- High overall collection efficiency and reliability.

- Relatively low power requirements.

- Ability to accommodate flue gas temperatures in the general range of 250° F to 550° F.

- Minimal change in collection efficiency over a wide range of particle sizes.

- Minimal fire hazard potential.

However, when combusting municipal solid waste, the potential operational problems typically encountered which affect ESP performance are:

- Variations in flue gas moisture content and flyash resistivity.
- Condensation of corrosive flue gas constituents.
- Variation in processing (and emission) rate.
- Deviations between design and actual gas flow rates.

Except for the corrosivity issue, the major negative effect of the potential problems stated above is to somewhat lower the collection efficiency. This deficiency can be resolved by increasing the overall design efficiency of the ESP. Corrosion problems can be alleviated through proper construction to avoid ambient air leakage into the ESP and insulation and external heating of the unit to avoid cold spots where condensation can occur. Corrosivity is normally not a problem as long as flue gas temperature remains above 250°F and below 550°F.

High Energy Wet Venturi Scrubber. Collection of particles in a venturi is accomplished through inertial impaction of the particles on droplets of water. The collection efficiency of the particles is proportionately related to the water droplet size. Due to the presence of submicron particulate in the combustion gases of resource recovery plants, a very high energy input is needed to form the small water droplets required for the high particulate removal efficiencies needed to meet regulations. Disadvantages of the venturi option are:

- Materials of construction must be corrosion resistant, hence costly.
- Flue gas will be saturated with resultant visible stack steam plume.
- Relatively poor plume rise due to low plume temperatures (unless stack gas reheat is utilized - which consumes energy).
- Additional waste water treatment facilities required.
- A sludge (wet) product must be disposed.
- Excessive energy-power costs will be required for the venturi to meet the proposed TSP guarantee. It is estimated the venturies will operate at approximately 50 inches water column pressure drop.

Due to these overwhelming disadvantages, the venturi alternative is not considered a viable means of TSP control and no further analysis of this option will be performed. The more detailed analysis of various control options focuses on those technologies with fewer limiting features.

Fabric Filters. The use of a fabric filtration system (baghouse) for controlling particulate emissions from combustion sources is an evolving technology and its application to resource recovery facility has been mostly limited to small plants, 100 tpd or less. Operating experience in large mass-burning plants has been largely unsuccessful due to deterioration of the bags from flue gas temperature excursions, to blinding of the bags from variable moisture content in the flue gas, and to corrosion of the bags and metal components from acid gas condensation.

Collection of particles is accomplished through filtration by multiple tubular fabric filter media (bags). The bags are contained in multiple modular units which comprise the total baghouse system. Initial collection forms a thick porous cake of collected particulate on the bags. This cake then acts as the filter collection device with the bag serving to support the particulate cake. As the cake builds, the pressure drop across the baghouse also increases and the cake must be removed or cleaned. Baghouses are categorized according to the method utilized for cleaning the bags: shaker, reverse-air and pulse jet. The shaker baghouse would not be suitable for this project, because the type of fabric required for this high-temperature application cannot structurally withstand the violent shaking action over an extended operating period. The other two systems gently clean the bags by reversing the air flow through the bags. The reverse air baghouse utilizes an external centrifugal fan and the pulse jet uses high-pressure compressed air.

The major advantages of the fabric filtration systems are the improved control efficiency for particulate removal over standard ESP systems. A fabric filter is not as dependent on gas volume and composition versus an ESP, and it will accept surges in gas flow and particulates with no significant increase in particulate emissions. Resistivity of flyash for low sulfur fuels, which affects ESP performance, is not a problem with a fabric filter. Fabric filtration systems also have a greater control efficiency for smaller particle sizes and even some affinity for condensable organics as compared to ESP systems.

The disadvantages of fabric filters are as follows:

- Susceptibility to fires.

- Consistent bag quality difficult to achieve (a possible problem due to the large number of bags used).

- Blinding or clogging of the filter fabric.

- Loss of structural integrity at high temperature surges above 550°F.

- Cementation in a humid low-temperature gas stream.

- Short and uncertain bag life because of limited operating experience.

These conditions could occur during the operation of the Hillsborough County Facility and cause the baghouse to become inoperable. As an example, if one bag should fail out of the approximate 1500 bags per furnace required, a visible particulate plume could result.

Fabric designs are available that minimize the effects of temperature, corrosivity, abrasion and the potential for combustion. Stainless steel bags could be used which would eliminate the possibility of fires. Individual bag failures can be limited when the fabric and cleaning methods are properly selected. Gas velocity, pressure drop, and the air-to-cloth ratio are important operating parameters that must be considered in designing a system. However, predicting the build up of filter cake and the resulting increase in pressure drop remains a difficult task that places uncertainties in designing the baghouse.

In general, fabric filters have not been proven on refuse combustion plants from a longevity standpoint, as compared with ESPs. To date, there have been only three full-scale mass burning facilities utilizing fabric filters as the sole control device, two in Switzerland, the other in East Bridgewater, Massachusetts. The East Bridgewater facility is composed of 2 units at 150 tpd each. Both facilities mentioned above are sized considerably lower than the proposed Hillsborough County facility. The chief problem at the East Bridgewater plant was corrosion to metal and fabric surfaces due to acid condensation occurring at cold spots during system shutdowns. The plant has been shutdown for several years.

Operating experience at the Neuchatal, Switzerland plant is reported to be satisfactory following considerable system modifications. No data is available on the other Swiss facility.

Recently, baghouses have been utilized on several small municipal plants utilizing modular combustion units (MCU's). These plants include:

- Windham, Connecticut
- Portsmouth, New Hampshire
- Auburn, Maine
- Industrial plant, Baltimore, Maryland

At these facilities (except the Baltimore plant), stainless steel bags were used to eliminate the possibility of bag damage due to fires. However, blinding of the bags has been a recurring problem at these plants due to variation in the moisture content of the flue gas. At the Windham plant, blinding of the bags was so severe that the suction from the I.D. fan collapsed the bags. At the facility in Baltimore, Maryland, fabric bags were used on a MCU facility burning plant trash. Bag failures (holes in bags) have occurred frequently due to carryover of glowing particles (sparklers). Similar problems were encountered at a municipal refuse facility in Gallatin, Tennessee which utilized Teflon bags. The baghouse is presently being abandoned, and an ESP will be installed.

Based on very limited operating data, bag life projections are difficult to estimate. For the Hillsborough County application, it is estimated that complete bag replacement would be required every two years.

Thus, the major uncertainty of fabric filtration systems, as compared to ESPs, is their reliability which is dependent on bag life and other variables and can result in increased O&M costs.

Performance Comparison of Alternative Systems

The ESP and Fabric filter control systems outlined above are both capable of meeting the particulate emission requirements proposed as LAER. The individual control efficiencies of the systems presented above can be compared based on actual operating experience and/or theoretical design values. The outlet particulate loading of 0.025 gr/dscf @ 12% CO_2 would require approximately 99+% control efficiency. Since either control alternative (ESP or baghouse) could achieve the proposed emission rate, the selection of particulate control technology will be based on reliability issues.

Based on an extensive literature search by O'Connell, et al., only three operational installations of fabric filters on large-scale incinerators were found. Recently, there have been a few fabric filter installations on small-scale MCUs which have been largely unsuccessful, as previously noted. Therefore, a rather low reliability would have to be assigned to the fabric filter based on its very limited operating experience. In contrast, the system with the highest reliability, longest operating history, and highest number of installed units is the electrostatic precipitator.

In conclusion, based on the proven operating record of the ESP, the control device selected to achieve LAER for particular matter at 0.025 gr/dscf is the electrostatic precipitator.

6.2 OXIDES OF NITROGEN

The installation of nitrogen dioxide (NO_x) emission control technologies on combustion units is in various stages of development. The USEPA is sponsoring pilot programs in conjunction with major utilities for post combustion NO_x control on fossil fuel-fired boilers. NO_x emissions can also be controlled in the combustion process.

NO_x emissions from combustion processes result from an oxidation of nitrogen compounds in the combustion air and in the refuse. Formation of NO_x is highly dependent on temperature, pressure and residence time in the combustion unit. A lower, uniform temperature and uniform mixing of air and burning refuse generally eliminates high oxygen concentration gradients and sharp temperature gradients that are conducive to nitrogen oxide formation. The amount of NO_x released from a specific source is therefore a function of the design and operation of the combustion unit.

Currently, NO_x control techniques other than standard refuse combustion control techniques (i.e., control of grate speed, refuse feed, temperature control, underfire and overfire air supply), are not practiced on mass-burning systems. Combustion modification techniques used on fossil fuel boilers are generally not applicable to mass-burn systems or tend to cause higher CO emissions and unacceptable boiler corrosion. Add-on NO_x control systems are still in the developmental stage and thus should not be considered as BACT or LAER technologies (O'Connell et al., 1982 and Russell, 1984).

Thus, the system for control of NO_x emission will be the proprietary grate and combustion control system of the mass-burn equipment boiler supplier.

According to EPA publication AP-42 (EPA, 1977), the emission of NO_x from a present-day resource recovery facility is approximately 3.0 pounds per ton of refuse charged. At this rate the maximum annual predicted impact concentration of NO_x from the proposed ESP control alternative case is 1.04 ug/m^3, well below the NAAQS standard of 100 ug/m^3 and essentially equal to the NAAQS significance level of 1.0 ug/m^3. Therefore, the source will have a minimal impact on air quality with respect to nitrogen oxides. BACT for nitrogen oxides is proposed as the combustion controls inherent to the system design as mentioned above.

6.3 CARBON MONOXIDE (CO)

The site area is designated as attainment with respect to the NAAOS for carbon monoxide, and therefore the source is subject to PSD review and is required to undergo BACT review for carbon monoxide. Since carbon monoxide is a product of incomplete combustion, its formation is largely dependent on the overfire air ratio, the design of the overfire air jets, and the combustion temperature. Specific add-on technologies for control of CO have not been incorporated into present-day resource recovery facility designs. CO emissions are controlled in modern facilities by using commonly-employed combustion control measures, i.e. control of the combustion air to achieve a minimum furnace temperature of approximately 1850°F, while mataining achieve a high enough temperature for good burn-out of volatilized hydrocarbons. This entails the optimal placement of the overfire air jets and the use of high pressure air to promote good mixing and turbulence of partially combusted furnace gases with the secondary air. Using these control measures usually provides adequate control of CO (O'Connell et al., 1982). No additional controls are required.

Based on modern plant design the emission rate for CO is estimated to be 1.8 lb per ton of refuse charged. The resulting maximum hourly CO concentration is estimated to be 31.5 ug/m^3 which is well below the significance level 2,000 ug/m^3, and the source will have an insignificant impact on air quality with respect to carbon monoxide. Therefore, BACT for CO is the grate and combustion control system of the boiler supplier.

6.4 VOLATILE ORGANIC COMPOUNDS

The project site is located in an ozone non-attainment area which usually requires stringent control for volatile organic compounds (VOC) or hydrocarbons (HC). Since the proposed emission for HC is less than the 100 tons per year, the facility is not subject to the LAER requirement. However, VOC are the products of incomplete combustion. Present-day grate and combustion control systems are designed to maintain elevated oxygen levels and provide for a near complete burnout of VOC. No existing resource recovery facility uses any type of add-on control system to reduce HC emissions. State-of-the-art combustion control systems inherent in the furnace/boiler design are usually considered LAER for VOC. The proposed facility shall employ such a furnace/boiler design. The proposed emission HC factor is, therefore, 0.2 lb/ton.

6.5 LEAD, MERCURY, AND BERYLLIUM

Due to the presence of trace quantities of these materials in refuse, a portion of these metals will be volatilized and delivered to the air pollution control device. Volatile trace metals are expected to condense upon the smaller particulates contained in the exhaust stream. Thus, by achieving control of particulate matter, control of trace metals (lead, mercury, and beryllium) is also practiced. Therefore, all of the control technologies evaluated for particulate matter are suitable for controlling the above trace metals. The control technologies for particulate matter have been previously described and the reliability characteristics of these systems have also been evaluated.

In general, fabric filters have the ability (as demonstrated in pilot tests) to capture a greater percentage of the fine particulate than an ESP and therefore should provide additional control of trace metals. Before a BACT determination can be made, the ambient air quality impacts and economics of these control alternatives must be evaluated.

Comparison of Trace Metal Air Quality Impacts For Alternative Control Technologies

To estimate potential public health impacts associated with an increase in air contaminants, it is most expedient to compare the estimated ground level concentrations to established state or national ambient air quality standards. However, there are many toxic pollutants for which there are no applicable national or state ambient air quality standards. Therefore, many public health and air quality specilists have been using established occupational standards which are not directly comparable to acceptable ambient levels because they are based on an exposure for a 40-hour work week, a healthy male, average worklife cycle, and other specific work place factors. It is therefore necessary to convert the higher work place standards to realistic ambient levels, designed to protect the public health.

The State of Florida has not developed any additional ambient air quality standards or guidelines dealing with noncriteria pollutants. However, a highly regarded set of standards/guidelines is the New York State Ambient Air Quality Standards and the Accepted Ambient Levels (AAL's) published by the New York State Department of Environmental Conservation (NYSDEC) - Division of Air Resources. The AAL's were developed from established occupational standards (Time Weighted Average/Threshold Limit Values) and appropriate factors of safety. The NYSDEC approach is used here because it provides a conservative framework for assessing the potential public health impacts associated with an increase in toxic air contaminants and the appropriate application of control equipment. These standards represent the most advanced formal program in the U.S. for the control of hazardous ambient air contaminants.

Lead

The lead emission rate for the ESP control alternative is 0.48 lb/ton. This results in an incremental ground level concentration of 0.017 ug/m^3 (annual average). This is approximately 1.1% of the NAAQS for lead of 1.5 ug/m^3. Therefore, the source is expected to have a minimal impact on air quality with respect to lead.

Mercury and Beryllium

Mercury emissions are minimally affected by particulate control devices. The mercury emission rate from the ESP control option is 5.2×10^{-3} lb/ton. This results in an incremental ground level concentration increase of 1.8×10^{-3} ug/m^3 (annual average). Although no federal or state standards exist for mercury, New York State has developed a guideline concentration to be followed in permitting activities. The New York State (AAL) guidelines list an annual mercury concentration of 0.167 ug/m^3. Although no mercury background concentrations are available, it is believed that due to the low levels of mercury projected (only 1.08% of the guideline) and the limited number of sources of mercury emissions to the atmosphere, the AAL guideline will not be exceeded.

The controlled beryllium emission rate is projected to be 1.31×10^{-6} lb/ton. The resulting incremental groundlevel concentration of beryllium from the ESP control case is 8.84×10^{-5} ug/m^3 for a 24 hour averaging time. Although no NAAQS exists for beryllium, New York has established a state air quality standard for beryllium of 0.01 ug/m^3 for a one month averaging time. Comparing a 24-hour predicted impact with a one month average standard results in a conservative assessment. The data indicate that the beryllium impact is well below the New York standard for beryllium. Although no beryllium background concentrations exist, it is believed that due to the low levels of beryllium projected and the limited number of sources of beryllium emissions to the atmosphere, the NYS beryllium standard (used as a guideline here) will not be exceeded.

Comparison of Environmental, Economic, and Reliability Issues for Trace Metal Control Technologies

As previously discussed, regardless of the control alternative selected, the facility is not expected to significantly impact ambient air quality with respect to lead, mercury, and beryllium.

The economic summary presented in Table 6-3 indicates that the incremental annual cost for the fabric filter alternative at $2.34 per ton is slightly greater thna the annual cost for the ESP alternative at $2.02 per ton. The ESP has a significantly higher capital cost than the fabric filter case, but the large operations and maintenance (O&M) cost for the fabric filter, particularly for bag replacement labor and materials, negates the capital cost advantage of the fabric filter. (The back-up data for the development of capital and O&M costs is presented in Section 6.7 - Supplemental Economic Data). Thus, on the basis of total annual cost there is a slight advantage to the ESP alternative.

Operating experience with fabric filters is very limited. Based on an extensive literature search by O'Connell, et al., (1982), only three operational installations of fabric filters on large-scale resource recovery facilities were found. Recently, there have been a few fabric filter installations on small-scale MCUs which have been largely unsuccessful, as previously noted. Therefore, a rather low reliability would have to be assigned to the fabric filter based on its very limited operating experience. In contrast, the system with the highest reliability, longest operating history, and highest number of installed units is the electrostatic precipitator.

TABLE 6-3

ECONOMIC COMPARISON OF
ALTERNATIVE TRACE METAL CONTROL STRATEGIES

System and Outlet Grain Loading (gr/dscf)[1]	Control Technology Cost Totals(2): Annual Cost For Control System($)	Annual Cost Per Ton ($)	Percent Over ESP Case Cost
ESP @ 0.025 gr/dscf	1,178,000.	2.02	--
Fabric Filtration	1,369,000.	2.34	.16

[1]Corrected to 12% CO_2.

[2]Increase in plant costs attributed to control devices.

In conclusion, since the environmental and economic issues are not conclusive in determining the trace metal control technology, the selection of control system is based on reliability issues. Based on the proven operating record of the ESP, the control device selected as BACT for trace metals is the electrostatic precipitator consistant with the LAER determination for particulate matter.

6.6 SULFUR DIOXIDE AND ACID GASES

The application of a control device to remove any one of these pollutants (SO_2, HCl, H_2SO_4, and HF) would be effective in controlling a portion of all of these emissions. In addition, they all play a role in forming acidic gases in the atmosphere (either directly or through a series of reactions). Therefore, these pollutants are addressed concurrently in the BACT/LAER analysis.

Federal authorities have not yet established sulfur dioxide or acid gas NSPS for MSW resource recovery facilities. Therefore a case-by-case review is required to determine an allowable emission rate for SO_2 and acid gases. The following analysis for SO_2 has been prepared to satisfy the impact assessment criteria within the scope of the BACT evaluation.

Alternative Control Systems

The control alternatives that would reduce SO_2 and acid gas emissions include wet scrubbers and dry scrubbers usually followed by an ESP or baghouse. Electrostatic precipitators and baghouses alone are not SO_2 (nor acid gas) control technologies.

Dry Scrubber - Electrostatic Precipitator System

Dry scrubbing systems control SO_2 and acid gases through chemical absorption and neutralization. This process is accomplished by contacting the flue gases with a fine alkaline slurry spray. The spray can be injected into the dry scrubber through atomizing nozzles or rotating discs.

Typically following dry scrubbing systems an electrostatic precipitator or fabric filter is utilized for particulate control.

A description of the dry scrubbing process follows:

- The fine droplets of either calcium or sodium based alkaline slurry quickly dry when contacted with the furnace gases in the quench reactor tower. The SO_2 and other acid gases will react with the calcium or sodium reagent while the H_2O is being evaporated, leaving a dry powder.

- A portion of the large (particle size) reacted dry particles, unreacted reagent, and inlet particles drop to the bottom of the dry scrubber and are discharged for disposal.

- Smaller (particle size) reacted particles, unreacted reagent and inlet particles exit the dry scrubber and enter the conventional particulate control device. If a baghouse is utilized as the TSP control device, the unreacted reagent will be retained in the thick dust cake on the bags. This unreacted reagent acts to further neutralize the SO_2 (approximately 5 percent) as the flue gases pass through the cake containing the reagent. An ESP will not further affect SO_2 and acid gas control.

The disadvantages of a dry scrubber are as follows:

- Minimal design and operation/maintenance experience.

- Susceptibility of clogging spray nozzles and/or quench tower wall chemical accumulation.

- Additional space requirements.

- Additional solids disposal (containing soluble salts).

- Decrease in plume temperature reducing plume rise thereby reducing plume dispersion.

The main advantage of a dry scrubbing system (in comparison to particulate control devices) is the ability to efficiently remove both particulate and gaseous (SO_2, H_2SO_4, HF, HCl) elements from the gas stream. Other advantages include the following:

- No visible steam plume (as with a wet scrubber) when ambient temperature is above approximately 40° F. This temperature will vary due to relative atmospheric humidity.

- No corrosion problems as compared to wet scrubber. Materials of construction are normally mild carbon steel.

- Lower pressure drop as compared to wet scrubber.

Operating experience with dry scrubbing technology (with either ESP or baghouse) is very limited. Presently the only dry scrubbing system in municipal solid waste service in the United States is the Teller Dry Scrubbing System, installed in 1979 at Framingham, Massachusetts. The Framingham refuse combustion facility is a 250 TPD plant consisting of two Volund rotary kilns; each sized at 250 TPD (100% standby capability). In comparison, the proposed Hillsborough County facility is composed of four units sized at 400 tpd each. These units are designed for full operation with no standby capability. The Framingham system utilizes a baghouse for final particulate control. After an initial extensive shakedown period, the system has reportedly been operating for the last 2.5 years in compliance with the Massachusetts Air Pollution Code. However, very little data has been made available concerning the operations and maintenance requirements and system availability of this unit.

There are a few European and Japanese resource recovery facilities which utilize dry scrubbing systems. A consultant's recent survey of dry scrubbing systems on MSW resource recovery facilities in Europe, conducted for the Port Authority of NY and NJ; concluded that the dry scrubbing process is essentially in the experimental stage, i.e., still under development (Dvirka, 1981). The following West German plants were visited: Hamburg-Stellinger Moor, Oberhausen, and Duesseldorf. Two of the installations were pilot plants, and the only fully operational plant is Hamburg-Stellinger Moor. The Hamburg plant was built with grant money from the West German federal government and was used for research and development activities. The primary function of the dry scrubbing equipment was to enhance ESP performance by cooling and humidifying the gases. It therefore can not be considered a commercial plant. The major problems at these installations were:

- Fouling of the reactor tower with alkaline chemicals
- Clogging and replacement of the atomizing slurry nozzles
- Frequent maintenance of chemical and residue handling systems
- Much higher than anticipated chemical usage
- Poor system reliability; i.e., acid gas absorption efficiencies have not been achieved on a sustained basis.

Only the Oberhausen plant (a research pilot plant) utilized a bag house, and the expected life of the bag filters could not be addressed since the plant did not operate consistently enough to yield reliable data. In contrast to the European experience, Teller Environmental Systems claims to have numerous operating installations, mostly in Japan. Limited operating data recently made available on a few of the newer installations indicate that these plants appear to be operating satisfactorily and meeting particulate and acid gas emission codes. Very little is known about the operating history, availability, and maintenance requirements of these facilities.

In summary, although recent facilities overseas appear to be operating satisfactorily, dry scrubbing is an evolving technology which as yet has not demonstrated commercial, long-term reliability on refuse combustion facilities, especially large-scale systems.

Electrostatic Precipitation - Wet Scrubber System. An alternative to the previously described system (dry scrubber/ESP or fabric filter) is a control technique that utilizes an ESP and wet scrubber to remove both particulate and gaseous pollutants from the flue gas stream. In this case, a standard ESP is installed ahead of the wet scrubber. The ESP is the primary particulate control device. The wet scrubber subsequently removes additional particulates as well as gaseous pollutants by absorption and neutralization.

Many variations of scrubber design exist such as packed towers, weir scrubbers, impingement scrubbers, crossflow scrubbers and venturi scrubbers. For the Hillsborough County facility, packed towers with sodium-based reagent slurries were selected for further analysis. Lime-based systems are not recommended for wet scrubbers due to the high likelihood of plugging and clogging of the packed tower section. A typical packed tower would be equipped with the following internals and their respective functions:

- Inlet spray manifold - cools the gases to adiabatic saturation temperature, approximately 140° F, with either fresh water or recirculated sodium-based slurry.

- Packed section - packing will distribute liquid sodium-based slurry and acid gases for complete mixing and absorption and neutralization of SO_2.

- Mist eliminator - removes carryover mist from reentrainment into the exiting gas stream. Mist would contain reacted solids and unreacted sodium reagent which could exit stack as particulate.

The disadvantages of the wet scrubber are as follows:

- Higher pressure drop as compared to the dry scrubber. A wet scrubber for gaseous pollutant control will operate with about a 6 inch w.c. pressure drop and a dry scrubber will operate with a 1.5 to 3.5 inch w.c. pressure drop.

- High corrosion-resistant materials of construction are required for the scrubber and downstream ductwork, fans and flues.

- Due to gases being lowered to the adiabatic saturation temperature, a dense steam plume from the stack will be visible. This problem can be solved by flue gas reheat downstream of the wet scrubber. Reheat could be accomplished through heat exchangers utilizing steam from the plant extracted from the flue gas by a heat exchanger, or fossil fuel-derived heat, all of which will increase operating costs.

- Liquid waste discharged from the scrubber water system contains sodium sulfite and sodium bisulfite which require oxidation before discharge to the co-located wastewater treatment plant (WWTP). Also, the maximum allowable concentration of total dissolved solids discharged to the WWTP is 500 mg/l, which would effectively prohibit the discharge of the scrubber water to the WWTP and a wastewater pretreatment system would be required prior to discharge.

The advantages of the wet scrubber are as follows:

- No solid discharge.

- Higher gaseous pollutant control efficiencies as compared to dry scrubbers.

- Longer operating history as compared to dry scrubbers.

Performance Comparison of Alternative Systems

The control efficiencies of the various systems for SO_2 and acid gases (HCl, HF, H_2SO_4) are tabulated in Table 6-4. The data indicate that the highest degree of control for SO_2 and acid gases is achieved by the ESP/wet scrubber system and the dry scrubber/fabric filter system respectively. However, the BACT evaluation of the performance of alternative control systems should be based on the control efficiency, environmental impact, reliability, operating experience and economics of the proposed systems.

TABLE 6-4

PERFORMANCE SPECIFICATIONS FOR ALTERNATIVE SO_2 CONTROL SYSTEMS

Control Alternative	Worst Case Stack Exit Conditions		Proposed Removal Efficiency(%)			
	Flow Rate (ACFM)	Temperature (°F)	Maximum TSP Loading (gr/dscf*)	TSP	SO_2	HCl, HF, H_2SO_4
ESP @ LAER	343,600	430	0.025	99+	0	0
ESP and dry scrubber	299,600	290	0.025	99+	65	80
ESP and wet scrubber	278,000	260	0.025	99+	75	90
Dry scrubber and fabric filter	289,600	290	0.025	99+	70	92

* Corrected to 12% CO_2

The removal efficiencies for the dry scrubber/electrostatic precipitator system (as quoted from performance data furnished by system vendors) are 65 percent for sulfur dioxide and 80 percent for acid gases. For the wet scrubber/electrostatic precipitator system the removal efficiencies are quoted as 75 percent for SO_2 and 90 percent for acid gases. The dry scrubber/fabric filter system has removal efficiencies of 70 percent for SO_2 and 92 percent for acid gases.

Particulate outlet loadings and removal efficiencies for the SO_2 control technologies are also listed in Table 6-4. These technologies are designed to control particulate matter to the same outlet loading as the proposed ESP case, 0.025 grains/dscf corrected to 12% CO_2.

Comparison of SO_2 Air Quality Impacts for the Alternative Control Technologies

A comparative analysis of the sulfur dioxide impacts of alternative technologies is presented in Table 6-5. The estimated maximum ground level concentrations were calculated by applying the EPA-approved ISC model. Worst-case operating conditions were applied to define stack operating conditions while design efficiencies were applied to calculate the pollutant release rates. A comparison of projected SO_2 impacts with the NAAOS, PSD significance levels, and PSD increments was made.

The facility impact on ambient SO_2 levels for the no SO_2 control options (ESP and fabric filter) is predicted to be insignificant for the annual concentration impact and slight for the 24 hour concentration impacts. The baseline control option (ESP case) results in a maximum annual incremental ground level concentration of 0.86 ug/m^3 and a 24 hour impact of 17.3 ug/m^3. These values correspond to 1.4 and 6.7 percent of the FAAOS for SO_2. Additionally, they consume approximately 4.3 and 19.0 percent of the total PSD increments. The annual SO_2 impact from the ESP control option is below the PSD significance level of 1.0 ug/m^3. The 24-hour SO_2 impact from this control option is 17.3 ug/m^3. This is above the significance level of 5.0 ug/m^3 but it indicates a slight impact, since it is only 6.7 percent of the FAAQS for SO_2. The SO_2 impacts for the dry and wet scrubber alternatives are also below the annual PSD significance levels.

TABLE 6-5

COMPARATIVE ANALYSIS OF ALTERNATIVE SO_2 CONTROL TECHNOLOGIES
ON ANNUAL AND 24-HOUR SULFUR DIOXIDE CONCENTRATIONS

	Annual Concentrations			24-Hour Concentration		
Control Alternative	Estimated Maximum Impact (ug/m^3)	Percent of FAAQS** (%)	Percent of PSD Increment** (%)	Estimated Maximum Impact (ug/m^3)	Percent of FAAQS*** (%)	Percent of PSD Increment*** (%)
ESP @ LAER	0.86	1.4	4.3	17.3	6.7	19.0
ESP-dry scrubber	0.51	0.9	2.6	8.2	3.2	9.0
ESP-wet scrubber	0.42	0.7	2.1	6.4	2.5	7.0
Dry scrubber - fabric filters	0.43	0.7	2.2	7.0	2.7	7.7

**Annual

FAAQS = 60 ug/m^3
Increment = 20 ug/m^3
Significance
Level = 1 ug/m^3

***24-Hour

FAAQS = 260 ug/m^3
Increment = 91 ug/m^3
Significance
Level = 5 ug/m^3

As stated previously, the SO_2 control technologies are designed to control particulate matter to the same degree as the ESP at 0.025 grains/dscf. The particulate air quality impacts for the SO_2 control technologies are presented in Table 6-6. For all dry and wet scrubber cases the annual and 24-hour particulate concentration levels were slightly greater than the concentrations for the proposed ESP case. Higher particulate air quality impacts result from the scrubbing alternatives, because the stack gases for these alternatives had a lower temperature and less buoyancy and hence dispersion would be less. This is a negative factor when considering these devices for application to this project because the area is designated as non-attainment for TSP. Therefore, TSP impacts should be reduced. However, for the dry and wet scrubbing alternatives the particulate impacts for the annual and 24-hour concentrations would be less than the PSD significance levels indicating an insignificant impact. Thus, for all control alternatives the impact on the annual and 24 hour particulate concentrations would be insignificant or negligible.

In addition, the proposed facility will satisfy an energy demand that would otherwise have to be satisfied by some other power generating facility. Typically, fossil fuels for large, central, power-generating stations contain 0.5 to over 2 percent sulfur content, whereas the sulfur content of the refuse burned at the proposed resource recovery facility is about 0.12 percent (CDM, 1984). Thus, the proposed resource recovery facility will burn a fuel containing 40 to 70 percent less sulfur than typical fossil fuel fired generating facilities. Therefore it is apparent that burning refuse to produce energy is an environmental benefit with respect to SO_2 emissions, in comparison to burning fossil fuels with 0.5 to over 2 percent sulfur content.

