November 27, 1985

Mr. C. H. Fancy
Bureau of Air Quality Management
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32301-8241

Dear Mr. Fancy:

This letter is being sent in response to your communication
of October 21, 1985, RE: Review of Application to Modify Permit
No. AC53-55780, Sulfur Pellet Handling and Melting Project.

In regard to the first request pertaining to a copy of the
computer print-out of the modeling study, a report has been
forwarded directly to Mr. Tom Rogers. Mr. Bob McCann of ES & E
sent the print-out on November 19th. A copy of his letter of
transmittal is attached.

The second item in the letter requested more supporting
literature on the efficiency of the H2S scrubber. Attached is a
report from the scrubber vendor that addresses the efficiency of
the unit. Notice that the handwritten note at the bottom of the
page gives the basis for 98% efficiency.

If you have any questions please do not hesitate to contact
me at (813) 428-1423.

Yours truly,

Edward E. Mayer

Edward E. Mayer,
Environmental Engineer

Attachment
cc: V. Snow
     E. de la Parte
     L. Lahman
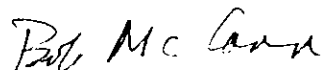
EEM/lgm

DER

DEC 02 1985

BAQM

November 19, 1985
ESE No. 85-123-0100-2110

Mr. Thomas Rogers
Department of Environmental Regulation
Bureau of Air Quality Management
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32301

Dear Tom:

Enclosed are the hard copy printouts for the Agrico South Pierce Facility.
If you have any questions, please contact me.

Sincerely,

Bob McCann

Robert C. McCann
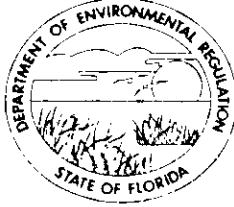Department Manager
Air Quality Modeling and
    Permitting

RCM/MHL/jay

cc: Ed Mayer, Agrico

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

BOB GRAHAM
GOVERNOR

VICTORIA J. TSCHINKEL
SECRETARY

October 31, 1985

Mr. L.C. Lahman
Agrico Chemical Company
P.O. Box 1969
Bartow, Florida   33830

RE: Review of Application to Modify Permit No AC53-55780,
     Sulfur Pellet Handling and Melting Project

Dear Mr. Lahman:

The bureau has received your application package dated
October 1, 1985. Please submit the following information to the
bureau, in order to process your application:

1. The computer print-out of the modeling done on the
    sources in your project.

2. Supporting literature for the basis of hydrogen sulfide
    removal efficiency of your proposed scrubber system.

If you have any questions please call Pradeep Raval or Tom
Rogers at (904) 488-1344 or write to me at the above address.

Sincerely,

C. H. Fancy
Deputy Chief,
Bureau of Air Quality
Management

cc: Bill Thomas
     Edward de la Parte

P 408 533 636

RECEIPT FOR CERTIFIED MAIL

NO INSURANCE COVERAGE PROVIDED—
NOT FOR INTERNATIONAL MAIL

(See Reverse)

Sent to Mr. L. C. Lahman	
Street and No.	
P.O., State and ZIP Code	
Postage	$
Certified Fee	
Special Delivery Fee	
Restricted Delivery Fee	
Return Receipt Showing to whom and Date Delivered	
Return Receipt Showing to whom, Date, and Address of Delivery	
TOTAL Postage and Fees	$
Postmark or Date	

10/31/85

PS Form 3800, Feb. 1982

PS Form 3811, July 1983

● **SENDER: Complete items 1, 2, 3 and 4.**

Put your address in the "RETURN TO" space on the reverse side. Failure to do this will prevent this card from being returned to you. **The return receipt fee will provide you the name of the person delivered to and the date of delivery.** For additional fees the following services are available. Consult postmaster for fees and check box(es) for service(s) requested.

1. ☐ Show to whom, date and address of delivery.

2. ☐ Restricted Delivery.

3. Article Addressed to:
Mr. L. C. Lahman
Agrico Chemical Company
P. O. Box 1969
Bartow, Florida 33830

4. Type of Service:	Article Number
☐ Registered ☐ Insured ☒ Certified ☐ COD ☐ Express Mail	P 408 533 636

Always obtain signature of addressee **or** agent and **DATE DELIVERED.**

5. Signature — Addressee
X

6. Signature — Agent
X

7. Date of Delivery

8. Addressee's Address *(ONLY if requested and fee paid)*

DOMESTIC RETURN RECEIPT

AIR QUALITY ASSESSMENT
OF THE PROPOSED AGRICO SOUTH PIERCE
PRILLED SULFUR HANDLING AND MELTING INSTALLATION

Prepared for:

DE LA PARTE AND GILBERT, P.A.

Regarding:

DER PERMIT NO. AC 53-55780
AGRICO CHEMICAL COMPANY'S PRILLED SULFUR
HANDLING AND MELTING INSTALLATION
SOUTH PIERCE CHEMICAL WORKS
Polk County, Florida

Prepared by:

ENVIRONMENTAL SCIENCE AND ENGINEERING, INC.
Gainesville, Florida

ESE No. 85-123-0100-2110

August 1985

TABLE OF CONTENTS

1.0   INTRODUCTION   1-1

2.0   SOURCE DESCRIPTION   2-1

3.0   METHODOLOGY   3-1

       3.1   MODEL DESCRIPTION   3-1

              3.1.1   Ambient Air Quality Analysis   3-1
              3.1.2   Particulate Deposition Rate Analysis   3-4

       3.2   EMISSION INVENTORY   3-5

              3.2.1   Ambient Air Quality Analysis   3-5
              3.2.2   Particulate Deposition Rate Analysis   3-8

       3.3   METEOROLOGICAL DATA   3-8

       3.4   RECEPTOR GRID   3-11

              3.4.1   Ambient Air Quality Analysis   3-11
              3.4.2   Particulate Deposition Rate Analysis   3-12

4.0   RESULTS   4-1

       4.1   AMBIENT AIR QUALITY ANALYSIS   4-1
       4.2   PARTICULATE DEPOSITION RATE ANALYSIS   4-6

REFERENCES

APPENDICES

       APPENDIX A--EXCERPTS FROM REVISED AIR CONSTRUCTION
                   PERMIT APPLICATION FOR PRILLED SULFUR,
                   AGRICO CHEMICAL COMPANY, SOUTH PIERCE
                   CHEMICAL WORKS   A-1
       APPENDIX B--ESTIMATION OF TOTAL SULFUR PARTICULATE
                   EMISSIONS FROM AGRICO'S SPCW PRILLED
                   SULFUR HANDLING AND MELTING INSTALLATION   B-1

LIST OF TABLES

LIST OF FIGURES

1.0 INTRODUCTION

Agrico Chemical Company is proposing to construct a prilled sulfur
handling and melting installation at their existing South Pierce Chemical
Works (SPCW) facility in Southern Polk County, Florida (see Figure 1-1).
The proposed installation will have a 600,000 long tons per year (TPY) or
672,000 short TPY capacity for receiving and melting prilled sulfur. The
Florida Department of Environmental Regulation (DER) has recently
promulgated revisions to Florida Administrative Code (FAC), Chapter 17-2,
which relate to the handling of solid sulfur in the State of Florida.
These rules require that an analysis of the probable particulate matter
(PM) air quality and deposition impact of any sulfur handling and storage
facility be assessed.

Agrico Chemical Company retained the services of Environmental Science
and Engineering, Inc. (ESE) to conduct the air quality impact analysis of
the PM emissions from the proposed prilled sulfur installation. The air
quality analysis was performed to assess the probable impacts upon total
suspended particulate (TSP) concentrations in the vicinity of SPCW. The
Florida Ambient Air Quality Standards (AAQS) and significant impact
levels for TSP are presented in Table 1-1. DER has adopted the
significant impact levels to specifically define air quality levels which
are considered to be insignificant and therefore no threat to AAQS. In
addition, an analysis of sulfur particulate deposition rates expected
from the proposed prilled sulfur installation was conducted.

