First in cellulose

The Buckeye
Cellulose Corporation

Mailing Address: Route 3 Box 260 Perry, Florida 32347 Phone: (904) 584-0121

January 17, 1986

DER
JAN 17 1986
BAQM

Mr. Bruce Mitchell
Florida Department of
Environmental Regulation
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, FL 32301

Re: Causticizing Modernization
No. 4 Lime Kiln GEP Stack
Height Determination & Precipitator Design
Construction Permit No: AC 62-107858

Dear Mr. Mitchell:

Enclosed are four copies each of the No. 4 Lime Kiln GEP stack height evaluation and final precipitator design information. Per your conversation with Ms. Julia Pringle on January 9, 1986, only one copy of the detailed modeling for the stack height determination is enclosed.

All of the sensitive information for which confidential treatment is requested has been collected in Attachment II. In accordance with Florida Laws, including 403-111 of the Florida Pollution Control Acts, confidential treatment of this section is requested.

Based on the GEP stack height determination, we propose constructing a 125' stack for the No. 4 Lime Kiln emission point. The following comments are for clarification:

1. Modeling uses a conservative approach based on minimum design rate volumes and maximum permitted emission rates. Modeling results presented are worst day impacts. Even the property line designations are conservative. For example, in Figure 3-2 in the main report, the area northeast of the plant process areas is actually Buckeye Cellulose plant property used for the Watkins parking area. Also, precipitator design is based on worst case air flows.

2. Worst day ground level impacts for all the contaminants modeled for both no downwash and downwash conditions are all under the PSD screening model significance level except for a minor exceedance of the 24-hour particulate level. This exception would only occur in downwash situations with winds blowing north at 340°. Due to the plant layout, it is a reasonable conclusion that interaction with other plant sources is minimal and, therefore, the impact is insignificant.

3. As part of an effort to develop possible worst case scenarios such as suppliers not meeting percent solids guaranteed in the lime mud feeding the kiln, a higher flue gas volume was initially modeled. After completing

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that model and evaluating the results, an addendum was prepared to evaluate worst case expected operation of the unit at maximum operating rates. All of this information is being supplied for a complete understanding of the modeling process.

After all the evaluations, it is clear that a 125' stack meets all the requirements to protect ambient air quality, the increment, and health.

We appreciate the cooperation and candid communication with the Department throughout this permitting process. Also, we thank you for agreeing to a meeting at 2:00 p.m. on Thursday, January 23, 1986 to discuss and confirm your approval of the 125' stack height.

Very truly yours,

THE BUCKEYE CELLULOSE CORPORATION

John Millican

John H. Millican
Environmental Control Manager

JHM/eph
1886H

Attachments

cc: Mr. Dave Buff, P.E. - KBN
Ms. J. W. Pringle

ATTACHMENT I

DER
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BUCKEYE CELLULOSE CORPORATION
Taylor County; Perry, Florida
January 17, 1986

CAUSTICIZING MODERNIZATION
No. 4 Lime Kiln with an Associated Electrostatic Precipitator
Construction Permit No. AC 62-107858

GEP Stack Height Evaluation for No. 4 Lime Kiln

(Report and Addendum)

GEP STACK HEIGHT EVALUATION FOR
LIME KILN NO. 4
BUCKEYE CELLULOSE CORPORATION
PERRY, FLORIDA

Prepared by

KBN ENGINEERING AND APPLIED SCIENCES, INC.

January 9, 1986

GEP STACK HEIGHT EVALUATION FOR
LIME KILN NO. 4
BUCKEYE CELLULOSE CORPORATION
PERRY, FLORIDA

PREPARED BY KBN ENGINEERING AND APPLIED SCIENCES, INC.
January 9, 1986

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1.0 INTRODUCTION

The Buckeye Cellulose Corporation owns and operates a kraft dissolving cellulose plant in Perry, Florida. Buckeye recently applied for and was granted an air construction permit for construction of a new lime kiln (No. 4 Lime Kiln). Buckeye stated in the air construction permit application that the stack for the new lime kiln had not yet been designed, but that the probable height of the stack would be in the range of 100 to 125 feet. Buckeye further stipulated that prior to construction of the stack, a good engineering practice (GEP) stack height analysis would be submitted to the Florida Department of Environmental Regulation (DER).

Presented in this report is the GEP stack height analysis for the No. 4 Lime Kiln with a 125 foot tall stack. Section 2.0 presents a discussion of the regulatory requirements which govern the analysis, and Section 3.0 presents the GEP stack height analysis. Section 4.0 presents an analysis of the air quality impact of the proposed No. 4 Lime Kiln, which evaluates the potential for building downwash to influence ground-level concentrations in the vicinity of the Buckeye plant. Conclusions of the study are presented in Section 5.0.

2.0 SUMMARY OF STACK HEIGHT REGULATION

2.1 BACKGROUND

The U.S. Environmental Protection Agency (EPA) promulgated final revised stack height regulations on July 8, 1985 (Federal Register, Vol. 50, No. 130). The revised regulation was effective as of August 7, 1985, and replaces stack height regulations promulgated on February 8, 1982 and proposed on November 9, 1984. The purpose of the stack height rule is to implement Section 123 of the Clean Air Act, as amended, which requires that the degree of emission limitation required for the control of any air pollutant is not affected by that portion of any stack height which exceeds GEP or by any other dispersion technique. Section 123 defines GEP as:

> "the 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 or wakes which may be created by the source itself, nearby structures or nearby terrain obstacles"

The stack height regulation does not restrict the actual height of any stack, but regulates the creditable stack height used to determine emission limits [e.g., the stack height used in a dispersion modeling analysis to determine compliance with ambient air quality standards (AAQS) or allowable Prevention of Significant Deterioration (PSD) increments]. The intent of this provision of the Clean Air Act is to prevent sources from constructing tall stacks or implementing other techniques, which rely on the dispersive effects of the atmosphere, as a means of complying with AAQS or PSD increments.

2.2 IMPLEMENTATION

Regulations to implement Section 123 of the Clean Air Act were proposed by EPA on January 12, 1979 and October 7, 1981, and promulgated on February 8, 1982. Revisions to this initial rulemaking were proposed on November 9, 1984, and promulgated on July 8, 1985. The regulations, contained in the

Code of Federal Regulations, Title 40, Part 51 (40 CFR 51), Sections 51.12 and 51.18, require that State Implementation Plans contain provisions to ensure that the degree of emission limitation required for any source is not affected by a stack height which exceeds GEP or any other dispersion technique. It also requires that new sources and modifications be reviewed to ensure compliance with the regulations.

In response to the EPA requirements, the State of Florida incorporated the provisions of 40 CFR 51 into the Florida Administrative Code (FAC), Chapter 17-2, Section 17-2.270. The State of Florida has not yet had sufficient time to incorporate the recent July 8, 1985, promulgation into FAC Chapter 17-2. However, for practical purposes, the EPA regulations must be complied with regardless of the status of the state regulations.

2.3 DEFINITIONS

Several key definitions form the heart of the stack height regulation. These definitions are summarized below:

1. <u>Good Engineering Practice (GEP) stack height (H_g)</u> -- means the greater of:
    a. 65 meters (213 feet)
    b. $H_g = H + 1.5 L$
       where H = height of "nearby" structures
       L = lesser dimension of height or projected width of "nearby" structures
    c. $H_g = 2.5 H$
       where H is as defined above (This equation is only applicable to stacks in existence on January 12, 1979 and only if this equation was relied upon in establishing an emission limitation).
    d. The height necessary to ensure that emissions do not result in "excessive" concentrations as a result of building or terrain influences, as demonstrated by a fluid modeling or field study.

In applying the above formulas, all heights are measured from the ground-level elevation at the base of the stack. The GEP stack height is the maximum creditable stack height allowed to be used in a dispersion modeling analysis to determine emission limits. The actual stack height can be greater, but no credit is received for that portion of the stack which exceeds GEP.