Comparison of Acid Gas Impacts For the Alternative Control Options

As was true with mercury and beryllium, no ambient air quality standards exist for acid gases emitted by the facility. Therefore, the NYSDEC guidelines for estimating Acceptable Ambient Levels (AAL's) were used to evaluate estimated air quality impacts from acid gases. The NYSDEC approach provides a conservative framework for assessing the potential

TABLE 6-6

PROJECTED PARTICULATE CONCENTRATIONS FOR ALTERNATIVE SO_2 CONTROL TECHNOLOGIES AS COMPARED TO FAAQS AND PSD INCREMENTS

	Annual Concentrations			24-Hour Concentration		
Control Alternative	Estimated Maximum Impact (ug/m^3)	Percent of FAAQS* (%)	Percent of PSD Increment* (%)	Estimated Maximum Impact (ug/m^3)	Percent of FAAQS** (%)	Percent of PSD Increment** (%)
ESP @ LAER (0.025 gr/dscf)	0.17	0.3	0.9	3.4	2.2	9.1
ESP and dry scrubber @ LAER	0.28	0.5	1.5	4.5	3.0	12.1
ESP and wet scrubber @ LAER	0.32	0.5	0.7	4.9	3.3	13.3
Dry scrubber and fabric filter @ LAER	0.28	0.5	0.5	4.5	3.0	12.1

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*Annual

FAAQS = 60 ug/m^3

Increment = 19 ug/m^3

Significance level = 1 ug/m^3

**24-Hour

FAAQS = 150 ug/m^3

Increment = 37 ug/m^3

Significance level = 5 ug/m^3

public health impacts associated with an increase in toxic air contaminants and the appropriate application of control equipment.

Hydrogen Chloride. The New York State Department of Environmental Conservation and Department of Health has classified toxic air contaminants based on their degree of risk to human health. HCl is classified as a low toxicity air contaminant. This classification refers to contaminants that are known irritants and have not shown any confirmed carcinogenicity in animal tests. Based on the NYSDEC classification, an acceptable ambient level (annual concentration) is calculated for HCl by dividing the Threshold Limit Value/Time Weighted Average for HCl by 50. The Threshold Limit Value (ACGIH, 1980) for HCl is 7000 ug/m^3, thus the acceptable ambient level is 140 ug/m^3.

The maximum increase in the ambient annual HCl concentration from the control alternative yielding the worst case impact is 1.42 ug/m^3 which is well below the acceptable ambient level (only about 1.0 percent of the AAL). This increase does not take into consideration existing background concentrations of HCl. No measured data exist on the background concentrations in the study area but due to the limited number of sources of HCl it is unlikely that it is much greater than the source concentration. Together the source and background concentration should be well below the 140 ug/m^3 guideline.

Sulfuric Acid Mist. H_2SO_4 is also classified as a low toxicity air contaminant by NYSDEC. Although no AAL has been developed for H_2SO_4, a TLV of 1000 ug/m^3 has been established. Using techniques suggested by NYSDEC an AAL can be calculated for comparison of impacts. To provide for a conservative analysis, the TLV was divided by 300 instead of 50 to develop the AAL of 3.33 ug/m^3. The conservatism lies in the fact that for low toxicity pollutants a factor of 50 applies, not 300. The maximum net increase in the ambient H_2SO_4 concentration from the control alternative yielding the worst-case annual impact (ESP case) is 0.027 ug/m^3 which is well below AAL, about 0.8 percent of the level. No data on H_2SO_4 background levels exist but due to the limited number of sources of H_2SO_4, it is believed that ambient levels are extremely low. With the additional impact from the worst case control option, it is expected that future levels will remain well within the guideline value.

Hydrogen Fluorides. Fluorine does not occur free in nature due to its extreme activity. No NAAQS have been developed for fluorides, but New York State has established a state fluoride ambient standard of 2.85 ug/m^3 averaged over a 24 hour period. The projected hydrogen fluoride impact from the facility utilizing the control alternative yielding the maximum impacts is predicted to be 0.41 ug/m^3 for a 24-hour averaging. This is well below the fluoride standard of 2.85 ug/m^3. Although no fluoride background concentration exists, it is believed that due to the low levels of hydrogen fluoride projected and the limited number of sources of fluoride emissions to the atmosphere, the fluoride standard will not be exceeded.

Comparison of Environmental, Economic and Reliability Issues For SO_2 and Acid Gas Control Technologies

As shown in Table 6-5, the emissions of SO_2 and acid gases are greatly affected by the selection of the control alternative. But, as described previously, the impacts of SO_2 are expected to have a slight to insignificant impact on air quality. In addition to emitting less SO_2 per energy unit input than fossil fuel facilities, the facility will generate electricity thereby satisfying a demand that would have had to be generated at some other facility, which in all probability would result in a net increase in SO_2 emissions in the region (albeit small). Therefore BACT for SO_2 and H_2SO_4 with respect to environmental criteria is to burn refuse as the boiler feed fuel which contains low quantities of sulfur (on the average 0.1% S). Also, the facility design will also provide space for possible future retrofit of acid gas controls, if their use becomes necessary due to changes in regulations.

In comparison with NYSDEC Acceptable Ambient Levels of pollutants, it has been determined that the acid gas emissions (from hydrogen fluoride, sulfuric acid, and hydrochloric acid) are not significant. Therefore, there does not appear to be sufficient justification to control SO_2 and acid gases from an environmental or health effects point of view.

The cost totals for all SO_2 and acid gas control alternatives are tabulated in Table 6-7. The data presented include the total annual cost for each control system, the annual cost per ton of solid waste processed, and the percent of the alternative's cost over the proposed ESP case at 0.025 gr/dscf. The annual cost per ton is meaningful in that it represents the relative increase in cost per ton of refuse disposed of at the facility directly attributable to the addition of control equipment. For the proposed ESP case (no SO_2 control) $2.02 will be added to the tipping fee for air pollution control. For SO_2 control between $5.41 (for dry scrubber/ESP) and $7.42 (wet scrubber/ESP) would be added to the tipping fee. The wet and dry scrubber system costs are 1.7 to 2.7 times greater than the cost of the ESP alone, and although considerable control of SO_2 and acid gases would be achieved with these systems, the environmental and health benefits (in terms of impact on ambient air quality) are not significant enough to warrant the much higher annual costs. As noted in the SO_2 air quality impact section, the ESP case would result in an insignificant impact on the annual SO^2 concentration and a slight impact on the 24-hour SO_2 concentration levels.

O'Connell, et al., (1982), arrived at a similar conclusion in their study of emissions and control technologies for modern municipal resource recovery facilities. They concluded that while scrubbing systems can be considered for LAER, high operating costs "will probably preclude them from being established as BACT." Therefore, dry or wet scrubbing systems were not considered cost-effective control strategies in light of the high capital and operating costs limited reliability performance data, and the minimal health and environmental benefits derived for most sources.

Concerning reliability, the lack of operating data on these systems has already been noted. O'Connell, et al., (1982); made a similar asessment stating that although these scrubbers appear to have demonstrated control of SO_2 and HCl in practice, no performance test data of adequate quality to meet EPA standards has been found to verify their performance. In addi-

TABLE 6-7

ECONOMIC COMPARISON OF ALTERNATIVE SO_2 AND ACID GAS CONTROL STRATEGIES

System and Outlet Grain Loading (gr/dscf)[1]	Control Technology Cost Totals(2) Annual Cost For Control System($)	Annual Cost Per Ton ($)	Percent Over Base Case Cost
ESP @ LAER 0.025	1,178,000.	2.02	--
Dry Scrubber & ESP @ 0.025	3,159,000.	5.41	168.
Wet Scrubber & ESP @ 0.025	4,389,000.	7.52	272.
Dry Scrubber & Fabric Filtration @ 0.025	3,339,000.	5.72	183.

(1) Corrected to 12% CO_2.

(2) Increase in plant costs attributed to control devices.

tion. Although manufacturers claim to have numerous installations, worldwide, only three dry scrubbing systems have been in operation over two years. Thus, the reliability of these systems, particularly the ability to perform at the proposed removal efficiencies (as stated in Table 6-4) for the 20-year design life is still questionable.

Based on the environmental, economic, and reliability issues presented above, BACT for SO_2 and the acid gases is the electrostatic precipitator. In other words no additional control is required for SO_2 and acid gases.

6.7 SUPPLEMENTAL ECONOMIC DATA

This section explains the basis of the economic analysis which was used to evaluate the cost-effectiveness of each control technology. The economic data and O&M requirements for the proposed control technologies were supplied by reputable equipment suppliers. Using good engineering judgment, CDM selected those data which most accurately represent the true capital and O&M costs for each control alternative. In order to be consistant in deriving unit costs, the continuous design rated capacity was used. This approach allows the itnercomparison of relative differences on the same basis.

Capital and Operations/Maintenance (O&M) costs for the alternative control systems are presented in Table 6-8. Capital costs were obtained from manufacturers of air pollution control systems and include shipping and installation. The least expensive system is the fabric filter (at 0.025 gr/dscf) at $3,694,000, while the most expensive is the dry scrubber/fabric filtration alternative at $12,887,000. Capital costs were annualized assuming a 20-year plant life and bond interest rate of 12.5% (capital recovery factor = 0.13810).

Operations and Maintenance costs include the following components: power, labor, materials and supplies, chemicals, waste disposal, and special costs. O&M costs are based on plant operation 24 hours/day, 365 days/year. Total power use for each control alternative is presented and contains an adjustment for additional I.D. fan horsepower to account for the pressure

TABLE 6-8

CAPITAL AND OPERATIONS/MAINTENANCE COSTS FOR ALTERNATIVE CONTROL STRATEGIES

	CAPITAL COSTS (IN THOUSAND OF $)		POWER REQUIREMENTS AND ANNUAL O&M COSTS (IN THOUSANDS OF $)									
System and Outlet Grain Loading, in gr/dscf[1]	Capital Cost	Annualized[2] Capital Cost	Power (KW)	Power[3] Cost	Labor[4] Cost	Materials[5] & Supplies	Chemical[6] Cost	Waste[7] Disposal	Special Costs	Total O&M Costs	Total Annual Cost
ESP @ 0.025	4,500.	622.	790.	540.	37.	90.	0.	152.	0.	819.	1,441.
Fabric Filter @ 0.025	3,694	510.	218.	152.	353.	112.	0.	152.	166.[8]	935.	1,445.
Dry Scrubber & ESP @ 0.025	12,831.	1,772.	1397.	980.	160.	336.	214.	187.	0.	1,877	3,649.
ESP @ 0.025 & Wet Scrubber	7,810	1,079.	1,751.	1,228.	160.	189.	242.	503.	1,602.[9]	3,924.	5,003.
Dry Scrubber & Fabric Filter @ 0.025	12,887.	1,780	1,175	824.	242.	398.	242.	187.	78.[10]	1,971	3,751.

NOTES

(1) Corrected to 12% CO_2.
(2) Annualized capital costs assume 20 year plant life and interest rate equals 12.5%, (capital recovery factor = 0.13810).
(3) Power costs assume plant operation 24 hr/day, 365 days/year. Power cost = $0.08/kwHr.
(4) Labor costs assume base labor rate equals $25,000/yr, fringe benefits @ 25%, 4 shifts.
(5) Materials and supplies were taken as 2% of capital cost for ESP cases and 3% of capital cost for all other cases.
(6) Chemical costs assume lime @ $90/ton and sodium carbonate @ $120/ton.
(7) Fee for hauling and disposal of flyash at landfill is $20/ton and sewer use fee equals $0.50/1000 gal.
(8) Bag replacement: 10% during 1st year and 100% at end of 2nd year, $40/bag, approximately 1500 bags/bag house.
(9) Steam used for stack gas reheat: valued at $7.00/1000 lb. steam. This steam would have been used to produce power if stack gas reheat was not required.
(10) Bag replacement: about 50% of bag replacement cost for fabric filter case due to upstream dry scrubbing system which extends bag life.

drop through the control device. Forfeited power costs were based on an estimated rate of $0.04 per kilowatt-hour.

Labor costs include manpower for normal operations and for scheduled and unscheduled maintenance. Of all the systems considered, the ESP is probably the most highly automated. The wet and dry scrubbing systems require a moderate degree of operator attention, mostly to assist with the chemical feed systems. The high labor cost for the fabric filter alternatives was due to maintenance labor for bag replacement, considering that every two years all the bags (approximately 6000 bags) would have to be replaced. Labor costs were based on a base rate of $25,000/year, fringe benefits at 25 percent, and 4 working shifts.

Materials and supply costs were calculated at 2 percent of the installed capital cost for the ESP cases and 3 percent for all other systems. This difference is due principally to the relative simplicity of the ESP compared to the other systems and the fact that there is a better data base for ESPs on solid waste combustion facilities than the other systems considered. Operational reliability for the other systems was judged to be not as great as for the ESP cases.

Based on system manufacturers' recommendations, chemical costs for the wet and dry scrubbing systems were based on use of lime (at $90/ton) and sodium carbonate (at $120/ton) (rather than caustic-NaOH). Lime and sodium carbonate is far less expensive than NaOH. For an equivalent amount neutralizing capacity, lime has only one tenth the cost of NaOH.

Waste disposal costs for hauling and landfilling of the flyash (particles captured by the air pollution control device) are recorded for each alternative. A hauling and disposal cost for Hillsborough County of $20.00/ton was used in this analysis. For the ESP/wet scrubber alternative, the waste disposal cost also includes the sewer use fee associated with discharging approximately 1.7 million gallons per day of scrubber water (laden with sodium chloride and sodium sulfate salts) to the co-located WWTP. A sewer use fee of $0.50/1000 gallons was used.

Special costs included the cost of bag replacement for the fabric filter alternatives. For the case with the fabric filter as the sole control device, bag replacement was estimated to be 10 percent in the first year and 100 percent at the end of the second year. Cost of the filter bags was $40/bag, and each baghouse contained approximately 1500 bags. For the dry scrubber/fabric filter case, bag replacement was estimated to be about 60% less frequent due to the beneficial effect of the upstream dry scrubber which would reduce the particulate loading and also the flue gas temperature.

Also under special costs, the ESP/wet scrubber alternative includes the energy cost for reheating the scrubber stack gas. The stack gas temperature exiting the scrubber would be low (approximately 140°F), and saturated with moisture, causing a large, white plume to be visible under certain meteorological conditions. Such a plume would be aesthetically undesirable. To alleviate this problem, a steam-to-gas heat exchanger would be used to reheat the scrubber exhaust gas to 260°F. This reduces condensation of moisture in the stack and decreases the frequency of plume visibility. The steam would be supplied by the refuse boiler, and therefore less steam would be available for power production. Approximately 7 percent of the total steam produced would be required for stack gas reheat. The value of the forfeited steam was assumed to be $7/1000 pounds of steam, a conservative low value.

Total annual costs for each alternative, presented in Table 6-8, were utilized in the BACT evaluations for each pollutant in the preceding sections.

6.8 THE PROPOSED BACT/LAER CONTROL TECHNOLOGY

The preceding sections have outlined on a pollutant-by-pollutant basis the various control technologies applicable for controlling air pollutant emissions from the proposed facility. Each has been evaluated on the basis of environmental, economic, and interrelated issues such as reliability and feasibility.

The recommended BACT for trace metals. SO_2 and acid gases indicate that the ESP alternative would best satisfy the energy, economic and environmental criteria important in this application. Furthermore, the proposed control technology designed to meet LAER for particulate matter is an ESP at 0.025 gr/dscf @ 12% CO_2. Thus, the control technology selected to meet LAER for particulates is compatible with the BACT for all applicable criteria pollutants, trace metals, and acid gases. Thus, the electrostatic precipitator with the ability to limit particulate emissions to 0.025 gr/dscf @ 12% CO_2, should be considered as LAER for particulate matter and, along with other design specifications. BACT for the other criteria pollutants for the proposed facility. The proposed LAER and BACT emission rates for all applicable pollutants appear to be well within other recent LAER and BACT determinations made for similar facilities listed in Table 6-2.

SECTION 7.0

AIR QUALITY ANALYSIS

7.0 AIR QUALITY ANALYSIS

An air quality analysis was conducted to evaluate the impact of the proposed emissions on ambient air quality in Hillsborough County. This analysis estimates the ambient concentrations of the quantifiable PSD pollutants and HCl. Each step of the modeling analysis was discussed with and approved by the Florida DER.

7.1 TECHNICAL APPROACH

The air quality impacts resulting from operation of the facility were estimated using EPA and DER approved and recommended mathematical dispersion models. Air quality modeling is an analytical tool used to predict ambient pollutant concentrations resulting from pollutant emission rates. Pollutants produced by the proposed resource recovery facility are emitted from the facility's stack at certain rates and concentrations. The pollutant concentration is a measure of how much of a given pollutant is contained in a unit volume (parcel) of exahust gas which is discharged from the stack. The pollutants emitted from the stack become mixed with the atmospheric flow and are transported downwind. The turbulent air motions dilute the parcel of polluted air with the surrounding air such that the concentration at ground level is substantially less than when it exitted the stack. Dispersion models estimate ground level concentrations at specific locations by mathematically simulating the dilution of the polluted air parcels between the source at specified locations (receptors). The rate at which dilution takes place depends on various meteorological factors, such as wind speed and direction, atmospheric stability, the mixing height, and other physical factors, such as topography and nearby building structures.

Model Selection

The Industrial Source Complex (ISC) model was selected to estimate ground-level concentrations from the proposed facility and other major sources within Hillsborough County. The ISC model is a steady-state Gaussian plume model which was developed and approved by EPA for simulating dispersion from various air pollution sources. The ISC model can simulate terrain, building downwash associated with stacks below GEP, and transitional plume rise for separately located sources in either urban or rural environments. Each of these factors are important in simulating dispersion of pollutants from the proposed Hillsborough County facility. ISC was selected principally for its ability to simulate aerodynamic downwash and handle multiple separately located sources.

Meteorology

Meteorological input to the model consists of surface and upper air data recorded at Tampa International Airport for 1970 to 1974. The surface data are composed of hourly values for wind speed, wind direction, temperature, and atmospheric stability. Atmospheric stability is a measure of the atmosphere's ability to promote or supress mixing. The upper air data are derived from vertical temperature profiles which are measured twice daily. From these temperature profiles hourly mixing heights are obtained using a method outlined by Holtzworth (1972). The mixing height is the depth of the atmospheric layer, measured from the surface upward to the first inversion, through which vertical mixing of stack emissions takes place.

Rural dispersion coefficients were used to simulate the dispersion environment characteristic of the site area using the land-use technique developed by AVER (1978) as recommended by EPA (1981).

A complete discussion regarding the suitability of the Tampa International Airport data can be found in the Power Plant Siting Application Section 2.3.7.1. Seasonal/Diurnal wind roses and stability/wind frequency distribution tables which complement this discussion are found in Exhibit B of this PSD. Hourly meteorological data associated with the peak concentrations are also presented in this section.

Source Data

The resource recovery facility will consist of four boilers each capable of firing 400 tons per day (tpd) of reference solid waste. The boilers will typically not be run above 100% of the maximum continuous rate (MCR) but operation at 110% of the MCR caused the greatest air quality impacts and was, therefore, used throughout the air quality analysis (See Section 3.0). The stack parameters and flue gas conditions for the "worst-case" boiler operating condition are presented in Table 7-1. The flue gases from each boiler will be vented to a separate flue; the four flues will be encased in a common stack. Pollutant emission rates quantified in Section 4.0 were used to estimate projected pollutant impacts. Emissions data are based on using an electrostatic precipitator (ESP) designed to meet an outlet particulate loading of 0.025 gr/dscf, corrected to 12% CO_2.

A major consideration in the modeling analysis of an air pollution source is the potential for aerodynamic downwash to occur. Aerodynamic downwash results in enhanced ground-level concentrations caused by pollutants emitted from the stack being caught in air passing over and around building structures. The region of disturbed air flow is known as the cavity zone or turbulent wake. The size of the cavity/wake region depends on the geometry of the facility structures and the relative wind direction. Pollutants emitted from the facility's stack upwind of a building can be entrained into the cavity/wake region, if the stack height is low, relative to the building height, or the momentum of the flue gases is insufficient to escape the turbulent zone. When aerodynamic down wash occurs, the pollutants are rapidly mixed within the cavity/wake region and brought down to ground-level much quicker than without the influence of building downwash.

Based on the dimensions of this facility, the Good Engineering Practice (GEP) stack height is 106.8 m. Because the proposed stack height (67.0 m) is less than GEP, a downwash analysis was performed with the ISC model. As indicated by the modeling results, utilizing a stack height lower than GEP produces acceptable air quality impacts. A discussion of the GEP stack height analysis is contained in Section 3.3 and in Appendix 10.16.

TABLE 7-1

STACK PARAMETERS USED IN REFINED MODEL ANALYSIS

Base Elevation	12.1 meters
Stack Height	67.0 meters
Effective Stack Diameter	3.5 meters
Exit Velocity*	16.82 m/s
Exhaust Temperature*	$494^{o}K$
Building Height	42.7 meters
Building Width	51.5 meters
Building Length	22.9 meters
Maximum Projected Width	56.4 meters
Equivalent Length/Width	49.9 meters

*Based on the worst-case boiler operating condition as defined in screening analysis.

7.2 MODELING APPROACH

The modeling analysis was conducted in three phases; screening analysis, refined modeling, and additional impact analysis. Each phase of the modeling was discussed with and approved by DER. Details of the screening analysis are discussed in Exhibit A. The refined modeling and additional impact analysis are discussed in Exhibit C. A synopsis of each modeling phase is contained below.

Screening Analysis

The screening analysis was conducted to identify the worst-case boiler operating condition, identify those pollutants with a potential for significant impact, and establish receptor locations for the refined modeling. The screening modeling runs were made using the ISC dispersion model and 26 worst-case meterological conditions recommended for use by EPA (1977). As previously stated, the 110% boiler load condition yielded the greatest air quality impact. This corresponds to a 440 tpd throughput per boiler of 4000 Btu/lb solid waste. Pollutants with annual averaging times were not evaluated since no scaling factor has been generally accepted which relates 1-hour concentrations to annual concentrations. Of those pollutants with shorter averaging times, SO_2 showed a potential for significant impact. The maximum short-term impact occured at 400m. Thus a grid with receptors located at 129m (closest property boundary), 200m, 300m, 400m, 500m, 600m and every kilometer from 1 to 10 km along radials located every 10^o beginning at 10^o of north was used for the refined analysis.

Refined Modeling

Using the information developed during the screening analysis, refined (hour-by-hour) modeling was performed using the ISC dispersion model and 5 years (1970 to 1974) of Tampa International Airport meterological data. The modeling was conducted using unit emissions (1 gram per second) and scaling the output from the model according to the magnitude of the emission rate for each pollutant (Table 7-2). These results were evaluated to

TABLE 7-2

EMISSION RATES FOR THE PROPOSED FACILITY

Pollutant	Emission Rates* #/ton	Emission Rates* g/s
Total Suspended Particulates	0.48	4.46
Sulfur Dioxide	2.5	23.1
Carbon Monoxide	1.8	16.6
Nitrogen Oxides	3.0	27.7
Lead	0.048	0.444
Mercurgy	5.2×10^{-3}	0.048
Sulfuric Acid Mist	7.68×10^{-2}	0.710
Beryllium	1.31×10^{-5}	1.21×10^{-4}
Fluorides	0.06	0.554
Non-Methane Hydrocarbons	0.2	1.85
Total Reduced Sulfur	neg.	neg.
Reduced Sulfur Compounds	neg.	neg.
Vinyl Chloride	neg.	neg.
Asbestos	neg.	neg.
Hydrogen Chloride	4.0	37.9

*Emission rates based on a throughput equal to 110% of design capacity.

identify those pollutants which had an impact greater than the significance level and define the significant impact area of those pollutants. The significant impact area (SIA) is then defined as a circular area whose radius is equal to the greatest distance to which the refined modeling shows the facility's emissions will have a significant impact. The modeling results showed that the 3-hour and 24-hour SO_2 concentrations were above the DER and EPA significance levels. Therefore additional detailed modeling of the background source emissions for assessing PSD increment consumption and compliance with ambient standards is required for these pollutant averaging periods. For all other pollutants and averaging periods the predicted concentrations will be added to the background levels and then compared to the corresponding FAAQS. The short-term (averaging period of 24-hour or less) NAAQS and PSD increments can be exceeded at each receptor once per calendar year. That is, the highest predicted short-term concentration at each receptor is not used to determine if the proposed source is in compliance with the standards. Rather, the highest of the second-highest short-term concentrations over all the receptors predicted for a calendar year is used to determine compliance. The predicted highest annual concentrations must be below the standards/increments at all receptors for each year.

Additional Source Analysis

Since the highest 3-hour and 24-hour SO_2 concentrations exceed the corresponding significance level, a more detailed evaluation for these time periods is required to assess the SO_2 impacts. This additional analysis included the modeling of existing sources which have a significant SO_2 impact with the facility's SIA as defined for the 3-hour and 24-hour averaging period. The full five years of hourly meteorological data was modeled using two separate receptor grids, one corresponding to the 3-hour SO_2 SIA which estends radially outward to 0.5 km, and the other grid corresponding to those additional receptors needed to define the 24-hour SO_2 SIA which estends outward to 0.9 km.

The existing SO_2 source inventory used in this analysis is listed in Table C-3. The existing background SO_2 sources were broken into two separate source groupings. They include:

- sources that were previously permitted under the PSD provisions (i.e., increment consuming sources), and
- other existing major sources that could potentially significantly impact the proposed SO_2 SIA for the facility (these sources do not consume any SO_2 increment).

The SO_2 impacts of these two source groupings were quantified and added to the measured SO_2 levels to establish the combined or enhanced background SO_2 concentrations for the 3-hour and 24-hour averaging times. Adding modeled impacts of existing sources to the monitored data results in a "double counting" in that the sources already contribute to the ambient levels. The conservativeness of this NAAQS/FAAQS compliance analysis is increased by adding the modeled results of the two separate source groups to the measured background levels without regard to the location or time (period, day or year) that the impact occurred.

7.3 AIR QUALITY MONITORING DATA

Among other activites, the Hillsborough County Environmental Protection Commission (HCEPC) is responsible for monitoring ambient air quality within the county. HCEPC operates 65 monitoring stations and receives information from other private monitoring stations totaling an air quality network of 83 stations, many of which monitor for more than one pollutant. A complete set of Standard Operating Procedures govern all aspects of the monitoring activities including installation, calibration, collection, and validation. A quality assurance program which governs the network operation is contained in HCEPC's "Air Monitoring Quality Assurance Plan", is published in Environmental Quality, and meets the PSD Quality Assurance requirements where applicable. The monitor located nearest the site for each of the criteria pollutants is listed in Table 7-3. Additional, HCEPC monitoring data is listed in Table D-2.

The SO_2 monitor at the HCEPC office, located 9.9 km from the facility, is the closest continuous SO_2 monitor to the proposed site. Two SO_2 monitors using bubblers are located 8.9 km and 6.6 km from the site, and operate

TABLE 7-3

Ambient Criteria Pollutant Concentrations in the Vicinity of the Proposed Facility

Pollutant	Monitor	Station No.	Location with Respect to the Proposed Facility		Averaging Period	Concentration Category	1983 Concentration ($\mu g/m^3$)
			Direction (Degrees)	Distance (km)			
SO_2*	HCEPC	4360-052 (120)	278^0	9.9	3-hour	Second-High	493
					24-hour	Second-High	86
					Annual	Highest	16
NO_x	HCEPC	4360-052 (120)	278^0	9.9	Annual	Highest	35
CO	HCEPC	4360-052 (120)	278^0	9.9	1-hour	Second-High	12,600
					8-hour	Second-High	5,700
TSP**	Orient Rd.	1800-082 (82)	285^0	3.3	24-hour	Second-High	115
					Annual	Highest	54
O_3**	Davis Island	4360-035 (63)	259^0	11.5	1-hour	2nd Daily High	281
Pb	Orient Rd.	1800-082 (82)	285^0	3.3	Calendar Quarter	Highest	0.8

*Two SO_2 monitors using bubblers are located closer to the facility and associated impact area. However, since these monitors only operate every sixth day, the continuous monitoring results should be more reliable. Additionally, the concentrations obtained at the bubbler sites were less than those recorded at the continuous monitoring site located at the Hillsborough County EPC offices.

**Designated as non-attainment

every sixth day. Although the measured concentrations are lower, the data recorded at the continuous monitor located at the HCEPC offices are considered to be more reliable. Therefore, the monitoring concentrations recorded at the HCEPC continuous monitor is considered at least as high as concentrations expected at the site and will be used to establish background concentrations.

The NO_x and CO monitors at the HCEPC office are the closest continuous NO_x and CO monitors to the proposed site. Auto emissions associated with large urban areas are the major contributors to the ambient concentrations of these pollutants. Since the HCEPC office is located within the City of Tampa, the concentrations of NO_x and CO monitored here are expected to be at least as great as those found at the proposed site.

The proposed site is located in a non-attainment area for TSP and O_3. The O_3 monitor at Davis Island clearly shows ambient concentrations in excess of the standard. The TSP monitor at Orient Road, however, shows concentrations less than the standard. There are a couple of reasons for this. There are about twenty TSP monitors within the non-attainment area; of these, two recorded a 24-hour TSP concentration in excess of the FAAQS in 1983. One is credited with exceeding the annual and 24-hour standards by having the annual and second-highest 24-hour concentrations greater than corresponding FAAQS. While having 18 of 20 monitors showing ambient concentrations better than the FAAQS is good, two years of violation-free monitoring is required before an area can be reclassified from non-attainment to attainment. Thus the Orient Rd. monitor for TSP is considered representative for the site even though the area is classified non-attainment and the monitor shows ambient concentrations less than the standard.

The Orient Road site is also the location for the nearest lead monitor. This site was initially chosen by HCEPC to monitor an existing source of industrial lead emissions. Lead concentrations at Orient Road are the second highest in Hillsborough County. Since the Orient Road monitor is already placed to monitor high lead concentrations, ambient concentrations monitored at the proposed site are expected to be lower.