The air quality analysis was based on predicted TSP concentrations using
the Industrial Source Complex (ISC) model approved by the U.S.
Environmental Protection Agency (EPA) and DER. For addressing the
24-hour average TSP impacts, hourly concentrations were predicted with
the short-term version of the model (ISCST) using actual hourly
meteorological data collected during a 5-year period by the National
Weather Service (NWS) in the Orlando area. A method recommended by EPA
for eliminating calm conditions (i.e., no measured wind direction and

1-1

KEY
- - PLANT BOUNDARY
⊛ PRILLED SULFUR FACILITY SITE

SCALE

| 1200 | 0 | 1200 | 2400 FEET |
| 400 | 0 | 400 | 800 METERS |

R. 24 E.   407   (BAIRD)   408   409   55'
4639 III NW

N
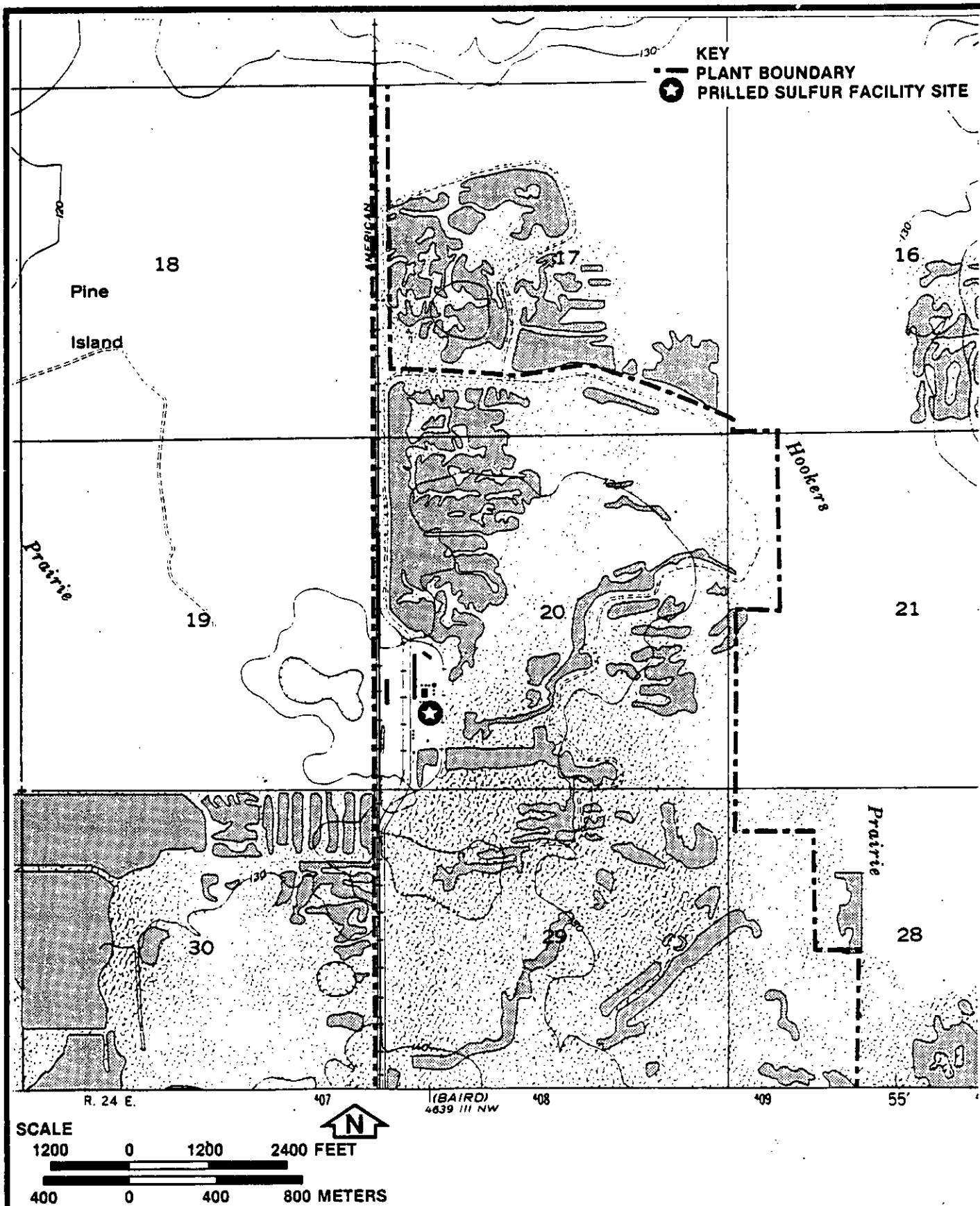
Figure 1-1
SITE LOCATION OF SOUTH PIERCE
CHEMICAL WORKS PLANT

AGRICO CHEMICAL COMPANY
Prilled Sulfur Facility

Table 1-1.   Air Quality Standards for Total Suspended Particulates
             Applicable to the Proposed SPCW Prilled Sulfur Installation

| Standard | Concentration ($\mu g/m^3$) | |
	Annual Geometric Mean	24-Hour
Florida Ambient Air Quality Standards	60	150*
Significance Limit	1	5

*Not to be exceeded more than once per year.

Sources: Code of Federal Regulations, Title 40, Parts 50, 51, and 52.
           FAC, Chapter 17-2.100.

wind speed less than 3 knots) from the meteorological data base was used
to produce valid 24-hour average concentrations. The ISC model may
produce unrealistically high concentrations if calm conditions are
included in the analysis. Annual average concentrations were determined
using the long-term version of the model (ISCLT) with annual average
emission rates reflective of the maximum annual hours of operation of
each activity.

The sulfur particulate deposition rate analysis was based upon predicting
deposition rates using the ISC model. Maximum annual and maximum monthly
deposition rates were estimated for the prilled sulfur installation using
the ISCLT model. This model is approved by EPA and DER for estimating
particulate deposition rates.

The following sections present a description of the facility, the methods
used in predicting expected maximum concentrations and deposition rates,
and the results of the air quality impact assessment.

2.0 SOURCE DESCRIPTION

The air quality impact analysis addresses impacts from the proposed prilled sulfur storage installation only. The proposed prilled sulfur installation will consist of facilities to unload prilled sulfur from a railcar, convey the sulfur to a surge hopper, and feed to one of three sulfur melters. A flow diagram of the process is presented in Figure 2-1, and a plot plan of the facility is shown in Figure 2-2. Prilled sulfur will be unloaded within a railcar unloading building by bottom-dump rail cars and dropped into an enclosed underground hopper and onto a conveyor belt (see Figure 2-3). A surfactant water spray system will be located around the periphery at the top of the unloading hopper to supress sulfur particulate emissions. The prilled sulfur will then be transferred onto a conveyor belt for transport to the surge hopper. The conveyor belt discharges directly into the surge hopper. A surfactant/water fog system will be installed at the transfer point to suppress sulfur particulate emissions (see Figure 2-3). The prilled sulfur is fed to the sulfur melters through enclosed systems, and no sulfur particulate emissions will occur from this operation. A more complete description of the process, taken from the revised air construction permit application, is presented in Appendix A.

The PM emissions from most of the proposed prilled sulfur emission sources are fugitive because they are not vented through a stack or vent. The activities which will result in fugitive emissions and the estimated maximum emissions for each activity are presented in Table 2-1. Emission estimates are presented for both wet-formed prill at 2.0 percent moisture (H_2O) and air-formed prilled sulfur at 0.5 percent H_2O. Suspended sulfur particulate emissions (for estimating ambient air quality impacts) and total sulfur particulate emissions (for estimating total sulfur deposition rates) are both shown. The suspended particulate estimates are considered representative of particulate which would be collected by the standard high-volume air sampler. For estimating maximum 24-hour emissions, the maximum throughput of prilled sulfur for the installation

Figure 2-1
PROCESS FLOW DIAGRAM--
SULFUR UNLOADING AND MELTING
SYSTEM--SOUTH PIERCE CHEMICAL WORKS

AGRICO CHEMICAL COMPANY
Prilled Sulfur Facility
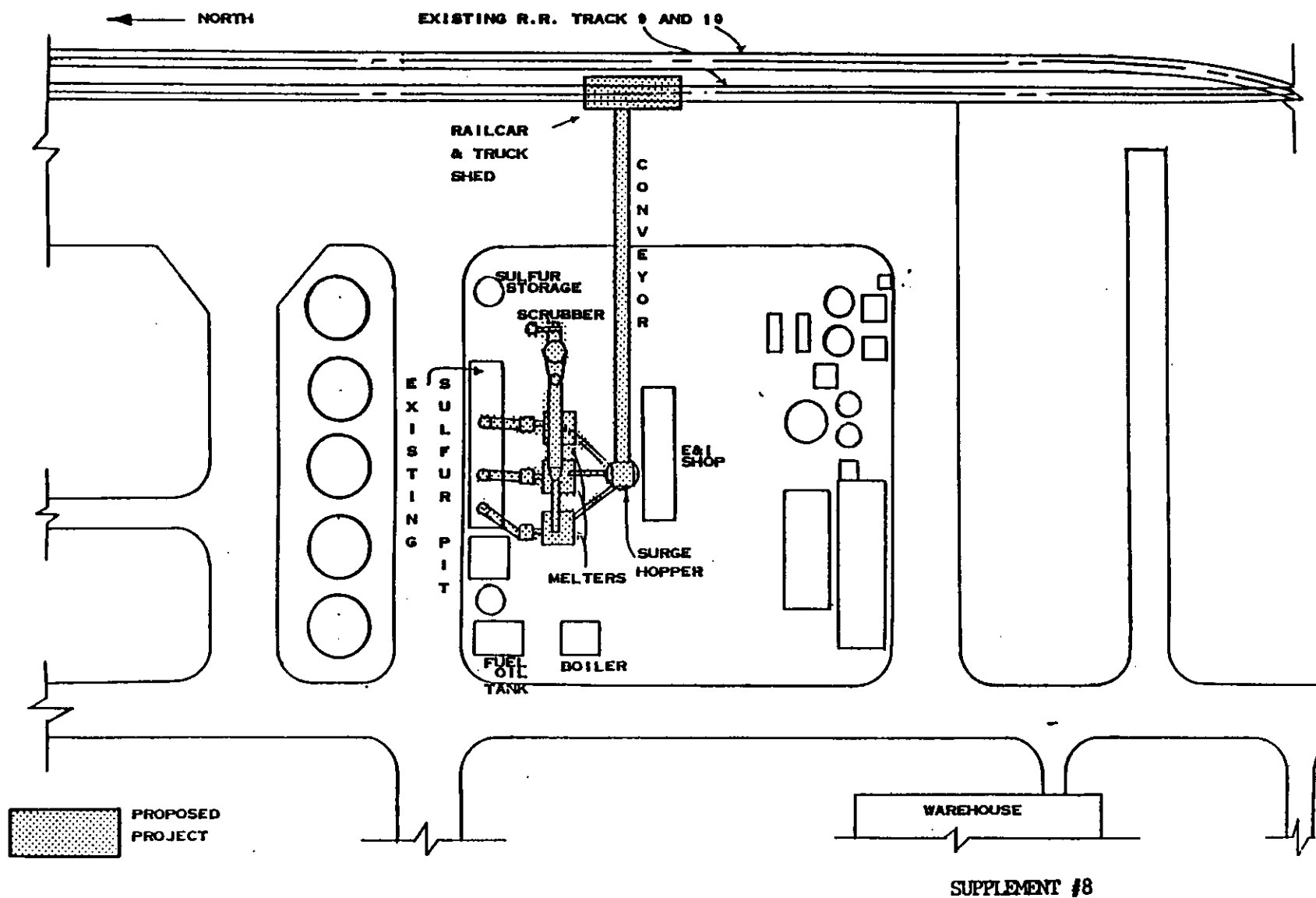
Figure 2-2
LOCATION PLAN--
PRILLED SULFUR HANDLING FACILITY--
SOUTH PIERCE CHEMICAL WORKS