2. Excessive Concentration -- means, in general, an increase of 40 percent or more in maximum ground-level concentrations due to downwash phenomena. In certain cases, the increase must also contribute to concentrations which exceed either a national AAQS or an allowable PSD increment.
3. Nearby -- means within five times the lesser of the height or projected width of a structure, but not greater than 0.8 km (0.5 miles), except in certain cases where a fluid modeling or field study is conducted, in which case the term can mean up to 10 times the maximum height of the terrain feature.
4. Dispersion Technique -- means any technique which attempts to affect the concentrations of a pollutant in the ambient air by:
    a. Constructing a stack which exceeds GEP height
    b. Varying emission rate according to atmospheric conditions or ambient pollutant levels
    c. Increasing exhaust gas plume rise by manipulating process, exhaust gas, or stack design parameters. Under certain conditions, the merging of exhaust gas streams is excluded from this definition. The reheating of an exhaust gas stream to the temperature the gas stream had prior to entering an air pollution control device, and facilities with allowable sulfur dioxide emissions of 5,000 tons per year or less, are excluded from this definition.

2.4 TECHNICAL GUIDANCE

Technical guidance on the practical application of the stack height regulations are provided in several EPA documents. The documents provide guidance in the two main areas listed below:

1. Practical Application of the GEP Stack Height Formulas
    a. "Guidance for Determination of Good Engineering Practice Stack Height (Technical Support Document for the Stack Height Regulation)", EPA-450/4-80-023R, June 1985.
2. Fluid Modeling Demonstrations
    a. "Guideline for Use of Fluid Modeling to Determine Good Engineering Stack Height", EPA-450/4-81-003, July 1981.
    b. "Guideline for Fluid Modeling of Atmospheric Diffusion", EPA-600/8-81-009, April 1981.

The procedures outlined in these documents are complex and require site-specific interpretation. The application of the stack height regulation and guidelines to the No. 4 Lime Kiln at the Buckeye Cellulose plant is presented in Section 3.0.

3.0 CALCULATION OF GEP STACK HEIGHT

3.1 METHOD OF ANALYSIS

A survey of the Buckeye Cellulose plant was conducted initially to view the proposed stack location in regard to nearby influential buildings and structures. Dimensions of both existing and planned structures were obtained along with other pertinent engineering information. Scale drawings, plot plans, and aerial photographs of the plant were reviewed.

The Buckeye Cellulose plant is situated in basically flat terrain (see Fig. 3-1). As a result, terrain obstacles and plume impaction upon such obstacles is not a factor in determining the GEP stack height for the No. 4 Lime Kiln. Any potential downwash effects upon the No. 4 Lime Kiln stack emissions will be due solely to building downwash effects. Grade elevation of the plant is approximately 55 feet above mean sea level.

The only major structures currently under design at the plant for future construction are those associated with No. 4 Lime Kiln and the associated new causticizing system. The major planned structures include the kiln, mud storage tanks, the building housing the precoat filters, the electrostatic precipitator, and the lime silos.

The GEP stack height regulation does not allow consideration of structures located beyond 0.8 km of the stack location in determining GEP stack height. However, all of the plant process structures are located within 0.6 km of the stack, and therefore, all of the process structures must be considered in determining GEP stack height for No. 4 Lime Kiln.

Shown in Figure 3-2 are the major planned structures associated with the No. 4 Lime Kiln and causticizing system expansion, the major existing structures at the plant, and the planned location of the proposed No. 4 Lime Kiln stack. Also shown are several less prominent structures which are located in the immediate vicinity of the No. 4 Lime Kiln stack location. These structures are generally either rectangular (buildings) or cylindrical (tanks) in shape.