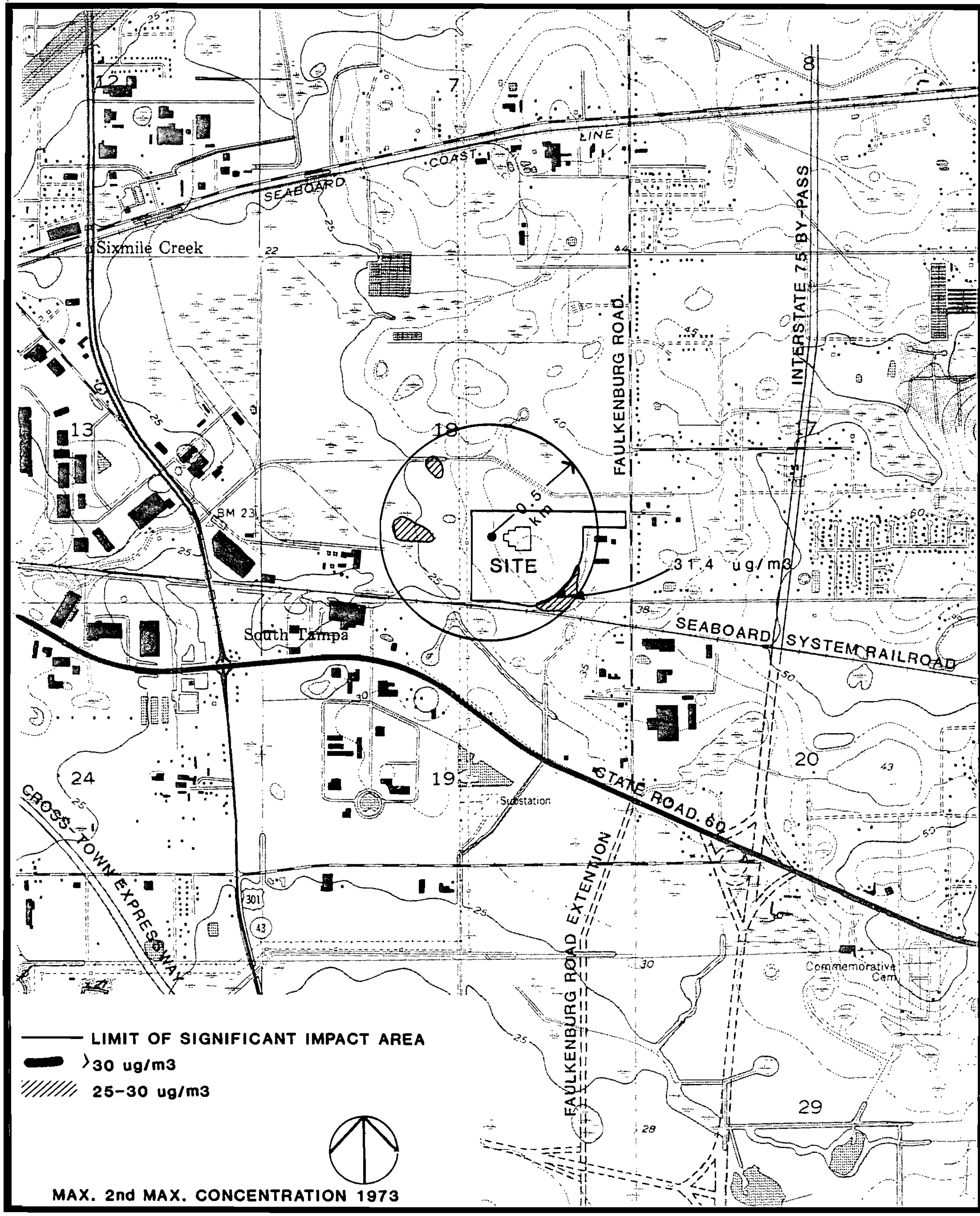
7.4 RESULTS OF THE MODELING ANALYSIS FOR THE CRITERIA POLLUTANTS

The results of the refined analysis indicate that the 3-hour and 24-hour SO_2 concentrations are above the significance levels previously defined in Table 2-5. The maximum 3-hour SO_2 concentration of 37.4 ug/m^3 and the maximum 24-hour SO_2 concentration of 17.3 ug/m^3 are compared to the significance limits of 25 ug/m^3 and 5 ug/m^3 respectively. The SIA is defined as a circular area whose radius is equal to the greatest distance to which the facility's emissions will have a significant impact. The 3-hour SO_2 SIA extends 0.5 km from the site (Figure 7-1). The 24-hour SO_2 SIA extends 0.9 km from the site (Figure 7-2).

The annual NO_2 concentration of 1.04 mg/m^3 exceeds the significance level at only one receptor location and only for one of the five modeled years. This level would not have been exceeded if annual average emissions and operating conditions had been used instead of maximum hourly conditions to estimate annual average concentrations. Furthermore, it was conservatively assumed in the analysis that all NO_x emitted by the facility was emitted as NO_2. EPA stated that the initial concentration of NO_2 may be adjusted if adequate data are available to account for the expected rate of conversion (45 Fed. Reg. 31311, May 13, 1980). If either of these methods were adopted, the resulting ground-level NO_2 concentrations would be below the significance level. DER has agreed that an additional impact analysis is not required for NO_2. (see Figure 7-3).

PSD Increment Consumption Analysis

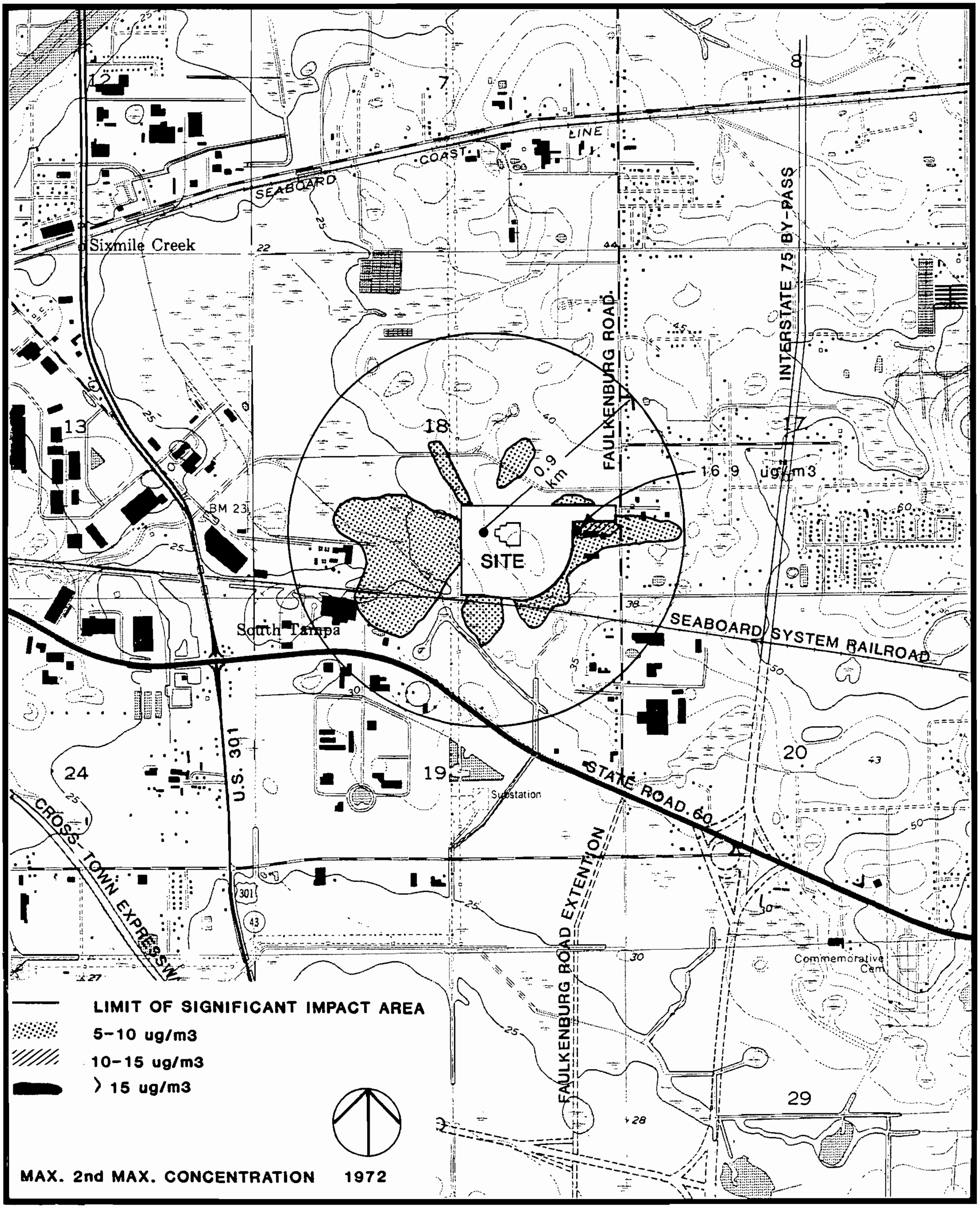
The PSD baseline date was triggered in December 1977 by the TECO Big Bend power plant. PSD increment must be shared between this and any other source permitted since that date. Other increment consuming sources include the McKay Bay and Pinellas County Resource Recovery facilities. Since the site is located in a TSP non-attainment area, particulate emissions are evaluated under the Non-attainment Area New Source Review provisions and not PSD. Thus, no TSP increment consumption analysis was conducted. The results of the SO_2 increment consumption analysis are presented in Table



HILLSBOROUGH COUNTY
ENERGY RECOVERY PROJECT

Figure 7-1
3-HOUR SO2 SIGNIFICANT IMPACT AREA

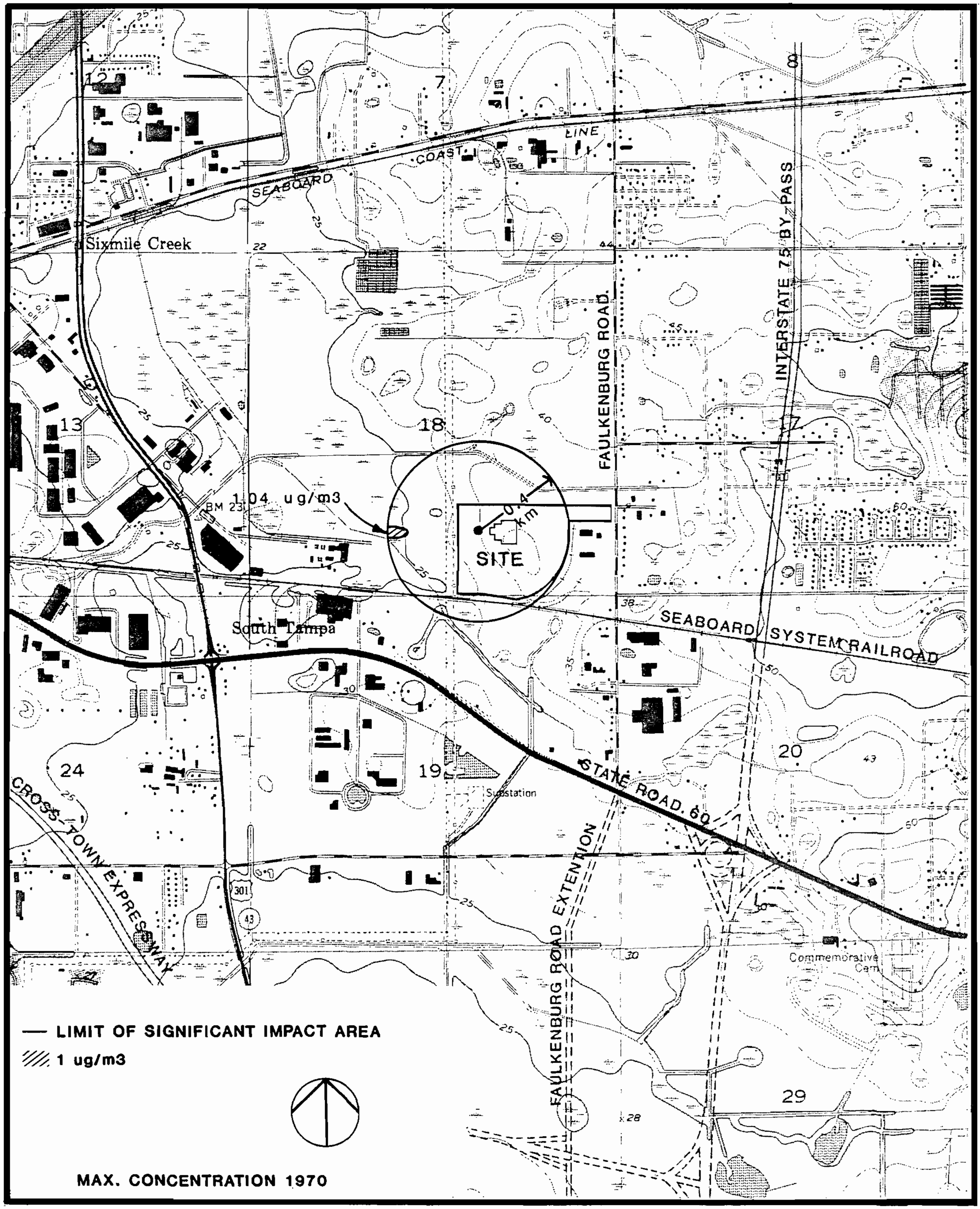
FEET 1000 0 1000 2000 3000



HILLSBOROUGH COUNTY
ENERGY RECOVERY PROJECT

Figure 7-2
24-HOUR SO2 SIGNIFICANT IMPACT AREA

1000 0 1000 2000 3000 FEET



HILLSBOROUGH COUNTY
ENERGY RECOVERY PROJECT

Figure 7-3
ANNUAL NOx SIGNIFICANT IMPACT AREA

FEET
1000 0 1000 2000 3000

7-4. Since the proposed resource recovery facility will have a significant impact for the 3-hour and 24-hour SO_2 averaging periods, increment consuming sources are included in the increment analysis. The combined impact of the previously permitted PSD sources consume 47% of the 3-hour SO_2 and 62.9% of the 24-hour SO_2 increment. The proposed facility will consume 6.1% of the 3-hour SO_2 increment and 18.6% of the remaining 24-hour SO_2 increment. The annual SO_2 impact is less than the significance level, therefore no increment analysis is required.

FAAQS Compliance Analysis

A demonstration of compliance with the FAAQS is required only for those criteria pollutants that have a significant impact, i.e., for 3-hour and 24-hour SO_2. For the sake of completeness, measured background concentrations have been added to the highest, second-highest short-term and highest annual predicted facility impacts for the other criteria pollutant/averaging periods to estimate total ambient concentrations. The results of the FAAQS analysis are presented in Table 7-4.

Compliance for the 3-hour SO_2 and 24-hour SO_2 averaging periods was demonstrated by adding the highest, second-highest predicted SO_2 concentrations to the combined background concentrations. The combined background concentration used in this analysis is the sum of three separate components:

- measured ambient background SO_2 levels,
- predicted background SO_2 levels from PSD sources, and
- predicted background SO_2 levels from other existing major sources (excluding PSD sources).

The results of this analysis indicates compliance with NAAQS and FAAQS for all PSD pollutants over all averaging periods. For all the pollutants subject to PSD, the major contributor to ambient air quality was the combined background concentration.

TABLE 7-4

PSD AND FAAQS COMPLIANCE DEMONSTRATION

Pollutant	Averaging Period*	Proposed Impact (ug/m^3)	% of FAAQS (%)	PSD Sources (ug/m^3)	Other Major Sources (ug/m^3)	Monitored Background (ug/m^3)	PSD Increment Consumed (ug/m^3)	PSD Increment Consumed (%)	Comparison to FAAQS (ug/m^3)	Comparison to FAAQS (%)
Sulfur Dioxide	3-hour	31.4	(2.4)	233.5	375.2	493	264.9	(51.7)	1133	(87.1)
	24-hour	16.9	(6.5)	57.2	81.6	86	74.1	(81.4)	241.7	(93.0)
	Annual	0.9	(1.5)	----	----	16	-----		16.9	(28.2)
Carbon Monoxide	1-hour	31.5	(0.1)	----	----	12,600	-----		12,632	(31.6)
	8-hour	16.3	(0.2)	----	----	5,700	-----		5,716	(57.2)
Nitrogen Oxide	Annual	1.0	(1.0)	----	----	35	-----		36	(36.0)
Lead	3-month**	0.034	(2.1)	----	----	0.8	-----		0.83	(55.6)

* Impacts for averaging periods of 24-hours or less are the highest, second-highest concentrations; the annual and 3-month concentration are the highest concentrations.

** Obtained using Larsen's scaling method.

7.5 AIR QUALITY IMPACT OF NON-CRITERIA POLLUTANTS

In addition to the analysis of criteria pollutants, non-criteria PSD pollutants including HCl were analyzed. The non-criteria pollutants are designated as such because they have no widely established ambient standard. Some states, like New York, have published guidelines, defined as Ambient Acceptable Levels (AAL) which are based on the Threshold Limiting Values/ Time Weighted Averages (TLV/TWA) established by the American Conference of Governmental and Industrial Hygenists (ACCIH). New York AAL's are annual concentrations and are 1/50 or 1/300 of the TLV/TWA depending on whether a particular pollutant is considered to have a low toxicity or a moderate to high toxicity. The guidelines are not standards and do not define legal limits, especially when they are used outside the state for which they were adopted. Thus, they will only be used here to establish whether the proposed impacts are relatively high or low. The maximum annual concentration for the non-criteria PSD pollutants and their corresponding AAL's or TLV's are listed in Table 7-5. HCl is not a PSD polluant but was included at the request of DER. Since the predicted impacts are well below the corresponding guidelines, no adverse air quality impacts are anticipated.

TABLE 7-5

MAXIMUM IMPACTS OF OTHER REGULATED POLLUTANTS

Pollutant	Averaging Period	Highest Predicted Concentration (ug/m^3)	Concentrations (ug/m^3)		
			NYAAQS**	TLV	AAL
Fluorides	24-hour	0.42	2.85	---	---
Beryllium	1-month*	1.58×10^{-5}	0.01	---	---
Mercury	8-hour	0.6	---	50	---
	Annual	1.8×10^{-3}	---	---	0.17
Sulfuric Acid Mist	8-hour	0.95	---	1,000	---
	Annual	2.7×10^{-2}	---	---	3.3
Hydrogen Chloride	8-hour	50.8	---	7,000	---
	Annual	1.42	---	---	140

* Obtained using Larson's scaling method.

** New York Ambient Air Quality Standard.

SECTION 8.0

ADDITIONAL IMPACT ANALYSES

8.0 ADDITIONAL IMPACT ANALYSES

This section describes the analysis performed to assess the impact of the proposed facility on Air Quality Related Values (AQRVs) as required under the PSD regulations. The AQRVs assessed are as follows:

- Visibility in Class I Areas within 100 Km, and
- Potential for impacts to soil and vegetation.

Analyses are also provided for assessing the potential for impact on Class I increments and non-attainment areas.

8.1 VISIBILITY

As required by the Clean Air Act, the potential for visibility degradation at Class I areas within 100 km has been assessed.

This section discusses the results of the Level-1 visibility screening analysis at Chassahowitzka National Wilderness Area (CNWA) for the proposed 1,600 tpd resource recovery facility. CNWA is located 79.6 km to the north-northeast (344°) from the proposed plant site. The Level-1 visibility screening analysis is a simple, straight-forward calculation designed to identify whether emissions from the proposed resource recovery facility would have any potential of adversely affecting visibility in CNWA, the closest Class I area to the proposed facility. If the project passes this first screening test, it is not likely to cause adverse visibility impairment, and further analysis becomes unnecessary. However, if the resource recovery project fails this test, additional analyses would be needed to quantify potential visibility impacts.

The Level-1 visibility screening analysis is described in detail by Latimer and Ireson (1980). Required inputs are source emissions of sulfur dioxide (SO_2), nitrogen oxides (NO_x), and total suspended particulates (TSP), as well as the minimum distance between the source and the Class I area and the regional background visual range. The emission rates used are 4.46 g/s for TSP, 27.7 g/s for NO_x, and 23.1 g/s for SO_2. The regional background visual range, taken from the workbook (Latimer and Ireson, 1980) is 25 km. The meteorology for maximum impact suggested by the workbook, which calls for stable (Pasquill-Gifford stability category F), light wind conditions with a 12-hour transport time to the closest Class I area, and limited mixing were assumed in the calculations.

Three parameters were calculated in the Level-1 visibility analysis: C_1 - plume contrast against the sky; C_2 - sky terrain contrast reduction; and C_3 - the change in sky terrain contrast caused by primary and secondary aerosols. If the absolute value of any of these parameters exceeds 0.10, then the source fails the Level-1 test and must proceed to the refined, Level -2 analysis. Table 8-1 presents the calculated value of these parameters, as well as the distance from the source where each parameter passed the Level-1 threshold value.

The results of the Level-1 calculation show the absolute value of all three parameters to be 2 to 3 orders of magnitude below the Level-1 test threshold. Therefore the proposed Hillsborough County Resource Recovery Facility is not likely to cause any visibility impairment at the Chassahowitzka National Wildlife Area.

8.2 GROWTH ANALYSIS

The proposed facility will employ approximately 58 persons. It is anticipated that the majority of these personnel requirements will be filled from within the local labor force. In-migration to the area is therefore not anticipated. As a result, no increase in population attributed to the facility in the area is expected to occur.

The project does not require the destruction, relocation, or alteration of any residential property in the area. In addition, since no net migration to the area is anticipated, there will be no change in demand for housing units in the area.

TABLE 8-1

VISIBILITY SCREENING PARAMETERS

Location	Downwind Distance	Visibility Parameters C1	C2	C3
Chassahowitzka NWA	79.6 km	-0.009	0.008	0.002
Visibility Threshold	14 km	-0.098	0.103	0.001

The construction and operation of the proposed facility will have a minor positive net effect on industrial and commercial development. The facility will promote development by providing for solid waste disposal, and thereby be an integral part of the plans for development within Hillsborough County. It is not anticipated that this effect will be significant when considered on a regional basis.

The growth analysis indicates that no net significant change in employment, population, housing, or commercial/industrial development will be associated with the project. As a result, there will not be any significant increases in pollutant emissions indirectly associated with the proposed resource recovery facility.

8.3 SOILS AND VEGETATION IMPACT ANALYSIS

INTRODUCTION

This section contains a discussion of the potential impacts resulting from emissions from the proposed facility on soils and vegetation of commercial or recreational value as required by FDER Chapter 17-2.500(5)(e). As described in Section 8.2, the proposed facility will not result in significantly increasing associated commercial residential or industrial land uses in the area. Therefore, this section addresses the potential impact on soil and vegetation which may result directly from the proposed facility. Potential impacts from emissions may result from direct deposition of particulates or compounds on leaf surfaces or soils; absorption of emitted compounds by rain droplets and resultant depositions on leaf surfaces and soil with precipitation; absorption of gaseous materials by plant surfaces; and accumulation of emitted compounds in soils to elevated levels which may ultimately affect plant growth or use of the soil.

Air pollutants at elevated concentrations can affect soils and vegetation in a number of ways, although the interrelations between air quality, soil and vegetation are not fully understood (Last, 1982). Pollutant effects on vegetation can manifest itself as a partial destruction of the leaf surface, interference with plant metabolism, flowering and fruiting and may ultimately result in plant death. In agricultural areas potential reduction in crop yield is of concern.

In uncultivated areas inhibition of seed production resulting from significant air quality degradation can diminish the capacity for natural regeneration and cause, in time, the disappearance of some species.

The Florida Ambient Air Quality standards (FAAQSs) were also established to protect non-health related parameters; such as vegetation, materials and visibility as well as human health. Pollutants for which standards have been set are: CO, NO_x, O_3, HC, TSP, Pb and SO_2. Maximum concentrations of pollutants emitted from the proposed Hillsborough County resource recovery facility are predicted to occur within one kilometer of the facility. These maximum concentrations will be within FAAQS. In addition, other pollutants are emitted from resource recovery facilities which are not specifically addressed by the FAAQS but may be injurious to plants at certain levels. It is therefore important to identify which types of plants are growing in the vicinity of the site and to determine if the ground level concentrations of pollutants predicted to occur as a result of the operation of the facility will cause any injury to these species.

EXISTING SOILS AND VEGETATION

Existing adjacent land uses to the proposed facility include vacant agricultural land, pasture land, commercial, light and heavy industrial uses, and residential. Directly north of the site, vacant agricultural land and pasture land is found as shown in Figure 2-4 in the Site Certification Application. Immediately adjacent to the site is an undeveloped wooded area. The majority of vegetation in the immediate site vicinity is comprised of pasture grasses, wetland vegetative types and forest species of which long leaf pine and live oak predominate with saw palmetto understory.

The majority of soils in the site vicinity are comprised of the somewhat poorly drained soils of the Leon-Immokalee association, the poorly drained soils of the Rutledge-Plummer association and the well drained soils of the Blanton-Lakeland-Eustis association. Other soil associations encountered within the area include the poorly drained Pompano-Felda-Manatee association, the very poorly drained organic soils of the Brighton-Terra-Ceia association and the well drained to excessively drained Pomello-St. Lucie-Lakewood soil association.

The soils of the Leon-Immokalee association have a characteristic organic pan and are generally used for range, pasture and forest. The Rutledge-Plummer association soils are less perfectly drained than the Leon-Immokalee association and are generally used for forest or, in some cases, pasture. The soils of the Blanton-Lakeland-Eustis association are well suited for many types of agricultural production including citrus crops and small fruits. Although the majority of agricultural production and pasture uses would occur on soils within the three above associations, specialty truck crops may be produced in organic soils of limited extent in the area.

Table 8-2 presents a listing of the different soil types found in the area and the plant communities that would normally be found associated with them. Table 8-3 presents both native and cultivated species that are found in the area. Many of the ornamental species presented in this listing are found to the west of the site, in the City of Tampa, and in the residential communities located to the east of the site. The closest active citrus groves to the site are located some three kilometers to the east, considerably beyond the point of maximum concentration which is within one kilometer of the site.

IMPACT ANALYSIS

The potential impact to soil and vegetation resulting from emissions from the proposed facility are discussed for the following specific compounds and materials: total suspended particulates (TSP); carbon monoxide (CO); sulfuric acid (H_2SO_4); sulfur dioxide (SO_2); nitrogen dioxide (NO_2); fluoride (F); lead (Pb); mercury (Hg); and beryllium (Be).

TABLE 8-2

SOIL AND VEGETATION COMMUNITIES

Soil Classification	Associated Major Community Species
Well drained deep sands	turkey oak, bluejack oak, slash pine, dogwood, hickory
Poorly drained sands over organic hardpans	pine flatwoods (slash pine, palmetto, wire grass)
Poorly drained sands over calcareous substrate	sabal palm, saw palmetto and wire grass
Well drained sands with phosphatic materials	live and laurel oaks, hickory, and pines
Tidal lands	white, black and red mangrove and black needlerush
Freshwater swamps	pond and bald cypress and sweet bay
Poorly drained acid sands	pine flatwoods (slash pine, palmetto, and wire grass)
Poorly drained neutral to alkaline soils	slash pine, water oaks and sweet bay
Poorly drained dark colored sands	pine flatwoods (slash pine, palmetto, and wire grass)
Urban lands	landscape plantings and backyard gardens; commercial/industrial open land is covered by Brazilian pepper
Agricultural lands	pasture land of bahia grass; some citrus groves (oranges, grapefruit)

Source: HDR, 1983

TABLE 8-3

LANDSCAPE, AGRICULTURE AND OTHER

NON-NATIVE SPECIES

Common Name	Genus	Species	Location
Grasses			
Bahiagrass	Paspalum	notatum	pastures and lawns
Bermudagrass	Cynodon	dactylon	lawns
St. Augustine Grass	Stenotaphrum	secundatum	lawns (most common lawn grass)
Wire Grass	Aristida	stricta	native; pine flatwoods
Panic Grass	Panicum	sp.	native; on disturbed sites
Ground Coverings			
Periwinkle	Vinca	spp	native; disturbed sites and landscape plantings
Lily-turn	Liriope	muscare	landscape plantings
Flowers			
Chrysanthemum	Chrysanthemum	indicum	landscape plantings
Begonia	Begonia	sp	landscape plantings & hanging baskets
Geranium	Pelargonium	sp	landscape plantings
Marigold	Tagetes	spp	landscape plantings
Phlox	Phlox	drummondi	native; along roads and railroad tracks
Rose	Rosa	spp	landscape plantings
Bulbs			
Day-lily	Hemerocallis	sp	landscape plantings
Canna lily	Canna	sp	landscape plantings
Ferns			
Asparagus Fern	Asparagus	sp	hanging baskets and window pots
Succulents			
Spanish Bayonet	Yucca	aloifolia	native; landscape plantings and along roadways
Century Plant	Agave	americana	landscape plantings

TABLE 8-3 (Continued)

Common Name	Genus	Species	Location
Palms			
Cabbage palm	Sabal	palmetto	native; prairies and landscape plantings (state fee)
Areca palm	Chrysali-docarpus	lutescens	landscape plantings
Canary Island data palm	Phoenix	canariencis	landscape plantings
Coconut palm	Cocos	nucifera	landscape plantings
Manila palm	Veitchia	merrillii	landscape plantings
Queen palm	Arecastrum	romanzof-fianun	landscape plantings
Native Trees			
Slash Pine	Pinus	elliottii	pine flatwoods, swamps, & left on developed land
Longleaf Pine	Pinus	palustris	on drier sites and in landscapes
Live Oak	Quercus	virginiani	better, dry soils and landscapes
Water Oak	Quercus	nigra	poorly drained sites
Red Cedar	Juniperus	silicicola	soils underlain by calcareous material and landscapes
Sweet Gum	Liquidambar	styraciflua	poorly drained sands and loams
Sweet Bay	Magnolia	virginiana	poorly drained acid sands
Turkey Oak	Quercus	laevis	excessively drained sands
Bluejack Oak	Quercus	incana	excessively drained sands
Bald cypress	Taxodium	disthichum	riverine swamps
Pond cypress	Taxodium	ascendens	cypress domes and depressed lands among pine flatwoods along ditches and streams
Black mangrove	Avicennia	nitida	tidal swamps
Red mangrove	Rhizophora	mangle	tidal swamps seaward of black mangrove
Hickory	Carya	sp	mesic forests

TABLE 8-3 (Continued)

Common Name	Genus	Species	Location
Native Shrubs			
Saw palmetto	Serenoa	sp	pine flatwoods and deep sands
Yaupon holly	Ilex	vomitoria	deep sands and landscapes
Gallberry	Ilex	coriacea	pine flatwoods
Wax myrtle	Myrica	certifera	pine flatwoods
Exotic Species			
Australian Pine	Casuarina	spp	along roads and property lines
Citrus	Sitrus	spp	oranges, grapefruits, limes, lemons, and tangerines in backyards or small groves
Jerusalem thorn	Parkinsonia	aculeata	disturbed open land and landscapes
Norfolk Island pine	Araucaria	excelsa	landscape plantings
Cajeput	Melaleuca	leucadendra	disturbed open land
Rubber tree	Ficus	sp.	landscape plantings
Banana	Musa	spp	landscape plantings
Sago palm	Cycas	revoluta	landscape plantings
Copper leaf	Acalypha	wilkesiana	landscape plantings
Croton	Cordiaeum	Variegatum	landscape plantings
Hibiscus	Hibiscus	spp.	landscape plantings
Oleander	Nerium	oleander	landscape plantings
Surinam cherry	Eugenia	unifloria	landscape plantings
Brazilian pepper			grows in dense thickets on disturbed open land.

Source: HDR, 1983

Total Suspended Particulates. Particulate matter can interfere with plant metabolism when large enough quantities coat leaf surfaces causing the blockage of gas and light exchange mechanisms. The specific sensitivity of plants to particulate matter produced by resource recovery facilities is not known, nor have levels which produce plant injuries from other sources been documented.

The proposed facility will contribute an annual average 0.17 ug/m^3 of TSP. The maximum observed level in 1983 was 54 ug/m^3, to which the facilities emissions will add an insignificant amount.

Carbon Monoxide. Plants appear to be resistant to high levels of CO. In most species tested, exposure to 115 mg/m^3 for up to three weeks did not produce visible injury (Zimmerman, et al., 1983). More recently exposure to less than 27 ug/m^3 (Chakrabarti, 1976) also produced no visible injury.

The proposed facility will contribute a maximum average annual concentration of 0.62 ug/m^3. Total concentrations, as a result of the operation of the proposed facility, will thus be considerably below concentrations causing visible injury to vegetation.

Sulfuric Acid. H_2SO_4 is formed when gaseous SO_3 produced by the facility reacts with water droplets. This acidified water vapor can result in acidic precipitation. It is difficult to predict the extent that H_2SO_4 produced by the facility will impact vegetation because (1) H_2SO_4 aerosols are neutralized by the presence of ammonia in the atmosphere (Huntzicher, et al., 1980); (2) when effects of acid precipitation on plants are observed they may be positive due to fertilization impacts of sulfur or negative due to the leaching of leaf surfaces; and (3) the impact of emissions of H_2SO_4 from a single facility on vegetation may be difficult to differentiate from the overall impacts of acid rain on vegetation.

Although evaluation of data relative to acidic precipitation impacts on vegetation is complex the majority of crop species studied to date indicates that exposure to simulated acid rain has little or no adverse impact on vegetative growth and yield.

The proposed facility will add an annual average of 0.03 ug/m^3 of H_2SO_4. It is not anticipated that this concentration will contribute significantly to acidic precipitation when compared to existing concentrations and other major producers, such as fossil fuel power plants.