AGRICO CHEMICAL COMPANY
Prilled Sulfur Facility
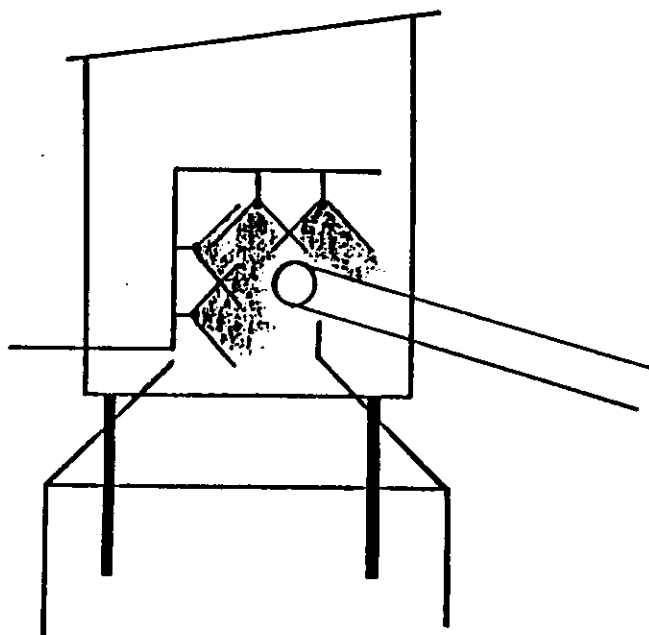
4 FOG SPRAY NOZZLES, 1/8" , 0.28 GPM EACH
AT 40 PSI, 90 DEGREE OR EQUIVALENT.
SURFACTANT ADDED TO WATER.
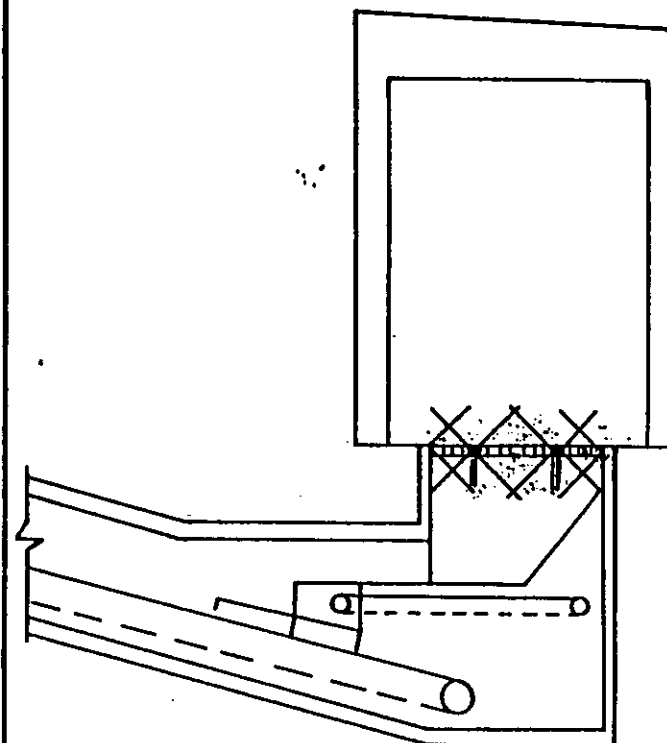
23 SPRAYING SYSTEM NOZZLES
MODEL 1/8 G 1.5 OR EQUAL
SURFACTANT ADDED TO WATER.

SUPPLEMENT #4

Figure 2-3
SURGE HOPPER--
WATER SPRAYS AND UNLOADING HOPPER--
WATER SPRAYS

AGRICO CHEMICAL COMPANY
Prilled Sulfur Facility

Table 2-1. Maximum Sulfur Particulate Emissions Associated with the
Proposed South Pierce Prilled Sulfur Handling and Melting
Installation

Activity	Suspended Particulate Emissions		Total Particulate Emissions	
	lb/hr	short TPY	lb/hr	short TPY
Wet-Formed Prill at 2.0 Percent H_2O				
Railcar to hopper	0.00454	0.01815	0.00953	0.03812
Hopper to conveyor belt	0.00605	0.02420	0.01271	0.05082
Conveyor belt to surge hopper	0.01360	0.05445	0.02856	0.11435
TOTALS	0.02419	0.09680	0.05080	0.20329
Air-Formed Prill at 0.5 Percent H_2O				
Railcar to hopper	0.0145	0.0581	0.0305	0.1220
Hopper to conveyor belt	0.0193	0.0773	0.0405	0.1623
Conveyor belt to surge hopper	0.0435	0.1741	0.0914	0.3656
TOTALS	0.0773	0.3095	0.1624	0.6499

Sources: ESE, 1985.
Agrico Chemical Company, 1985.

was 84 short tons per hour (TPH). For estimating maximum annual emissions, a maximum annual throughput of prilled sulfur of 672,000 TPH was used. The derivation of emission estimates, including supporting data, assumptions, and control efficiencies, are presented in the revised construction permit application for the prilled sulfur installation.

3.0 METHODOLOGY

3.1 MODEL DESCRIPTION

3.1.1 Ambient Air Quality Analysis

The ISC model (Cramer, 1979) was used to predict the 24-hour and annual
average TSP concentrations due to emissions from all sources considered
in the analysis. The ISC model is capable of simulating the effects of
emissions from a wide variety of industrial sources, including the
fugitive PM emissions resulting from the proposed prilled sulfur
installation. In estimating suspended particulate concentrations, the
effects of gravitational settling of PM were not considered. Therefore,
the emitted suspended particulate was assumed to remain suspended
indefinitely in the atmosphere. Based on the generic modeling approach
recommended in the ISC Model User's Guide, the proposed prilled sulfur
installation activities were modeled as volume sources.

Concentrations due to volume source emissions are calculated by the ISC
model using the steady-state Gaussian plume equation for a continuous
point source. Initial horizontal and vertical dimensions are assigned to
each volume source to simulate the initial dispersion of pollutants
within the volume source. For sources located in or near buildings,
these initial dimensions are generally based on the physical structure of
the building to account for the wake effects produced by the building. A
summary of the procedures used to estimate the initial dimensions is
given in Table 3-1. The horizontal dimensions of the volume source must
be square for input to the model. If a source cannot be characterized as
square, then the general procedure for describing the source is to
determine the actual area of the source and recalculate an effective
square area.

The generalized Briggs (1971, 1975) plume rise equations, including the
momentum terms, are used to calculate plume rise as a function of
downwind distance for point sources. In this study, no point sources
were modeled; therefore, the plume rise equations were not a factor in

3-1

Table 3-1.   Summary of Procedures for Estimating Initial Lateral (σ_{yo})
and Vertical (σ_{zo}) Dimensions for Volume Sources

Source Type	σ_{yo}	σ_{zo}
Single, elevated volume source on or adjacent to a building	$\dfrac{(\text{width x length})^{1/2}}{4.3}$	$\dfrac{\text{building height}}{2.15}$
Single, ground-based volume source	$\dfrac{(\text{width x length})^{1/2}}{4.3}$	$\dfrac{\text{vertical dimension of source}}{2.15}$
Single, elevated volume source not on or adjacent to a building	$\dfrac{(\text{width x length})^{1/2}}{4.3}$	$\dfrac{\text{vertical dimension of source}}{4.3}$

Source: Cramer, 1979.

calculating concentrations. A wind profile exponent law is used to
adjust the observed mean wind speed from the measurement height to the
emission height for the concentration calculations. The Pasquill-Gifford
(Turner, 1970) dispersion curves are used to calculate the horizontal
standard deviation (σ_y) and vertical standard deviation (σ_z) of the plume
spread.