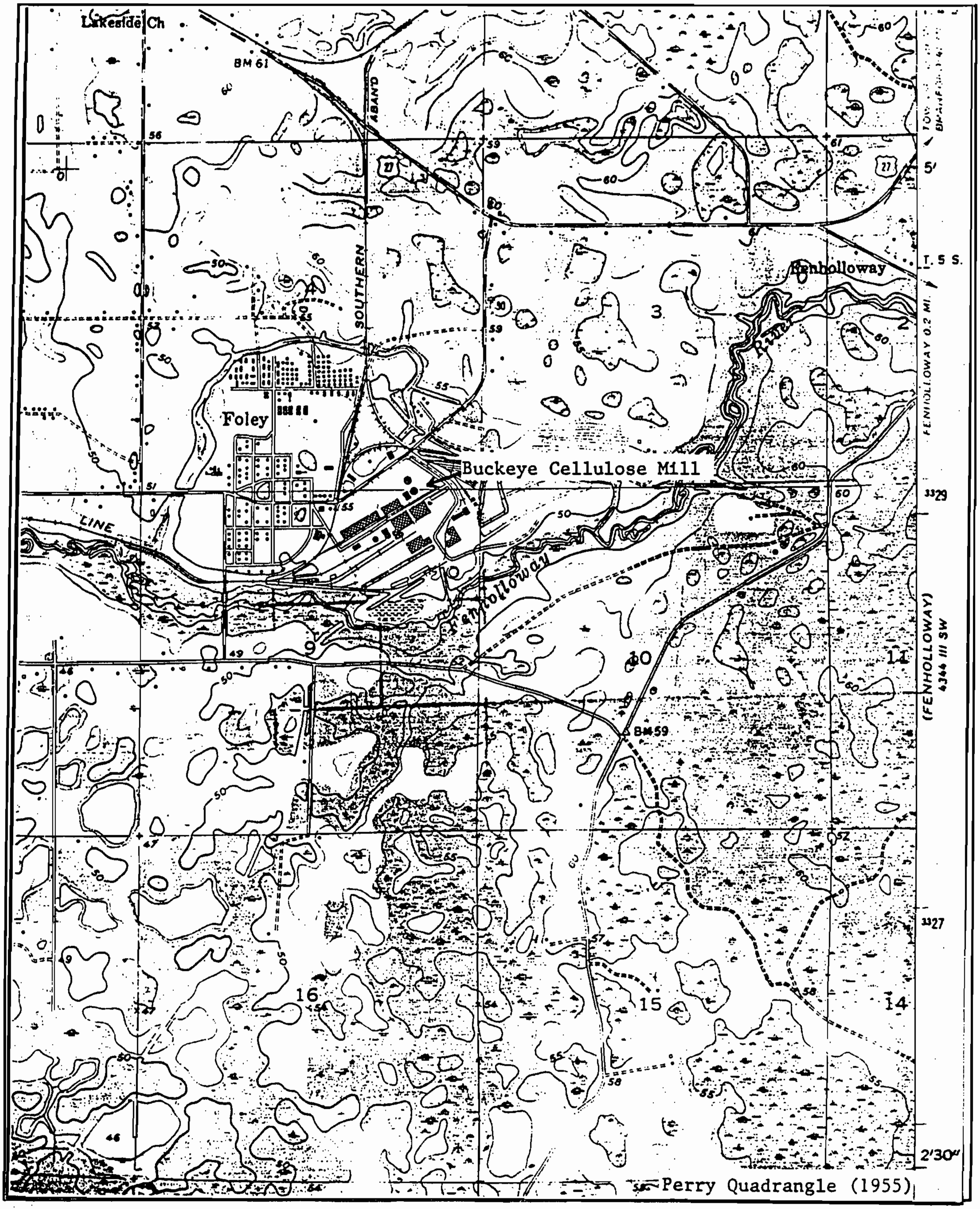

FIGURE 3-1. LOCATION MAP OF BUCKEYE CELLULOSE CORPORATION

Source: USGS, 1955

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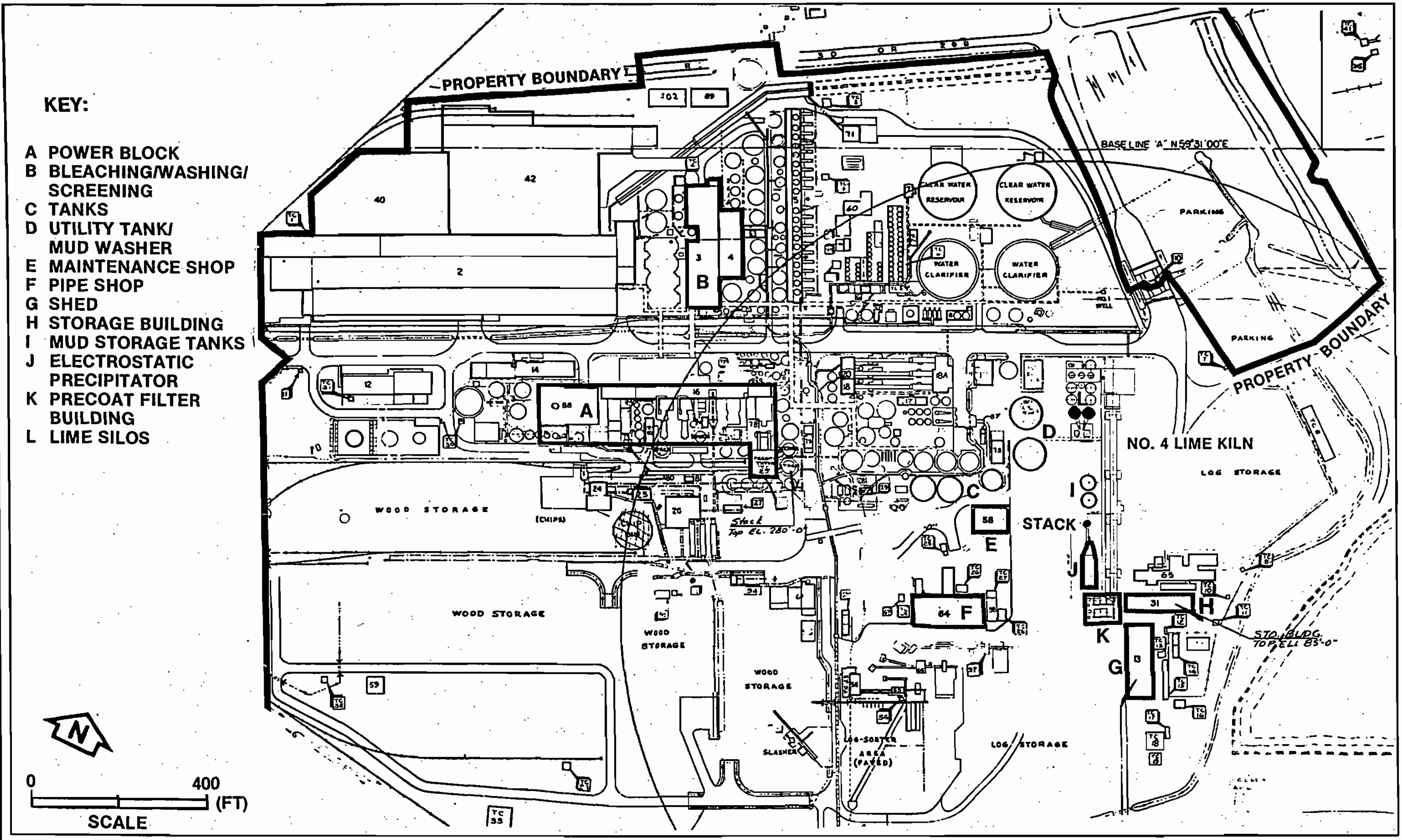

Figure 3-2
MAJOR STRUCTURES AT
BUCKEYE CELLULOSE PLANT

GRADE ELEVATION IS APPROXIMATELY 55 FEET ABOVE MEAN SEA LEVEL.

The most prominent structures at the Buckeye plant are those located within the Power block (designated as "A" in Figure 3-2). This area includes the buildings containing the Nos. 2, 3 and 4 Recovery Boilers, Nos. 1 and 2 Power Boilers, and Nos. 1 and 2 Bark Boilers. Heights of these buildings range up to 150 feet above grade. A detail drawing of the individual major structures within the Power block is presented in Appendix A.

Only those structures which are "nearby" are considered in determining GEP stack height. "Nearby" is defined as a distance up to five (5) times the lesser of the height or projected width of the structure. The projected width is determined by projecting the frontal area of the structure onto a plane perpendicular to the wind direction. For each building, this wind direction would be the direction which aligns the particular structure and the proposed stack.

Presented in Table 3-1 is a compilation of the structure dimensions, the projected width, and the influencing area of each major structure shown in Figure 3-1. In addition, a column is shown which identifies if the proposed stack falls within the area of influence of the structure. The GEP stack height is calculated based upon each influencing structure and the GEP formula. The GEP formula is as follows:

$$H_g = H + 1.5 L$$

where H = height of nearby structure

L = lesser dimension of the height or projected width of the nearby structure.

All heights are measured relative to the ground elevation at the base of the stack. Under GEP rules, structures located close to each other are to be treated as a single structure if the distance separating the structures is less than the smallest width of either structure. This provision affects structures A3, C, D, I and L, as reflected in either the length or width dimension shown in Table 3-1.

Table 3-1. GEP Stack Height Analysis for No. 4 Lime Kiln

Structure	Map Key	Height (ft)	Length* (ft)	Width# (ft)	Projected Width (ft)	Area of Influence** (ft)	Stack Within Area of Influence	GEP Stack Height## (ft)
Existing Structures								
Power Block								
No.4 Recovery Boiler	A1	150	90	140	95	475	NO	-
No.3 Recovery Boiler	A2	120	60	120	60	300	NO	-
No.1&2 Power Boilers/ No.1 Bark Boiler	A3	70	50	140	50	250	NO	-
No.2 Bark Boiler	A4	115	60	60	60	300	NO	-
No.2 Recovery Boiler	A5	120	60	70	60	300	NO	-
No.2 Recovery Blr.ESP	A6	100	100	70	100	500	NO	-
Bleaching/Washing/ Screening	B	95	270	110	260	475	NO	-
Tanks (3)	C	45	50	200	100	225	YES	113
Util. Tank/Mud Washer	D	45	160	70	110	225	YES	113
Maintenance Shop	E	25	60	80	60	125	NO	-
Pipe Shop	F	27	70	160	150	135	NO	-
Shed	G	32	160	60	110	160	NO	-
Storage Building	H	30	40	150	140	150	NO	-
Planned Structures								
Mud Storage Tanks	I	35	72	35	35	175	YES	88
Electrostatic Precip.	J	62	65	25	25	125	YES	100
Precoat Filter Bldg.	K	75	65	80	80	375	YES	188
Lime Silos	L	90	25	55	55	275	YES	173

* Dimension of structure in a plane parallel to plant north

\# Dimension of structure in a plane perpendicular to plant north

** Five (5) times the lesser of the height or projected width (L)

\## Based upon GEP formula $H = H + 1.5 L$ (see text for details)

Note: Grade elevation for all structures is 55 ft above mean sea level. All heights shown in table represent height above grade

3.2 RESULTS

The results of the GEP stack height analysis are presented in the last column of Table 3-1. The results show that of the existing structures at the plant, only the utility tanks (structure C) and the utility/mud washing tanks (structure D) have the potential to affect the No. 4 Lime Kiln stack emissions. The calculated GEP stack height for both of these structures is 113 feet (34.4 m). The areas of influence of the other existing structures, including the Power block, do not encompass the proposed stack location, either due to the relatively short heights of these structures or the distance between the structure and the proposed stack location.

Several of the planned structures associated with the No. 4 Lime Kiln and causticizing system have the potential to influence emissions from the kiln. These are the mud storage tanks, electrostatic precipitator, precoat filter building and lime silos, which are located in close proximity to the proposed stack. The precoat filter building and lime silos are the most predominant of these structures, with the precoat filter building resulting in the larger GEP stack height of 188 feet (57.3 m).

The influencing structures identified in Table 3-1 will influence No. 4 Lime Kiln stack emissions for only certain wind directions. These are wind directions which align the structures and the proposed stack location. The influencing wind directions for each structure are presented in Table 3-2. Review of this table shows that for certain wind directions, namely 0° to 70°, 170° to 250° and 350° to 360° (directions towards which the wind is blowing), no building downwash effects will occur.

The proposed stack for No. 4 Lime Kiln will be constructed to a height of 125 feet. This height does not exceed the GEP stack height of 188 feet, which would be creditable under the GEP stack height regulations. Since the actual stack height of the kiln will be less than the GEP stack height, an air quality analysis of the emissions from the proposed stack was conducted to evaluate the potential impacts due to building downwash effects. This analysis is presented in Section 4.0.

Table 3-2. Influencing Structures and Wind Directions Aligning No. 4 Lime Kiln Stack

Structure	Map Key	Influencing Wind Directions* (deg)
<u>Existing Structures</u>		
Tanks (3)	C	70-95, 250-275
Utility Tank/Mud Washer	D	95-130, 275-310
<u>Planned Structures</u>		
Mud Storage Tanks	I	140-170, 320-350
Electrostatic Precipitator	J	140-160, 320-340
Precoat Filter Building	K	130-160, 310-340
Lime Silos	L	140-160, 320-340

* Direction towards which wind is blowing (degrees from due north)

4.0 AIR QUALITY ANALYSIS

4.1 OBJECTIVE

In order to evaluate the potential air quality impacts of the new No. 4 Lime Kiln at the proposed 125 foot stack height, an atmospheric dispersion modeling analysis was conducted. The objective of the modeling was to predict maximum air quality impacts of No. 4 Lime Kiln, and to compare these impacts to EPA and Florida DER significant impact levels and AAQS. Since the proposed stack height of 125 feet is less than the calculated GEP stack height of 188 feet, the potential effects of building downwash conditions on maximum predicted air quality impacts were also investigated.