Sulfur Dioxide. Sensitivity of plant species to SO_2 appears to vary not only with the climate of an area, but with the duration of exposure. Garsed and Rutter (1982) reported that various species of conifer (*Pinus* sp.) had markedly differing sensitivities to levels of SO_2 ranging from 200 ug/m^3 for 11 months to 8000 ug/m^3 for 6 hours. A 14% reduction in relative growth rate was seen in one pine species at the 200 ug/m^3 dosage level. A number of oak and pine species (black and red oak, white pine) have been reported to develop visible injury when exposed to concentrations of SO_2 between 786 and 1,572 ug/m^3 for three hours (Jones, *et al.*, 1974). Jones, *et al.* (1979), have reported a threshold value for foliar injury to certain species (blackberry winged sumac, other herbaceous species) at 340 ug/m^3 for 3 hours under environmental conditions which maximized plant sensitivity.

A maximum annual ground level concentration for SO_2 of 0.86 ug/m^3 is predicted for the Hillsborough County Facility. This value, when added to a background level of 16 ug/m^3 (see Table 4-3) is considerably below the concentration causing a reduction in relative growth rate of a pine species. The maximum background level of SO_2 over a three hour averaging period, however, is 493 ug/m^3 to which the facility will add 31.4 ug/m^3. Existing maximum levels thus exceed threshold values for certain sensitive species under worst-case conditions.

Nitrogen Dioxide. Nitrogen dioxide can be beneficial to vegetation in specific amounts. Uptake of NO_2 varies with a number of factors such as nutrient supply in the soil, fertilization, and rainfall. NO_2 can also be converted to nitric acid and contribute to acid precipitation. Natural biological cycling of nitrogen compounds produces greater acidity than does atmospheric decomposition (Frink, *et al.*, 1976).

Short-term injury threshold for NO_2-tolerant species, such as corn and sorghum, has been found to be 24,400 ug/m^3 NO_2 for a one-hour exposure when grown in a controlled environment (Heck and Tingey, 1970). Continuous exposure throughout the growth period to 470 ug/m^3 NO_2 reduced size and productivity and increase senescence in tomatoes and navel oranges (Taylor, et al., 1975; Spierings, 1971). The concentration of NO_2 has been found to be a greater influence on the extent of injury than the length of exposure.

The greater-than-additive effect of NO_2 and SO_2 in combination on crops has been shown to vary between crop species and varieties. In a recent study of yield reduction in soybeans, no adverse effect was observed at atmospheric concentrations of 481 ug/m^3 SO_2 in combination with 155 ug/m^3 of NO_2 (Amundson, 1983). The results of these investigations indicate that the presence of elevated levels of NO_2 in the atmosphere in combination with SO_2 above a threshold level can lead to adverse crop response. NO_2 concentrations below 120 ug/m^3 have not been reported to produce injury in the absence of other pollutants (Thompson, et al., 1974).

The proposed facility will produce a maximum annual NO_2 concentration of 1.04 ug/m^3. The maximum annual ambient NO_2 concentration recorded in the county was 35 ug/m^3. Total concentrations will thus be well below the estimated threshold level (120 ug/m^3) of injury to certain plants.

Fluoride. Fluoride is the most phytotoxic of the common air pollutants. Susceptible species can be injured at atmospheric concentrations 10 to 100 times lower than those of other major pollutants (0.8 ug/m^3) (Weinstein and Alscher-Herman, 1982). It accumulates in plants and can cause disease in herbivores which consume vegetation.

Thompson, et al. (1967), reported that Citrus sp. exposed to 0.32 to 0.77 ug HF/m^3 showed no reduction in photosynthesis. Gladiolus sp. were effected by HF at 1.2 ug/m^3 concentrations after 27 days exposure, but not at 0.8 ug/m^3 (Hill, 1969). One of the most sensitive responses of a plant to F is the production of SRS (suture red spots) on peach fruits (Weinstein and Alscher-Herman, 1982). Exposure to the equivalent of 4 ug/m^3 for 5.25 days induced SRS in more than 50% of fruit (MacLean, et al., via Weinstein and Alscher-Herman, 1982).

Since most F is absorbed through the foliage of plants and stored there, the critical period of exposure is during the months of the growing season. Broadleaf plants which shed their leaves annually accumulate F on a yearly basis only; evergreen species, however, may accumulate F within foliage retained over several years (Sidhu, 1977; Amundson and Weinstein, 1980). Studies by Sidhu (1977, 1978) indicated that defoliation occurred after accumulated F levels in vegetation reached 35 ppm. This threshold level was attained when atmospheric F concentrations during the growing season averaged 0.20 ug/m^3 for conifers and 0.4 ug/m^3 for deciduous, broadleaf species.

Levels of fluoride predicted to be emitted by the Hillsborough County resource recovery facility, 0.02 ug/m^3 (as HF) as an annual average, are below levels seen to cause damage in even the most sensitive species tested.

Lead. Studies have shown that soils are capable of fixing large additions of lead compounds absorbed from the atmosphere (Chapman, 1966). Natural soils typically contain 2-200 ppm of lead (Allaway, 1968). Lead is strongly adsorbed in soils, therefore only minor amounts are available for uptake by vegetation.

Although lead in soils is largely unavailable to plants, the primary entryway of lead into vegetation is through the root system (Zimdahl, 1976). Lagerwerff (1971) found that in radishes grown in an area contaminated by auto emissions, nearly all of the lead in the roots and 60% of the lead in the above-ground parts was attributable to soil, not airborne lead.

Lead toxicity has not been observed in plants growing under natural conditions, except in areas adjacent to heavy emission sources.

The maximum annual predicted incremental ground level pollutant concentration of lead resulting from the proposed facility is 0.02 ug/m^3 which is a relatively low concentration when compared to heavy emission sources.

Mercury. Mercurial compounds emitted to the atmosphere could affect plants by either foliar adsorption or by uptake and translocation from soils (CAST, 1976).

The levels at which adverse impacts to vegetation would result from Hg emissions and deposition, however are not expected to result strictly due to resource recovery facility operations. Grasses growing near an active mercury mine and refining facility in Almadén, Spain, contained levels of Hg 10 to 20 times the world average with no reported vegetative damage (Lundberg, et al., 1979). The concentration of mercury in the soils near the mine ranged from 2.5 to 100 mg/kg whereas the average level of Hg in soils is 0.05 mg/kg (Bohn, et al., 1977). The accumulation of mercury by plants is therefore more of concern due to bioaccumulation in the food chain than due to phytotoxic effects even at these elevated levels. The effects of applying 10 mg/kg of Hg to soils in an experiment to evaluate uptake of Hg by bromegrass indicated that considerable accumulation of Hg was found in the plant root system and only small amounts were translocated to the above ground portions of the plant (Hogg, et al., 1978). The environmental hazards associated with high levels of mercury deposition to soils at waste application sites has therefore been identified as those related to ingestion of soil and plant parts by grazing animals. In the above studies the environmental concentrations of mercury are considerably greater than those expected in the vicinity of the proposed facility. Vegetative impacts are therefore not expected to occur.

Of greater importance is the potential for biomagnification through the food chain, particularly in the vicinity of the proposed resource recovery facility where cattle graze in neighboring pastureland. The predicted mercury impact from the proposed facility, 0.0018 ug/m^3 as an annual average, is considered to be so small that the bioaccumulation/biomagnification of this metal should not present a problem.

Beryllium. Beryllium is highly toxic to plants due to poisoning of plant metabolic functions and nutrient depletion. Visual toxicity and decreases in growth rates have been observed in bean plants grown in nutrient solutions of 3-5 ppm (Romney, et al., 1962). Since Be is more strongly immobilized in calcareous soils, the sensitivity of vegetation to Be is reduced as soil pH is increased (Lisk, 1972) Be content of typical soils range from 0.5 to 10 mg/kg (Bohn, et al., 1977).

Although Be is toxic to plants when added to soils, it associates with organic matter hazards and tends to precipitate as hydroxides, which renders it less available for plant uptake.

The predicted annual Be impact from the proposed facility, 4.9×10^{-7} ug/m^3 as an annual average, is so small compared to naturally occurring levels that no toxic effects to vegetation are anticipated.

Hydrogen Chloride. Gaseous HCl will be emitted from the proposed facility as a result of the combustion of certain materials contained in the refuse (especially plastics). HCl fallout onto soil does not pose a serious risk to vegetation. HCl disassociates in soil, and the Cl which occurs in a dissolved form is generally leached from the soil with precipitation. Since it is therefore unavailable for uptake through plant roots, indirect injury to vegetation through the soil is unlikely (Guderian, 1977).

Studies of plant growth in an environment containing gaseous HCl have reported that exposures on the order of 10,000 ug/m^3 for 1 to 2 hours will produce plant injury. Intermittent exposure to concentrations of approximately 50 ug/m^3 were found to pose minimal risk to sensitive vegetation (Guderian, 1977). Benedict (1974) suggested that concentrations ranging from approximately 6,000 ug/m^3 for 1.5 hours to 372 ug/m^3 for 120 hours or below would provide for adequate protection from HCl injury.

The proposed facility will increase HCl concentrations by a 1-hour maximum of 109 ug/m^3 and an annual average of 1.4 ug/m^3. Peak and long term concentrations are well below levels specifically documented to cause injury and those proposed as adequate for vegetation protection. Therefore, HCl emissions are not expected to adversely impact local vegetation.

8.4 SPECIAL RECEPTOR ANALYSIS

The impact of the proposed emission on the nearest Class I area and Pinellas County SO_2 non-attainment area were evaluated, as required by DER. This analysis included placing a receptor at the corners of the SO_2 non-attainment and Class I areas closest to the proposed source for each of the five years modeled and comparing the predicted impact to the corresponding significance limits. For Class I areas the significance impact levels for 24-hour TSP and SO_2 concentrations are much lower and therefore more stringent than any other area.

CLASS I AIR QUALITY ANALYSIS

As mentioned in section 8.1, the class I area nearest to the facility is the Chassakowitzka National Wildlife Area (CNWA) located 79.6 km to the north-northwest. An analysis of potential impacts on this area was performed using the ISC dispersion model and the same five year meteorological data set and source input values employed for the compliance demonstration in section 7. The pollutants analyzed are those with specified increments, namely SO_2 and TSP, as well as NO_2, and CO. These four were chosen due to their regulatory status as criteria pollutants, and the significance of their emissions.

Table 8-4 presents the results of this analysis for the averaging periods of interest. X/Q (concentration/emission rate) values are presented in this table for 1 gram/second emission rate. The day and year of the predicted maximum is also listed. Table 8-5 details the maximum concentration and the appropriate significance level for the four pollutants at the proposed emission rates. As can be noted from Table 8-5, all predicted impacts are approximately 10% or less of their respective significance levels. Therefore, no significant impact is predicted at the CNWA.

TABLE 8-4

SPECIAL RECEPTOR MODELING RESULTS

Averaging Period	Receptor	Maximum X/Q	Day	Year
Annual	SO_2 NA[a]	0.00192	--	1970
	Class I[b]	0.00059	--	1971
24-hour	SO_2 NA	0.01864	355	1970
	Class I	0.01256	46	1974
8-hour	SO_2 NA	0.05118	355	1972
	Class I	0.03858	46	1974
3-hour	SO_2 NA	0.12345	355	1972
	Class I	0.10289	46	1972
1-hour	SO_2 NA	0.24369	2	1974
	Class I	0.18397	347	1970

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a - SO_2 Non-Attainment Area, modeled at 43.5 km at 296° from proposed source.

b - Chassahowitzka National Wildlife Area, modeled at 79.6 km at 344° from proposed source.

TABLE 8-5

MAXIMUM CONCENTRATIONS -- SPECIAL RECEPTORS

Pollutant	Averaging Time	Receptor	Maximum Concentration (ug/m3)	PSD Significant Impact Level
SO_2	Annual	SO_2 NA	0.04	1
		Class I	0.01	1
	24-hour	SO_2 NA	0.4	5
		Class I	0.3	1
	3-hour	SO_2 NA	2.9	25
		Class I	2.4	25
TSP	Annual	Class I	0.003	1
	24-hour	Class I	0.06	1
NO2	Annual	Class I	0.02	1
CO	8-hour	Class I	0.6	500
	1-hour	Class I	3.1	2000

SO_2 NON-ATTAINMENT AREA ANALYSIS

As identified in Table 8-4, an SO_2 non-attainment area is located 43.5 km west-northwest (296°) of the proposed resource recovery plant. An analysis similar to that used for the CNWA Class I area was conducted. Results of the analysis is presented in Tables 8-4 and 8-5. As with the Class I area, no significant impact is predicted.

SECTION 9.0

EMISSION OFFSETS

9.0 EMISSION OFFSETS

The proposed Hillsborough County Resource Recovery Facility will be located in an ozone (O_3) and total suspended particulate matter (TSP) non-attainment area. The entire county is classified as non-attainment with respect to the standards for O_3. The TSP non-attainment area is defined as a circle with a 12 km radius centered at the intersection of U.S. 41 and State Road 60. The Non-attainment Area New Source Review regulations provide that major sources emitting the affected pollutant at amounts equal to or greater than 100 tons per year are subject to obtain emission offsets. Resource recovery facilities need not obtain all the necessary offsets prior to the issuance of a permit to construct, as long as the best effort was made to obtain the required offsets, all available offsets have been secured, and a commitment is made to continue to seek emission offsets and apply them as the offsets become available (FAC 17-2.510(3)(c)).

Ozone is a secondary pollutant formed by interactions of primary pollutants, primarily hydrocarbons, and is not directly emitted in any discernable amount from the proposed facility. Therefore, hydrocarbon emissions are regulated to achieve compliance with the ambient O_3 standard. The maximum allowable annual emission rate for hydrocarbons from the proposed facility is 58 tons per year. Since this is less than the 100 tons per year cutoff level, the application of LAER and emission offsets are not required for this pollutant.

The maximum allowable annual particulate emission rate for the proposed resource recovery facility is 140 tons per year, which does not exceed the 100 ton per year threshhold. The facility is, therefore, subject to the appication of LAER and the commitment of emission offsets for particulate matter. To obtain these offsets a list of major sources of particulate matter was compiled from the 1982 emission inventory maintained by the Hillsborough County Environmental Protection Commisison. Three sources were identified: Gardinier Inc., General Portland Inc., and Tampa Electric Company. Hillsborough County has sent a letter to each of these sources requesting available offsets. The responses from these letters will be forwarded to the Florida DER as they are received. Hillsborough County will apply any and all offsets when they become available.

MAJOR SOURCES OF PARTICULATE EMISSIONS
WITHIN THE TSP NON-ATTAINMENT AREA

NAME OF FIRM	TELEPHONE
1. Allen Morrison, Environmental and Chemical Services Manager Gardinier, Inc. P.O. Box 3269 Tampa, Florida 33601	(813) 677-9111
2. Henry Winders, Environmental Manager c/o Bob Pretat, Senior Plant Engineer General Portland, Inc., Fla. Division P.O. Box 1002 Tampa, Florida 33601	(813) 872-7777
3. Jerry L. Williams, Director - Environmental Planning Tampa Electric Company P.O. Box 111 Tampa, Florida 33601	(813) 228-4837

COUNTY OF HILLSBOROUGH
P.O. BOX 1110 TAMPA, FLORIDA 33601

NORMAN W. HICKEY, COUNTY ADMINISTRATOR

July 19, 1984

Jerry L. Williams, Director-Environmental Planning
Tampa Electric Company - Tampa
P.O. Box 111
Tampa, Florida 33601

Dear Mr. Williams:

Hillsborough County will be constructing a 1200 ton per day solid waste energy resource recovery facility on a 50 acre site north of State Road 60 and west of Faulkenburg Road. This facility will take municipal solid waste generated within the unincorporated areas of Hillsborough County and convert it into electricity for sale to the Tampa Electric Company. Each of the three boilers will be fitted with an electrostatic precipitator and operate at the lowest achievable emission rate for particulate matter.

The State of Florida non-attainment new source review regulations require that emission offsets be obtained for non-attainment pollutants emitted from sources located in non-attainment areas. Because the Faulkenburg Road site is located within a Total Suspended Particulate (TSP) non-attainment area in Hillsborough County, the County is seeking TSP offsets from other major particulate sources.

Emission offsets represent a reduced emission rate due to improved particulate control, reduced operating hours, or some other means. If your firm possesses such offsets, please contact Dr. Marc Rogoff, at (813)272-6674.

Your time and consideration are appreciated.

Sincerely,

Warren N. Smith

Warren N. Smith, Director
Department of Solid Waste

WNS/pd

COUNTY OF HILLSBOROUGH
P.O. BOX 1110 TAMPA, FLORIDA 33601

NORMAN W. HICKEY, COUNTY ADMINISTRATOR

July 19, 1984

Robert Pretat, Senior Plant Engineer
General Portland, Inc., Florida Division
P.O. Box 1002
Tampa, Florida 33601
Attn: Henry Winders, Environmental Engineer

Dear Mr. Pretat:

Hillsborough County will be constructing a 1200 ton per day solid waste energy resource recovery facility on a 50 acre site north of State Road 60 and west of Faulkenburg Road. This facility will take municipal solid waste generated within the unincorporated areas of Hillsborough County and convert it into electricity for sale to the Tampa Electric Company. Each of the three boilers will be fitted with an electrostatic precipitator and operate at the lowest achievable emission rate for particulate matter.

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WNS/pd

COUNTY OF HILLSBOROUGH
P.O. BOX 1110 TAMPA, FLORIDA 33601

NORMAN W. HICKEY, COUNTY ADMINISTRATOR

July 19, 1984

Allen Morrison, Environmental
and Chemical Services Manager
Gardinier, Inc.
P.O. Box 3269
Tampa, Florida 33601

Dear Mr. Morrison:

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WNS/pd

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Exhibit A

SCREENING MODEL ANALYSIS

EXHIBIT A

SCREENING ANALYSIS FOR WORST CASE
BOILER LOADING CONDITIONS

A screening analysis, using the expected air pollutant emission rates from the proposed Hillsborough Resource Recovery Facility, has been performed to identify those conditions and pollutants which warrant additional review. As the boiler's operating load changes the plume dispersion characteristics change. The condition yielding the greatest air quality impact must be identified for future modeling activities. The pollutant impacts must be assessed for their potential for significant impact. Pollutants displaying no such potential may be subject to a less rigorous review. Finally the areas downwind of the plume subject to the greatest impact, must be identified so that receptor placement in a more refined analysis will yield the maximum pollutant concentrations.

The Industrial Source Complex Short-Term (ISCST) dispersion model was applied with a range of meteorological conditions. The facility is situated in a rural setting, therefore, the rural option was employed (based on EPA recommended methodology-[Auer, 1978]) in the execution of the model. With the proposed stack height being below the GEP height for the facility, the building induced downwash option was employed. The receptor locations, meteorological conditions and the scaling factors to determine the concentrations for various short-term averaging periods were approved by FDER. A summary of those options and conditions used in the initial screening model analysis are located in Tables A-1 and A-2.

The boiler loads examined are those representing the maximum (110% load), typical (100% load), and minimum (50% load) operating conditions. The heat content of the refuse was also investigated by making modeling runs using values of 4,000 and 4,500 Btu/lb. These boiler loads and heating values are summarized into four cases (Table A-3). The stack parameters and

TABLE A-1

MODEL OPTIONS USED IN SCREENING MODEL ASSESSMENT

Options	Description	
Dispersion Paramater	Rural	
Wind Profile Exponent	Stability	Exponent
	A	.10
	B	.15
	C	.20
	D	.25
	E	.30
	F	.30
Vertical Potential Temp. Gradient	Default	
Plume Rise	Transitional	
Stack Tip Downwash	Not Used	
Number of Receptors	38	
Entrainment Coefficient for Unstable Atmosphere	Beta 1 - .600	
Entrainment coefficient for Stable Atmosphere	Beta 2 - .600	
Anemometer Height	10.0m	
Decay Coefficient	0.0	
Building Induced Downwash	Yes	

TABLE A-2

METEOROLOGICAL CONDITIONS USED IN SCREENING MODEL ANALYSIS

Stability	Mixing Height (m)	Winds Speed (m/s)
A	5000	1.0
A	5000	2.0
A	5000	3.0
B	5000	1.0
B	5000	2.0
B	5000	3.0
B	5000	4.0
B	5000	5.0
C	5000	1.0
C	5000	3.0
C	5000	5.0
C	5000	7.0
C	5000	10.0
D	5000	1.0
D	5000	3.0
D	5000	5.0
D	5000	7.0
D	5000	10.0
D	5000	12.0
D	5000	15.0
D	5000	20.0
E	5000	1.0
E	5000	3.0
E	5000	5.0
F	5000	1.0
F	5000	3.0

TABLE A-3

BOILER OPERATING CONDITIONS

CASE	Refuse Fired(1) Heat Content (BTU/lb)	Firing Rate* (TPD)	Flue Exit (from all 4 boilers) Exit Gas Temperature °F (°K)	Flow Rate ACFM	Exit Gas Velocity fps**	(m/s)
A	4,000	440	430 (494)	343,635	55.2	(16.82)
B+	4,500	400	455 (508)	351,030	56.4	(17.19)
C	4,000	200	430 (494)	156,190	25.1	(7.65)
D	4,000	400	430 (494)	312,395	50.3	(15.32)

(1) Norminal Facility Capacity is 1,600 tpd (400 tpd for 4 boilers).

*Per boiler (4 boiler total).
**Flue diameter = 5.75 ft (1.75 m) for an effective diameter of 3.5 m.
+Case B is the typical load case firing reference waste.

building dimensions used in the screening runs are listed in Table A-4. Table A-5 shows the emission rates for each of the pollutants examined. The stack parameters and emission rates reflect the variations in the boiler operating conditions.

The ground level concentrations shown in Table A-6 are scaled, using the wind direction persistence scaling factors from the maximum one-hour concentration calculated in each of the screening runs . These concentrations represent a conservative analysis particularly for pollutant concentrations with longer averaging times.

The results indicate that the maximum load case (Case A) of 110% of nameplate rating, firing a waste with a low BTU content (4,000 BTU/lb) produced the highest ground level pollutant impacts. The results tabulated in Table A-6 indicate a potential for significant SO_2 impact.

The areas downwind of the plume showing greatest impact are between 0.3 and 0.7 km. During the refined modeling analysis receptors would be concentrated within this range.

Although there is no generally accepted scaling factor for estimating maximum annual concentrations from 1-hour modeled values, the potential for a significant annual impact for SO_2 and NO_2 exists. This is based on the ratio of maximum modeled annual concentrations to 1-hour concentrations of 0.05 from other modeling studies involving a single facility. Actual determination of significant impacts and significant impact areas were based on the refined modeling analysis presented in Exhibit C. This analysis consisted of employing a computer-simulated dispersion model using sequential meteorological data from Tampa International Airport. The results from this analysis were used to further quantify the impacts from the proposed facility on the surrounding area.

TABLE A-4

STACK PARAMETERS USED IN SCREENING MODEL ASSESSMENT

Base Elevation	-	12.1 meters
Stack Height	-	67.0 meters
Exit Temperature	-	494.0 °K Cases A,C & D 508.0 °K - Case B
Exit Velocity	-	Case A - 16.82 m/s Case B - 17.19 m/s Case C - 7.65 m/s Case D - 15.32 m/s
Effective Stack Diameter	-	3.5 meters
Building Height	-	42.7 meters
Building Width		51.5 meters
Building Length		22.9 meters
Maximum Projected Width		56.4 meters
Equivalent Length/Width		49.9 meters

TABLE A-5

EMISSION ESTIMATES FROM PROPOSED FACILITY

Pollutant	Emission Rate (grams/sec)[1] Case A	Case B,D	Case C
Particulate Matter	4.47	4.06	2.03
Sulfur Dioxide	23.1	21.0	10.5
Nitrogen Oxides	27.7	25.2	12.6
Carbon Monoxide	16.6	15.1	7.6

(1) Combined emission rates for all four boilers operating under the condition defined by the corresponding case.

TABLE A-6

SUMMARY OF SCREENING MODELING RESULTS

Pollutant	Averaging Period	MAXIMUM CONCENTRATION ($\mu g/m^3$) Load Condition Case A	B	C	D	Significant Impact Level
TSP	24 hr	3.1	2.8	2.1	2.9	5
SO_2	3 hr	36.0	32.1	25.0	33.8	25
	24 hr	16.0	14.3	11.1	15.0	5
CO	1 hr	28.7	25.6	20.0	27.0	2,000
	8 hr	20.1	18.0	14.0	18.9	500
NO_2	1 hr	47.9	42.7	33.4	45.1	*

*No significant impact level is defined for NO_2 for a 1-hour averaging time. Its supplied only to make an approximation of the annual NO_2 impact.

STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL REGULATION

TWIN TOWERS OFFICE BUILDING
2600 BLAIR STONE ROAD
TALLAHASSEE, FLORIDA 32301-8241

BOB GRAHAM
GOVERNOR

VICTORIA J. TSCHINKEL
SECRETARY

November 8, 1983

Mr. Donald M. Pomelia
Camp, Dresser, and McKee Inc.
One Center Plaza
Boston, Massachussetts 02108

Re: Hillsborough County Resource Recovery Project

Dear Mr. Pomelia:

Enclosed please find copies of the meteorological data from Tampa, Florida for the specified days you requested.

The proposed modeling methodology you have outlined in your November 4, 1983 letter is appropriate and acceptable for the air quality analysis. In addition to the placement of the receptors you have noted, additional receptors should be placed at the boundaries of any Class I area within 100 kilometers of the source and along the boundary of any nonattainment area within 50 kilometers of the sources unless it is clear from the screening modeling that these areas will not be significantly impacted.

If we can be of any further assistance please let us know.

Sincerely,

Thomas Rogers
Meteorologist

TR/s
enclosures
cc: Larry George

EXHIBIT B

METEOROLOGICAL DATA

METEOROLOGICAL DATA
ASSOCIATED WITH
HIGHEST CONCENTRATIONS

Meteorological Data

The meteorological data corresponding to the highest, second-highest (HSH) concentrations corresponding to each of the short-term averaging times is listed in the following tables. These tables are presented chronologically. The averaging periods are block averages, for example, eight 3-hour averages and one 24-hour average would be calculated for each day.

The concentrations corresponding to the highest 3-hour and highest 8-hour averaging times occur in 1972 on day 50 (Table B-1) during period five (hours 13 to 15) and period two (9 to 16) respectively. These periods are characterized by a moderate northwest wind during neutral stability conditions.

The highest 24-hour pollutant concentration occurs on day 173 of the year 1972. This day is characterized by moderate westerly winds under neutral stability conditions. The following day, 174 (Table B-3) corresponds to the HSH 24-hour concentration. The conditions on this day are similar to the previous day.

The concentrations corresponding to the HSH 8-hour averaging time occur in 1972 on day 175 (Table B-4) in period one (hours 1 to 8). The conditions on this day are similar to the two previous days with moderate westerly winds and neutral stability.

The meteorological data in 1973 day 355 (Table B-5) period 3 (hours 7 to 9) produce the HSH 3-hour concentrations. Neutral stability and moderate northwest winds prevail during this period.

The highest and HSH 1-hour concentrations occur in 1974 on day 351 during hour 21 and 22 respectively. The conditions associated with these hours are moderate west-northwest winds and stable stability.