The ISC model has rural and urban options which affect the wind speed
profile exponent law, dispersion rates, and mixing height formulations
used in calculating ground-level concentrations. The criteria used to
determine when the rural or urban mode is appropriate are based on land
use near the proposed installation's surroundings (Auer, 1978). If the
land use is classified as heavy industrial, light-moderate industrial,
commercial, or compact residential for more than 50 percent of the area
within a 3-kilometer (km) radius circle centered on the proposed
installation, the urban option should be selected. Otherwise, the rural
option is more appropriate. Based upon review of the Bradley Junction,
Florida, United States Geological Survey quadrangle map (1972) and survey
of the SPCW area, less than 50 percent of the area within a 3-km radius
is utilized as heavy industrial, light moderate industrial, commercial,
or compact residential. Therefore, the rural mode was used in
calculating ground-level concentrations.

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

The first model code, the ISCST model, is an extended version of the
single-source (CRSTER) model (EPA, 1977). The ISCST model is designed to
calculate hourly concentrations based on hourly meteorological parameters
(i.e., wind direction, wind speed, atmospheric stability, ambient

temperature, and mixing heights), emission rates, and emission charac-
teristics. The hourly concentrations are processed into nonoverlapping,
short-term and annual averaging periods. For example, a 24-hour average
concentration is based on twenty-four 1-hour averages calculated from
midnight to midnight of each day. For each short-term averaging period
selected, the highest and highest, second-highest average concentrations
are calculated for each receptor. As an option, a table of the
50 highest concentrations over the entire field of receptors can be
produced.

The second model code is the ISCLT model, which is an extension of the
Air Quality Display Model (AQDM) and the Climatological Dispersion Model
(CDM). The ISCLT model uses joint frequencies of wind direction, wind
speed, and atmospheric stability to calculate seasonal and/or annual
average ground-level concentrations. Because the input wind directions
are for 16 sectors, with each sector defined as 22.5 degrees, the model
calculates concentrations by assuming that the pollutant is uniformly
distributed in the horizontal plane within a 22.5-degree sector. For
this analysis, the ISCLT model was used to calculate annual average
concentrations.

3.1.2 Particulate Deposition Rate Analysis

Sulfur particulate deposition rates were predicted for the proposed
prilled sulfur installation only. The ISCLT model was used for this
analysis. The ISCLT model was applied in the same manner as the ambient
air quality analysis discussed in Section 3.1.1, except that particulate
deposition information was also input into the model. The ISC model
accounts for both gravitational settling and dry deposition of PM. As
stated in the ISC User's Guide, the effects of gravitational settling are
considered in the model (at the user's option) by assuming the plume is
tilted, with the plume axis inclined to the horizontal at an angle given
by the arctan of $V_s/\bar{u}$, where V_s is the gravitational settling velocity
and $\bar{u}$ is the ambient wind speed. For a given source, the total

particulate emissions can be separated into a maximum of 20 particle-size categories, for which the mass-mean diameter and settling velocity are calculated.

Dry deposition is considered in the analysis by assigning a reflection coefficient for each particle-size category. The reflection coefficient, which was based on the settling velocity and Figure 2-8 in the ISC User's Guide, is a term used in the ISC model to account for the amount of material that reaches the ground surface by the combined processes of gravitational settling and atmospheric turbulence and is reflected from the surface. A value of 1.0 for the reflection coefficient term assumes that the material is completely reflected from the surface, while a value of 0.0 indicates complete retention or deposition at the surface.

Joint frequencies of wind direction, wind speed, and atmospheric stability were developed on a monthly and annual basis to estimate maximum monthly and annual sulfur particulate deposition rates. The year of meterological data selected for analysis was the year which resulted in the highest annual ambient air quality impact.

3.2 EMISSION INVENTORY

3.2.1 Ambient Air Quality Analysis

For determining impacts on ambient air quality due to the proposed prilled sulfur installation, the suspended particulate emissions presented in Table 2-1 were used as input to the ISC model. The actual physical dimensions associated with the prilled sulfur installation are presented in Table 3-2. The source input parameters considered in the ISC model are presented in Table 3-3. The actual physical dimensions of the proposed source configuration were based on the physical layout of the building or structure in which the activities occur and reasonable estimates of the initial extent of emission releases. As shown in Table 3-3, the fugitive sources were treated as volume sources because the emissions were assumed to be uniformly mixed in a volume of air

Table 3-2. Physical Dimensions of Activities Associated with the Prilled Sulfur Installation

Activity	Emission Release Height (ft)	Activity Dimensions (ft)*	
		Horizontal	Vertical
Railcar to hopper	0-25	20 x 40	25
Hopper to conveyor belt	0-25	20 x 40	25
Conveyor belt to surge hopper	40-56	20 x 20	16

*Based on structure in which activity occurs.

Source: ESE, 1985.

Table 3-3. Model Inputs of Emission Sources Associated with the Prilled Sulfur Installation

Modeled Source	Activity	ISC Source Type	Source Dimensions (ft)				Initial Plume Dispersion (ft)	
			Height	Horizontal	Vertical	Diameter	Horizontal	Vertical
Railcar to hopper/ hopper to belt	Railcar unload/transfer	Ground-based volume	12.5	28.3*	25	—	6.6	11.6
Belt to surge hopper	Load surge hopper	Elevated volume†	48	20	16	—	4.65	7.44

*The actual horizontal dimensions are assumed to be 20 ft x 40 ft. Since the model requires that all volume sources be represented as a square, the modeled horizontal source dimension is based on calculating the side of a square using the area defined by the actual dimensions (i.e., 28.3 = $\sqrt{20 \times 40}$).
†Assumed to be on or adjacent to a building.

Source: ESE, 1985.

before dispersing in the atmosphere. Emissions for certain activities
were combined because they were assumed to occur over the same area in
both horizontal and vertical directions. For modeling purposes, the belt-
to-surge hopper source was arbitrarily located at the center of the model
grid and had x and y coordinates of 0.0 and 0.0 meter (m), respectively.
The railcar-to-hopper and hopper-to-belt sources were located relative to
the belt-to-surge hopper source and had x and y coordinates of 68.3 and
0.0 m, respectively.

3.2.2 Particulate Deposition Rate Analysis

The emission inventory used in the sulfur particulate deposition rate
impact analysis was the same as described in Section 3.2.1 for the
prilled sulfur installation, except that the estimated emissions for each
source were the total particulate emissions shown in Table 2-1. The
derivation of these emissions is presented in Appendix B.

Several other input parameters to the ISC must be specified for each
source, as described in Section 3.1.2. These parameters are shown in
Table 3-4, and their derivations are presented in Appendix B.

3.3 METEOROLOGICAL DATA

Meteorological data used in the ISC model to determine air quality
impacts consisted of a 5-year period (1974-1978) of hourly surface
weather observations from the NWS station in Orlando, Florida, and upper
air observations from Ruskin, Florida. Meteorological data from these
stations were used because they are considered representative of the
plant site's conditions due to the NWS station's proximity to the plant
site and similar surrounding topographical features at the plant site.

Maximum 24-hour average concentrations were calculated using the ISCST
model, which calculates hourly ground-level concentrations using hourly
meteorological data. The hourly concentrations were processed into
sequential, nonoverlapping 24-hour average concentrations.

Table 3-4. Particle Size Distribution and Settling Velocities for Total Sulfur Particulate Emissions Used in ISC Model

Class	Mass-Median Diameter (microns)	Percent Weight in class	Settling Velocity (cm/s)	Reflection Coefficient
1	2	10	0.013	0.95
2	6	10	0.11	0.90
3	11	10	0.37	0.85
4	18	10	0.98	0.77
5	26	10	2.04	0.70
6	37	10	4.14	0.64
7	52	10	8.14	0.54
8	64	10	11.7	0.45
9	110	10	29.0	0.025
10	160	10	52.0	0.0

Sources: ESE, 1985.
Agrico Chemical Company, 1985.
Dr. Dale Lundgren, 1985.

An integral part of the short-term modeling evaluation was the analysis of calm meteorological conditions, which occurred about 8.8 percent of the time in the 5-year Orlando meteorological data base. During calm conditions, neither a wind direction nor wind speed is recorded. For such hours, the ISCST model uses the last recorded wind direction and a wind speed of 1 meter per second (m/s) to calculate concentrations and continues these conditions until the next noncalm condition is recorded. The persistence in wind direction caused by calm conditions can cause artificially and unrealistically high concentrations to be predicted by the ISC model.

As part of the analysis to review occurrences of calm meteorological conditions, the post-processing computer program, Calms Processor (CALMPRO), was used to identify the wind direction and wind speed assigned for each hour and to adjust the short-term average concentrations if an hourly average concentration was produced during calm conditions. The CALMPRO program was developed by EPA (1984), and the method used for evaluating the effects of calm conditions is reflective of current EPA modeling policy (EPA, 1983). The following criteria were used to calculate valid 24-hour average concentrations.

1. Valid hourly average concentrations for each receptor were based on any concentration predicted during noncalm conditions.

2. Hours of calm conditions were considered invalid, and concentrations were set to zero for all receptors for that hour.

3. Valid 24-hour average concentrations were calculated by summing concentrations produced during noncalm hours and dividing by the maximum of 18 hours or the number of noncalm hours during the 24-hour period.

The following examples illustrate how this method is used to calculate 24-hour average concentrations when calm conditions occur.