4.2 METHODOLOGY

4.2.1 General

The dispersion modeling analysis was conducted using the EPA and DER approved Industrial Source Complex Short-Term (ISCST) model. The ISCST model is a Gaussian plume model which can be applied to a wide variety of sources associated with an industrial complex (such as a pulp mill). A unique feature of the model is its ability to roughly simulate the effects of building downwash upon stack emissions. The ISCST model was used to predict maximum air quality impacts associated with No. 4 Lime Kiln under both non-downwash and downwash conditions. A more detailed description of the model is contained in Appendix B.

A one (1) year hourly meteorological data base from the National Weather Service (NWS) in Tallahassee, Florida (1981) was used for the air impact analysis. The Tallahassee NWS office is located about 50 miles northwest of the Buckeye plant, and is the closest, most representative NWS station which records the hourly surface data required by the dispersion model. The year 1981 represents the latest year for which data were available. These data are approved by Florida DER for use in dispersion modeling of sources located in the Perry, Florida area. Because a one year meteorological database was used in the modeling, the highest predicted short-term concentrations were used for comparison to air quality guidelines and standards.

Stack parameters used in the modeling evaluation were based upon the latest design information available for No. 4 Lime Kiln. The construction permit application for No. 4 Lime Kiln presented exhaust gas flow rates for both gas and oil firing, and a range of values for stack diameter, temperature and velocity. The values selected for the modeling analysis reflect conditions resulting in minimum expected plume rise (and therefore, maximum expected air quality impacts). These conditions reflect 100% oil burning (for lowest exhaust gas flow rate). The stack parameters used in the modeling were as follows:

Stack height: 125 ft.
Stack diameter: 7.25 ft.
Exhaust gas temperature: 320° F
Exhaust gas volume: 105,300 acfm
Exhaust gas velocity: 42.5 ft./sec.

The air quality impact analysis evaluated all criteria pollutants (i.e., pollutants for which AAQS have been set), except for ozone and lead. Ozone is produced by photochemical reactions associated with volatile organic compounds (VOC). VOC emissions cannot presently be accurately modeled because of its reactive nature. Emissions of lead have not been associated with lime kilns.

The pollutant emission rate used in the modeling analysis was reflective of the maximum permitted particulate matter (PM) emission rate for No. 4 Lime Kiln of 56.20 lb/hr (7.08 g/sec). Since the modeling analysis was conducted for the No. 4 Lime Kiln stack only, the results of the PM modeling can be used to determine the impacts for other pollutants as well. This is accomplished by applying a pollutant-specific factor to the PM results. The factors are based upon the ratio of emission rates. The emission rates for each pollutant considered in the analysis and associated factors are:

Pollutant	Emission Rate (lb/hr)	Factor
Particulate matter	56.2	1.00
Sulfur dioxide	20.1	0.36
Nitrogen oxides	95.0	1.69
Carbon monoxide	81.3	1.45

For sulfur dioxide and carbon monoxide, the emission rates are reflective of maximum hourly emissions, and these rates were used to predict both annual average and short-term maximum concentrations. The emission rate for nitrogen oxides is reflective of the average annual emission rate, and was used to predict maximum annual average nitrogen dioxide impacts (only an annual average AAQS exists for this pollutant).

4.2.2 Gaussian (non-downwash) Dispersion Modeling Analysis

The Gaussian dispersion modeling analysis did not consider the effects of building downwash conditions in predicting maximum air quality impacts. Dispersion models based upon the Gaussian plume equation have undergone a great deal of testing and validation, and are considered to be reliable tools for estimating maximum air quality impacts in flat or gently rolling terrain. In comparison, modeling of building downwash phenomena is in the development stage (see Section 4.2.3 for further discussion), and therefore, the results of such modeling are considered to be less reliable at this time. It is, therefore, important to consider the results from standard Gaussian dispersion modeling in any downwash analysis. In addition, building downwash effects may not occur under all conditions, such as light wind speeds or certain wind directions which do not interact the emitted plume with the wake region of a structure.

As discussed previously, the ISCST model was used in the modeling analysis. For the Gaussian (non-downwash) application, current EPA/DER guidance on the application of air quality models was followed (EPA, 1983). This guidance recommends selection of the "final plume rise" option, default values for wind profile exponents and vertical potential temperature gradients, and no inclusion of stack tip downwash effects.

A radial receptor grid centered on the proposed No. 4 Lime Kiln stack location was utilized. The grid consisted of 36 radials spaced at 10° increments and ranging from 10° to 360°. Receptors were placed at distances ranging from 100 m to 1900 m along each radial. Spacing between the receptors along each radial was 200 m.

4.2.3 Downwash Modeling Analysis

Potential building downwash effects on No. 4 Lime Kiln emissions were evaluated with the ISCST model, using the building wake-effects option. The procedure followed is the current EPA policy on downwash modeling (EPA, 1983). A copy of this policy is provided in Appendix C. This policy recommends evaluation of both the cavity region and wake region downwind of a structure. The cavity region extends from the downwind edge of a structure to a distance of 3L, where L is the lesser of the building height or projected width. Based upon the building heights and projected widths presented in Table 3-1, and the location of the No. 4 Lime Kiln stack (proposed) and influencing structures, the cavity regions downwind of the influencing structures would all fall within the Buckeye Cellulose plant property boundaries (i.e., those areas restricted from public access). Therefore, no concentration calculations were made for the cavity region.

Analysis of the wake region followed the EPA recommended policy, except that instead of utilizing a representative set of worst-case meteorological conditions, the one-year meteorological database from Tallahassee (1981) was used to identify actual worst-case meteorology. Model options selected were the same as those for the Gaussian model analysis (see Section 4.2.2), except that the distance dependent plume rise option was selected. The building downwash option within the model is invoked by including building dimensions in the source input data.

Four structures were evaluated for building downwash effects upon the No. 4 Lime Kiln stack emissions: the existing utility tanks (C), the utility/mud washer tanks (D) and the No. 4 Lime Kiln mud storage tanks (I) and precoat filter building (K). The No. 4 Lime Kiln electrostatic precipitator (J) and lime silos (L) were not evaluated because the influencing wind directions for the precoat filter building overlap the influencing wind directions for these two structures (see Figure 3-2 and Table 3-2). Since a larger GEP stack height is associated with the precoat filter building, indicative of greater building downwash influences, analysis of the precoat filter building will result in the highest predicted air quality impacts. This situation also exists for the No. 4 Lime Kiln mud storage tanks; however, the influencing wind directions for the precoat filter building do not completely overlap those for the mud storage tanks. Therefore, the mud storage tanks (I) were analyzed for the non-overlapping directions (170° and 350°; refer to Table 3-2).

A radial receptor grid centered on the proposed stack location was used in the modeling analysis with radials ranging from 10° to 360° and spaced at 10° increments. Receptors were placed along each radial at distances ranging from 100 m to 1900 m, with a 200 m spacing between receptors. This grid was used for each of the four structures evaluated for building downwash.

Receptors falling within plant property boundaries were not considered in determining predicted maximum impacts due to the No. 4 Lime Kiln. This procedure is consistent with EPA's definition of "ambient air," which excludes those areas which the general public does not have access. Property boundaries lying to the north and west of the No. 4 Lime Kiln stack location are shown in Figure 3-2. To the south, the boundary is the Fenholloway River, which is more than 500 m from the stack location.