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Table B-1

*** HILLSBOROUGH COUNTY RESOURCE RECOVERY FACILITY 1972 ***

* METEOROLOGICAL DATA FOR DAY 50 *

HOUR	FLOW VECTOR (DEGREES)	RANDOM FLOW VECTOR (DEGREES)	WIND SPEED (MPS)	MIXING HEIGHT (METERS)	TEMP. (DEG. K)	INPUT STABILITY CATEGORY	ADJUSTED STABILITY CATEGORY
1	150.0	154.0	8.23	1220.4	286.5	4	4
2	150.0	150.0	7.20	1234.9	285.4	4	4
3	150.0	150.0	5.66	1249.3	284.3	4	4
4	150.0	153.0	6.69	1263.7	283.7	4	4
5	150.0	154.0	6.17	1278.1	283.2	4	4
6	140.0	141.0	5.66	1292.6	282.6	4	4
7	130.0	133.0	8.23	1307.0	282.6	4	4
8	110.0	113.0	7.72	1321.4	283.2	4	4
9	130.0	132.0	11.32	1335.9	284.3	4	4
10	120.0	117.0	12.86	1350.3	284.8	4	4
11	130.0	131.0	13.38	1364.7	285.9	4	4
12	130.0	133.0	14.40	1379.1	285.9	4	4
13	130.0	132.0	15.43	1393.6	285.4	4	4
14	130.0	131.0	13.89	1408.0	285.4	4	4
15	130.0	130.0	13.38	1408.0	284.8	4	4
16	130.0	127.0	12.35	1408.0	284.8	4	4
17	140.0	149.0	9.26	1408.0	284.3	4	4
18	150.0	153.0	9.26	1408.0	283.7	4	4
19	150.0	151.0	7.20	1408.5	282.6	4	4
20	140.0	141.0	9.23	1409.1	283.2	4	4
21	150.0	149.0	7.20	1409.8	282.6	4	4
22	150.0	150.0	7.72	1410.4	282.6	4	4
23	150.0	153.0	6.75	1411.1	282.5	4	4
24	160.0	158.0	7.20	1411.5	281.5	4	4

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Table B-2

*** HILLSBOROUGH COUNTY RESOURCE RECOVERY FACILITY 1972 ***

* METEOROLOGICAL DATA FOR DAY 173 *

HOUR	FLOW VECTOR (DEGREES)	RANDOM FLOW VECTOR (DEGREES)	WIND SPEED (MPS)	MIXING HEIGHT (METERS)	TEMP. (DEG. K)	INPUT STABILITY CATEGORY	ADJUSTED STABILITY CATEGORY
1	70.0	74.0	5.14	979.6	298.7	5	5
2	60.0	60.0	6.17	948.1	299.3	4	4
3	80.0	76.0	6.17	916.5	299.3	4	4
4	70.0	74.0	6.69	884.9	299.3	4	4
5	90.0	88.0	7.20	853.3	299.3	4	4
6	60.0	80.0	7.20	821.7	299.3	4	4
7	80.0	76.0	6.69	790.1	299.8	4	4
8	90.0	92.0	7.72	758.5	300.4	4	4
9	80.0	84.0	8.23	726.9	300.9	4	4
10	80.0	79.0	7.20	695.4	300.9	4	4
11	90.0	91.0	8.75	663.8	301.5	4	4
12	90.0	93.0	8.23	632.2	302.0	4	4
13	90.0	92.0	8.23	600.6	302.6	4	4
14	90.0	87.0	8.23	569.0	302.6	4	4
15	90.0	86.0	7.72	569.0	302.6	4	4
16	90.0	93.0	7.20	569.0	302.6	4	4
17	90.0	94.0	7.20	569.0	302.0	4	4
18	90.0	92.0	7.20	569.0	300.9	4	4
19	90.0	92.0	5.14	569.0	300.9	4	4
20	90.0	91.0	5.14	591.5	300.4	4	4
21	90.0	91.0	5.14	630.2	299.8	4	4
22	90.0	88.0	4.12	666.8	299.3	4	4
23	90.0	87.0	5.14	707.1	299.8	4	4
24	90.0	93.0	6.69	748.1	299.8	4	4

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Table B-3

*** HILLSBOROUGH COUNTY RESOURCE RECOVERY FACILITY 1972 ***

* METEOROLOGICAL DATA FOR DAY 174 *

HOUR	FLOW VECTOR (DEGREES)	RANDOM FLOW VECTOR (DEGREES)	WIND SPEED (MPS)	MIXING HEIGHT (METERS)	TEMP. (DEG. K)	INPUT STABILITY CATEGORY	ADJUSTED STABILITY CATEGORY
1	80.0	77.0	5.66	784.6	299.8	4	4
2	80.0	83.0	5.14	823.3	299.8	4	4
3	90.0	94.0	6.17	861.9	299.8	4	4
4	90.0	88.0	6.17	900.5	299.8	4	4
5	90.0	87.0	6.17	939.2	299.8	4	4
6	90.0	89.0	6.17	977.8	299.8	4	4
7	90.0	86.0	4.63	1016.5	299.8	4	4
8	90.0	94.0	5.14	1055.1	300.4	4	4
9	90.0	88.0	6.17	1093.8	300.9	4	4
10	90.0	91.0	6.17	1132.4	301.5	4	4
11	100.0	103.0	6.69	1171.1	302.0	4	4
12	100.0	97.0	6.69	1209.7	302.6	4	4
13	100.0	103.0	7.20	1246.4	303.2	4	4
14	100.0	103.0	7.20	1287.0	303.2	3	3
15	90.0	91.0	8.23	1287.0	303.2	4	4
16	100.0	97.0	7.72	1287.0	303.2	4	4
17	90.0	88.0	7.20	1287.0	302.0	4	4
18	90.0	92.0	7.72	1287.0	302.0	4	4
19	90.0	92.0	6.69	1287.0	300.9	4	4
20	90.0	89.0	5.66	1291.6	300.4	4	4
21	90.0	89.0	6.17	1299.7	300.4	4	4
22	90.0	94.0	5.14	1307.7	299.8	4	4
23	80.0	80.0	5.14	1315.7	299.8	4	4
24	80.0	85.0	5.14	1323.7	299.8	4	4

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Table B-4

*** HILLSBOROUGH COUNTY RESOURCE RECOVERY FACILITY 1972 ***

* METEOROLOGICAL DATA FOR DAY 175 *

HOUR	FLOW VECTOR (DEGREES)	RANDOM FLOW VECTOR (DEGREES)	WIND SPEED (MPS)	MIXING HEIGHT (METERS)	TEMP. (DEG. K)	INPUT STABILITY CATEGORY	ADJUSTED STABILITY CATEGORY
1	90.0	91.0	5.14	1331.7	299.8	4	4
2	90.0	90.0	5.66	1339.7	299.8	4	4
3	90.0	91.0	7.20	1347.8	299.8	4	4
4	90.0	87.0	7.72	1355.8	299.8	4	4
5	90.0	93.0	7.20	1363.8	299.8	4	4
6	90.0	86.0	5.66	1371.8	299.8	4	4
7	100.0	99.0	7.20	1379.9	299.8	4	4
8	90.0	92.0	7.72	1387.9	299.8	4	4
9	110.0	114.0	4.12	1395.9	299.3	4	4
10	90.0	92.0	3.09	1403.9	302.0	4	4
11	100.0	97.0	7.72	1411.9	302.0	4	4
12	100.0	105.0	6.69	1420.0	303.2	4	4
13	90.0	91.0	6.17	1428.0	303.2	3	3
14	90.0	91.0	7.20	1436.0	303.7	3	3
15	90.0	92.0	6.17	1436.0	303.2	4	4
16	100.0	101.0	6.17	1436.0	303.2	4	4
17	90.0	86.0	5.66	1436.0	303.2	4	4
18	90.0	[illegible]	5.14	1436.0	302.0	4	4
19	90.0	91.0	4.63	1436.0	300.9	4	4
20	80.0	85.0	4.12	1421.3	295.8	5	5
21	80.0	77.0	4.12	1395.8	299.8	5	5
22	90.0	89.0	5.14	1370.3	299.8	5	5
23	80.0	79.0	5.14	1344.7	299.8	4	4
24	90.0	91.0	6.17	1319.2	299.8	4	4

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Table B-5

*** HILLSBOROUGH COUNTY RESOURCE RECOVERY FACILITY 1973 ***

* METEOROLOGICAL DATA FOR DAY 355 *

HOUR	FLOW VECTOR (DEGREES)	RANDOM FLOW VECTOR (DEGREES)	WIND SPEED (MPS)	MIXING HEIGHT (METERS)	TEMP. (DEG. K)	INPUT STABILITY CATEGORY	ADJUSTED STABILITY CATEGORY
1	110.0	106.0	9.77	244.2	288.7	4	4
2	100.0	104.0	10.29	254.9	287.6	4	4
3	110.0	113.0	10.29	265.6	287.0	4	4
4	110.0	107.0	6.69	276.2	285.9	4	4
5	130.0	126.0	7.72	286.9	285.4	4	4
6	130.0	126.0	7.72	297.6	284.8	4	4
7	130.0	129.0	7.20	308.3	284.3	4	4
8	130.0	130.0	8.23	318.9	284.3	4	4
9	130.0	127.0	8.23	329.6	285.4	4	4
10	140.0	142.0	8.23	340.3	285.9	4	4
11	120.0	117.0	8.75	351.0	287.0	4	4
12	110.0	111.0	10.29	361.6	286.5	4	4
13	120.0	123.0	9.26	372.3	285.9	4	4
14	120.0	116.0	8.23	383.0	285.9	4	4
15	120.0	124.0	9.26	383.0	285.4	4	4
16	130.0	134.0	9.26	383.0	284.8	4	4
17	130.0	128.0	7.72	383.0	283.7	4	4
18	140.0	140.0	7.20	388.3	282.0	4	4
19	140.0	146.0	5.14	400.8	280.9	5	5
20	140.0	142.0	4.63	413.4	279.3	5	5
21	160.0	165.0	4.63	426.0	279.3	5	5
22	160.0	160.0	3.60	438.6	278.7	5	5
23	180.0	179.0	3.60	451.2	278.2	5	5
24	200.0	203.0	3.60	463.8	277.6	5	5

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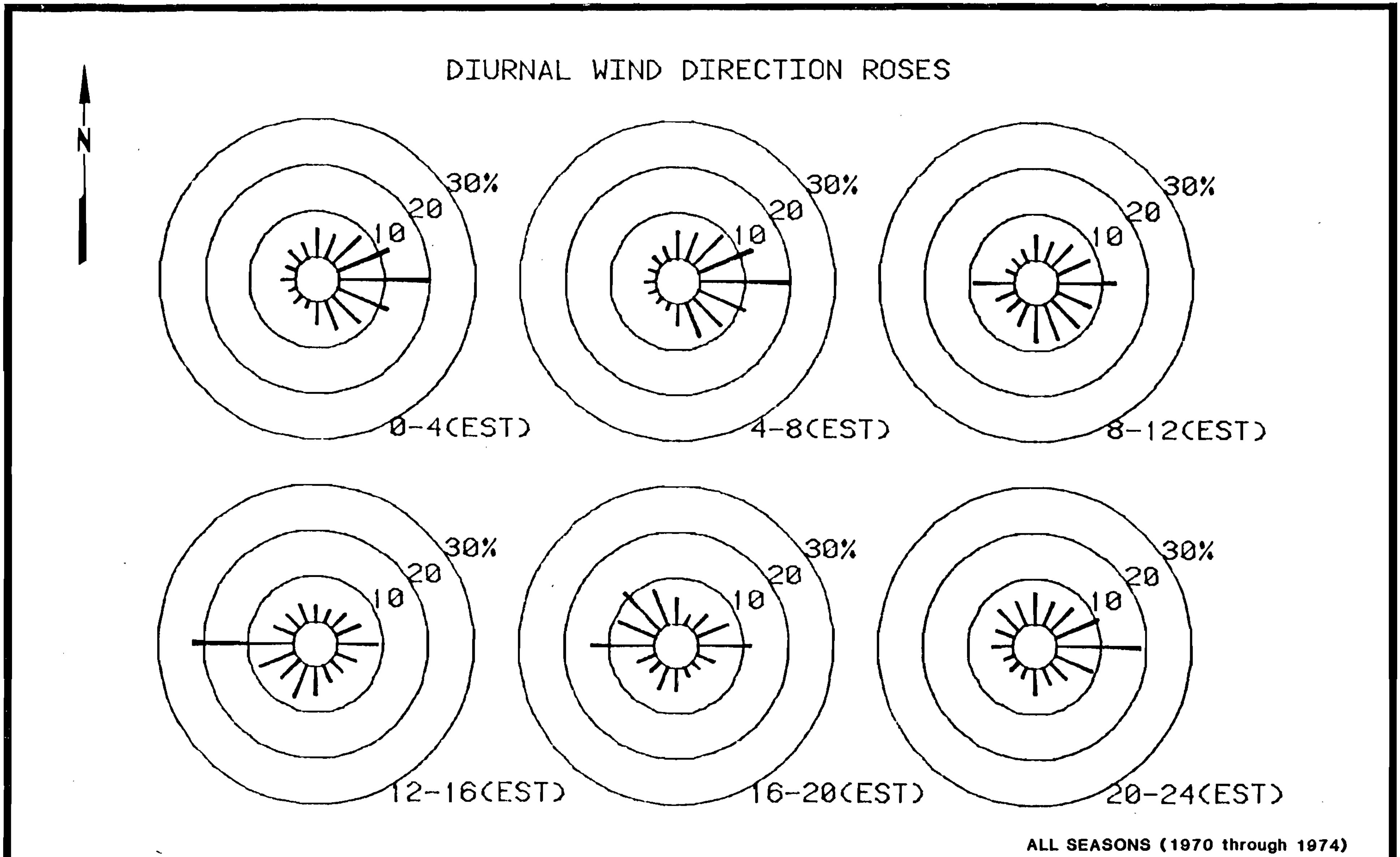
Table B-6

*** HILLSBOROUGH COUNTY RESOURCE RECOVERY FACILITY 1974 ***

* METEOROLOGICAL DATA FOR DAY 351 *

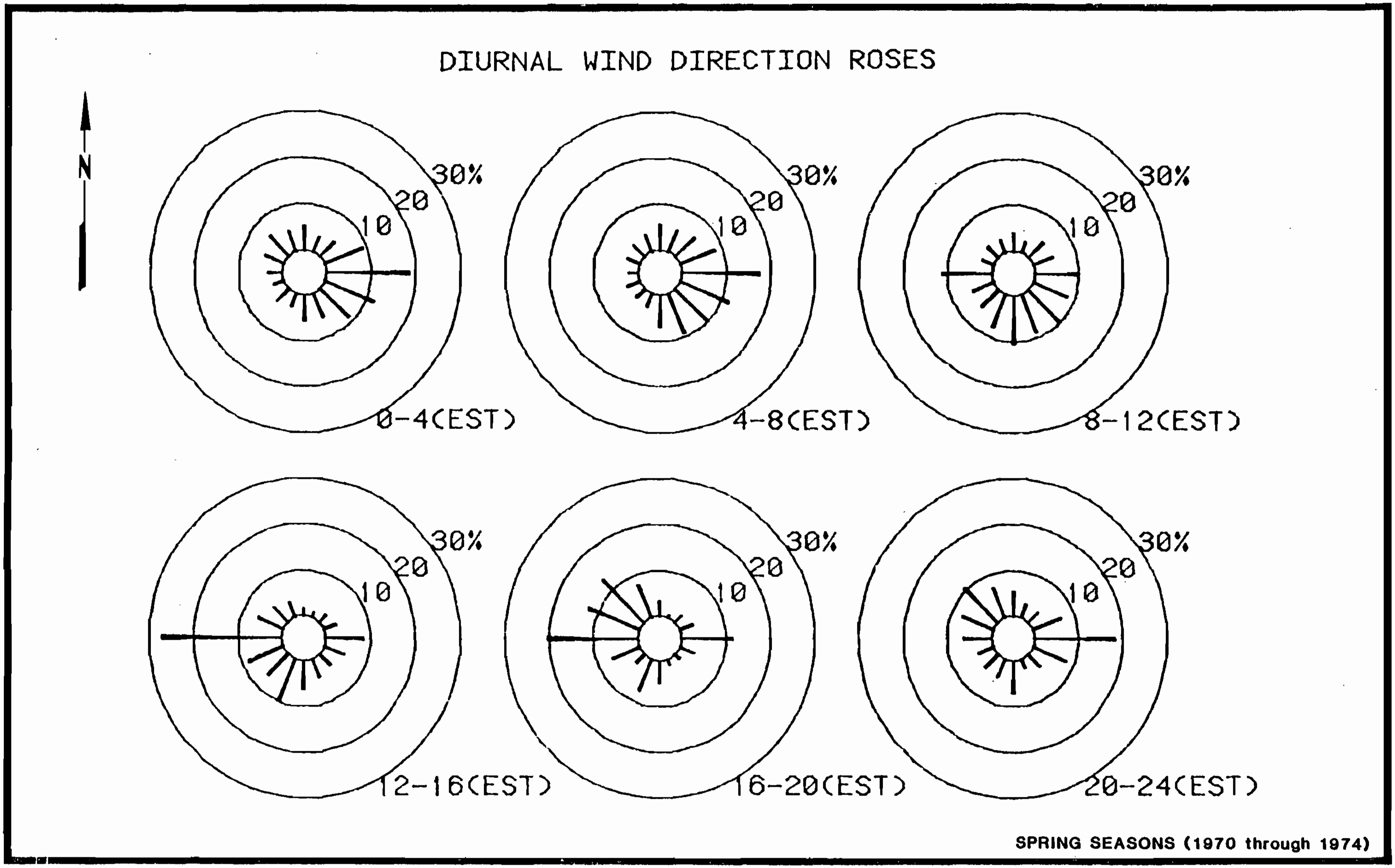
HOUR	FLOW VECTOR (DEGREES)	RANDOM FLOW VECTOR (DEGREES)	WIND SPEED (MPS)	MIXING HEIGHT (METERS)	TEMP. (DEG. K)	INPUT STABILITY CATEGORY	ADJUSTED STABILITY CATEGORY
1	150.0	150.0	3.60	636.1	286.5	4	4
2	170.0	172.0	1.54	648.0	285.9	5	5
3	190.0	192.0	2.57	659.8	285.4	5	5
4	350.0	347.0	1.54	671.6	284.3	6	6
5	90.0	87.0	1.54	683.5	285.4	6	6
6	90.0	93.0	1.00	695.3	285.4	6	6
7	140.0	141.0	2.06	707.1	285.4	5	5
8	120.0	125.0	1.54	90.1	285.4	4	4
9	120.0	120.0	1.00	198.4	286.5	3	3
10	110.0	113.0	2.06	316.7	288.2	3	3
11	20.0	25.0	3.09	435.1	289.8	4	4
12	30.0	31.0	1.12	553.4	290.4	3	3
13	150.0	155.0	10.29	671.7	288.2	4	4
14	130.0	133.0	7.20	790.0	289.3	4	4
15	120.0	121.0	7.20	790.0	289.8	4	4
16	120.0	116.0	7.72	790.0	289.3	4	4
17	130.0	127.0	5.14	790.0	287.6	4	4
18	140.0	143.0	5.14	793.0	286.5	5	5
19	140.0	142.0	2.57	799.6	284.3	6	6
20	100.0	103.0	1.54	806.3	283.7	6	6
21	110.0	109.0	7.20	812.9	286.5	6	6
22	110.0	109.0	3.09	819.6	286.5	5	5
23	140.0	143.0	6.17	826.2	286.5	4	4
24	140.0	144.0	5.66	832.9	285.4	4	4

SEASONAL/DIURNAL WIND ROSES



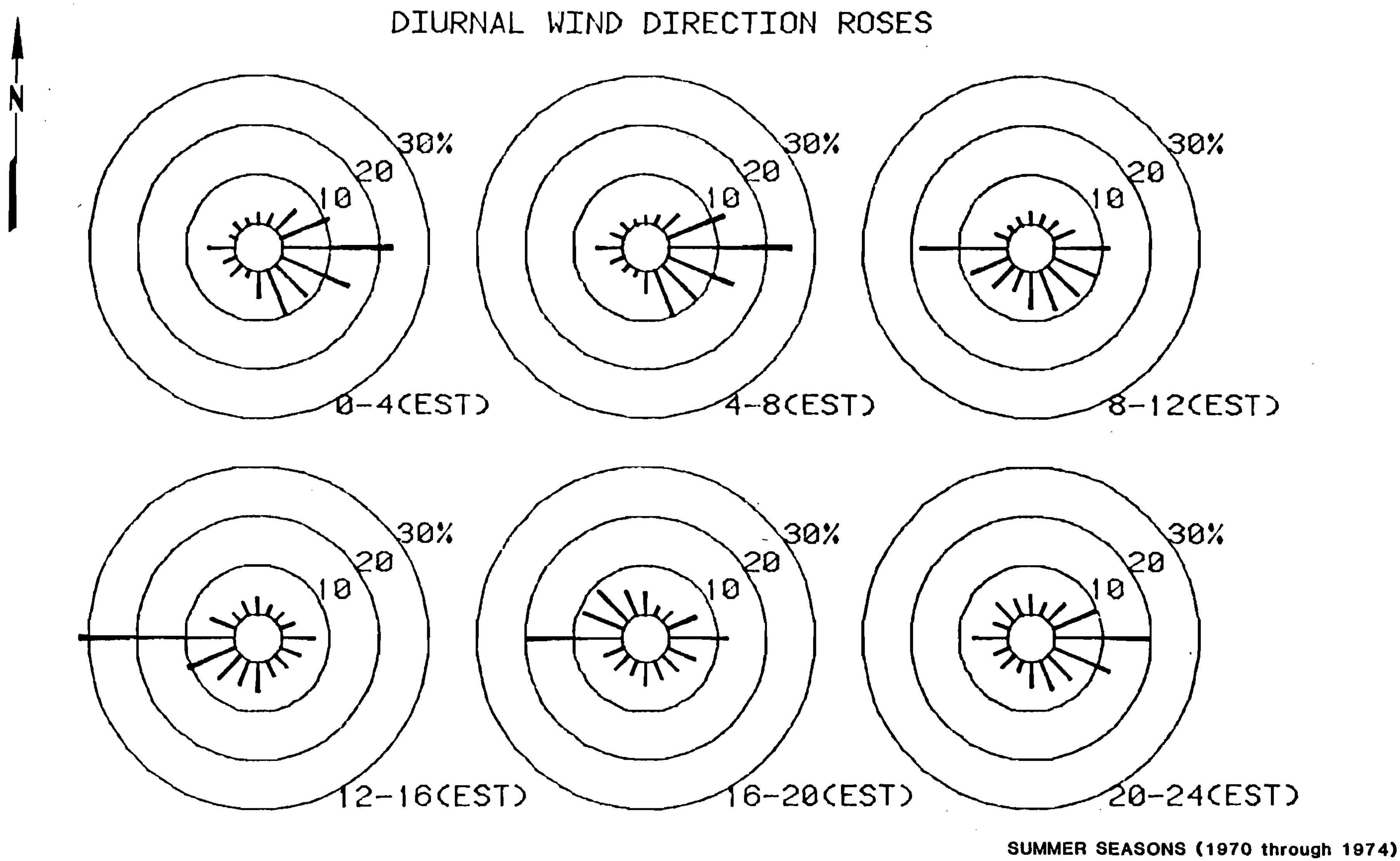
HILLSBOROUGH COUNTY
ENERGY RECOVERY PROJECT

FIGURE B-1
DIURNAL WIND DIRECTION ROSES



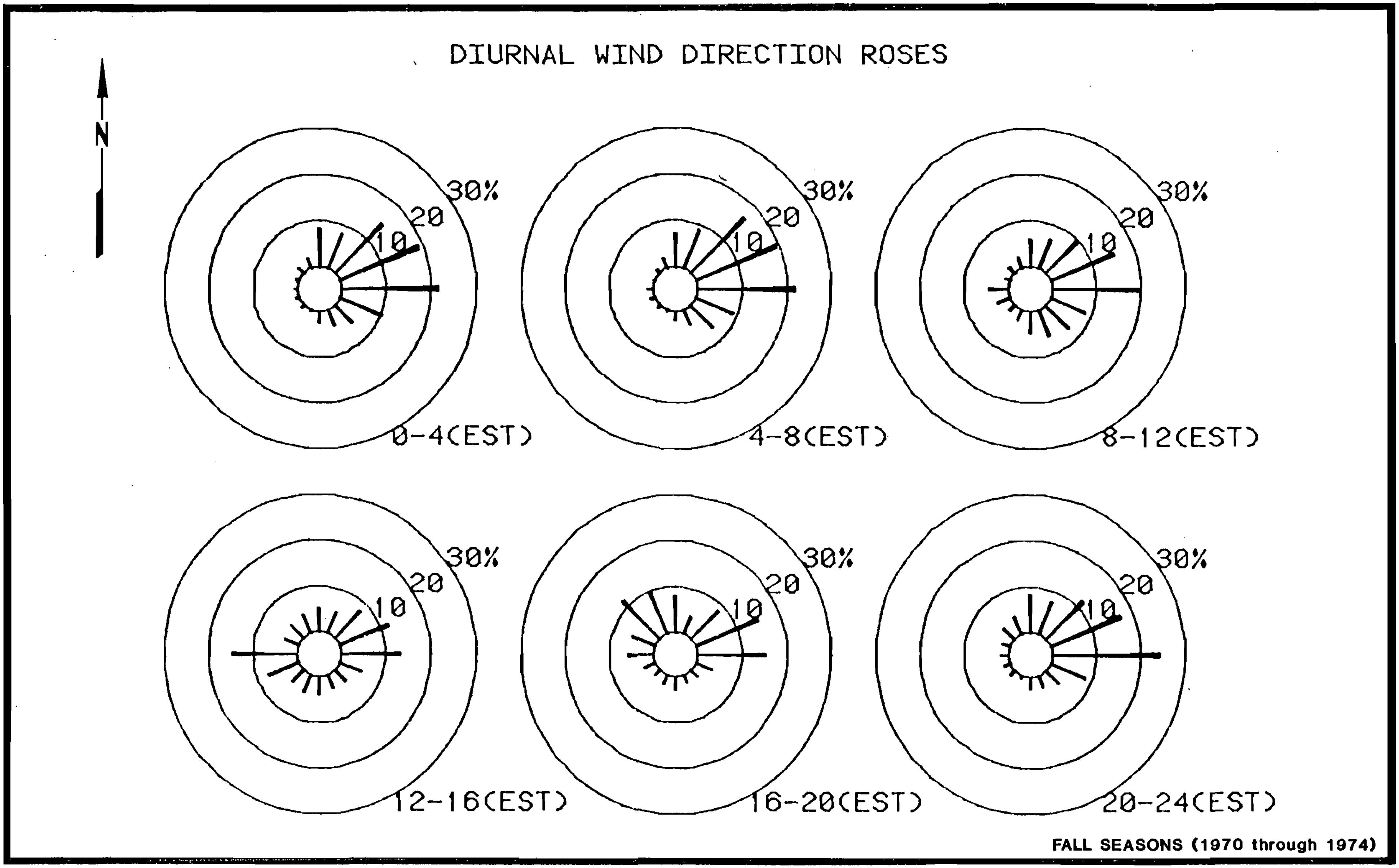
HILLSBOROUGH COUNTY
ENERGY RECOVERY PROJECT

FIGURE B-2
DIURNAL WIND ROSES FOR SPRING



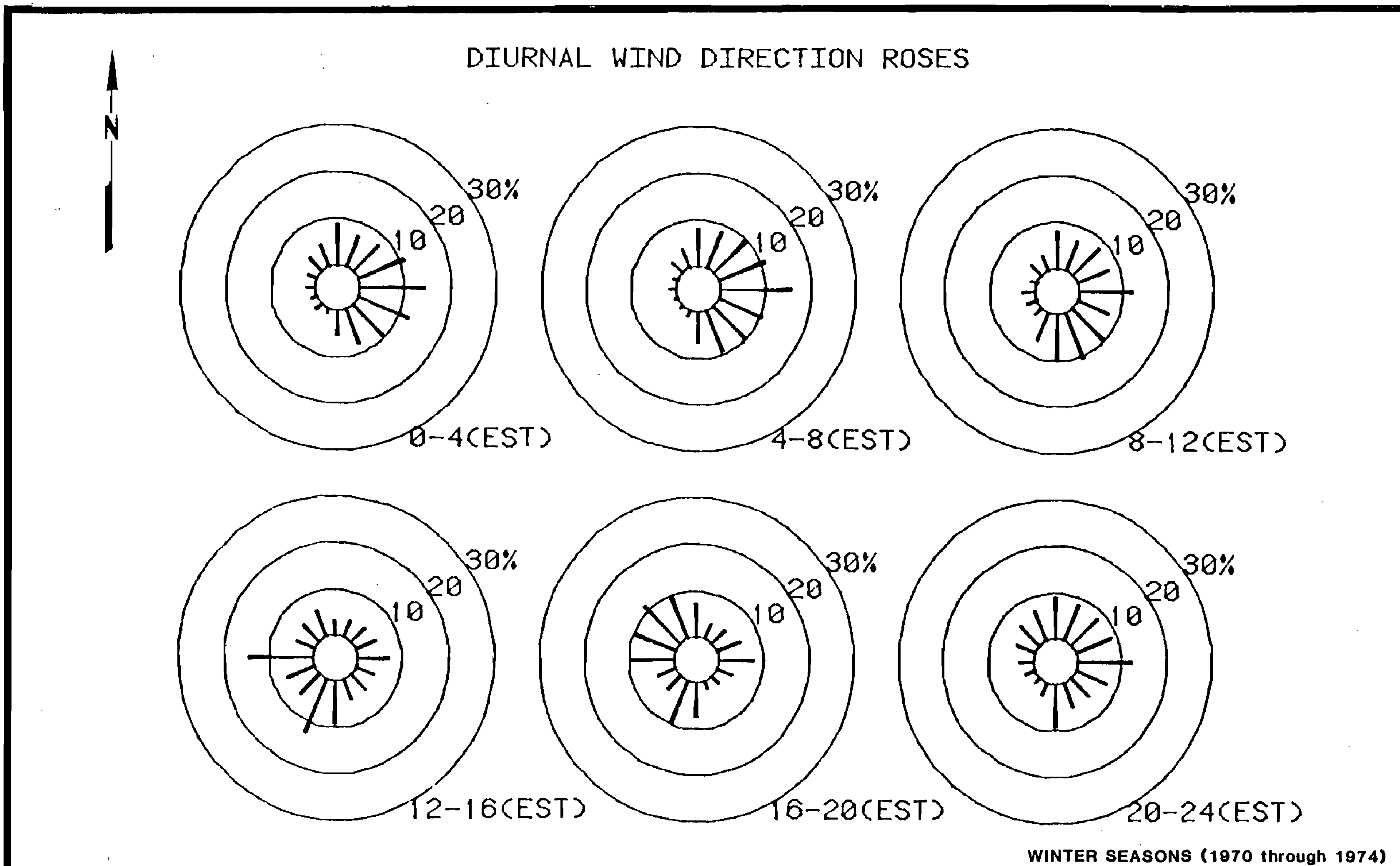
HILLSBOROUGH COUNTY
ENERGY RECOVERY PROJECT

FIGURE B-3
DIURNAL WIND ROSES FOR SUMMER



HILLSBOROUGH COUNTY
ENERGY RECOVERY PROJECT

FIGURE B-4
DIURNAL WIND ROSES FOR FALL



HILLSBOROUGH COUNTY
ENERGY RECOVERY PROJECT

FIGURE B-5
DIURNAL WIND ROSES FOR WINTER

STABILITY/WIND

FREQUENCY DISTRIBUTIONS

Table B-7

METEOROLOGY FOR TAMPA INTERNATIONAL AIRPORT
HILLSBOROUGH COUNTY RESOURCE RECOVERY PROJECT

STABILITY WIND ROSE

STABILITY CLASS A

FROM JAN. 1 1970 THROUGH DEC. 31 1974

DIRECTION	0-2	2-3	3-5	5-8	8-11	>11	TOTAL	AVERAGE WIND SPEED
	+-------WIND SPEED CLASSES (MPS)---------+							
N	0.00	0.08	0.00	0.00	0.00	0.00	0.08	0.00
NNE	0.00	0.29	0.00	0.00	0.00	0.00	0.29	0.45
NE	0.00	0.42	0.00	0.00	0.00	0.00	0.42	0.95
ENE	0.00	0.61	0.00	0.00	0.00	0.00	0.61	0.91
E	0.00	0.84	0.00	0.00	0.00	0.00	0.85	1.00
ESE	0.01	0.67	0.00	0.00	0.00	0.00	0.67	1.68
SE	0.00	0.40	0.00	0.00	0.00	0.00	0.41	2.19
SSE	0.00	0.19	0.00	0.00	0.00	0.00	0.19	2.88
S	0.00	0.23	0.00	0.00	0.00	0.00	0.24	1.17
SSW	0.00	0.05	0.00	0.00	0.00	0.00	0.05	6.31
SW	0.00	0.12	0.00	0.00	0.00	0.00	0.13	0.80
WSW	0.00	0.11	0.00	0.00	0.00	0.00	0.11	1.57
W	0.01	0.23	0.00	0.00	0.00	0.00	0.24	0.77
WNW	0.00	0.19	0.00	0.00	0.00	0.00	0.20	1.32
NW	0.00	0.47	0.00	0.00	0.00	0.00	0.47	0.50
NNW	0.00	0.49	0.00	0.00	0.00	0.00	0.49	1.12
TOTAL	0.05	5.40	0.00	0.00	0.00	0.00	5.45	1.21
AVG SPD	1.40	1.39	0.00	0.00	0.00	0.00	1.21	1.21

Table B-8

METEOROLOGY FOR TAMPA INTERNATIONAL AIRPORT
HILLSBOROUGH COUNTY RESOURCE RECOVERY PROJECT

STABILITY WIND ROSE

STABILITY CLASS B

FROM JAN. 1 1970 THROUGH DEC. 31 1974

DIRECTION	+--------WIND SPEED CLASSES (MPS)--------+						TOTAL	AVERAGE WIND SPEED
	0-2	2-3	3-5	5-8	8-11	>11		
N	0.01	0.01	0.03	0.00	0.00	0.00	0.06	2.84
NNE	0.01	0.05	0.12	0.00	0.00	0.00	0.18	3.12
NE	0.01	0.05	0.13	0.00	0.00	0.00	0.19	3.20
ENE	0.01	0.04	0.19	0.00	0.00	0.00	0.24	3.27
E	0.02	0.08	0.33	0.00	0.00	0.00	0.42	3.32
ESE	0.03	0.06	0.18	0.00	0.00	0.00	0.27	3.07
SE	0.02	0.06	0.24	0.00	0.00	0.00	0.32	3.30
SSE	0.01	0.05	0.24	0.00	0.00	0.00	0.30	3.28
S	0.01	0.04	0.28	0.00	0.00	0.00	0.33	3.44
SSW	0.01	0.04	0.28	0.00	0.00	0.00	0.33	3.56
SW	0.01	0.04	0.39	0.01	0.00	0.00	0.44	3.63
WSW	0.00	0.05	0.53	0.00	0.00	0.00	0.59	3.65
W	0.02	0.09	0.81	0.01	0.00	0.00	0.94	3.66
WNW	0.01	0.02	0.12	0.01	0.00	0.00	0.15	3.48
NW	0.01	0.02	0.04	0.00	0.00	0.00	0.06	2.99
NNW	0.01	0.03	0.07	0.00	0.00	0.00	0.11	3.02
TOTAL	0.20	0.70	3.99	0.04	0.00	0.00	4.93	3.43
AVG SPD	1.60	2.56	3.77	5.62	0.00	0.00	3.43	3.43