1. If calm conditions occurred for 6 hours, a valid 24-hour average concentration would be calculated using the 18 hours of valid concentrations only (i.e., 18-hour average), which is the

minimum number of hours used for determining a 24-hour average
concentration. The 6 hours of calm conditions would be
eliminated from the data set.

2. If calm conditions occurred for 12 hours, a valid 24-hour
average concentration would be calculated based on the summation
of concentrations produced by the remaining 12 hours, divided by
18.

Maximum annual average concentrations and monthly and annual average
depositions were calculated using the ISCLT model, which calculates
concentrations and depositions based on the joint frequencies of wind
direction, wind speed, and atmospheric stability for the specific
averaging period. The joint frequencies were tabulated using the
stability array (STAR) program developed by the National Climatic Center
and accepted by the EPA and DER. No adjustments were made to the
predicted concentrations for calm conditions.

3.4 RECEPTOR GRID

3.4.1 Ambient Air Quality Analysis

3.4.1.1 Short-Term Analysis--To address the maximum air quality impacts
of the proposed prilled sulfur installation in the vicinity of the Agrico
SPCW facility, screening and refined phases were considered in the
general modeling approach. For the screening phase, concentrations were
predicted for a coarse receptor grid that included 288 receptors. The
receptors were located along 36 radials spaced at ten degree increments
around the facility and centered at the belt-to-surge hopper source.
Along each radial, receptors were located at 200, 300, 400, 600, 800,
1,000, 1,500, and 2,000 m from the center of the grid.

For this phase, only emissions for the air-formed prilled sulfur were
considered since emissions for wet-formed prilled sulfur were lower,
which will result in lower ground-level concentrations and deposition
rates.

After the screening phase was completed, the refined modeling was
conducted by modeling the proposed sources using a refined receptor grid
centered on the receptor which had the highest, second-highest 24-hour
concentration. The receptors were located at intervals of 100 m in a
200-m by 200-m grid, for a total of nine receptors. Concentrations were
predicted for only the period which produced the highest, second-highest
24-hour concentration. For this phase, both emissions for the wet-formed
prilled and air-formed prilled sulfurs were modeled since the maximum
concentrations for both emission scenarios are expected to occur under
the same meteorological conditions and at the same location.

3.4.1.2 Long-Term Analysis--Annual average concentrations were predicted
for emissions from both the wet-formed and air-formed prilled sulfurs
using the same receptor grid used in the screening analysis for 24-hour
concentrations. Refined modeling analysis was not performed for the
annual averaging time because the spatial distributions of annual average
concentrations are not expected to vary significantly from those produced
during the screening analysis.

3.4.2 Particulate Deposition Rate Analysis
The receptor grid used in the particulate deposition rate analysis is
presented in Figure 3-1, which is the same grid used in the screening
phase of the ambient air quality analysis. No refined analysis was
performed because monthly or annual average deposition calculations are
not expected to vary significantly for the receptor locations modeled.

4.0 RESULTS

4.1 AMBIENT AIR QUALITY ANALYSIS

Based upon the screening analysis, a summary of the highest, second-highest 24-hour and annual average TSP concentrations due to the proposed Agrico SPCW prilled sulfur installation only are presented in Table 4-1. Results are presented for both wet-formed prill and air-formed prill. As discussed in Section 3.0, a screening analysis was not performed for wet-formed prill emissions for the 24-hour period, since emissions are lower than the air-formed prill emissions, which will result in lower predicted concentrations. For the 5 years of analysis, the highest, second-highest predicted 24-hour TSP concentration due to the proposed prilled sulfur installation only was predicted to occur during 1974 (Day 115). This worst-case day was refined for both wet- and air-formed prill emissions and resulted in concentrations of 1.4 microgram per cubic meter ($\mu g/m^3$) and 2.3 $\mu g/m^3$, respectively. These maximum concentrations are both predicted to occur at 200 m to the south-southeast (i.e., direction of 160 degrees) of the prilled sulfur installation. The spatial distribution of the composite highest, second-highest 24-hour TSP concentrations for the 5 years due to the proposed sulfur installation only is shown in Figure 4-1 for air-formed prill. The predicted spatial distribution for wet-formed prill is expected to be similar, but concentrations for wet-formed prill would be decreased by a factor of about 3.2 (i.e., ratio of short-term air-formed to wet-formed emissions).

The maximum annual average TSP concentration predicted for the proposed sulfur installation only is 0.21 $\mu g/m^3$ for wet-formed prill and 0.33 $\mu g/m^3$ for air-formed prill (see Table 4-1). These maximum concentrations are less than 1 percent of the Florida AAQS of 60 $\mu g/m^3$ and 33 percent of the significance limit of 1 ug/m^3.

The spatial distribution of the composite highest annual concentrations due to the proposed sulfur installation only, for wet- and air-formed prill are shown in Figures 4-2 and 4-3, respectively.

Table 4-1. Predicted Highest, Second-Highest 24-Hour and Maximum Annual
Average TSP Concentrations from the Screening Analysis

Year	Concentration ($\mu g/m^3$) Predicted for Proposed Sulfur Installation Only	
	24-hour	Annual
Air-Formed Prill at 0.5 Percent H_2O		
1974	2.3	0.33
1975	2.1	0.25
1976	1.7	0.25
1977	1.4	0.22
1978	1.7	0.24
Wet-Formed Prill at 2.0 Percent H_2O		
1974	*	0.21
1975	*	0.16
1976	*	0.16
1977	*	0.14
1978	*	0.15

Note: Florida AAQS: 150 $\mu g/m^3$, 24-hour; 60 $\mu g/m^3$, annual.
       Significance Limit: 5 $\mu g/m^3$, 24-hour; 1 $\mu g/m^3$, annual.

*No screening analysis performed.

Source: ESE, 1985.

KEY
‒ ‐ ‒ PLANT BOUNDARY
☆ PRILLED SULFUR FACILITY SITE
▲ MAXIMUM CONCENTRATION
(2.3 ug/m3)

Figure 4-1
COMPOSITE OF MAXIMUM 24-HOUR
AVERAGE TSP CONCENTRATIONS (ug/m³)
FOR PRILLED SULFUR INSTALLATION
ONLY——AIR-FORMED PRILL

AGRICO CHEMICAL COMPANY
Prilled Sulfur Facility

Figure 4-2
COMPOSITE OF MAXIMUM ANNUAL AVERAGE TSP CONCENTRATIONS (ug/m³) FOR PRILLED SULFUR INSTALLATION ONLY——WET-FORMED PRILL

AGRICO CHEMICAL COMPANY
Prilled Sulfur Facility

KEY
- — · — PLANT BOUNDARY
- ⊕ PRILLED SULFUR FACILITY SITE
- ▲ MAXIMUM CONCENTRATION
  (0.33 ug/m3)

Figure 4-3
COMPOSITE OF MAXIMUM ANNUAL
AVERAGE TSP CONCENTRATIONS (ug/m³)
FOR PRILLED SULFUR INSTALLATION
ONLY——AIR-FORMED PRILL

AGRICO CHEMICAL COMPANY
Prilled Sulfur Facility

4.2 PARTICULATE DEPOSITION RATE ANALYSIS

Results of the sulfur particulate deposition rate analysis for the prilled sulfur installation only are presented in Table 4-2. The results are based upon 1974 meteorological data, which is the year of predicted maximum annual average TSP impacts (see Table 4-1). The maximum annual deposition rate predicted at any receptor was 0.099 grams per square meter (g/m^2) [2.18 pounds per hectare (lb/ha)] for the wet-formed prill and 0.32 g/m^2 (7.05 lb/ha) for the air-formed prill. The maximum monthly deposition rate predicted for any receptor was 0.025 g/m^2 (0.55 lb/ha) for wet-formed prill and 0.079 g/m^2 (1.74 lb/ha) for air-formed prill. The maximum monthly deposition rate was predicted to occur in October for both wet and air-formed prill.