The ISC model uses an "average" building width, based upon the specified building length and width, in its downwash calculations. This average width is appropriate if all potential wind directions are being evaluated, such as with a one-year hourly sequential database. However, if only specific wind directions are being analyzed, then the actual projected width of the building should be simulated. The projected widths for the four structures analyzed in this study were presented in Table 3-1. The procedure recommended by EPA to calculate appropriate model input values for building length and width, based upon the actual projected width, is shown in Appendix C. Application of this procedure resulted in the following equal values of building length and width input to the model for each structure analyzed:

Existing Utility Tanks (C) - 97.5 ft. (29.7 m)
Mud Storage Tanks (I) - 31.0 ft. (9.5 m)
Precoat Filter Building (K) - 70.9 ft. (21.6 m)

The initial results of the downwash modeling analysis indicated a significant influence of calm wind conditions upon maximum predicted air quality impacts. The Tallahassee meteorological database reflects an unusually high degree of calm wind conditions (about 33 percent of all hours). As a result, the Calms Processor (CALMPRO) post-processing routine was applied to the ISCST downwash model results. The post-processor is recommended for use by EPA in cases where calm winds affect model concentration predictions (EPA, 1983).

The building downwash algorithms contained in the ISCST model are based upon fluid modeling experiments, and reflect a specific stability, building shape and building orientation with respect to the mean wind direction. Therefore, the downwash simulation may not be applicable or accurate for all situations. However, as stated in the ISC user's guide (Cramer, 1979), the equations used are based upon the best available data and are considered "interim procedures" until additional data become available.

4.3 RESULTS

4.3.1 Gaussian (non-downwash) Dispersion Modeling Analysis

The results of the dispersion modeling analysis for the No. 4 Lime Kiln with a 125 foot tall stack, neglecting potential building downwash effects, are presented in Table 4-1. The results were obtained by applying the methodology described in Section 4.2.2. Also shown in Table 4-1 are the EPA and Florida DER "significance levels." Air quality impacts below these levels are considered to be insignificant. The screening analysis results show that predicted maximum impacts of all pollutants are below the significance levels. The 24-hour maximum particulate matter (PM) impact of 4.2 ug/m^3 represents 84% of the 24-hour significance level of 5 ug/m^3. Because this impact is approaching the significance level, the maximum impact was further refined using a 100 m receptor spacing. The resulting maximum 14-hour impact was 4.3 ug/m^3, still below the significance level. This maximum impact represents only 2.9% of the Florida 24-hour PM AAQS of 150 ug/m^3, and therefore is considered minimal.

Because of the insignificant nature of the predicted maximum non-downwash impacts, a refined modeling analysis was not justified for other pollutants and averaging times. Since a radial receptor grid of 10^o radial spacing and 200 m spacing between receptors along each radial was used, a more refined grid spacing would not yield significantly different results.

4.3.2 Downwash Modeling Analysis

The results of the downwash modeling analysis are presented in Table 4-2. These results reflect generally small increases in maximum impacts over those obtained from the Gaussian (non-downwash) modeling analysis. The maximum predicted impacts of all pollutants are still less than the significance levels, except for the 24-hour PM impact, even when considering potential downwash effects. The maximum predicted 24-hour impact of PM (5.8 ug/m^3), although slightly above the significance level, is still well below the Florida AAQS. The maximum predicted 24-hour PM impact represents less than 4 percent of the 24-hour PM AAQS.

Table 4-1. Predicted Maximum Impacts Due to No. 4 Lime Kiln Without Downwash Effects: 125 Ft. Stack Height

Pollutant	Averaging Time	Day	Period	Radial Dir.* (°)	Downwind Distance* (m)	Maximum Concentration# (ug/m^3)	EPA/DER Significant Impact Level** (ug/m^3)	Florida AAQS## (ug/m^3)
Particulate Matter	Annual	-	-	360	1300	0.30	1	60
	24-hour	65	-	180	1300	4.2	5	150
Sulfur Dioxide	Annual	-	-	360	1300	0.11	1	60
	24-hour	65	-	180	1300	1.51	5	260
	3-hour	97	5	260	1000	5.1	25	1300
Nitrogen Dioxide	Annual	-	-	360	1300	0.51	1	-
Carbon Monoxide	1-hour	300	11	140	1000	31	2000	40,000
	8-hour	65	2	180	1300	15	500	10,000

* Direction and distance from No. 4 Lime Kiln stack location.

\# Based upon 1981 Tallahassee meteorology. All impacts reflect highest predicted concentrations.

** Florida Administrative Code, Chapter 17-2.100

\## Florida Administrative Code, Chapter 17-2.300

BUC.CEL.TAB.4-2
1/09/86

Table 4-2. Predicted Maximum Impacts Due to No. 4 Lime Kiln With Downwash Effects: 125 Ft. Stack Height

Pollutant	Averaging Time	Day	Period	Radial Dir.* (°)	Downwind Distance* (m)	Maximum Concentration# (ug/m^3)	EPA/DER Significant Impact Level** (ug/m^3)	Florida AAQS## (ug/m^3)
Particulate Matter	Annual	-	-	340	300	0.34	1	60
	24-hour	88	-	340	300	5.8	5	150
Sulfur Dioxide	Annual	-	-	340	300	0.12	1	60
	24-hour	88	-	340	300	2.1	5	260
	3-hour	41	4	330	300	12.6	25	1300
Nitrogen Dioxide	Annual	-	-	340	300	0.57	1	100
Carbon Monoxide	1-hour	41	10	330	300	53.2	2000	40,000
	8-hour	41	2	330	300	20.0	500	10,000

* Direction and distance from No. 4 Lime Kiln stack location.

\# Based upon 1981 Tallahassee meteorology. All impacts reflect highest predicted concentrations. Effects of calm winds have been removed.

** Florida Administrative Code, Chapter 17-2.100

\#\# Florida Administrative Code, Chapter 17-2.300

All maximum impact concentrations were produced for wind directions aligning the proposed stack and the precoat filter building (structure K) (i.e., 310° to 340°). This is an expected result because the precoat filter building is taller than the other structures evaluated. All maximums occurred at or near the property boundary (i.e., 100 m or 300 m), which is a result of the predicted downwash influence.

Maximum off-plant property impacts due to downwash effects from the other structures evaluated were substantially lower than those predicted due to the precoat filter building. This is a result of the lower heights of these structures and the greater distances to property boundaries along the directions which align the structures and the proposed No. 4 Lime Kiln stack location.

5.0 CONCLUSIONS

The Buckeye Cellulose Corporation is proposing to construct a 125 foot tall stack for the No. 4 Lime Kiln at their Perry, Florida plant. The GEP stack height analysis demonstrates that the proposed stack height does not exceed GEP stack height, and therefore, the proposed construction will comply with the recently promulgated EPA stack height regulation.

Because the proposed stack height is significantly less than the GEP stack height, both a Gaussian (non-downwash) and downwash modeling analysis was conducted to evaluate maximum expected impacts from the lime kiln. The analysis demonstrates that emissions from the lime kiln with a 125 foot stack will cause insignificant or minimal impacts for all criteria pollutants. Maximum impacts were predicted to be less than 4 percent of any AAQS, even when considering building downwash effects.

The maximum impacts were predicted due to the building downwash influence of the future precoat filter building associated with the No. 4 Lime Kiln. Other existing or planned structures at the plant have considerably less potential influence upon No. 4 Lime Kiln stack emissions. The proposed stack location is a sufficient distance from other major structures at the plant, (e.g., the power block) such that it does not fall within the area of influence of these structures.

Based upon the analysis presented in Sections 3.0 and 4.0, it is concluded that construction of the No. 4 Lime Kiln stack at a height of 125 feet will comply with all air quality regulations and standards. Emissions from the stack will have a minimal effect upon air quality in the vicinity of the Buckeye Cellulose plant.

REFERENCES

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U.S. Environmental Protection Agency. 1983. Regional Workshops on Air Quality Modeling: A summary Report. EPA-450/4-82-015.

U.S. Environmental Protection Agency. 1984. Calms Processor (CALMPRO) User's Guide. EPA-901/9-84-001.