Table B-9

METEOROLOGY FOR TAMPA INTERNATIONAL AIRPORT
HILLSBOROUGH COUNTY RESOURCE RECOVERY PROJECT

STABILITY WIND ROSE

STABILITY CLASS C

FROM JAN. 1 1970 THROUGH DEC. 31 1974

DIRECTION	+--------WIND SPEED CLASSES (MPS)--------+						TOTAL	AVERAGE WIND SPEED
	0-2	2-3	3-5	5-8	8-11	>11		
N	0.01	0.02	0.08	0.03	0.00	0.00	0.14	3.98
NNE	0.01	0.06	0.33	0.15	0.00	0.00	0.56	4.23
NE	0.02	0.06	0.42	0.18	0.00	0.00	0.67	4.24
ENE	0.03	0.10	0.63	0.32	0.00	0.00	1.08	4.24
E	0.02	0.16	1.02	0.47	0.01	0.00	1.68	4.27
ESE	0.02	0.12	0.63	0.30	0.00	0.00	1.07	4.25
SE	0.02	0.09	0.59	0.29	0.00	0.00	0.99	4.30
SSE	0.02	0.08	0.60	0.32	0.00	0.00	1.03	4.34
S	0.06	0.08	0.48	0.33	0.01	0.00	0.96	4.34
SSW	0.04	0.05	0.52	0.37	0.01	0.00	0.99	4.52
SW	0.01	0.05	0.48	0.22	0.00	0.00	0.77	4.28
WSW	0.01	0.09	0.69	0.36	0.00	0.00	1.16	4.36
W	0.03	0.09	1.44	1.36	0.05	0.00	2.97	4.85
WNW	0.04	0.04	0.27	0.22	0.02	0.00	0.59	4.55
NW	0.02	0.04	0.20	0.14	0.01	0.00	0.41	4.40
NNW	0.01	0.03	0.19	0.15	0.01	0.00	0.39	4.73
TOTAL	0.39	1.17	8.56	5.21	0.14	0.01	15.48	4.43
AVG SPD	1.45	2.49	4.17	5.71	8.72	13.17	4.43	4.43

Table B-10

METEOROLOGY FOR TAMPA INTERNATIONAL AIRPORT
HILLSBOROUGH COUNTY RESOURCE RECOVERY PROJECT

STABILITY WIND ROSE

STABILITY CLASS D

FROM JAN. 1 1970 THROUGH DEC. 31 1974

	+--------WIND SPEED CLASSES (MPS)---------+							AVERAGE
DIRECTION	0-2	2-3	3-5	5-8	8-11	>11	TOTAL	WIND SPEED
N	0.01	0.05	0.20	0.33	0.03	0.00	0.63	5.12
NNE	0.05	0.17	0.68	1.00	0.04	0.00	1.94	4.89
NE	0.04	0.22	0.87	1.58	0.08	0.00	2.79	5.10
ENE	0.05	0.34	1.28	1.43	0.07	0.00	3.18	4.75
E	0.10	0.61	2.12	2.53	0.10	0.00	5.46	4.77
ESE	0.09	0.32	1.12	1.18	0.04	0.00	2.75	4.60
SE	0.05	0.21	0.90	1.13	0.02	0.00	2.32	4.76
SSE	0.06	0.22	0.92	1.05	0.04	0.00	2.30	4.74
S	0.07	0.24	0.96	1.28	0.12	0.01	2.67	5.01
SSW	0.04	0.14	0.61	1.03	0.10	0.00	1.92	5.24
SW	0.02	0.14	0.42	0.44	0.02	0.00	1.04	4.63
WSW	0.03	0.11	0.54	0.62	0.04	0.00	1.33	4.88
W	0.03	0.22	1.11	2.71	0.12	0.01	4.20	5.38
WNW	0.05	0.11	0.55	1.12	0.22	0.04	2.08	5.73
NW	0.04	0.12	0.64	1.22	0.24	0.03	2.30	5.68
NNW	0.03	0.10	0.58	1.13	0.22	0.01	2.07	5.67
TOTAL	0.76	3.32	13.51	19.79	1.50	0.12	39.00	5.05
AVG SPD	1.43	2.46	4.05	6.33	9.32	12.58	5.05	5.05

Table B-11

METEOROLOGY FOR TAMPA INTERNATIONAL AIRPORT
HILLSBOROUGH COUNTY RESOURCE RECOVERY PROJECT

STABILITY WIND ROSE

STABILITY CLASS E

FROM JAN. 1 1970 THROUGH DEC. 31 1974

DIRECTION	+--------WIND SPEED CLASSES (MPS)--------+						TOTAL	AVERAGE WIND SPEED
	0-2	2-3	3-5	5-8	8-11	>11		
N	0.01	0.06	0.18	0.04	0.00	0.00	0.29	3.61
NNE	0.04	0.24	0.50	0.12	0.00	0.00	0.90	3.52
NE	0.06	0.32	0.83	0.14	0.00	0.00	1.36	3.48
ENE	0.07	0.72	1.24	0.17	0.00	0.00	2.21	3.32
E	0.16	1.07	2.07	0.28	0.00	0.00	3.58	3.33
ESE	0.10	0.58	1.02	0.20	0.00	0.00	1.90	3.36
SE	0.06	0.33	0.74	0.10	0.00	0.00	1.23	3.38
SSE	0.04	0.32	0.59	0.06	0.00	0.00	1.00	3.23
S	0.04	0.32	0.49	0.06	0.00	0.00	0.90	3.20
SSW	0.03	0.13	0.28	0.02	0.00	0.00	0.46	3.28
SW	0.02	0.18	0.25	0.00	0.00	0.00	0.45	3.03
WSW	0.04	0.11	0.25	0.04	0.00	0.00	0.44	3.33
W	0.07	0.17	0.49	0.08	0.00	0.00	0.82	3.38
WNW	0.06	0.18	0.38	0.05	0.00	0.00	0.66	3.15
NW	0.07	0.28	0.62	0.04	0.00	0.00	1.01	3.18
NNW	0.03	0.20	0.48	0.06	0.00	0.00	0.77	3.37
TOTAL	0.89	5.20	10.41	1.46	0.00	0.00	17.96	3.33
AVG SPD	1.41	2.44	3.94	5.43	8.75	0.00	3.33	3.33

Table B-12

METEOROLOGY FOR TAMPA INTERNATIONAL AIRPORT
HILLSBOROUGH COUNTY RESOURCE RECOVERY PROJECT

STABILITY WIND ROSE

STABILITY CLASS F

FROM JAN. 1 1970 THROUGH DEC. 31 1974

DIRECTION	+--------WIND SPEED CLASSES (MPS)--------+						TOTAL	AVERAGE WIND SPEED
	0-2	2-3	3-5	5-8	8-11	>11		
N	0.02	0.17	0.08	0.00	0.00	0.00	0.28	2.49
NNE	0.12	0.60	0.20	0.00	0.00	0.00	0.92	2.36
NE	0.14	0.93	0.34	0.00	0.00	0.00	1.40	2.39
ENE	0.26	1.72	0.58	0.00	0.00	0.00	2.56	2.40
E	0.39	2.50	0.96	0.00	0.00	0.00	3.85	2.42
ESE	0.21	1.15	0.48	0.00	0.00	0.00	1.84	2.40
SE	0.15	0.57	0.24	0.00	0.00	0.00	0.95	2.34
SSE	0.12	0.47	0.28	0.00	0.00	0.00	0.87	2.45
S	0.12	0.45	0.19	0.00	0.00	0.00	0.75	2.38
SSW	0.03	0.14	0.06	0.00	0.00	0.00	0.23	2.45
SW	0.07	0.20	0.10	0.00	0.00	0.00	0.37	2.36
WSW	0.10	0.20	0.09	0.00	0.00	0.00	0.38	2.24
W	0.10	0.18	0.14	0.00	0.00	0.00	0.42	2.31
WNW	0.11	0.28	0.12	0.00	0.00	0.00	0.52	2.32
NW	0.16	0.57	0.25	0.00	0.00	0.00	0.98	2.34
NNW	0.12	0.56	0.19	0.00	0.00	0.00	0.87	2.33
TOTAL	2.22	10.68	4.28	0.01	0.00	0.00	17.19	2.39
AVG SPD	1.38	2.43	3.27	5.65	0.00	0.00	2.39	2.39

EXHIBIT C

REFINED MODEL ANALYSIS

EXHIBIT C

Refined Model Analysis

Model Parameters

The Industrial Source Complex Short Term (ISCST) Model was used along with the options listed in Table C-1. Based on the screening analysis (Exhibit A), the worst-case condition (i.e. causing maximum impacts) was identified as the 110% load case. Therefore, source parameters defining facility operation at that load condition (Table C-2) were input to the model in the refined analysis.

The receptor grid was based on results of the screening modeling runs and preliminary sequential (hour-by-hour) modeling runs. Receptors were located at downwind distances of 129m (nearest receptor allowed in the ISC run due to the height of the building), 200 m, 300 m, 400 m, 500 m, 600 m, and every kilometer from 1 km to 10 km located along radials placed every 10°. This arrangement isolated the maximum concentrations (within a 100 m fine grid) as well as established the significant impact areas (SIAs). Additional rings located at 700 m, 800 m, and 900 m, were modeled for 1972 to locate the limits of the 24-hour SIA for SO_2. Special receptors were located at the boundary of the Chassahowitzka National Wilderness Area (nearest Class I area) and the SO_2 nonattainment area in Pinellas County.

Meteorological Data

Surface and upper air data obtained from DER and recorded at the Tampa International airport for the years 1970 through 1974 was used as model input. DER identified a three day period (172, 173 and 174) in 1972 that could produce substantial ground level concentrations, if these concentrations are excessive an alternative could be discussed.

TABLE C-1

Refined Analysis
ISC Model Inputs and Options

Dispersion Parameter	Rural Mode
Building Downwash	Employed
Plume Rise	Transitional plume rise
Anemometer height	6.7 m
Meteorological Data Base	Hour-by-hour observations taken between 1970-1974 (5 years), Tampa surface data and Tampa upper air data*
Receptor Locations	129 m, 200 m, 300 m, 400 m, 500 m, 600 m, and every kilometer from 1 km to 10 km**
All Other Options	Default
Building Configuration	A three tiered structure will be used, the largest part of the structure, the boiler building will be used to define building characteristics in the model
Width	51.5 m
Length	22.9 m
Height	42.7 m
Maximum Projected Width	56.4 m
Equivalent length/width (m)***	49.9 m

*Obtained from DER.
**For 1972 receptors were placed at 700 m, 800 m and 900 m to define the limit of the 24-hour SO_2 SIA.
***The width/length dimension is the dimension of the width and length of a fictitious building whose area is equal to that of a circle whose diameter is the maximum projected width listed above.

TABLE C-2

STACK PARAMETERS USED IN REFINED MODEL ANALYSIS

Base Elevation	12.1 meters
Stack Height	67.0 meters
Effective Stack Diameter	3.5 meters
Exit Velocity*	16.82 m/s
Exhaust Temperature*	494°K
Building Height	42.7 meters
Building Width	51.5 meters
Building Length	22.9 meters
Maximum Projected Width	56.4 meters
Equivalent Length/Width	49.9 meters

*Based on the worst case boiler operating condition as defined in screening analysis.

Air Quality Impact

Sequential (hour-by-hour) modeling was performed to determine the highest, second-highest (HSH) short-term pollutant impact and highest annual pollutant impacts. These values are contained in Section 7.0 of the PSD application and were used throughout the air quality impact analysis. These impacts were compared with the significant impact levels adopted by FDER/EPA. Pollutant impacts that were less than significant were added to measured HSH short-term pollutant levels or highest annual monitored pollutant levels recorded from nearby monitors to determine the total future concentration to be compared with the NAAQS and FAAQS. For pollutant impacts that were significant, interactive source modeling of other existing facilities was performed to determine their contribution to ambient background levels. Based on the refined modeling analysis, the SIA for SO_2 and NO_x was established. The SIA is defined as a circular area whose radius is equal to the greatest distance to which the refined modeling shows the facility's emissions will have a significant impact.

An increment analysis for SO_2 was conducted. Since the area is classified as nonattainment for TSP, no TSP increment analysis was performed. The proposed source along with other SO_2 increment consuming sources were modeled and the results were compared to PSD Class II increments. No increment is consumed outside the SIA.

In addition to assessing the impacts of all the PSD pollutants, a special analysis was done for HCl. This analysis included projecting facility HCl emission rates and ambient impacts.

Emission Inventory

The SO_2 emission inventory used for the additional source modeling was derived from the Pinellas County Resource Recovery Facility and AMAX phosphate applications. Discrepencies between these two sources were resolved through the 1982 source inventory received from Hillsborough Co. Environmental Protection Commission (HCEPC). The inventory listed in Table C-3 includes the SO_2 sources within 30 km and several large sources within 50 km of the proposed site.

TABLE C-3

EMISSION INVENTORY

Source *	X (km)	Y (km)	SO_2 (g/s)	Stack hgt. (m)	Temp. (ok)	Exit Vel. (m/s)	Stack dia. (m)
PSD Sources							
Pinellas RRF 1-3	335.20	3084.1	31.5	49.1	505	26.8	2.37
McKay Bay RRF	360.00	3091.9	21.4	45.7	500	21.3	1.91
TECO Big Bend	361.90	3075.0	6002.2	149.4	426	15.6	7.00
NAAQS SOURCES							
FPC Bartow	342.4	3082.7	722.2	91.4	408	44.0	3.35
FPC Higgins	336.5	3098.5	286.7	53.0	422	10.4	3.81
FPC Anclote #1	324.9	3119.0	1631.9	152.1	416	50.0	3.66
FPC Anclote #2	324.9	3119.0	816.0	152.1	416	28.3	3.66
TECO Hooker Pt. #1)	358.0	3091.0	41.30	85.4	402	18.2	3.40
TECO Hooker Pt. #2)	358.0	3091.0	41.30	85.4	402	18.2	3.40
TECO Hooker Pt. #3)	358.0	3091.0	57.00	85.4	397	11.5	3.70
TECO Hooker Pt. #4)	358.0	3091.0	57.00	85.4	397	11.5	3.70
TECO Hooker Pt. #5	358.0	3091.0	84.50	85.4	402	18.2	3.40
TECO Hooker Pt. #6	358.0	3091.0	107.80	85.4	436	17.9	2.90
TECO Gannon #1	360.0	3087.5	174.2	93.3	438	22.5	3.70
TECO Gannon #2	360.0	3087.5	174.2	93.3	438	32.4	3.10
TECO Gannon #3	360.0	3087.5	198.2	93.3	427	35.4	3.20
TECO Gannon #4	360.0	3087.5	260.0	93.3	443	24.6	2.90
TECO Gannon #5	360.0	3087.5	316.6	93.3	415	20.6	4.50
TECO Gannon #6	360.0	3087.5	526.4	93.3	415	23.7	5.40
General Portland	358.0	3090.6	101.0	44.3	473	6.6	4.72
Gardiner	363.4	3082.4	413.60	29.4	333	9.1	2.10
Gardiner	363.4	3082.4	-210.26	36.5	344	11.8	2.00

*Sources within 30 km of site.

STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL REGULATION

TWIN TOWERS OFFICE BUILDING
2600 BLAIR STONE ROAD
TALLAHASSEE, FLORIDA 32301-8241

BOB GRAHAM
GOVERNOR

VICTORIA J. TSCHINKEL
SECRETARY

May 22, 1984

Mr. Donald M. Pompelia
Camp, Dresser and McKee, Inc.
One Center Plaza
Boston, Massachusettes 02108

Re: Hillsborough County Resource Recovery Facility

Dear Mr. Pompelia:

Enclosed is the permit application, DER Form 17-1.202(1), you requested.

I have reviewed your modeling protocol for the refined analysis and it appears to satisfy our modeling requirements. In addition to the specific modeling requirements be sure to address all of the preconstruction review requirements contained in rules 17-2.500(5) and 17-2.510(4), Florida Administrative Code.

Please call me at (904)488-1344 or write if you have any questions.

Sincerely,

Thomas Rogers
Meteorologist

TR/s
enclosure

cc: Larry George

EXHIBIT D

AMBIENT MONITORING DATA

Exhibit D

Ambient Monitoring Data

For pollutants subject to New Source Review, ambient air quality monitoring may be required to define background concentrations. These ambient levels are then used as a basis for establishing whether the proposed emissions contribute to the violation of ambient air quality standards. Sources may be exempt from air quality monitoring if the impact of a given pollutant falls below the de minimis concentration (17.2500(3)(e)). A refined analysis was done using the Industrial Source Complex (ISC) dispersion model and sequential (hour-by-hour) meteorological data over a 5-year period to identify the pollutants which exceeded these guidelines. From this analysis the highest, second-highest concentrations were compared to the appropriate de minimis concentration levels (Table D-1). Pollutants whose concentrations exceeded the guideline are SO_2, lead, and fluorides

Among other activities, the HCEPC is responsible for monitoring air quality data within the County. HCEPC runs 65 monitoring stations and receives information from other private monitors totaling an air quality network of 83 stations, many of which monitor for more than one pollutant. Ambient monitors for all the criteria pollutants are within 12 km of the site (Table D-2). The measurement method for each pollutant is listed in Table D-3.

Three SO_2 monitors are located within 10 km of the site. Two of these sites, Brandon and Highway 41, are bubbles which sample for 24 hours every sixth day. The monitor at the HCEPC office is a continuous monitor. Concentrations recorded here are much higher and considered more reliable than the bubbler data.

Lead is monitored at 6 sites within Hillsborough County. Of these sites Orient Rd. is the closest to the proposed site. Concentrations reported at this station are the second-highest recorded in the County for 1983.

TABLE D-1

De MINIMIS MONITORING GUIDELINE

Pollutant	Averaging Time	Highest 2nd-Highest Concentration (ug/m^3)	De Minimis Monitoring Guideline (ug/m^3)
Total Suspended Particulates	24-hour	3.26	10
Sulfur Dioxide	24-hour	16.9**	13
Carbon Monoxide	8-hour	16.3	575
Nitrogen Oxides	Annual*	1.04	14
Lead	24-hour	0.32**	0.1
Mercury	24-hour	0.035	0.25
Berryllium	24-hour	8.8×10^{-5}	5.0×10^{-4}
Fluorides	24-hour	0.405**	0.25
Vinyl Chloride	24-hour	Negligible	15
Total Reduced Sulfur	1-hour	"	10
Reduced Sulfur Compounds	1-hour	"	10
Hydrogen Sulfide	1-hour	"	0.04

*The annual concentration is based on the highest annually ave. conc.
**Concentration exceeds the de minimis monitoring guideline.

TABLE D-2

AMBIENT AIR MONITORING DATA FOR HILLSBOROUGH COUNTY

SITE State	ID CO.	SITE NAME	TOTAL SUSPENDED PARTICULATES (ug/m^3) Annual (GM) 1982	Annual (GM) 1983	24-Hour 1982 High	24-Hour 1982 2nd High	24-Hour 1983 High	24-Hour 1983 2nd High
1800 082	82	Orient Road	53	54	149	126	132	115
			54	53	166	117	138	115
4360 024	86	311 S. 22nd St.	53	55	133	91	92	83
0370 001	7	Brandon (Rainbow Tr.)	31	--	98	65	--	--
0370 002	7	Brandon	--	33	--	--	86	86
1800 083	93	Highway 41	38	43	96	85	174	113
4360 051	115	Hooker's Point (Lehman)	56	--	169	135	--	--
4360 062	115	Hooker's Point (Maritime)	--	58	--	--	141	90
4360 002	1	Health Dept.	53	56	116	104	90	85
			52	54	110	96	91	78
4360 035	63	Davis Island						
4360 060	122	Seminole H&E School	45	52	74	63	81	78
4440 001	5	Temple Terrace	35	48	361	151	232	196

TABLE D-2 (Cont.)

AMBIENT AIR MONITORING DATA FOR HILLSBOROUGH COUNTY

SITE State	ID CO.	SITE NAME	OZONE (ppm) 1-Hour 1982 High	1982 2nd High	1983 High	1983 2nd High	Exceedences High	Exceedences 2nd High
4360 035	63	Davis Island	.102	.095	.145	.143	0	3
4360 055	119	Beach Park	.115	.110	.128	.118	0	1

SITE State	ID CO.	SITE NAME	CARBON MONOXIDE (mg/m^3) 1-Hour 1982 High	1-Hour 1982 2nd High	1-Hour 1983 High	1-Hour 1983 2nd High	8-Hour 1982 High	8-Hour 1982 2nd High	8-Hour 1983 High	8-Hour 1983 2nd High
4360 052	120	NCEPC	11	10	12	11	6	6	7	5
4360 035	63	Davis Island	7	4	7	7	3	3	3	3
4360 056	121	Hillsborough Building	14	11	12	11	7	6	7	7
4360 060	122	Seminole High School	11	11	13	10	9	8	8	6

SITE State	ID CO.	SITE NAME	LEAD (ug/m^3) Calendar Quarter 1982	1983
1800 082	82	Orient Road	0.3	0.8
4360 051	115	Hooker's Point (Lehman)	0.2	-
4360 062	115	Hooker's Point (Maritime)	-	0.6
4360 002	1	Health Department	0.4	0.4
4360 035	63	Davis Island	0.2	0.3
4360 060	122	Seminole Heights School	1.1	1.1

TABLE D-2 (Cont.)

AMBIENT AIR MONITORING DATA FOR HILLSBOROUGH COUNTY

SITE State	ID CO.	SITE NAME	SULFUR DIOXIDE (ug/m^3) Annual 1982	Annual 1983	24-Hour 1982 1	24-Hour 1982 2	24-Hour 1983 1	24-Hour 1983 2	3-Hour 1982 1	3-Hour 1982 2	3-Hour 1983 1	3-Hour 1983 2
0870 00I	7	Brandon	6	3	37	24	10	8	--	--	--	--
1800 083	93	Highway 41	8	8	52	31	76	31			--	--
			9	8	55	39	76	31			--	--
4360 052	120	HCEPC (5135)	21		116	105			545	461		
		(170)	25	16	60	38	108	86	147	144.	527	493
4360 051	115	Hooker's Point (Lehman)	24	--	117	97	--	--	452	327	--	--
4360 021	81	906 Jackson Street	24	--	113	113	--	--	517	453	--	--
4360 035	63	Davis Island	25	21	103	88	85	77	376	334.	327	291

SITE State	ID CO.	SITE NAME	NITROGEN OXIDES Annual 1982	Annual 1983
0370 001	7	Brandon	22	23
4360 052	120	HCEPC	40	35
4360 051	115	Hooker's Point (Lechman)	30	--
4360 055	119	Beach Park	25	29

TABLE D-3

AIR POLLUTION MEASUREMENT METHODS

Parameter	Method or Reference
Carbon Monoxide	Title 40 Code of Federal Regulations (40 CFR), Part 50, Appendix C Beckman Model 866; EPA No. RFCA-0876-12
Dust (Microscopy)	EPC - Nikon Polarization Microscope
Dustfall	Journal of Air Pollution Control Association July 66, Vol. 16, No. 7
Nitrogen Dioxide:	
Bubbler	EPA No. EQN-1277-026 page 62971 Federal Registry Vol. 42
Continuous	40 CFR, Part 50, Appendix F 1. Monitor Labs Model 8440; EPA No. RFNA-0677-021 2. Bendix Model 8101-B Analyzer
Ozone	40 CFR, Part 50 Appendix D 1. Bendix Model 30002; EPA No. RFOA-0176-007 2. Dasibi Model 1003 AH; EPA No. EQOA-0577-019
Sulfur Dioxide:	
Bubbler	40 CFR, Part 50, Appendix A
Continuous	1. Thermo Electron Model 43; EPA No. QSA-0276-009 2. Philips Model PW9755; EPA No. EQSA-0676-010
Suspended Particulate:	
Total	40 CFR, Part 50, Appendix B
Sulfates	EPC - Turbidimetric Method
Lead	40 CFR, Part 50, Appendix G

SOURCE: Environmental Quality; Hillsborough County Environmental Protection Commission; 1981.

No ambient air data for fluorides are monitored by the HCEPC. There are no sources of fluorides in the vicinity of the site so background concentrations are considered small. The HCEPC does have a program which measures fluoride concentrations in grass. The sampling areas are primarily located in eastern Hillsborough County 30 to 50 km from the proposed site. Fluoride concentrations in grass near the proposed site is expected to be near background levels and below concentrations considered unsafe.

The data from these monitors are believed to be sufficient to establish the baseline concentrations in the vicinity of the proposed site and to evaluate whether the proposed emissions violate any ambient air quality standards.

Hillsborough County Energy Recovery Facility

APPENDIX 10.16

STACK HEIGHT ANALYSIS AND RECOMMENDATIONS

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LIST OF FIGURES

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1.0 SUMMARY

Based on the analysis presented in this appendix, supplemented by the air quality analysis contained in the PSD application (Appendix 10.1.5 of the Application for Power Plant Site Certification), it has been determined that a 220 foot stack is feasible for the proposed energy recovery facility. The analysis contained here and in the PSD application examines the aerodynamic downwash issues and the groundlevel concentrations of pollutants associated with the proposed facility. The analyses show that neither downwash nor pollutant concentrations will be a problem at the facility with a 220 foot stack.

Overview

The development of a resource recovery facility in Hillsborough County includes the design of a stack for discharging exhaust gases to the atmosphere. A principal feature of stack design is the selection of an acceptable stack height to avoid unacceptable impacts on ambient air quality. As a rule-of-thumb, if the stack height is equal to or greater than 2.5 times the principal onsite structures, aerodynamic downwash effects are not encountered and unacceptable impacts on air quality due to these effects are avoided. However, the stack height can be less than the rule-of-thumb height if an evaluation shows the lower stack height will avoid unacceptable impacts.

The regional topography in the vicinity of the site for the proposed facility is relatively flat. Tall structures can have a significant visual effect. The stack for the facility has been designed with the intent of minimizing air quality impacts while avoiding excessive visual impacts. As a result, a less than the rule-of-thumb height has been selected.

The USEPA has a standard set of atmospheric dispersion models that are recommended for use in demonstrating compliance with established air quality standards and guidelines. The EPA recommended model for stack heights less than the above 2.5 times ratio is the Industrial Source Complex (ISC) model (EPA, 1978 & 1983). ISC is used in this analysis to assess and compare the impacts from a stack which does not conform to good engineering practice (GEP) guidelines of 2.5 times the principal onsite structures with that of a GEP stack. Other factors, including economic and aesthetic considerations, should be judged against actual pollutant increases/decreases. The sensitivity of ground level concentration impacts to stack height, especially under the influence of turbulence caused by nearby structures, suggests that a more refined analysis beyond the ISC model be applied to verify the ISC model results.

Basis of Analysis

Along with the recommended ISC modeling analyses, additional analyses were conducted in order to provide a reasonable degree of confidence in the suitability of the selected stack height. This report summarizes the analyses that have been performed to evaluate the impact of facility emissions on ambient air quality levels for the chosen stack height of 67 meters (220 feet) above grade level (agl). The report contains two methods which have been applied in evaluating impacts, one, the standard Industrial Source Complex (ISC) computer model, the other, a method developed by Halitsky (1976).

The ISC model is regarded as state-of-the-art in estimating ground-level concentrations via Gaussian dispersion assumptions. Subroutines within the model envoke various algorithms depending upon the stack height to building height ratio to address the increased turbulence which is likely to occur from a non-GEP stack. These algorithms modify the standard dispersion coefficients, sigma y (S_y) and sigma z (S_z), as a function of downwind distance. These dispersion coefficients, in turn, dictate the rate of expansion and dilution of the plume, thereby affecting ground level concentrations.

The Halitsky approach is similar in that the standard Gaussian dispersion coefficients are also modified as a function of downwind distance. However, the modification is based on algorithms developed from site specific structure dimensions (Halitsky, 1976). ISC also analyzes the structure dimensions but envokes one of three generic algorithms based on the structure classification (either squat or tall) or the stack placement in relation to the facility (USEPA, 1979).

ISC is often regarded as the regulatory model of choice in downwash applications. However, verification of the model results to this point is incomplete. The comparison to the Halitsky model is being made to assure that the ISC at least provides a conservative estimate.

The advantages and shortcomings of each model, as well as a description of the algorithms used is presented herein. The actual algorithms utilized as well as the respective input parameters, are presented in Attachment A.

The models have not been compared for all possible conditions likely to occur at the proposed site. Instead, several meteorological conditions that will likely cause the greatest facility related impacts on short-term concentration patterns were used as the basis for comparing model results.

Findings

Using EPA recommended screening techniques, it was shown that the plume will clear the cavity region, thereby limiting the increase in ground level impacts to wake-related turbulence. A downwash analysis on the wake region using the USEPA recommended ISC computer model has been performed to evaluate the potential ground level impacts of the resource recovery facility proposed for Hillsborough County. Due to the sensitivity of ground level impacts to stack height, especially under the influence of structure-related turbulence, a more refined analysis was included to insure the conservativeness and accuracy of the ISC analysis. The refined analysis included algorithms suggested by Halitsky (1976) for comparitive purposes.

The downwash analysis was completed using a number of options available in the algorithms. The results were then compared to assess the overall effect these options have on ground level impacts. A set of four meteorological conditions representing worst-case short-term events were selected for ambient data input. If a large degree of variability between the models resulted, a more refined analysis would be necessary. A comparison was also made between the impacts from a GEP and a non-GEP stack with the ISC computer model. These results as well as the results of the other comparisons are made below.

Based on the overall results, the ISC model utilized in both the refined stack analysis, as well as the full grid analysis of the facility found in the main text, was found to be the most conservative method for this level of detail. The Halitsky analysis, which used more realistic algorithms based on structure dimensions, resulted in lower ground level impacts in the four cases studied.

The purpose of the stack height analysis is to provide the technical foundation for determining the implications of a stack height at less than GEP. The analysis compared two methods of assessing downwash -- ISC and Halitsky. It also compared the predicted relative ground level concentrations of a 220 foot stack to those of a 375 foot stack which would have been the design height of a "rule-of-thumb" GEP stack.

This stack height analysis was performed without consideration of actual pollutant emission rates and groundlevel concentrations. It showed on a comparative basis that the use of the standard ISC model would be a conservative method of assessing downwash. The use of the ISC model in the detailed air quality analyses which was performed using estimates of actual pollutant emission rates and predicted groundlevel concentrations has shown that there is no problem with downwash.

In order to determine the actual impacts of a 220 foot stack, detailed modeling and a comprehensive air quality analysis that includes other major sources must be performed. The detailed air quality assessment is presented in Appendix 10.1.5 "Prevention of Significant Deterioration" of the Application for Power Plant Site Certification.

2.0 TECHNICAL EVALUATION

2.1 Location of Influential Structures

The proposed Hillsborough County resource recovery facility is located on a 50.4 acre parcel of land bordered on the east by Faulkenburg Road, to the south by the Seaboard System Railroad, and to the west by Tampa Electric Company Power Lines. The site is zoned C-U, Community Unit District,and is classified on the Horizon 2000 Land Use Plan Map as Public/Semi-Public.

Onsite, the tallest structure will be the proposed facility's stack at 67 meters agl, while the tallest structures associated with the proposed facility are 42.7 meters agl. A wastewater treatment plant is to be co-located on the site but it will have structures no greater than 2 stories in height. For aesthetic purposes, the proposed site is planned to be landscaped on all sides with trees.