The spatial distribution of annual sulfur particulate deposition rates is portrayed in Figure 4-4 for wet-formed prill and in Figure 4-5 for air-formed prill. Similarly, Figures 4-6 and 4-7 depict the spatial distribution of the composite maximum monthly deposition rates for wet- and air-formed prill, respectively. These figures show that air-formed prill results in the maximum annual and monthly deposition rates at each receptor.
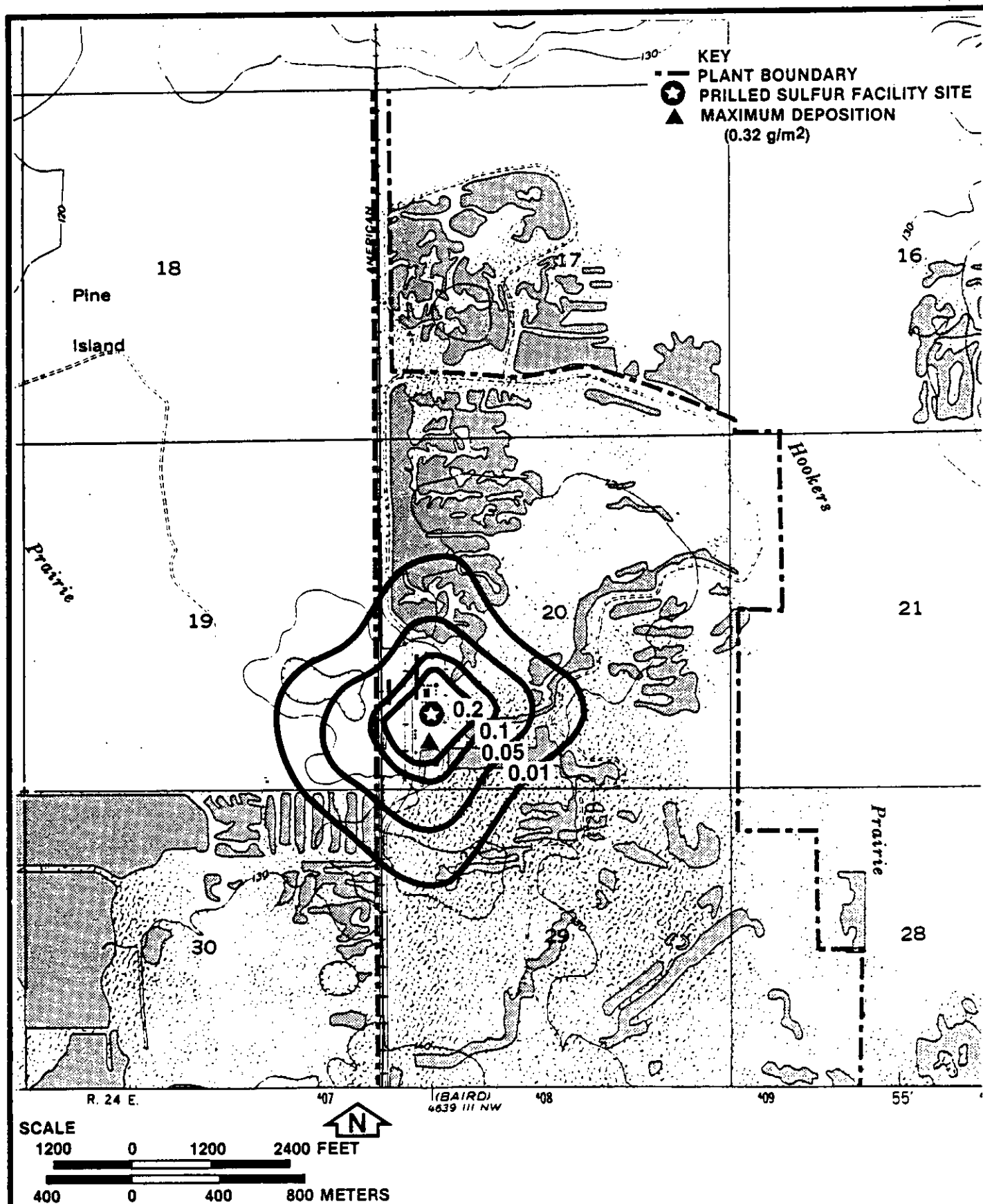
Table 4-2. Estimated Sulfur Particulate Deposition Rates, Prilled Sulfur
Installation Only

| Period† | Wet-Formed Prill | | Air-Formed Prill | |
| | Maximum Deposition Rate* | | Maximum Deposition Rate* | |
	g/m^2	lb/hectare	g/m^2	lb/hectare
January	0.013	0.29	0.043	0.95
February	0.010	0.22	0.031	0.68
March	0.012	0.26	0.038	0.84
April	0.008	0.18	0.027	0.59
May	0.011	0.24	0.037	0.82
June	0.010	0.22	0.033	0.73
July	0.009	0.20	0.029	0.64
August	0.011	0.24	0.036	0.79
September	0.010	0.22	0.032	0.71
October	0.025	0.55	0.079	1.74
November	0.019	0.42	0.060	1.32
December	0.012	0.26	0.039	0.86
Annual	0.099	2.18	0.320	7.05

*The location of maximum monthly values change; therefore, the sum of the
monthly values does not equal the annual deposition value.
†Based on 1974 meteorological data.

Note: g/m^2 x 22.03 = lb/hectare.

Figure 4-4
1974 ANNUAL SULFUR PARTICULATE
DEPOSITION RATES (g/m^2)——
WET-FORMED PRILL

AGRICO CHEMICAL COMPANY
Prilled Sulfur Facility

KEY
- ■ PLANT BOUNDARY
- ⊛ PRILLED SULFUR FACILITY SITE
- ▲ MAXIMUM DEPOSITION (0.32 g/m2)

Figure 4-5
1974 ANNUAL SULFUR PARTICULATE DEPOSITION RATES (g/m²)—— AIR-FORMED PRILL

AGRICO CHEMICAL COMPANY
Prilled Sulfur Facility

KEY

--·-- PLANT BOUNDARY
○☆ PRILLED SULFUR FACILITY SITE
▲ MAXIMUM DEPOSITION
   (0.025 g/m2)