APPENDIX A

DETAIL DRAWING OF RECOVERY BOILERS/POWER BOILERS BLOCK

WATKINS ENGINEERS & CONSTRUCTORS

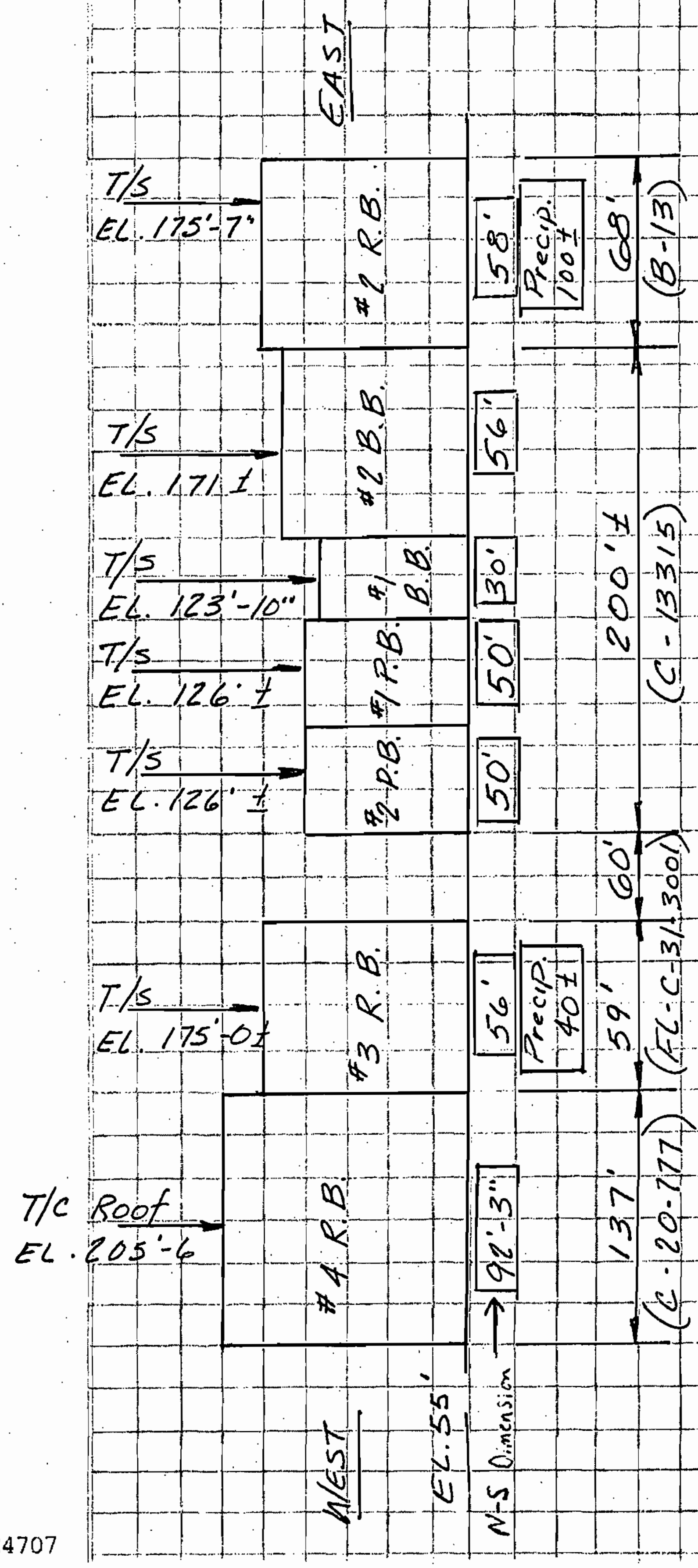
ZK01016CSA

ENGINEERING SECTION

CALCULATION AND SKETCH SHEET

Project Caust. Moder'z'n **Computer** JY/WFK

P.H. Bldg. Heights **Date** 12-13-8



EL = Elevation M.S.L

T/C = Top of Concrete

T/S = Top of Structural steel

± = exact dim not readily availabl Dim. shown is likely within 12"

( ) Ref. Drwg. No.

☐ N-S Dim.

APPENDIX B

DESCRIPTION OF THE INDUSTRIAL SOURCE COMPLEX MODEL

DESCRIPTION OF THE INDUSTRIAL SOURCE COMPLEX MODEL

1.0 GENERAL

The Industrial Source Complex (ISC) dispersion model (EPA, 1979) is a Gaussian plume model which can be used to assess the air quality impact of emissions from a wide variety of sources associated with an industrial source complex. The model is contained in EPA's User's Network for Applied Modeling of Air Pollution (UNAMAP), Version 5 (EPA, 1982). The model is applicable to sources located in either flat or rolling terrain, where terrain heights do not exceed stack heights. The model can be used to predict ambient concentrations of gaseous pollutants or particulate matter. The ISC Model can account for the effects on ambient particulate concentrations of gravitational settling and dry deposition. Alternately, the ISC Model can be used to calculate dry deposition.

The ISC consists of two computer codes. The ISC short-term model (ISCST), an extended version of the Single Source (CRSTER) Model (EPA, 1977), is designed to calculate hour-by-hour concentrations or deposition values and to provide averages for time periods of 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 or deposition values. The ISC long-term model (ISCLT) is a sector-averaged model that extends and combines basic features of the Air Quality Display Model (AQDM) and the Climatological Dispersion Model (CDM). The long-term model uses statistical wind frequencies to calculate seasonal (quarterly) and/or annual ground-level concentration or deposition values. Both ISCST and ISCLT use either a polar or a Cartesian receptor grid.

The ISC model programs accept stack, area, and volume source types. The volume source option is also used to simulate line sources. The steady-state Gaussian plume equation for a continuous source is used to calculate ground-level concentrations for stack and volume sources. The area source equation in the programs is based on the equation for a continuous and finite crosswind line source. Consideration of time-dependent exponential decay of pollutants is directed through specification of a decay rate.

The generalized Briggs (1971 and 1975) plume rise equations, including the momentum terms, are used to calculate plume rise as a function of downwind distance. Procedures suggested by Huber and Snyder (1976) and Huber (1977) are used to evaluate the effects of the aerodynamic wakes and eddies formed by buildings and other structures on plume dispersion. 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 (EPA, 1977) are used to account for variations in terrain height over the receptor grid.

The Pasquill-Gifford curves (Turner, 1970) are used to calculate lateral (σ_y) and vertical (σ_z) plume spread. The ISC model has rural and urban options. In the Rural Mode, rural mixing heights and the σ_y and σ_z values for the input stability category are used in the calculations. In Urban Mode 1, the stable E and F stability categories are redefined as neutral D stability. In Urban Mode 2, the E and F stability categories are combined and the σ_y and σ_z values for the stability category one step more unstable than the input stability category (except A) are used in the calculations. Urban mixing heights are used in both urban modes.

2.0 ISC SHORT-TERM MODEL

The ISCST program allows the user to select from a number of model options. A brief description of these options is provided below:

- Concentration/Deposition Option - Selects average concentration or total deposition calculations

- Receptor Grid System Option - Selects a Cartesian or a polar receptor grid system

- Discrete Receptor Option - Allows the specification of individually located receptors
- Receptor Terrain Elevation Option - Allows the use of terrain elevations for each receptor
- Tape Output Option - Allows output results to be written to tape
- Print Input Data Option - Directs the printing of program control parameters, source data , meteorological data, and receptor data
- Meteorological Data Option - Directs the reading of hourly data from either the meteorological preprocessor format or a card image format
- Rural/Urban Option - Specifies whether the concentration or deposition calculations are made in the Rural Mode, Urban Mode 1 or Urban Mode 2
- Wind-Profile Exponent Option - Allows user-provided wind-profile exponents or the use of default values
- Vertical Potential Temperature Gradient Option - Allows user-provided vertical potential temperature gradients or the use of default values
- Source Combination Option - Allows the user to specify the combinations of sources for which concentration or deposition estimates are required
- Single Time Period Interval Option - Directs the printing of concentration or deposition values for a specific time interval

within a day

- Variable Emission Rate Option - Allows the user to vary a source's emission rate by season or month, by hour of the day, by season and hour of the day, or by wind speed and stability

- Plume Rise as a Function of Distance Option - Directs the program to calculate plume rise as a function of downwind distance or to use final plume rise for all downwind distances

- Stack-Tip Downwash Option - Allows use of the Briggs (1973) procedures for evaluating stack-tip downwash for all stack sources

- Building Wake Effects Option - Allows the evaluation of building wake effects due to adjacent or nearby structures

3.0 ISC LONG-TERM MODEL

The options available within the ISCLT model are generally the same as those available for the ISCST model. Additional or different options are described below:

- Print Seasonal/Annual Results Option - Print seasonal and/or annual concentration or deposition values

- Maximum 10 Options - Prints the maximum 10 concentration (deposition) values and receptors, the results of the calculations at all receptors without maximums, or other related scenarios

- Combined Sources Option - Allows the user the flexibility of specifying multiple sets of sources to use in forming combined sources output.