Office buildings, light industries and light industrial/business parks are located offsite and to the east of Faulkenburg Road and the south of the Seaboard System Railroad. Scattered residential units are presently situated to the immediate east of Faulkenburg Road, north of the railroad. The tallest offsite structures of significant size are associated with the Tampa Central Park Office Building Complex located approximately 1,100 meters to the south-southwest. The tallest structure in this complex is about 12 stories high. The proposed site location is well outside the zone where structural turbulence from this complex is significant. Therefore, the onsite structures were the only structures of interest in this analysis.

2.2 Impact Analysis

The environmental impact from the facility air emissions on the ambient air quality of the surrounding community will depend primarily on the diffusion characteristics of the facility surroundings and the facility design. These features primarily include stack height, exit diameter, temperature and velocity and the interaction of the plume with turbulence generated by onsite structures and the surrounding surface cover. Aside from the buoyant and momentum properties of the exhaust plume, the stack height plays the primary role in determining the level and location of plume impact. Generally, the higher the stack, the further away from the facility the maximum ground level impacts are located. This is due to the fact that most of the pollutants are being released higher into the atmosphere. The resulting diffusion pattern places impacts further away from a facility as well as decreases concentrations prior to impact.

The accepted conservative rule-of-thumb on stack design is to construct the stack so that:

$$H_g = H + 1.5(L)$$

Where

H_g = Good engineering practice (GEP) stack height.

H = Height of the principal structure or nearby principal structure.

L = Lesser dimension (height or width) of the structure or nearby structure.

The GEP rules adopted by the EPA (1981) have been successfully challenged by the Sierra Club and others in court and at present some of the issues involved in the stack height regulations have been remanded to EPA for further study or definition. The final ruling may be retroactive to all stacks constructed since 1970. However, it has been recommended to use current GEP guidelines until the issue is resolved (USEPA, 1984).

The FDER has also adopted guidelines for modeling stack heights. According to FDER, any stack height above 2 times the principal structure height is basically considered out of the zone of structure related downwash and can be modeled by a standard technique (FDER, 1983).

The Hillsborough County resource recovery facility is proposed with a stack height of 67 meters (220 feet). The tallest facility building proposed onsite is the boiler room which has a roofline elevation of 42.7 meters agl. Applying the current EPA GEP guideline of 2.5 times the height of the tallest structure would mean a GEP stack height of 107 meters. The current design is 1.6 times the boiler house height, or 39.6 meters below the EPA GEP guidelines, and 18.3 meters below the FDER GEP guidelines.

Two regions of potential ground level pollutant impact should be analyzed when a stack does not conform with GEP. The first area is the cavity region, up to 3(L) downwind, where (L) is the lesser of the building height or projected width, and the second is the wake region; 3(L) to 10(L) downwind. These regions as well as other building induced flow characteristics are shown in Figure 2-1. If significant building induced turbulence affects plume dispersion, an even more refined analysis will be necessary.

Cavity and wake-related impacts can be assessed either theoretically by applying equations based on the laws of physics and thermodynamics to the stack or by physical/fluid modeling. The latter approach involves the construction of a scale model of the facility. For this analysis, the theoretical approach will be taken and if substantial impacts are indicated the more refined physical/fluid modeling approach may be warranted.

2.1.1 Cavity Analysis

The building induced turbulence can be expected to occur within the recirculating cavity region. If the plume becomes entrained within this region, ground level impacts would increase. Excessive ground level concentrations typically will not result when:

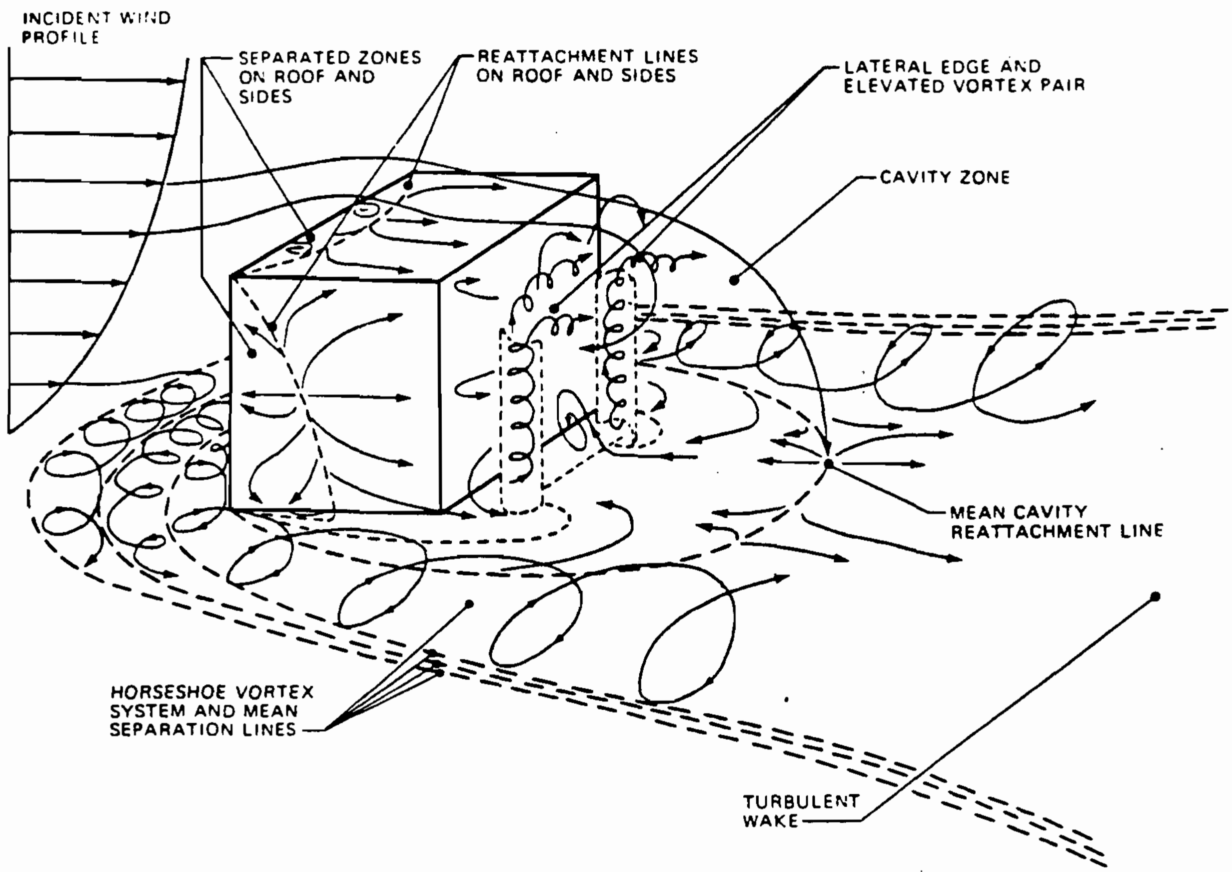

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FIGURE 2-1
ILLUSTRATION OF THE WIND FIELD SURROUNDING A RECTANGULAR BLOCK STRUCTURE

- o The emission point is well above the disturbed flow.

- o The plume rise is sufficiently great to keep a significant part of the effluent outside the area of disturbed flow.

- o The wind direction places the stack outside the area of disturbed flow.

To determine if the emission point is well above the disturbed flow, the vertical extent of the cavity region must be calculated. Current guidance suggests the vertical extent of the cavity is approximated by:

(1) $$h_c = H + 0.5(L)$$ (EPA 1983)

where;

h_c = Vertical extent of cavity region.

H = Height of the principal structure or nearby principal structure.

L = Lesser dimension (height or width) of the principal structure or nearby structure.

Substituting in the appropriate values for the proposed facility.

h_c = 64.0(m)

Since the proposed stack height is greater than the cavity height, it may be assumed using EPA guidelines (EPA, 1977), that the maximum impacts will occur beyond the cavity region.

The downwind extent of the cavity can be determined by current guidelines (EPA, 1983). For short buildings ($Y/H<2$), the cavity length (X_r) extends to;

(2) $$X_r = Y + \frac{(A)(W)}{1.0 + B(W/H)}$$ (EPA, 1983)

where;

H = Building height (meters)

Y = Along wind building dimensions
(49.9 meters)

W = Crosswind building dimensions
(49.9 meters)

$$A = -2.0 + 3.7\ (Y/H)^{-1/3}$$

$$B = -0.15 + 0.305\ (Y/H)^{-1/3}$$

Substituting in the appropriate values for the Hillsborough facility;

$$X_r = 114.8 \text{ (meters)}$$

The cavity is therefore predicted to extend 114.8 meters from the downwind edge of the facility.

Although the stack release point is above the maximum turbulent zone a more refined analysis is needed to determine the effects that atmospheric conditions will have on plume rise. To determine such effects the critical wind speed (u_c) must first be determined. The critical wind speed is the speed, based on stack exit parameters, that downwash will occur (EPA, 1977). Neutral atmospheric conditions will be assumed in this assessment.

The critical wind speed can be approximated by:

(3) $$u_c = \frac{(udh)}{hs} \quad \text{(EPA, 1977)}$$

where: hs = stack height

$udh = 21.4F^{3/4}$ when $F < 55\ m^4/sec^3$

$= 38.7F^{3/5}$ when $F \geq 55\ m^4/sec^3$

(4) and: $$F = \frac{g}{4} V_s d^2 \frac{T_s - T_a}{T_s}$$

where:
g = Acceleration of gravity (9.8 m/sec^2)
T_a = Ambient temperature (assume 298°K)
V_s = Stack gas exit velocity (16.82 m/sec)
d = Inner stack diameter (3.5 m)
T_s = Stack gas temperature (494°K)

Substituting in the appropriate values:

$$F = 200.2\ m^4/sec^3$$

thereby: $udh = 38.7F^{3/5}$

$= 930.2$

and: $u_c = 13.9$ m/sec

The characteristics of the plume leaving the proposed Hillsborough County resource recovery facility (high exit velocity leaving the stack) indicate that momentum forces will dominate plume rise during the initial phases of plume history. In relation to the momentum forces, buoyancy doesn't start to affect plume history until the plume is beyond the cavity region. This is taken into consideration later on in this analysis with the incorporation of both buoyancy and momentum forces into the plume rise algorithm for both the ISC and Halitsky analyses.

The momentum plume rise (hm) is calculated from:

(5) $$h_m = \left(\frac{3Fm\ (x)}{b^2\ u_c^{\ 2}}\right)^{1/3}$$ (AMS, 1975)

Where: $b = (1/3 + u_c/Vs)$ (equal to 1.16)

u_c = Critical wind speed (13.9 m/sec)

x = Downwind distance (assume X=2 building heights downwind; 85 meters) (EPA, 1979)

$F_m = \frac{Ta}{Ts} Vs^2 \frac{d}{4}^2$ (see equation (4) for definition of remaining terms; (EPA, 1979)

Fm = 522.7

Substituting in the appropriate values:

hm = 8.00 (m)

Adding the plume rise (due to momentum) to the physical stack height, the plume centerline height at two building heights downwind for the critical wind speed is equal to:

hp = hs + hm

hp = 75.0 (m)

Under worst-case conditions (neutral atmospheric conditions and wind speed at the critical level (13.9 m/sec)) it is demonstrated that the plume centerline will be above the structure wake cavity with a stack height of 67 meters.

2.2.2 Wake Analysis

Although the plume centerline has been predicted to rise above the cavity region, high concentrations can still result if a portion of the plume becomes trapped within the cavity. The plume centerline height has been previously determined to equal 75 meters at two building heights downwind with winds at the critical speed. Assuming a neutral stability, the vertical sigma of the plume would be approximately 4 meters (USDOH, 1970). The visible edge of the plume has often been assumed to coincide roughly with the point at which the concentration falls to 10 percent of its axial value. The distance of this edge from the plume centerline is estimated to equal 2.14 times the vertical sigma value (Slade, 1968) or 8.6 meters in the Hillsborough case. Subtracting this value from the plume centerline height of 75 meters (at two building heights downwind), the resultant value equals 66.4 meters. At this height 90 percent of the plume would be above the cavity region with a safety factor of 2.4 meters. Therefore, high concentrations from partial plume entrainment are not expected to occur.

Although the trajectory of the plume centerline has been predicted via theoretical equations to clear the region of maximum building-related turbulence, the cavity, the analysis must be refined further to indicate whether any portion of the plume below the centerline is entrained into the turbulent wake. The ISC computer model (EPA, 1979) and a method put forth by Halitsky (1976) were chosen for the refined analysis. A detailed analysis of the cavity region by theoretical application has not been developed to the same extent as that of the wake region. The outcome of the wake analysis should indicate if an in-depth analysis, possibly involving physical/fluid modeling, is needed for the wake region.

The two models of choice are discussed in generic terms below. Algorithms utilized, as well as their input values, are presented in greater detail in attachment A.

2.2.2.1 ISC Model Description

The Industrial Source Complex (ISC) dispersion model combines and enhances various dispersion model algorithms into a set of two computer programs that can be used to assess the air quality impact of emissions from the wide variety of sources. The ISC short-term model (ISCST), an extended version of the Single Source (CRSTER) model, is designed to calculate concentration or deposition values for time periods of 1,2,3,4,6,8,12 and 24 hours. If used with a year of sequential hourly meteorological data, ISCST can also calculate annual concentration values.

The ISC model programs can be applied to point area and volume sources. The steady-state Gaussian plume equation for a continuous source is used to calculate ground level concentrations. The generalized Briggs plume-rise equations, including the momentum terms, are used to calculate plume rise as a function of downwind distance (EPA, 1979). Procedures suggested by Huber and Snyder are used to evaluate the effects of the aerodynamic wakes and eddies formed by buildings and other structures on plume dispersion (EPA, 1979). A wind-profile exponent law is used to adjust the observed mean wind speed from the measurement height to the emission height for the plume rise and concentration calculations. Procedures utilized by the Single Source (CRSTER) Model are used to account for variations in terrain height over the receptor grid. The Pasquill-Gifford curves are used to calculate lateral (S_y) and vertical (S_z) plume spread. The ISC model has rural and urban options. In the rural mode utilized in this analysis, rural mixing heights and the S_y and S_z values for the indicated stability category are used in the calculations.

When a downwash application is indicated, the ISCST model is utilized. According to USEPA guidelines (EPA, 1979), when used in the downwash mode, ISC is to be run with gradual plume rise (GPR) activated (plume rise at each downwind distance is computed), and no stack tip downwash (STD) (stack related turbulence is ignored).

In this analysis, ISC was run in four configurations or modes. The first mode was that recommended in EPA guidelines (with GPR and no STD). The second mode was run with STD incorporated and no GPR and the third mode assumed no building wake turbulence but included gradual plume rise and no stack tip downwash. The first two modes were included to determine the significance that the options chosen would have in the downwash calculations, while the third was included as a control case. The later case would indicate the differences in concentrations that would result by not utilizing the wake analysis equations, thereby testing the actual significance of these algorithms. The fourth mode was run to indicate ground level impacts from a GEP stack at 375 feet agl. This run included the use of the gradual plume rise option and no stack tip downwash.

In evaluating wake effects, the first step in the procedure used by ISC is to calculate the plume rise due to momentum at a distance of two building heights downwind from the stack. If the plume height, given by the sum of the stack height and the momentum rise at a distance of two building heights, is greater than either 2.5 building height (2.5 h_b) or the sum of the building height and 1.5 times the projected building width (h_b & 1.5 h_w), the plume is assumed to be unaffected by the wake. (ISC assumes a projected width (h_w) by assigning a circle of area equal to the horizontal width of the building, with the diameter of the circle being the projected width). Otherwise, the plume is assumed to be affected by the wake and the program modifies the dispersion coefficients (S_z and/or S_y) according to the plume height to building height ratio and placement of the stack in relation to the main structure (the user must determine this location and choose one of 2 algorithms by envoking the proper option) (EPA, 1979). The algorithms utilized in the ISC analysis are presented in Attachment A. Input parameters, receptors utilized and general model information are presented in Table 2-1.

INPUT PARAMETERS, RECEPTOR CONFIGURATION AND
COMPUTATION MODE OF THE ISC COMPUTER
PROGRAM USED IN THE DOWNWASH ANALYSIS

COMPUTATIONAL MODE:

MODEL VERSION	- VERSION 82340 FROM UNAMAP 5, DECEMBER 1982
MODE	- RURAL
OPTIONS AVAILABLE	- GPR (GRADUAL PLUME RISE)
	- STD (STACK TIP DOWNWASH)

RECEPTOR CONFIGURATION:

- ASSUME ZERO TERRAIN
- 8 RECEPTORS @ 250,500,750,1000, 1500,3000,5000, and 10,000 METERS DOWNWIND

INPUT PARAMETERS:

STACK HEIGHT	- 67 METERS (ABOVE GRADE LEVEL)
EFFECTIVE STACK DIAMETER	- 3.5 METERS
EXIT GAS TEMPERATURE	- 494 DEGREES KELVIN
EXIT GAS VELOCITY	- 16.82 METERS/SECOND
FACILITY ELEVATION	- ASSUMED @ ZERO METERS
INPUT METEOROLOGY	- AMBIENT TEMPERATURE; 298 DEGREES KELVIN
	- MIXING HEIGHT; 5000 METERS
	- STABILITY/WIND; A/3.0 METERS/SECOND D/5.0 METERS/SECOND D/10.0 METERS/SECOND D/15.0 METERS/SECOND
	- WIND PROFILE EXPONENTS; A STABILITY = 0.10 D STABILITY = 0.25

ANEMOMETER HEIGHT - ASSUMED @ 10 METERS (ABOVE GRADE LEVEL)

TABLE 2-1

INPUT PARAMETERS, RECEPTOR CONFIGURATION AND COMPUTATIONAL MODE OF THE ISC MODEL USED IN THE DOWNWASH STUDY

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One of the primary drawbacks of the ISC model is the limitation of how close to the structure concentration estimates will be predicted. ISC will supply concentration estimates to within 3 building heights or 100 meters downwind of the structure, whichever is greater. The dispersion values supplied by the Pasquill-Gifford curves begin at 100 meters; this is the primary reason why the ISC model cannot predict impacts within the cavity region. (The cavity, as predicted by equation (2), extends to 114.8 meters downwind.)

2.2.2.2 The Halitsky Model for Determining Structure Related Turbulence

The Halitsky approach (Halitsky, 1976) is based on the results of a wind tunnel study, as well as field study of a nuclear power reactor complex in the mid-western United States. The Halitsky model was chosen because it is based on a comprehensive study using both wind tunnel and field data.

The meteorological parameters observed during the field study by Halitsky included the mean wind speed and direction, the standard deviation (both horizontal and vertical) of the wind direction, and the temperature difference at various elevations. These observations were recorded both upwind and downwind of the facility during various times of the testing period. The wind tunnel simulation was comprised of a 1 to 96 scale model of the facility and was limited to neutral stabilities.

The relationship of the building configuration to observed mean velocities, turbulence and wake boundaries were developed from the nuclear facility. These equations were then used to plot the horizontal and vertical turbulence excess due to the building, which occurred in addition to the ambient turbulence. These equations were modified for the Hillsborough County resource recovery facility, and by using the applicable Halitsky assumptions, were used to generate the predicted turbulent excess for the proposed facility.

This approach is somewhat similar to the one taken by ISC. However, the modification of the dispersion coefficients S_y and S_z is more building specific in the Halitsky approach. ISC assigns algorithms for the modification of S_y and S_z from a broader classification scheme.

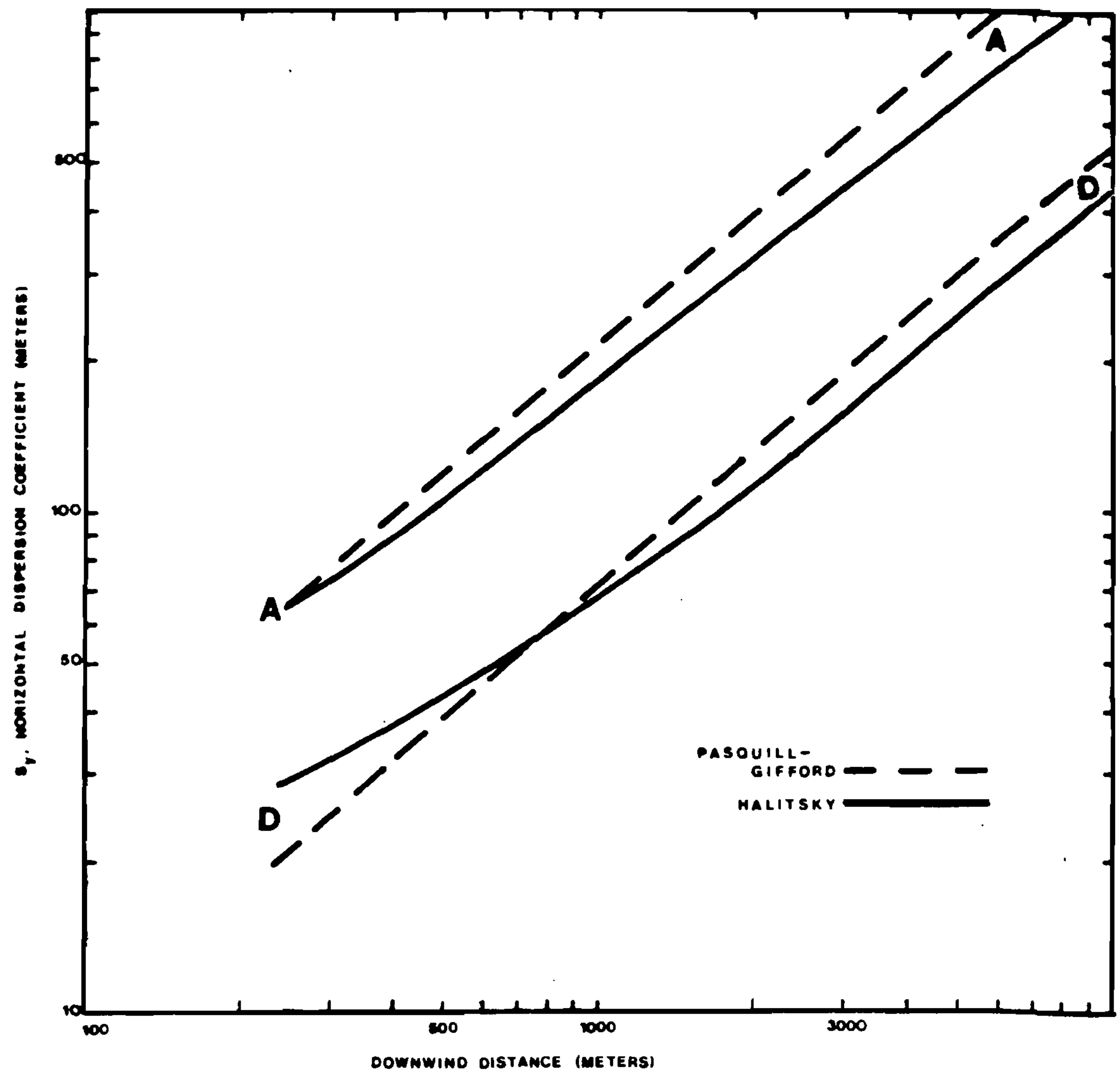
The proposed structure was modeled as an equivalent flat plate, perpendicular to the wind. The excess width from the shorter onsite structures was added to the width of the tallest structure, thereby creating a rectangular plate 42.7 meters high by 72.7 meters wide.

One of the assumptions used from the Halitsky study was that the plume distribution in the lateral direction (Sy) approached a parabolic rather than a Gaussian distribution. This assumption was based on field data collected by Halitsky. Since no field data existed for the vertical distribution (Sz), a Gaussian spread was assumed. ISC assumes a Gaussian distribution for both cases.

The standard Pasquill-Gifford diffusion curves were modified to account for building-related turbulence using Halitsky equations, adjusted for the proposed facility. These adjustments are shown in Figures 2-2 and 2-3 for the S_y and S_z curves, respectively. As can be seen from both figures, the curves are amplified in-close. This relative increase in diffusion is due to the influence of the building and decreases with downwind distance. The curves predicted for the Hillsborough County resource recovery facility cross the standard Pasquill-Gifford curves further downwind for the S_y values. This crossover is due to the assumption of parabolic rather than Gaussian diffusion rates in the lateral direction.

Using these new curves, the standard Gaussian model was utilized to predict downwind concentrations with the modified S_y and S_z values.

The predictions for the Halitsky method were computed with and without the stack downwash algorithm utilized in the ISC analysis. Concentrations were predicted at the downwind distances for the same meteorological conditions that were modeled in ISC (Table 2-1).



LETTERS REPRESENT STABILITY CLASS

LETTER	STABILITY CLASS
A	VERY UNSTABLE
D	NEUTRAL

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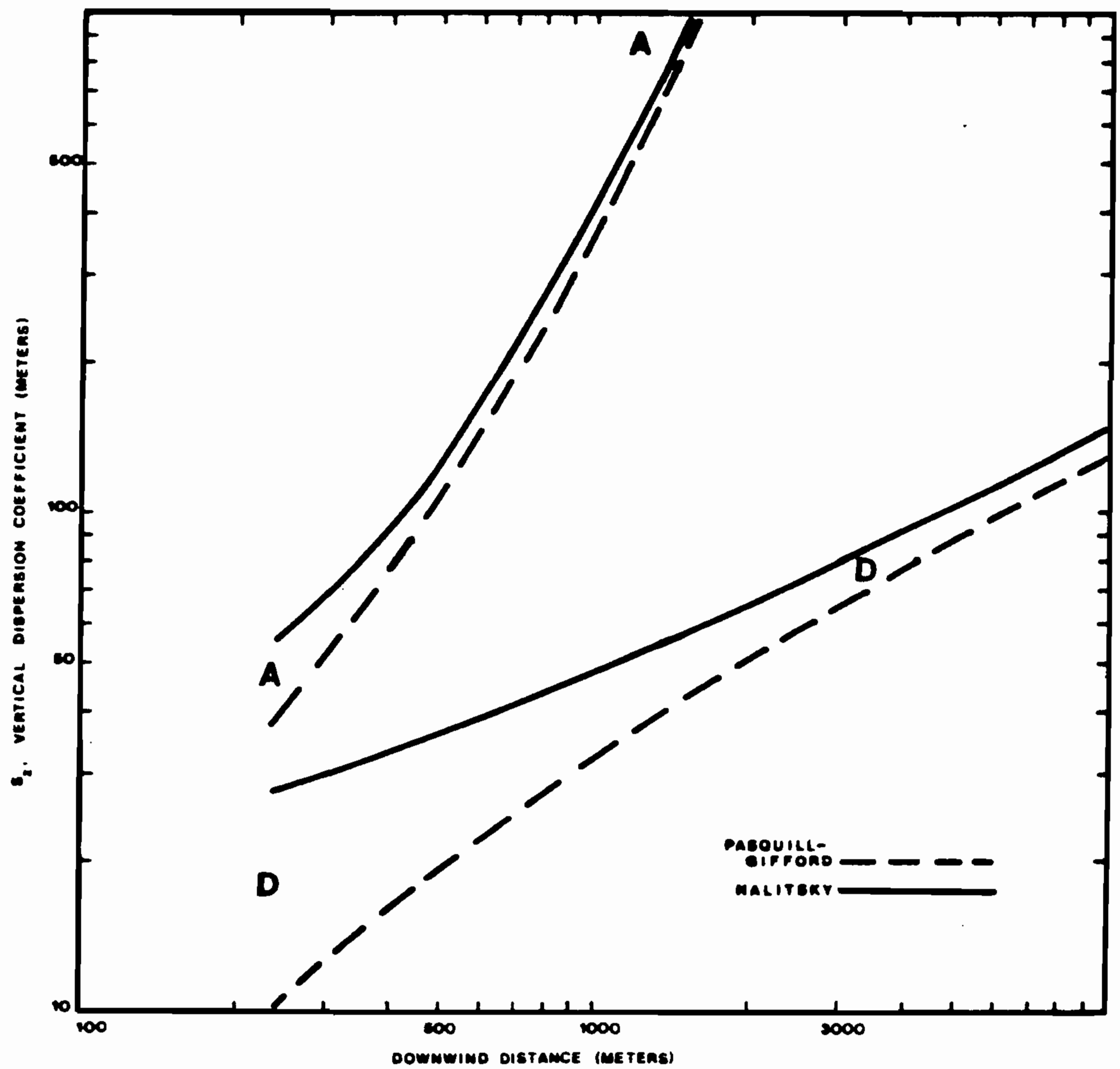
FIGURE 2-2
STANDARD PASQUILL - GIFFORD HORIZONTAL DISPERSION CURVES MODIFIED DUE TO THE PROPOSED HILLSBOROUGH FACILITY (MODIFICATIONS FOR A & D STABILITES ONLY)



LETTERS REPRESENT STABILITY CLASS

LETTER	STABILITY CLASS
A	VERY UNSTABLE
D	NEUTRAL

FIGURE 2-3

STANDARD PASQUILL - GIFFORD VERTICAL DISPERSION CURVES MODIFIED DUE TO THE PROPOSED HILLSBOROUGH FACILITY (MODIFICATIONS FOR A & D STABILITES ONLY)

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2.2.3 Comparison and Analysis of ISC and Halitsky Results

The results of the two model comparison are presented in Table 2-2. The models were run using identical algorithms except for those algorithms which modified the turbulence in the wake of the structure. A unitized emission rate of one gram per second was applied to both models yielding normalized concentrations that are directly comparable.

The first comparison of note is the Halitsky results incorporating and not incorporating the stack tip downwash (STD) algorithm. When the stack exit velocity is great, STD is not expected to occur in light wind speed cases. Based on the proposed Hillsborough County resource recovery facility exit velocity, the STD algorithm indicates no STD for the 3.0 and 5.0 meter per second cases. In the two situations in which STD was used (the 10 and 15 meter per second wind speed cases), the concentrations for the stack tip downwash case were 50 percent higher at the maximum, with both cases gradually reaching parity downwind.

For the three non-GEP ISC cases, for all simulated meteorological conditions, the concentrations in-close varied to different degrees. However, as downwind distance increased, the differences in concentrations decreased to a point of convergence in certain cases. This is to be expected as the variations in option choice tends to be magnified in-close due to the effects of building related turbulence.