SCALE

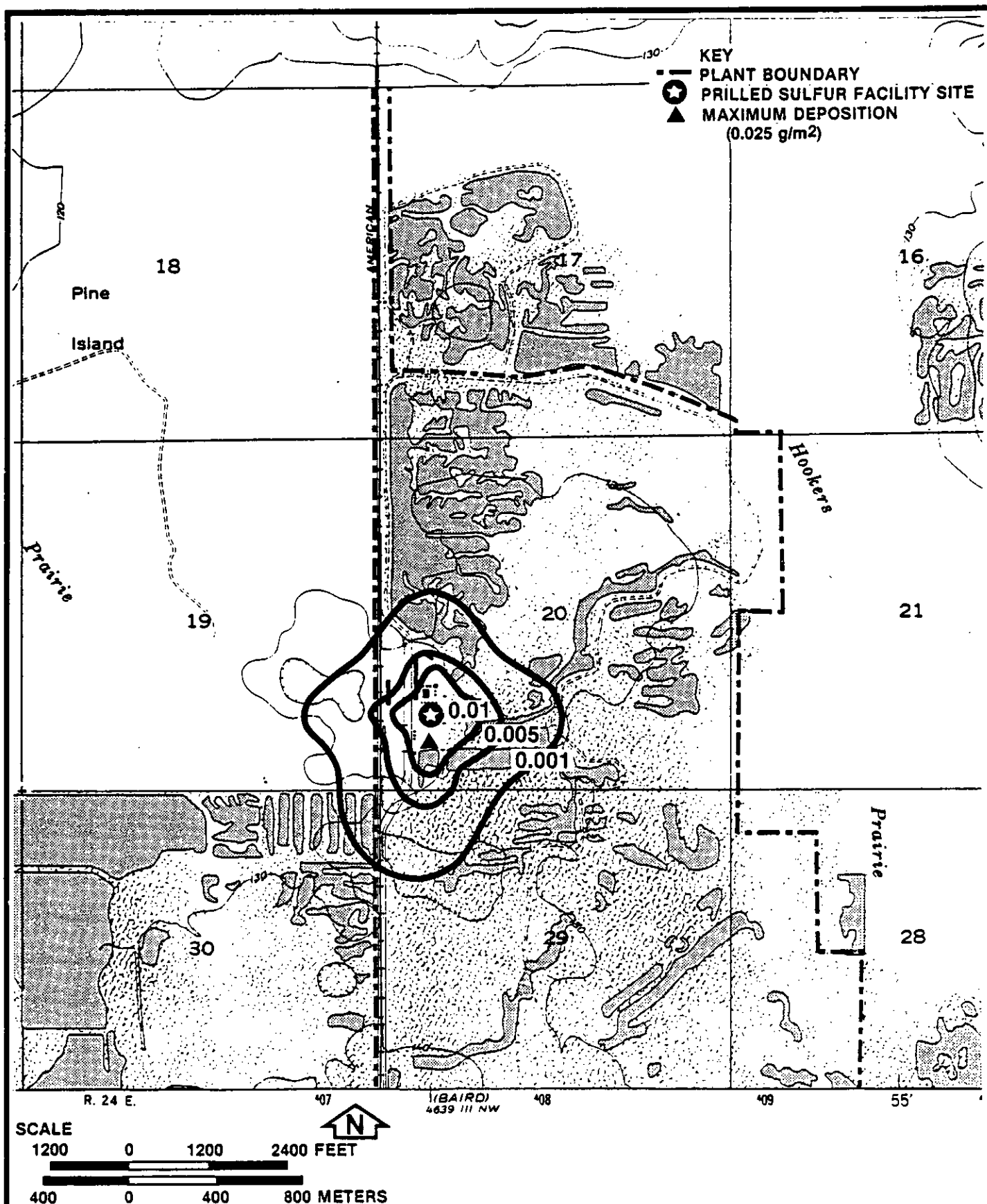1200   0   1200   2400 FEET

400   0   400   800 METERS

Figure 4-6
COMPOSITE OF MAXIMUM 1974 MONTHLY
SULFUR PARTICULATE DEPOSITION RATES
(g/m²)——WET-FORMED PRILL

AGRICO CHEMICAL COMPANY
Prilled Sulfur Facility

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KEY
- - - PLANT BOUNDARY
⬡ PRILLED SULFUR FACILITY SITE
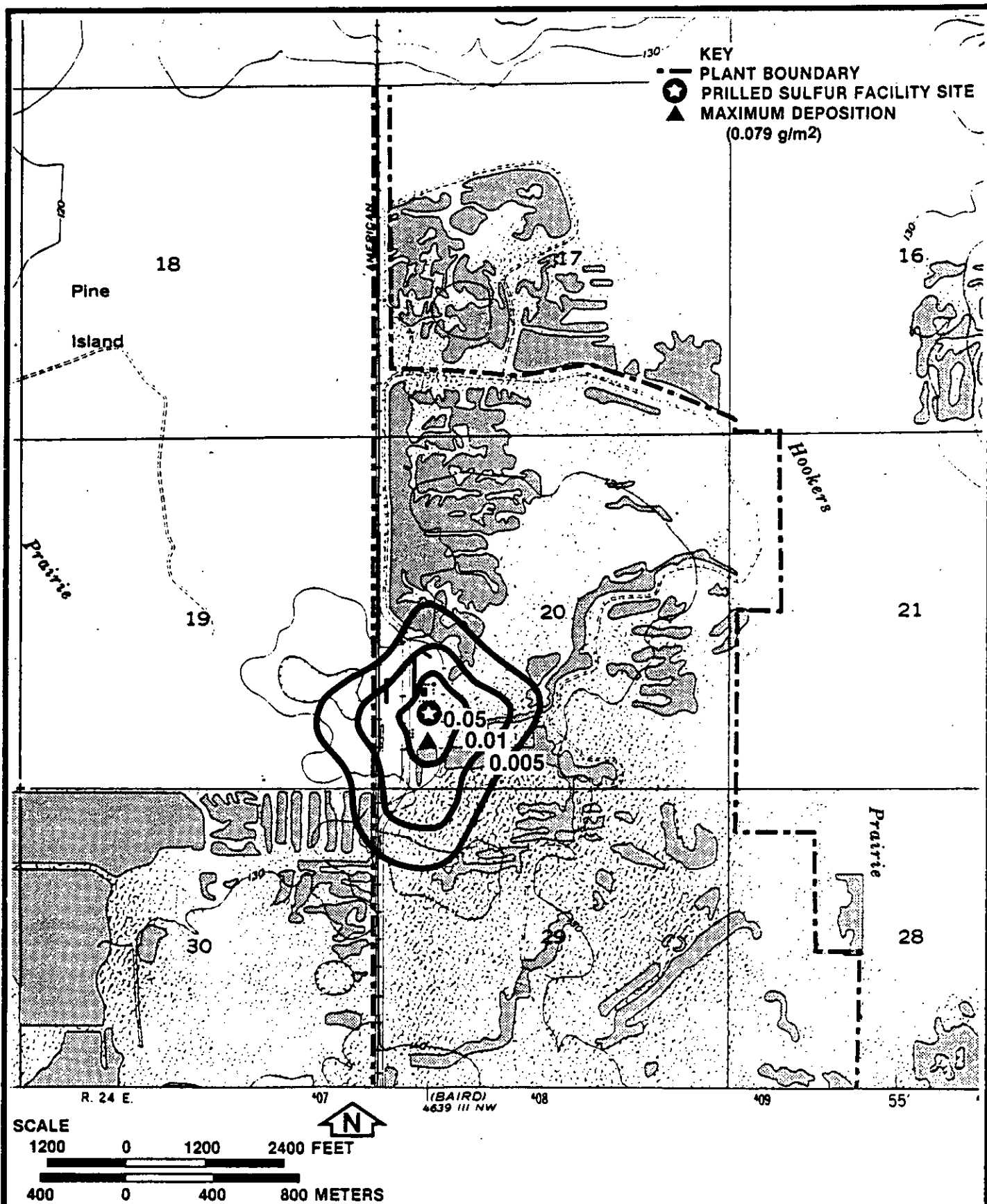▲ MAXIMUM DEPOSITION
(0.079 g/m2)

Figure 4-7
COMPOSITE OF MAXIMUM 1974 MONTHLY
SULFUR PARTICULATE DEPOSITION RATES
(g/m²)——AIR-FORMED PRILL

AGRICO CHEMICAL COMPANY
Prilled Sulfur Facility

SCALE

1200 0 1200 2400 FEET

400 0 400 800 METERS

APPENDIX A

EXCERPTS FROM REVISED AIR CONSTRUCTION
PERMIT APPLICATION FOR PRILLED SULFUR

AGRICO CHEMICAL COMPANY
SOUTH PIERCE CHEMICAL WORKS

APPENDIX A
PROCESS DESCRIPTION
PRILLED SULFUR

The purpose of the project is to construct a handling facility at the existing Agrico South Pierce Plant to receive and transfer prilled sulfur to a new sulfur melting system. The sulfur will be received at a rate of 1800 long tons per day. The facility will process a maximum of 600,000 long tons per year.

Standard sulfur pellets are received in covered hopper railroad cars, or covered hopper trucks, and positioned over the unloading hopper, Item 1, within the unloading shed. The unloading hopper is a below grade small hopper which will receive material from only one hopper section of a railcar at a time so as to minimize the free fall and minimize the hopper area required. This in turn minimizes the amount of fugitive particulate generated by the free fall of material from the hopper car or truck to the unloading hopper. The unloading hopper is equipped with high efficiency water sprays, Item 2, around the periphery, which will collect 85% of the fugitive particulate generated by this free

fall. The spray water will be treated with a surfactant.

The unloading rate is controlled by the belt feeder, at the bottom of the unloading hopper. Under normal unloading conditions the unloading hopper will be full, and the flow from the hopper car or hopper truck will flow under choked conditions, thereby eliminating the free fall.

The sulfur pellets are transfrerred from the belt feeder to the unloading belt, Item 4, and conveyed to the 150 ton surge hopper, Item 6. The transfer point of the material to the surge hopper is hooded and equipped with a water spray containing suffactants, Item 5.

The sulfur pellets are metered and conveyed by the feed/transfer screws, Item 7, to one of three sulfur melters, in which the sulfur prills are melted. The resulting molten sulfur flows by gravity to the existing sulfur pit, Item 9. The sulfur melters, Item 8, are completely enclosed, high speed and agitated. The capacity of the melters is 900 long tons per day each, with one of the melters serving as an installed spare. The vent gases from the melter contain steam produced by the vaporization of the water content of the sulfur, a small amount (up to approximately 3,000 ppm) of H_2S and even a smaller amount of sulfur vapor. These off

gases from the melters are collected in a duct system into which heated air is introduced after having been heated by the dilution air pre-heat coil. This heated dilution air prevents the condensation of sulfur vapor in the duct work leading to the vapor scrubber, Item 10.

The vapor scrubber system consists of a Venturi spray tower scrubber, the vapor scrubber circulation pumps, and the vapor scrubber fan. The sulfur melter vapors are scrubbed by a circulating solution of sodium hydroxide with the hydrogen sulfide being converted to sodium sulfide. The scrubber system is designed for a 98% removal of both hydrogen sulfide and 95% removal of condensed sulfur. An additional purpose of the heated air is to maintain a water balance on the vapor scrubber circulating liquid. That is, a sufficient amount of heat will be added to balance condensation of water vapor into the scrubbing solution with evaporation of water from this solution.

The volume of circulating solution within the scrubber system is such that this solution will not need to be changed more than once per day. The circulating solution is spent when essentailly all of the sodium hydroxide has been converted to sodium sulfide. When this occurs, the nearly spent solution is pumped to the spent caustic treated, Item 12, while the vapor scrubber is in

operation. The scrubber is then refilled with fresh caustic solution back to normal operating level.

The spent caustic is treated on a batch basis by the slow addition of hydrogen peroxide and sulfuric acid into the circulating solution. This converts the sodium sulfide to sodium sulfate and elemental sulfur. Any excess caustic is also neutralized by the addition of sulfuric acid, Item 13.

The effluent from the spent caustic treatment and water spray drainage will all be collected in the effluent surge tank, Item 14. The liquid is then pumped to the sulfur recovery filter, Item 15. Sulfur is removed and the remaining liquid is then consumed in the phosphoric acid plant reactor, Item 16, where it is used as process water. The recovered sulfur is discharged to the surge hopper, Item 6.

LOCATION OF PARTICULATE EMISSION SOURCES

POINT 1

Car Unloading Hopper

1. From point of release to midway in hopper is 5 feet.

2. Wind - 2 MPH based upon 8 MPH Avg. x 75% control factor for enclosure.

3. Spray efficiency with surfactant - 85%.

POINT 2

Transfer from hopper belt to conveyor belt.

1. Underground drop of 2 feet from one belt to another.

2. Underground transfer - wind 1 MPH (or less).

POINT 3

1. Conveyor belt into 150 T surge hopper. Midway distance is 15 feet.

2. Wind - 2 MPH based upon 8 MPH Avg. x 75% control factor for enclosure.

3. Spray efficiency with surfactant - 85%.

SUPPLEMENTS #2, 3 & 5

APPENDIX B

ESTIMATION OF TOTAL SULFUR PARTICULATE EMISSIONS
FROM AGRICO'S SPCW PRILLED
SULFUR HANDLING AND MELTING INSTALLATION

Rule 17-2.515(4)(c) sets forth the requirements to determine total sulfur particulate emissions for deposition rate analysis. These factors are to be used to estimate sulfur deposition rates due to emissions from a sulfur handling facility. The rule requires that a particle-size distribution curve (aerodynamic particle diameter size) be calculated based upon tests, published data, or prior test results. Particles from 0 to 300 micrometers (μm) in diameter are to be considered. The emission estimates developed according to Rule 17-2.215(4)(a) (i.e., Table 2-1 as applied to SPCW) must be assumed to represent the 0- to 30-μm size particles. Using these emission estimates and the calculated particle-size distribution, the weight of particles in the 30- to 300-μm size range is to be estimated. For deposition calculations, the distribution is to be broken into a number of particle-size ranges, with the mass median diameter used to represent each particle-size category. Control efficiencies are to be developed and applied to each particle-size range. Agrico has developed sulfur deposition emission estimates according to the applicable rules, as described below.