4.0 PROCEDURES USED TO ACCOUNT FOR THE EFFECTS OF BUILDING WAKES ON EFFLUENT DISPERSION

The procedures used by the ISC Model to account for the effects of the aerodynamic wakes and eddies produced by plant buildings and structures on plume dispersion follow the suggestions of Huber and Snyder (1976) and Huber (1977). Their suggestions are principally based on the results of wind-tunnel experiments using a model building with a crosswind dimension double that of the building height. The atmospheric turbulence simulated in the wind-tunnel experiments was intermediate between the turbulent intensity associated with the slightly unstable Pasquill C category and the neutral D category. Thus, the data reported by Huber and Snyder reflect a specific stability, building shape and building orientation with respect to the mean wind direction. Therefore, the ISC Model wake-effects evaluation procedures may not be strictly applicable to all situations. However, the equations used in the ISC model are based on the best available data and are used as interim procedures until additional data become available.

The wake-effects evaluation procedures may be applied by the user to any stack on or adjacent to a building. The distance-dependent plume rise option generally should be used with the building wake effects option. Because the effects of stack-tip downwash are implicitly included in the building wake effects option, the stack-tip downwash option normally should not be used in combination with the building wake effects option.

The first step in the building wakes evaluation procedure in the ISC is to determine if the plume rise due to momentum only at a distance of two building heights downwind is within the building wake region (equal to building height plus 1.5 times the lesser of the building height or projected width). The ISC Model programs account for the effects of building wakes by modifying only σ_z, for cases where plume height (momentum only) to building height ratios are greater than 1.2 and by modifying both σ_y and σ_z for cases with plume height to building height ratios less than or equal to 1.2. The ISC Model defines buildings as squat ($h_w \geq h_b$) or tall ($h_w < h_b$). The building width h_w is approximated by the diameter of a circle with an area equal to the horizontal area of the building. The ISC Model includes a general procedure for modifying σ_z and σ_y at distances greater than 3 h_b for squat buildings or 3 h_w for tall buildings (i.e., beyond the cavity region). The ISC Model assumption that this recirculating cavity region extends to a downwind distance of 3 h_b for a squat building or 3 h_w for a tall building is most appropriate for a building whose width is not much greater than its height. The ISC Model user is cautioned that, for other types of buildings, receptors located at downwind distances of 3 h_b (squat buildings) or 3 h_w (tall buildings) may be within the recirculating region.

The ISC model uses a single effective building width h_w for all wind directions. This is a simplification that is required to enable the computer program to operate efficiently. Tall buildings typically have lengths and widths that are equivalent so that the use of one value of h_w for all wind directions does not significantly affect the accuracy of the calculations. However, the use of one value of h_w for squat buildings with plume height to building height ratios less than or equal to 1.2 affects the accuracy of the calculations near the source if the building length is large in comparison with the building width. Thus, the user should exercise caution in interpreting the results of calculations for receptors located near a squat building if the stack height to building height ratio is less than or equal to 1.2.

If a long-term hourly sequential meteorological database is used with the building wakes effects option, actual building length and width should be input to the model. The model will then internally calculate an average building dimension (equal to the diameter of a circle having the same area as the building), which will be used in all model calculations for all wind directions. Thus ISC assumes:

$$L \times W = \pi D^2/4$$

where D is the building width used by the model.

After identification of worst-case meteorological conditions from the sequential run, the worst-case meteorology should be refined using a more appropriate building width. Therefore, determine the actual projected width based upon the wind direction and building dimensions and orientation. Then set D equal to the projected width and solve the above equation with L = W, as follows:

$$L = \sqrt{\pi D^2/4} = W$$

The calculated value should then be used as inputs to ISC for building length and width (EPA, 1982).

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Huber, A. H., 1977. Incorporating building/terrain wake effects on stack effluents. Preprint Volume for the Joint Conference on Applications of Air Pollution Meteorology, American Meteorological Society, Boston, Massachusetts.

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APPENDIX C

CURRENT EPA DOWNWASH MODELING PROCEDURE

EPA-450/4-82-015

REGIONAL WORKSHOPS ON AIR QUALITY MODELING: A SUMMARY REPORT

APRIL 1981

Updated Through December 1983

Source Receptor Analysis Branch
Monitoring and Data Analysis Division
Office of Air Quality Planning and Standards
U.S. Environmental Protection Agency
Research Triangle Park, North Carolina

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, where 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) and

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 neutral atmospheric conditions. First compute the momentum flux, Fm:

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

where T_a = ambient air temperature (°K) (assume 293°K),

T_s = stack exit temperature (°K),

v = stack exit velocity (m/s) and

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 plume 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), measured from the lee side of the building:

for short buildings (Y/H<2):

$$x_r = \frac{(A)(W)}{1.0 + B(W/H)},$$

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

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

Next, compare the cavity length to the closest distance to the plant property line. Consider only 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" concentration impacts (X) can be estimated by the following 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) and

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. It is considered to be conservative. If this conservative estimate proves unacceptable, one 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 with 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 gave the greatest stack 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.

$L = W$

$L^2 = \pi D^2/4$

$L = \sqrt{\pi D^2/4} = W$

where D = projected width

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. For example, if a building is 60 m tall, 40 m long and 30 m wide, the greatest GEP height is found by maximizing the projected width (using the 50 m diagonal). In this case, set D = 50 and solve the above equation to find L = W = 44 m. This dimension is then used as the input for L and W in ISC.

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). The following combinations of stability class and wind speed should be used in the model to insure use of the "worst case" meteorological conditions:

Stability Class	Wind Speed (m/s)
A	1, 3
B	1, 3, 5
C	1, 3, 5, 10
D	1, 3, 5, 10, 20
E	1, 3, 5
F (rural only)	1, 3, 5

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. If other combinations of parameters (stability, wind speed, temperature, etc) are known or suspected to cause problems, they should also be modeled.

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. Maximum concentrations for longer averaging times should be estimated using the procedures described in EPA's "Guidelines for Air Quality Maintenance Planning and Analysis, Volume 10 (Revised): Procedures for Evaluating Air Quality Impact of New Stationary Sources." EPA-450/4-77-001, October 1977 (pp 4-20 thru 4-22).

ADDENDUM TO
GEP STACK HEIGHT EVALUATION FOR
LIME KILN NO. 4

Prepared by

KBN ENGINEERING AND APPLIED SCIENCES, INC.

January 11, 1986

Addendum to
GEP Stack Height Evaluation For
Lime Kiln No. 4

1.0 INTRODUCTION

This addendum is a supplement to the report entitled "GEP Stack Height Evaluation for Lime Kiln No. 4, Buckeye Cellulose Corporation, Perry, Florida" (KBN, 1986). This report presented a stack height evaluation and air quality impact analysis for the No. 4 Lime Kiln to be constructed at Buckeye Cellulose´s Perry plant. Subsequent to the completion of the original report, updated information concerning flue gas parameters for the No. 4 Lime Kiln were received by Buckeye. This new information indicated different flue gas volumes and temperatures then those used in the original analysis. These differences could potentially result in different air quality impacts then those presented in the original report. As a result, an air quality analysis was conducted using the revised flue gas parameters. The results of this analysis are presented in this addendum.

2.0 REVISED STACK PARAMETERS

The flue gas parameters presented in the original report were as follows:

Stack height = 125 ft.
Stack diameter = 7.25 ft.
Flow rate = 105,300 acfm
Temperature = 320 °F

These parameters were based upon 60% solids in the lime mud filter cake of the No. 4 Lime Kiln system. The revised flue gas parameters for the No. 4 Lime Kiln are presented in Table 2-1 for a range of potential operating conditions. The revised parameters reflect revised lime mud filter percent solids contents of 70% to 80%. No change has been made in the proposed stack height and diameter for the No. 4 Lime Kiln.

Calculated particulate matter (PM) emissions (lb/hr) for each operating scenario are shown in Table 2-1, based upon the flue gas oxygen content and emission limit (0.091 gr/dscf @ 10% O_2 for oil and 0.067 gr/dscf @ 10% O_2 for natural gas). Emissions of other pollutants are expected to be lower than those rates presented in the original report. However, for purposes

Table 2-1. Revised Flue Gas Parameters and Particulate Matter Emissions for No. 4 Lime Kiln.