A comparison of results from the two ISC cases, one with GPR and no STD and the other without GPR but incorporating STD illustrates that substantial differences are possible in predicted impacts in-close by choosing different options. The differences are most apparent for the D stability cases. The cases with GPR show higher predicted concentrations in-close over the non-GPR case. The GPR algorithm gradually elevates the plume height until a final height is reached (at 991 meters downwind for the Hillsborough County case). The final

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TABLE 2-2

COMPARISON OF NORMALIZED MAXIMUM GROUND LEVEL CONCENTRATIONS BETWEEN THE HALITSKY METHOD AND ISC COMPUTER MODEL AT SELECTED RECEPTORS FOR A 220 FOOT STACK (FOR A STABILITY AND 3 METER/SECOND WINDS)

NORMALIZED GROUND LEVEL CONCENTRATIONS FOR A 67 METER (220') STACK
HALITSKY AND ISC METHODS
(grams per cubic meter)

DOWNWIND DISTANCE (METERS)

STABILITY A		250	500	750	1000	1500	3000	5000	10000
	H	174	234	285	329	329	329	329	329
(Reference wind speed = 3.0 m/sec)	H '	*	*	*	*	*	*	*	*
	S_Z	55	122	264	471	1089	4678	5000**	5000**
	S_Y	60	101	140	177	247	442	685	1277
	X	1.81×10^{-7}	1.14×10^{-6}	1.34×10^{-6}	8.31×10^{-7}	3.14×10^{-7}	4.27×10^{-8}	2.58×10^{-8}	1.38×10^{-8}
	X '	*	*	*	*	*	*	*	*
	ISC [a]	1.23×10^{-9}	6.23×10^{-7}	1.14×10^{-6}	7.15×10^{-7}	2.62×10^{-7}	4.14×10^{-8}	2.62×10^{-8}	1.45×10^{-8}
	ISC [b]	***	5.64×10^{-8}	9.13×10^{-7}	7.15×10^{-7}	2.62×10^{-7}	4.14×10^{-8}	2.62×10^{-8}	1.45×10^{-8}
	ISC [c]	1.01×10^{-9}	6.23×10^{-7}	1.14×10^{-6}	7.15×10^{-7}	2.62×10^{-7}	4.14×10^{-8}	2.62×10^{-8}	1.45×10^{-8}
	ISC [d]	3.17×10^{-12}	2.42×10^{-7}	9.01×10^{-7}	6.40×10^{-7}	2.46×10^{-7}	3.92×10^{-8}	2.49×10^{-8}	1.37×10^{-8}

H - Stack Height for Halitsky (H' = stack height for Halitsky W/STD).
X - Estimated Concentration for Halitsky (X' = estimated concentration for Halitsky W/STD).
ISC[a] - ISC Computer Model W/GPR - No STD.
ISC[b] - " " " W/STD - No GPR.
ISC[c] - " " " W/GPR - No STD, No Downwash Analysis.
ISC[d] - " " " W/GEP Stack, GPR - No STD.
STD - STACK TIP DOWNWASH.
GRP - GRADUAL PLUME RISE.
* - H'=H therefore X'=X.
** - Assumed Equal to 5000 (M).
*** - Value Less than 10^{-18}.

TABLE 2-2 (continued)

COMPARISON OF NORMALIZED MAXIMUM
GROUND LEVEL CONCENTRATIONS
BETWEEN THE HALISTSKY METHOD AND ISC COMPUTER MODEL
AT SELECTED RECEPTORS FOR A 220 FOOT STACK
(FOR D STABILITY AND 5 METER/SECOND WINDS)

NORMALIZED GROUND LEVEL CONCENTRATIONS FOR A 67 METER (220') STACK
HALITSKY AND ISC METHODS
(grams per cubic meter)

DOWNWIND DISTANCE (METERS)

STABILITY D

(Reference wind speed = 5.0 m/sec)

	250	500	750	1000	1500	3000	5000	10000
H	143	187	223	255	255	255	255	255
H '	*	*	*	*	*	*	*	*
S_Z	27	35	42	49	59	82	106	152
S_Y	27	40	53	65	90	157	241	449
X	4.54×10^{-11}	1.75×10^{-11}	1.34×10^{-11}	1.71×10^{-11}	6.58×10^{-10}	2.44×10^{-8}	8.66×10^{-8}	1.42×10^{-7}
X '	*	*	*	*	*	*	*	*
ISC^a	5.74×10^{-7}	5.36×10^{-7}	1.86×10^{-7}	8.65×10^{-8}	1.28×10^{-7}	2.33×10^{-7}	2.75×10^{-7}	2.24×10^{-7}
ISC^b	4.42×10^{-9}	4.32×10^{-8}	6.29×10^{-8}	8.65×10^{-8}	1.28×10^{-7}	2.33×10^{-7}	2.75×10^{-7}	2.24×10^{-7}
ISC^c	***	5.00×10^{-18}	2.33×10^{-14}	1.26×10^{-12}	5.48×10^{-10}	6.01×10^{-8}	1.76×10^{-7}	2.12×10^{-7}
ISC^d	***	***	1.00×10^{-18}	1.92×10^{-15}	1.11×10^{-11}	1.12×10^{-8}	6.71×10^{-8}	1.30×10^{-7}

H - Stack Height for Halitsky (H' = stack height for Halitsky W/STD).
X - Estimated Concentration for Halitsky (X' = estimated concentration for Halitsky W/STD).
ISC^a - ISC Computer Model W/GPR - No STD.
ISC^b - " " " W/STD - No GPR.
ISC^c - " " " W/GPR - No STD, No Downwash Analysis.
ISC^d - " " " W/GEP Stack, GPR - No STD.
STD - STACK TIP DOWNWASH.
GRP - GRADUAL PLUME RISE.
* - H'=H therefore X'=X.
** - Assumed Equal to 5000 (M).
*** - Value Less than 10^{-18}.

TABLE 2-2 (continued)

COMPARISON OF NORMALIZED MAXIMUM GROUND LEVEL CONCENTRATIONS BETWEEN THE HALITSKY METHOD AND ISC COMPUTER MODEL AT SELECTED RECEPTORS FOR A 220 FOOT STACK (FOR D STABILITY AND 10 METER/SECOND WINDS)

GROUND LEVEL CONCENTRATIONS FOR A 220' STACK FROM HALITSKY AND ISC METHODS
(grams per cubic meter normalized from a 1 gram per second release rate)

DOWNWIND DISTANCE (METERS)

STABILITY D		250	500	750	1000	1500	3000	5000	10000
	H	91	104	116	125	125	125	125	125
(Reference wind speed = 10 m/sec)	H '	88	101	113	122	122	122	122	122
	S_Z	27	35	42	49	59	82	106	152
	S_Y	27	40	53	65	90	157	241	449
	X	$9.26x10^{-8}$	$1.72x10^{-7}$	$1.97x10^{-7}$	$2.41x10^{-7}$	$3.96x10^{-7}$	$4.81x10^{-7}$	$3.86x10^{-7}$	$2.07x10^{-7}$
	X '	$1.34x10^{-7}$	$2.20x10^{-7}$	$2.38x10^{-7}$	$2.80x10^{-7}$	$4.38x10^{-7}$	$5.06x10^{-7}$	$3.99x10^{-7}$	$2.09x10^{-7}$
	ISC a	$1.58x10^{-6}$	$1.44x10^{-6}$	$8.10x10^{-7}$	$5.42x10^{-7}$	$5.05x10^{-7}$	$4.19x10^{-7}$	$3.15x10^{-7}$	$1.73x10^{-7}$
	ISC b	$1.55x10^{-7}$	$6.84x10^{-7}$	$6.31x10^{-7}$	$6.05x10^{-7}$	$5.52x10^{-7}$	$4.43x10^{-7}$	$3.27x10^{-7}$	$1.76x10^{-7}$
	ISC c	***	$2.62x10^{-12}$	$4.71x10^{-10}$	$4.31x10^{-9}$	$5.15x19^{-8}$	$2.57x10^{-7}$	$2.80x10^{-7}$	$1.75x10^{-7}$
	ISC d	***	***	$6.93x10^{-14}$	$1.33x10^{-11}$	$1.58x10^{-9}$	$5.70x10^{-8}$	$1.17x10^{-7}$	$1.11x10^{-7}$

H - Stack Height for Halitsky (H' = stack height for Halitsky W/STD).
X - Estimated Concentration for Halitsky (X' = estimated concentration for Halitsky W/STD).
ISC[a] - ISC Computer Model W/GPR - No STD.
ISC[b] - " " " W/STD - No GPR.
ISC[c] - " " " W/GPR - No STD, No Downwash Analysis.
ISC[d] - " " " W/GEP Stack, GPR - No STD.
STD - STACK TIP DOWNWASH.
GPR - GRADUAL PLUME RISE.
*** - Value Less Than 10^{-18}.

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TABLE 2-2 (continued)

COMPARISON OF NORMALIZED MAXIMUM
GROUND LEVEL CONCENTRATIONS
BETWEEN THE HALITSKY METHOD AND ISC COMPUTER MODEL
AT SELECTED RECEPTORS FOR A 220 FOOT STACK
(FOR D STABILITY AND 15 METER/SECOND WINDS)

GROUND LEVEL CONCENTRATIONS FOR A 220' STACK FROM
HALITSKY AND ISC METHODS
(grams per cubic meter normalized from a 1 gram per second release rate)

DOWNWIND DISTANCE (METERS)

STABILITY D		250	500	750	1000	1500	3000	5000	10000
	H	83	92	99	106	106	106	106	106
(Reference wind speed = 15 m/sec)	H'	77	86	93	100	100	100	100	100
	S_Z	27	35	42	49	59	82	106	152
	S_Y	27	40	53	65	90	157	241	449
	X	1.62×10^{-7}	2.99×10^{-7}	3.68×10^{-7}	3.99×10^{-7}	4.97×10^{-7}	4.45×10^{-7}	3.14×10^{-7}	1.52×10^{-7}
	X'	3.09×10^{-7}	4.60×10^{-7}	5.12×10^{-7}	5.18×10^{-7}	5.89×10^{-7}	4.87×10^{-7}	3.31×10^{-7}	1.56×10^{-7}
	ISC [a]	1.70×10^{-6}	1.50×10^{-6}	9.39×10^{-7}	6.78×10^{-7}	5.63×10^{-7}	3.84×10^{-7}	2.58×10^{-7}	1.28×10^{-7}
	ISC [b]	5.60×10^{-7}	1.11×10^{-6}	9.12×10^{-7}	7.96×10^{-7}	6.42×10^{-7}	4.17×10^{-7}	2.72×10^{-7}	1.32×10^{-7}
	ISC [c]	1.00×10^{-18}	6.80×10^{-11}	4.72×10^{-9}	2.59×10^{-8}	1.27×10^{-7}	2.92×10^{-7}	2.49×10^{-7}	1.32×10^{-7}
	ISC [d]	***	1.80×10^{-17}	1.26×10^{-12}	1.20×10^{-10}	4.96×10^{-9}	7.15×10^{-8}	1.10×10^{-7}	8.59×10^{-8}

H - Stack Height for Halitsky (H' = stack height for Halitsky W/STD).
X - Estimated Concentration for Halitsky (X' = estimated concentration for Halitsky W/STD).
ISC[a] - ISC Computer Model W/GPR - No STD.
ISC[b] - " " " W/STD - No GPR.
ISC[c] - " " " W/GPR - No STD, No Downwash Analysis.
ISC[d] - " " " W/GEP Stack, GPR - No STD.
STD - STACK TIP DOWNWASH.
GPR - GRADUAL PLUME RISE.
*** - Value Less Than 10^{-18}.

plume height is based on an algorithm presented in the attachment and is equal to the plume height set in the non-GPR case. Since the plume height in-close for the non-GPR is higher than the case with GPR, concentrations are lower. The predicted normalized concentrations for the two runs converge when the gradual plume rise height in the GPR case equals the final plume height in the non-GPR case.

The aforementioned results are mainly applicable for the D stability cases when atmospheric dispersion is limited and turbulence-related impacts are due to structural influences. The ISC concentrations for the A stability case are very close indicating that strong atmospheric turbulence (as in the case for A stability) dominates the building-related turbulence. The effects of the GPR option are fully realized here when a comparison is made between the ISC run with STD and no GPR and the ISC run with no building wake effects but with GPR. The latter run indicates that for this case, the strong dispersion associated with the A stability case plus the GPR option causes impacts greater (in-close) than the former case which utilized the downwash option and no GPR. This case demonstrates the variability which can result in using these models in a limited short-term case-by-case basis.

The results from the ISC run for a facility with a GEP stack indicate concentration estimates lower than all of the other runs performed (Halitsky included). The concentration difference between the GEP and non-GEP stack height runs is greatest in-close (from about 300 to 700 meters) with lessening differences with increasing downwind distance. Comparing the GEP/non-GEP ISC runs with the same options (GPR-no STD) the differences at the maximum point of impact for all input meteorological conditions shows the non-GEP stack yielding concentration impacts 88 percent greater than the GEP case. As presented in the PSD appendix (Appendix 10.1.5), the second maximum impact of the 24 hour SO_2 value is only 6.5 percent of the standard using the non-GEP stack. The economic and aesthetic offsets can justify the increase in predicted impacts.

The final comparisons of the ISC and Halitsky runs is for the 10 and 15 meter per second wind speed cases. The Halitsky results lie between the ISC wake and no wake cases and then converges with them beyond 3,000 meters. The approximate differences in predicted concentrations impacts, based on a one gram per second unitized emissions rate, is one order of magnitude. These differences occur from the inner boundary of 250 meters out to 1,500 meters after which convergence begins.

For the 5 meter per second D stability case, the same results emerge; relatively large differences in-close with convergence further downwind. In-close, the difference between ISC and Halitsky (both using GPR) is approximately 5 orders of magnitude. In this case, light winds and neutral stability do little to dilute the plume. The primary dilution comes about from the building-related turbulence and thereby highlights the differences in the algorithms used in these two approaches. The ISC results are the more conservative of the two.

2.2.4 Analysis of Actual Worst-Case Meteorological Conditions in Hillsborough County

The ambient conditions expected to cause the maximum downwash-related impacts are expected to occur during limited meteorological events in Hillsborough County. A program called STEADY was applied to identify periods of persistent meteorological conditions which may potentially cause maximum ground level impacts.

The STEADY program (CDM, 1977), requires input ranges for wind speed, wind direction and stability, individually or in any combination. Furthermore, input information is needed on the duration that the specified condition is to last before being considered persistent as well as the number of excursions allowed from the input range.

Since the proposed facility and stack axis is orientated in an east to west direction, a range of winds from these two quadrants were screened for persistence. Using 1974 meteorological data recorded at Tampa/St. Petersburg Airport as an average case year (based on the full grid analysis in the main text) previous computer runs, winds between 240 and 300^{o}, as well as 60 and 120^{o} were checked for persistence (with no allowable excursions outside the range) over 24 hours or more. No limits were imposed on wind speed or the stability.

For the year 1974, there were 6 episodes during which winds blew from the east for 24 or more consecutive hours. The maximum duration was 34 hours while the minimum was 26 hours. Of the 178 total hours of the six episodes, not one hour exceeded the critical wind speed of 13.9 meters per second (the wind speed at which downwash could occur) during the specified direction for the specified duration. Out of the total year this persistent event occurred 2.0 percent of the time.

Winds blew from the west, with the same 24-hour persistence (or greater) during 3 episodes in 1974. The greatest duration was 34 hours while the least was 31 hours. During the 3 episodes, recorded wind speed never blew in excess of the critical wind speed. Winds with a 24-hour or greater persistence blew from the west 1.1 percent of the time that year. The total percentage of the year in which the wind blew between 240 and 300^{o}, and 60 and 120^{o} for 24 or more hours was 3.1 percent.

From the screening of actual meteorological data it is evident that persistent worst-case conditions, from a viewpoint of continued potential downwash from the proposed facility, are not too common. However, shorter events with winds from the aforementioned quadrants and in excess of the critical wind speed are likely. These short-term events were analyzed via the Halitsky and ISC methods and no significant impacts were noted. As noted above, the chance of the modeled short term events extending into persistent events in the Tampa Bay area is remote based on 1974 conditions.

3.0 CONCLUSIONS

Using EPA recommended screening techniques, it was shown that the plume will clear the cavity region, thereby limiting the increase in ground level impacts to wake-related turbulence. A downwash analysis on the wake region using the USEPA recommended Industrial Source Complex (ISC) computer model has been performed to evaluate the potential ground level impacts of the resource recovery facility proposed for Hillsborough County. Due to the sensitivity of ground level impacts to stack height, especially under the influence of structure-related turbulence, a more refined analysis was included to insure the conservativeness and accuracy of the ISC analysis. The refined analysis included algorithms suggested by Halitsky (1976) for comparative purposes.

The downwash analysis was completed using a number of options available in the algorithms. The results were then compared to assess the overall effect these options have on ground level impacts. A set of four meteorological conditions representing worst-case short-term events were selected for ambient data input. If a large degree of variability between the models resulted, a more refined analysis would be necessary. A comparison was also made between the impacts from a GEP and a non-GEP stack with the ISC computer model. These results as well as the results of the other comparisons are summarized below.

The results of the two model comparison and GEP/non-GEP comparison indicated:

- o Overall, the predicted concentrations from the two models were similar. In the one case where a large degree of variability existed, the ISC model proved the most conservative.

- o The Halitsky model predicted concentrations that were lower in the D stability cases, and only slightly higher in the A stability case.

- The various options selected resulted in differences in close, but with convergence occurring soon after the turbulence zones were cleared. The EPA recommended options did yield the most conservative results.

- The maximum short-term concentration predicted from the four worst-case input conditions yielded values just slightly below the maximum short-term values obtained in the analysis using a full year of meteorological data obtained from Tampa/St. Petersburg Airport (see results in main text).

- A screening analysis performed on 1974 Tampa Bay/St. Petersburg meteorological data indicates that persistent conditions likely to result in maximum ground level concentrations are uncommon in the Hillsborough area, and are likely to occur approximately 3 percent of the time for an average case year.

- As presented in the PSD appendix (Appendix 10.1.5), the second maximum impact of the 24-hour SO_2 value is only 6.5 percent of the standard using the non-GEP stack.

Based on the overall results, the ISC model utilized in both the refined stack analysis, as well as the full grid analysis of the facility described in the main text, was found to be the most conservative method for this level of detail. The Halitsky analysis, which used more realistic algorithms based on structure dimensions, resulted in lower ground level impacts in the four cases studied.

Due to model limitations which restricted the inner boundary of the analysis to the wake region, and the variability between the models within this region, the results should not be looked upon as absolute. However, due to the relative consistency between the results of the ISC and Halitsky analyses and since the predicted worst-case concentrations are below a level of concern, additional analyses on the stack height issue do not appear warranted.

The purpose of the stack height analysis is to provide the technical foundation for determining the implications of a stack height at less than GEP. This analysis compared two methods of assessing downwash--ISC and Halitsky. It also compared the predicted relative ground level concentrations of a 220 foot stack to those of a 375 foot GEP stack.

Based on the analysis presented in this appendix, supplemented by the air quality analysis contained in the PSD application (Appendix 10.1.5 of the Application for Power Plant Site Certification), it has been determined that a 220 foot stack is feasible for the proposed energy recovery facility. The analysis contained here and in the PSD application examines the aerodynamic downwash issues and the ground-level concentration of pollutants associated with the proposed energy recovery facility. The analyses show that neither downwash nor pollutant concentrations will be a problem at the facility with a 220 foot stack.

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ATTACHMENTS

A - LISTING AND DESCRIPTION OF ALGORITHMS USED IN DOWNWASH ANALYSIS.

B - MEMO FROM STEPHEN PERKINS (USEPA) REGARDING CONSENSUS DOWNWASH MODELING POLICY.

ATTACHMENT A

EQUATIONS UTILIZED IN STACK DOWNWASH ANALYSIS:

A) GROUND LEVEL CONCENTRATION ALONG CENTERLINE UNDER THE PLUME;

GAUSSIAN PLUME DISTRIBUTION

$$\underline{ISC} > x = \frac{Q}{\pi u S_z S_y} e^{-\frac{(-H^2)}{(2S_z^2)}} \qquad (1) \quad (EPA, 1979)$$

where;

H = Plume height (meters).
S_z = Vertical plume spread (meters).
S_y = Horizontal plume spread (meters).
u = Average wind speed at stack height (meters/second).
Q = Emission rate (normalized at 1 gram/second).
x = Ground level concentration (meters^3/seconds^4).

HALITSKY > SAME AS (1).

B) WIND SPEED ADJUSTMENT AT STACK HEIGHT;

LOG WIND PROFILE

$$\underline{ISC} > \quad u(h) = u_1 \left(\frac{h}{Z_1}\right)^P \qquad (2) \quad (EPA, 1979)$$

where;

h = Emission height (meters).
Z = Wind system measurement height (10 meters).
u_1 = Average wind speed at measurement height (meters/second).
P = Wind profile exponent.
u(h) = Average wind speed at emission height (meters/second).

Value of P; (EPA, 1979)

Pasquill Stability Category	Wind Profile Exponent - P
A	0.10
B	0.15
C	0.20
D	0.25
E	0.30
F	0.30

HALITSKY - SAME AS (2).

- SAME VALUES of P.

C) CALCULATION OF S_Y AND S_Z VALUES (EPA, 1979);

ISC > $S_Y = 465.12(x)\ \mathrm{TAN}\ (TH)$ (3)

where;

TH = 0.0175 (c-d ln(x)

c&d = Coefficients which are stability dependent (listed in EPA, 1979 p. 2-27)

x = Downwind distance (Kilometers).

$S_Z = a(x)^b$ (4)

where;

a&b = Coefficients which are stability dependent (listed in EPA, 1979 p. 2-28 & 2-29).

x = Downwind distance (Kilometers).

ISC classifies the proposed facility as a "squat" building, modifying S_y & S_z as follows (EPA, 1979);

$$S_Y' = 0.35h_w + 0.067(x-3h_b) \quad \text{for } 3h_b < x < 10h_b \qquad (3a)$$

$$S_Y' = (x + X_Y) \quad \text{for } x \geq 10h_b \qquad (3b)$$

where;

x = Downwind distance (Kilometers).

X_Y = $\left(\frac{0.35h_w + 0.5h_b}{p}\right)^{1/q} - 0.01h_b$

h_w = Building width (diameter of circle of equal horizontal building area in meters).

h_b = Building height (meters).

p&q = Stability dependent coefficients listed in EPA, 1979 p. 2-32.

$$S_Z' = 0.7h_b + 0.067(x-3h_b) \quad \text{for } 3h_b < x < 10h_b \qquad (4a)$$

$$S_Z' = (x + X_Z) \quad \text{for } x \geq 10\ h_b \qquad (4b)$$

where;

x = Downwind distance (kilometers)

X_Z = $\left(\frac{1.2h_b}{a}\right)^{1/b} - 0.01h_b$

a&b = Stability derived coefficients listed in EPA, 1979 p. 2-28, 2-29.

h_b = Building height (meters).

<u>HALITSKY</u> > $S_Y = Y_b/\sqrt{10}$ (Halitsky, 1976) (5)

where;

Y_b = $36.35 + 2.5\ c\ (x)^d$

c&d = Coefficients which are stability dependent (listed in EPA, 1979 p. 2-27).

x = Downwind distance (kilometers).

$$S_Z = Z_b/2.5 \qquad \text{(Halisky, 1976)} \qquad (6)$$

where;

Z_b = $42.7 + 2.5\ a(x)^b$

a&b = Stability dependent coefficients listed below.

x = Downwind distance (kilometers).

a & b - calculated from lines fitted to Pasquill-Gifford equations.

	STABILITY = A		STABILITY = D	
DOWNWIND DISTANCE (km)	a	b	a	b
.25	221	.94	71	.95
.50	220	.94	70	.95
.75	214	.94	69	.95
1.0	209	.94	68	.95
1.5	205	.94	68	.95
3.0	194	.94	65	.95
10.0	194	.94	65	.95

Equations Y_b + Z_b derived from Halitsky data modified for the proposed Hillsborough facility.

D) <u>ALGORITHM USED TO CALCULATE PLUME HEIGHT AS A FUNCTION OF DOWNWIND DISTANCE:</u>

BRIGGS PLUME RISE (GRADUAL PLUME RISE)

<u>ISC</u> > $dh = \left(\frac{3F_m(x)}{B_j^2(u)^2} + \frac{3F(x)^2}{2B_i(u)^3} \right)^{1/3}$ (EPA, 1979) (7)

where;

F_m = (see equation (5) in appendix).
F = (see equation (4) in appendix).
u = Average wind speed at emission height (meters/second).
B_j = $(Y_3 + \frac{u}{V_s})$ where V_s = Exit velocity (meters/second).
u = Average wind speed at stack height in meters/second).
B_i = 0.6
x = Downwind distance.

The calculation to determine the downwind distance of final height;

<u>ISC</u> > $x' = 3.5x^*$ (for F>0) (EPA, 1979) (8)

where;

$x^* = 34F^{2/5}$ (for F>55 $meters^4/seconds^3$)
x' = Distance to final height (meters).

<u>HALITSKY</u> > same as (7) and (8).

E) <u>ALGORITHM USED TO ASSESS STACK TIP DOWNWASH (EPA, 1979)</u>;

<u>ISC</u> > $h' = h$ if $V_s \geq 1.5\ u(h)$ (9)

$h' = h + 2[V_s/u(h) - 1.5]d$ if $V_s < 1.5u(h)$ (10)

where;

h' = Adjusted stack height (meters).

h = Original stack height (meters).

$u(h)$ = Wind speed at stack height (meters/second).

V_s = Stack exit velocity (meters/second).

d = Diameter (meters).

<u>HALITSKY</u> > same as (9) and (10).

ATTACHMENT B

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

DATE: March 16, 1983

SUBJECT: Consensus Downwash Modeling Policy

FROM: Stephen S. Perkins SSP Eric Chasanoff
Region I Region II

TO: Regional Modeling Contacts, Regions III-X

As requested at the Denver Modeling meeting, we have been working on the development of a consensus downwash policy. A draft policy was distributed for comment on November 5, 1982. Written comments were received from three Regional Offices and OAQPS. The remaining regions were contacted by telephone.

We have synthesized all the comments and have attached our final proposal for a downwash modeling policy. At the suggestion of OAQPS, we have presented the policy in the form of revisions to the Workshop Summary Report (WSR). The comments received on the policy aspects of the November draft were almost unanimously favorable. As a results, the proposed revisions to the WSR are almost identical to the first section of the draft.

The comments received on modifications to ISC were not nearly as unanimous Given the range of comments received, we believe that further discussion of any modifications is warranted. We recommend that OAQPS establish a working group to prioritize and evaluate refinements to ISC. Since these further discussions are necessary, we have decided not to include the issue of modifications to ISC as part of EPA's current technical guidance.

ATTACHMENT C

APPENDIX C

BUILDING DOWNWASH SCREENING PROCEDURES

When a GEP analysis indicates that a stack is less than the GEP height, the following screening procedures should be applied to assess the potential for air quality problems. The building downwash screening procedure is divided into two major areas of concern. Within the cavity region (up to 3L downwind (L = the lesser of the building height or projected width), a series of simple hand calculations can be used. Within the wake region (3L to 10L downwind), the ISC model can be used in a screening mode. Details on both procedures are provided below.

Cavity Region

The cavity effects screening procedure consists of four sequential steps.

Step 1. Compare the stack height to the cavity height. Calculate the cavity height h_c:

$$h_c = H + 0.5(L)$$

where H = Height of structure (m)

L = Lesser dimension (height or projected width) of structure (m)

If the stack height is greater than or equal to the cavity height, then it may be assumed that maximum impacts will be dominated by the wake effects, and no further cavity analysis is required. Proceed to perform the wake effects analysis. If the stack height is less than the cavity height, proceed to Step 2.

Step 2. Estimate the momentum plume rise for windy neutral atmospheric conditions. First compute the momentum flux F_m:

$$F_m = (T_a/T_s)\ v^2\ d^2/4$$

where T_a = Ambient air temperature (°K) (assume 293 °K)

T_s = Stack exit temperature (°K)

v = Stack exit velocity (m/s)

d = Stack inner diameter (m)

Next, compute the momentum plume rise h_m:

$$h_m = \left[\frac{3F_m(x)}{b^2\ u^2}\right]^{1/3}$$

where $b = (\ 1/3 + u/v_s)$

u = Critical wind speed (m/s) (assume 7.5 m/s)

x = Downwind distance (m) (assume 2 building heights downwind)

The plume height can be calculated by adding the momentum plume rise to the stack height. If the plume height is greater than or equal to the cavity height calculated in Step 1, then it may be assumed that maximum impacts will be dominated by the wake effects and no further cavity analysis is required. Proceed to the wake effects analysis. If the stack height is less than the cavity height, proceed to Step 3.

Step 3. Estimate the downwind extent of the cavity. Compute the cavity length X_r:

For short buildings (Y/H < 2)

$$X_r = Y + \frac{(A)(W)}{1.0 + B(W/H)}$$

For long buildings (Y/H $\geq$ 2)

$$X_r = \frac{1.75(W)}{1.0 + 0.25(W/H)}$$

where H = Building height (m)

Y = Alongwind building dimension (m)

W = Crosswind building dimension (m)

$A = -2.0 + 3.7(Y/H)^{-1/3}$

$B = -0.15 + 0.305(Y/H)^{-1/3}$

Next, compare the cavity length to the closest distance to the plant property line. Only consider plant property to which public access is precluded. If the cavity does not exceed this distance, then it may be assumed that cavity effects will not impact ambient air, and no further cavity analysis is required. Proceed to the wake effects analysis. If the cavity extends beyond plant property, proceed to Step 4.

Step 4. Estimate impacts within the cavity. "Worst case" impacts can be estimated by the following simple approximation:

$$X = \frac{Q}{1.5(A)(u)}$$

where Q = Emission rate (g/s)

A = Cross-sectional area of building normal to wind (m^2)

u = Wind speed (m/s)

For u, one should choose the lowest wind speed likely to result in entrainment of most or all of the pollutant into the cavity. If no data are available from which the minimum speed can be estimated, assume a worst case wind speed of 3 m/s.

This concludes the cavity effects screening procedure. Proceed to the wake effects analysis. The above procedures are considered to be conservative. If the conservative estimate proves unacceptable, an applicant may wish to consider a field study or fluid modeling demonstration to show maintenance of the NAAQS or PSD increments within the cavity. If such options are pursued, prior agreement on the study plan and methodology should be reached between the applicant and the Regional Office.

Wake Region

Wake effects screening can be performed with ISC using a set of representative "worst case" meteorological conditions. The procedure consists of three steps.

Step 1. Determine the "worst case" building dimensions for input to the model. To model "worst case" conditions, care should be taken to use the same critical building dimensions (maximum projected width and/or height) that give the greatest height in the GEP analysis. The way ISC is constructed, the user inputs a building length and width, instead of the projected width used in the GEP analysis. The model calculates an area based on this length and width and then determines the diameter of a circle with equal area. This so called "effective diameter" (D) is used in all other model calculations as the projected width of the building. Thus ISC assumes:

$$(L)(W) = (\pi/4)\, D^2$$

To model the projected width determined in the GEP analysis, set D equal to the projected width and solve the above equation assuming L = W. The calculated value should then be used as inputs to ISC for L and W.

Step 2. Calculate maximum hourly concentrations using ISC. The following procedures should be followed:

A. Use the wake effects option with building dimensions determined in Step 1, transitional plume rise (ISW(24)=2), and no stack tip downwash (ISW(25)=1).

B. With the source at the center of the grid, place receptors downwind along a single radial. Receptors should be spaced no more than 100 m apart within 2000 m of the source. Additional receptors may be needed on a case specific basis to ensure prediction of the maximum concentration.

C. A set of representative "worst case" meteorological conditions should be used in conjunction with the model option that reads hourly data in card image format (ISW(19)=2). A temperature of 293 °K, a mixing height of 5000 m, and a wind direction along the line of receptors should be used for each hour. At a minimum, the following combinations of stability class and wind speed should be modeled:

Stability Class	Wind Speed (m/s)
A	1, 3
B	1, 3, 5
C	1, 3, 5, 10
D	1, 3, 5, 10, 15
E	1, 3, 5
F (rural only)	1, 3

Step 3. Obtain concentration estimates for the averaging times of concern. The maximum 1-hour concentration is the highest of the concentrations estimated in Step 2. The ratio between a longer-term maximum concentration and a 1-hour maximum will necessarily be site-specific and should be based on considerations of source characteristics, local climatology and topography.