A particle-size distribution curve for particulate emissions from prilled sulfur was prepared by Dr. Chatten Cowherd of Midwest Research Institute (MRI). This distribution is based on particle-size data given in AP-42 and MRI prilled sulfur emissions measurements reported in "Measurement of Fugitive Dust Emissions from Prilled Sulfur Handling" (June 1984). The MRI data, obtained for wet-formed prilled sulfur, are in general agreement and support the AP-42 data.

The procedure for developing the particle-size distribution is based on the particle size data given in AP-42 (batch drop equation) together with the MRI emissions data collected during the June (1984) field tests. The size distribution of the <50 μm Aerodynamic (μmA) particulate emissions measured during the first nine handlings of the sulfur prill in California was found to agree very closely with AP-42. A spline-fit of the sulfur particle-size data, following the procedure described in

"A Computer-Based Cascade Impactor Data Reduction System" (EPA-600/
7-78-042), was used to obtain an estimate of the mass fraction of total
particulate emissions in the <50 µmA particle-size range, for which the
AP-42 equations were originally developed. A second spline-fit for
particles of all sizes was then obtained using the estimated <50 µmA
fraction, the size fractions given in AP-42, and an estimated largest
particle diameter of 300 µmA. The resulting particle size distribution
is shown in Figure B-1 and represents uncontrolled total sulfur particle
emissions. Since the California testing represents the only particle
size data for sulfur particulate emissions, Figure B-1 was assumed
applicable to both wet- and air-formed prilled sulfur particulate
emissions.

In performing the deposition calculation, the mass distribution curve
must be divided into a number of particle-size intervals. This number
should normally be 10, or at most 20. The distribution should be divided
into equal weight fractions. If 10 intervals are chosen, each interval
should represent 10 percent of the total aerosol mass. Each interval
should be modeled using the interval mass median particle size to
represent that interval. For example, the cumulative mass distribution
curve (see Figure B-1) would be divided into 10 equal mass fractions
(0 to 10 percent, 10 to 20 percent, 20 to 30 percent, etc.). The mass
median diameter of the 0- to 10-percent fraction is the 5-percent
particle size. The mass median diameter of the 10- to 20-percent
fraction is the 15-percent particle size, etc.

These 10 median diameters (5-percent size, 15-percent size, 25-percent
size, 35-percent size, etc.) are then used to make the deposition
calculations using the gravitational settling velocity for particles of
these sizes. Ten percent of the total aerosol mass is attributed to each
interval and the results of the ten calculations summed to obtain the
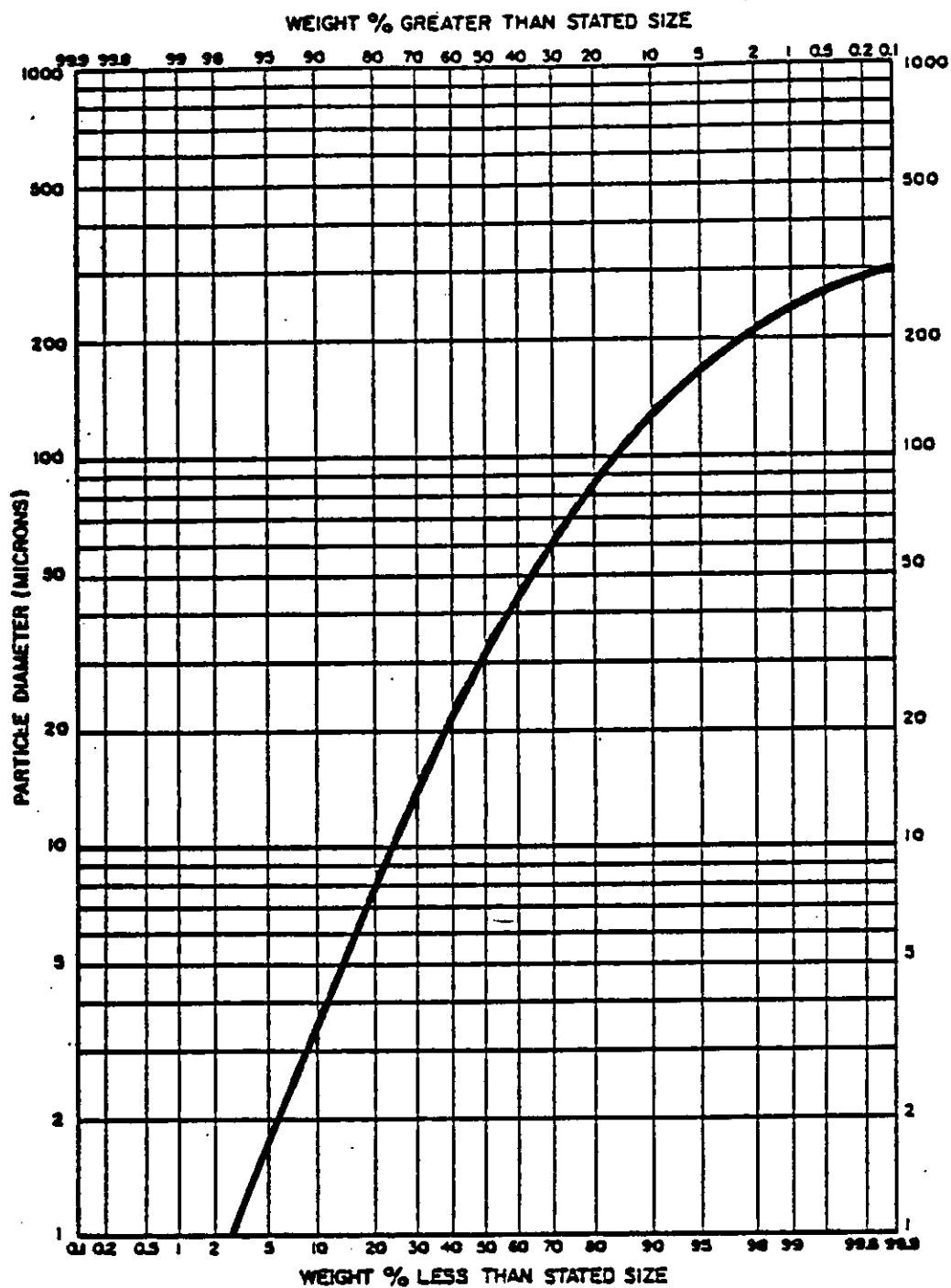total deposition.

Figure B-1
PARTICLE SIZE DISTRIBUTION FOR FUGITIVE EMISSIONS FROM PRILLED SULFUR

AGRICO CHEMICAL COMPANY
Prilled Sulfur Facility

If the most accurate calculation is desired, then 20 intervals, each
representing 5 percent of the total aerosol mass, would be used.
Inherent model limitations and inaccuracy limit the maximum useful
interval number to 20. Ten intervals would normally produce similar
accuracy. Ten intervals were therefore used for the Big Bend analysis.

For the distribution shown, the ten diameters used in the deposition
calculations are as follows:

   D-5% = 2 μm, Settling Velocity = 0.013 cm/sec
   D-15% = 6 μm, Settling Velocity = 0.11 cm/sec
   D-25% = 11 μm, Settling Velocity = 0.37 cm/sec
   D-35% = 18 μm, Settling Velocity = 0.98 cm/sec
   D-45% = 26 μm, Settling Velocity = 2.04 cm/sec
   D-55% = 37 μm, Settling Velocity = 4.14 cm/sec
   D-65% = 52 μm, Settling Velocity = 8.14 cm/sec
   D-75% = 64 μm, Settling Velocity = 11.7 cm/sec
   D-85% = 110 μm, Settling Velocity = 29.0 cm/sec
   D-95% = 160 μm, Settling Velocity = 52.0 cm/sec

Total aerosol mass used in the deposition calculations is determined by
multiplying the AP-42 calculated emissions by 2.1. The 2.1 factor was
derived from Figure A-1 by assuming that the AP-42 estimates represent
the total aerosol mass in the 0- to 30-μm size range (i.e., 48 percent by
weight). The resulting emissions represent total aerosol mass in the 0-
to 300-μm size range. Ten percent of this total mass is apportioned to
each of the ten particle sizes listed above to represent the ten
distribution weight fractions modeled.

The control measures to be applied to the prilled sulfur installation
operations consist of water/surfactant spray or fogging systems.
Sufficient data are not available to estimate control efficiency versus
particle-size category for these control measures for 0- to 300-μm
particles. Therefore, the estimated control efficiencies were assumed to

apply equally to all particle-size categories. The suspended particulate emissions after control can then be multiplied by the previously derived factor of 2.1 to obtain total particulate emissions (0 to 300 μm) after control.