Operating Condition		Flue Gas Parameters				PM Emissions	
Fuel	Percent Solids in Filter Cake	ACFM	SCFM	Oxygen (%)	Temp. (^{o}F)	Corrected gr/dscf*	lb/hr
Oil	70% - High	91,500	36,500	5.4	390	0.129	40.4
Oil	70% - Low	75,500	30,500	3.0	340	0.149	39.0
Oil	80% - High	81,500	33,000	5.1	450	0.132	37.3
Oil	80% - Low	66,500	27,600	2.9	400	0.150	35.5
Natural Gas	70% - High	96,000	36,000	5.6	400	0.094	29.0
Natural Gas	70% - Low	79,000	30,000	3.2	350	0.108	27.8
Natural Gas	80% - High	85,000	33,000	5.4	460	0.095	26.9
Natural Gas	80% - Low	70,000	27,000	3.0	410	0.110	25.5

* Corrected to 10% Oxygen

Source: F.L. Smidth & Co., 1986

of the analysis presented in this addendum, emissions of these other pollutants were assumed to be the same as presented in the original report.

3.0 METHODOLOGY

Review of Table 2-1 reveals that oil burning conditions result in lower flue gas volumes (acfm) and temperatures than the corresponding natural gas burning conditions. As a result, oil burning conditions will result in higher ground-level air quality impacts, given equal pollutant emission rates. As discussed in Section 2.0, emission rates for pollutants other than PM were assumed to remain at the levels presented in the original report, regardless of operating condition. In the case of PM, review of Table 2-1 shows that PM emissions will always be higher when burning oil as compared to natural gas. Based upon these considerations, only the oil burning operating conditions were analyzed for air quality impacts for this addendum.

Review of Table 2-1 further reveals that the "Low" oil burning operating conditions result in significantly less flue gas volumes (acfm) and temperatures than the comparable "High" conditions. However, calculated maximum PM emissions do not differ significantly between the "Low" and "High" conditions for a given percent solids in the filter cake. As a result, only the "Low" operating conditions were considered in the air quality impact analysis, as they will result in maximum air quality impacts.

The modeling methodology for this addendum followed the same general procedures as described in the original report. Both non-downwash (Gaussian) and downwash atmospheric conditions were evaluated. The downwash analysis presented in the original report identified the precoat filter building as the most influencing structure at the plant, and when considering property boundaries, maximum air quality impacts occurred due to predicted downwash from this building. Therefore, only the precoat filter building was considered in the revised downwash analysis for this addendum.

An analysis was also conducted to determine if the stack emissions from the No. 4 Lime Kiln would be emitted into the cavity region downwind of any influencing structure. This analysis was performed according to recommended U.S. EPA procedures (EPA, 1983). Once again, only the precoat filter building was evaluated. since this building was determined to be the greatest influencing structure for No. 4 Lime Kiln (i.e., resulted in greatest GEP height).

4.0 RESULTS

4.1 NON-DOWNWASH RESULTS

Results of the revised Gaussian (non-downwash) modeling analysis are presented in Table 4-1. The maximum predicted impacts are lower for PM, as compared to the original report, due to the lower emissions associated with the lower flue gas flow rates and temperatures. Maximum predicted impacts for all other pollutants are higher than previously reported, but the increase is small. This is a result of assuming the same emission rates as in the original report, but using the lower flue gas volumes presented in this addendum. Maximum predicted impacts for all pollutants remain below significance levels.

The maximum annual average impacts were predicted for the "70% - Low" operating condition. Maximum predicted impacts for all other averaging times occurred under the "80% - Low" operating condition. However, maximum impacts for both operating conditions were very similar.

4.2 DOWNWASH RESULTS

Results of the downwash evaluation for the precoat filter building using the revised flue gas parameters are presented in Table 4-2. In this case, the maximum predicted 24-hour PM impact is slightly higher than was predicted in the original analysis (6.0 ug/m^3 versus 5.8 ug/m^3), while the annual average PM maximum impact did not change.

For all other pollutants and averaging times, small increases in maximum impacts were predicted. These impacts remained below the significance levels. In general, the maximum impacts were predicted at receptors located closer to the No. 4 Lime Kiln, reflecting the lower plume rise associated with the revised flue gas parameters.

Table 4-1. Predicted Maximum Impacts Due to No. 4 Lime Kiln Without Downwash Effects: 125 Ft. Stack Height (Revised Flue Gas Parameters)

Pollutant	Averaging Time	Day	Period	Radial Dir.* (o)	Downwind Distance* (m)	Maximum Concentration# (ug/m^3)	EPA/DER Significant Impact Level** (ug/m^3)	Florida AAQS## (ug/m^3)
Particulate Matter	Annual	-	-	360	1100	0.28	1	60
	24-hour	65	-	180	1100	3.8	5	150
Sulfur Dioxide	Annual	-	-	360	1100	0.14	1	60
	24-hour	65	-	180	1100	2.0	5	260
	3-hour	97	5	260	900	6.6	25	1300
Nitrogen Dioxide	Annual	-	-	360	1100	0.68	1	-
Carbon Monoxide	1-hour	183	9	250	1700	41	2000	40,000
	8-hour	65	2	180	1100	19	500	10,000

* Direction and distance from No. 4 Lime Kiln stack location.

\# Based upon 1981 Tallahassee meteorology. All impacts reflect highest predicted concentrations.

** Florida Administrative Code, Chapter 17-2.100

\#\# Florida Administrative Code, Chapter 17-2.300

Table 4-2. Predicted Maximum Impacts Due to No. 4 Lime Kiln With Downwash Effects: 125 Ft. Stack Height (Revised Flue Gas Parameters)

Pollutant	Averaging Time	Day	Period	Radial Dir.* (°)	Downwind Distance* (m)	Maximum Concentration# (ug/m^3)	EPA/DER Significant Impact Level** (ug/m^3)	Florida AAQS## (ug/m^3)
Particulate Matter	Annual	-	-	340	300	0.34	1	60
	24-hour	88	-	340	200	6.0	5	150
Sulfur Dioxide	Annual	-	-	340	300	0.18	1	60
	24-hour	88	-	340	200	3.1	5	260
	3-hour	41	4	330	200	16.6	25	1300
Nitrogen Dioxide	Annual	-	-	340	300	0.83	1	100
Carbon Monoxide	1-hour	89	19	330	200	72	2000	40,000
	8-hour	146	2	340	200	28	500	10,000

* Direction and distance from No. 4 Lime Kiln stack location.

\# Based upon 1981 Tallahassee meteorology. All impacts reflect highest predicted concentrations. Effects of calm winds have been removed.

** Florida Administrative Code, Chapter 17-2.100

\#\# Florida Administrative Code, Chapter 17-2.300

Similar to the non-downwash analysis results, the maximum predicted short-term impacts for the downwash analysis were due to "80% - Low" kiln operating conditions. Maximum annual average impacts were equal for the two operating conditions.

4.3 CAVITY ANALYSIS

Based upon recommended U.S. EPA procedures (EPA, 1983), the height of the cavity region downwind of a structure can be calculated from the formula:

$$H_c = H + 0.5 L,$$

where H_c = cavity height

H = height of structure

L = lesser dimension of height or projected width of structure.

Based upon the precoat filter building, the height of the cavity region is calculated as follows:

$$H = 75 + 0.5 (75) = 112.5 \text{ ft.}$$

The proposed stack height of the No. 4 Lime Kiln of 125 feet will therefore be above the cavity region, and the kiln exhaust gas plume should not be emitted into the cavity region under any conditions. As a result, no further analysis of the cavity region was necessary.

5.0 CONCLUSIONS

The air quality impact results presented in this addendum, based on revised flue gas parameters for No. 4 Lime Kiln, do not differ significantly from the results presented in the original report. All maximum impacts are still below significance levels, even when considering potential downwash effects, except for the 24-hour PM impact. The 24-hour PM impact is predicted to slightly exceed the significance level when downwash effects are considered. However, the maximum predicted impact of 6.0 ug/m^3 represents only 4% of the AAQS of 150 ug/m^3. It is therefore concluded that a 125 foot stack height for No. 4 Lime Kiln will comply with all air quality standards, and will have minimal effect upon air quality levels in the vicinity of the Buckeye plant.

REFERENCES

KBN, 1986. GEP Stack Height Evaluation for Lime Kiln No. 4, Buckeye Cellulose Corporation, Perry, Florida. KBN Engineering and Applied Sciences, Inc., Gainesville, Florida.

U.S. Environmental Protection Agency. 1983. Regional Workshops on Air Quality Modeling: A Summary Report. EPA-450/4-82-015.