Air Quality Guidelines

AIR QUALITY GUIDELINES

FEBRUARY 1985

AIR QUALITY GUIDELINES

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HIGHWAY DESIGN DIVISION

AIR QUALITY GUIDELINES

101 GENERAL

An Air Quality Analysis (AQA) is considered by Highway District personnel or private consultants during planning for highway projects. For many projects a few simple statements are sufficient. An amplified Air Quality Analysis is prepared for an environmental document when either the one-hour or eight-hour CO concentration exceeds 50% of the National Ambient Air Quality Standard (NAAQS). An amplified Air Quality Analysis (AQA) should be summarized in environmental documents (EA or EIS). The detailed AQA for an amplified analysis should be kept on file in the District Office to document the analysis performed.

102 LEVELS OF ANALYSIS

The level of the air quality analysis refers to the complexity and comprehensiveness required in the Air Quality Analysis. The level of consideration is dependent on the traffic volume, type of highway improvement, and anticipated CO concentration at logical receptors along the right of way. The first step in the preparation of any Air Quality Analysis should be selection of the appropriate level of analysis. Use of procedures appropriate for the minimum level of effort required can save valuable time and manpower and still adequately address air quality aspects of the environmental document. The flow diagram in 102-1 may be used to visualize selection of the level of analysis.

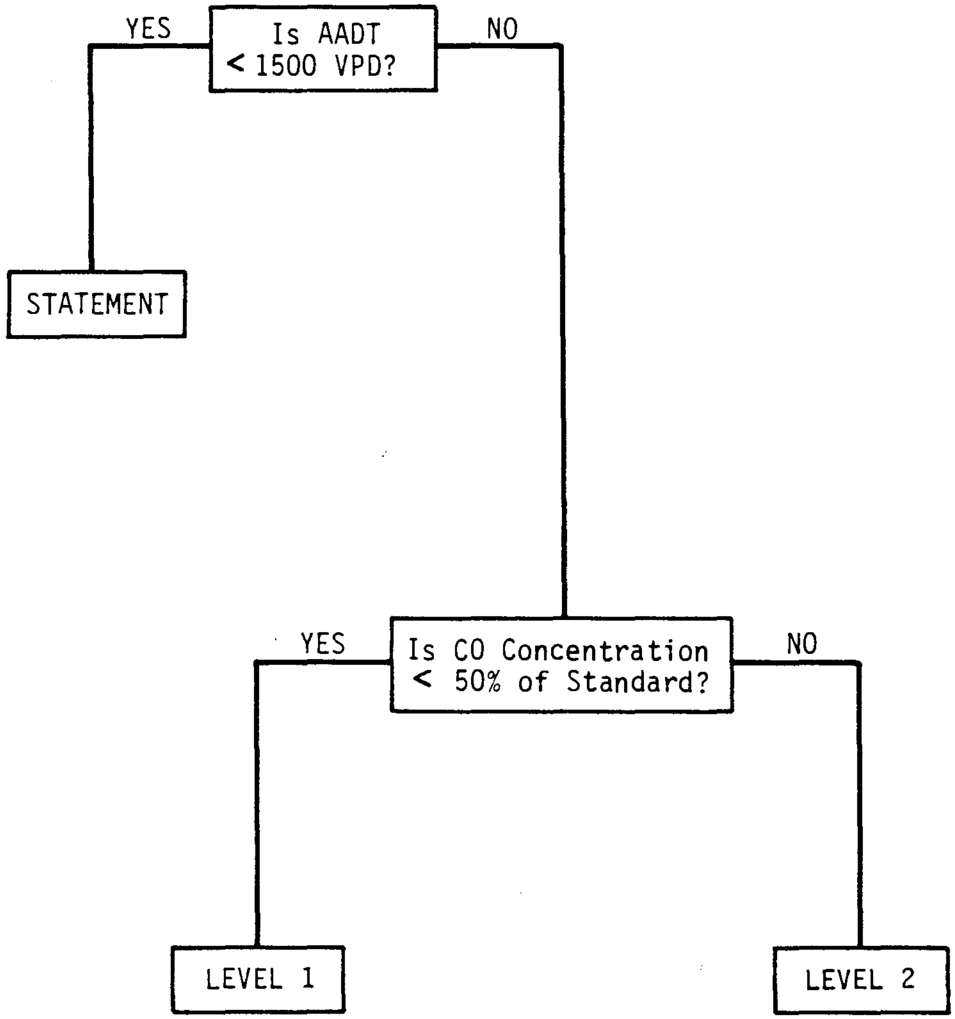


FIGURE 102-1 FLOW DIAGRAM FOR
SELECTION OF LEVEL OF ANALYSIS

102.1 Low Volume Roadways. If the traffic volume is less than 1500 vehicles per day, a simple statement such as the following will suffice: "This project will have an insignificant effect on air quality." In addition, the basis for that statement should be included; for example, "This is based on analysis of similar low traffic volume projects." No further analysis is necessary where traffic volumes meet the low volume criteria.

102.2 Screening Technique. If the predicted traffic volume is greater than 1500 v.p.d., a screening technique such as the Tabular Method of Estimating CO Concentration should be used. Some reasonably quick method of approximating the CO concentration at logical receptors is needed if the traffic volume exceeds 1500 v.p.d. Input values can be approximate, but should be reasonably realistic.

102.3 Level One Analysis. If the CO concentration at logical receptors using the Tabular Method is less than 50% of the one-hour or eight-hour CO standards, either a Level One Analysis or a general statement as described in Section 102.4 will suffice. A Level One Analysis is described in Section 103.2.

102.4 Insignificant Impact. If the project CO concentrations plus the background level is known to be well below (less than 50% of) the 1 and 8 hour National Ambient Air Quality Standards for carbon monoxide of 35 and 9 ppm, respectively, the air quality CO impact may be judged insignificant and a microscale analysis will not be needed. In this event the environmental document should summarize the basis for this conclusion. The judgment on the degree of CO impact may be based on previous analysis for similar projects, previous general analyses for various classes of projects, or a simplified screening method such as the Tabular Method.

102.5 Level Two Analysis. If the CO concentration is greater than 50% of the standard using the Tabular Method, a Level Two Analysis should be performed. A Level Two Analysis is described in Section 103.3.

103 GENERAL GUIDELINES

103.1 Checklist. The checklists in Figures 103.1-1 and 103.3-1 should be used to establish the basic format for Air Quality Analyses. Additional data may be used, but normally no section should be omitted from the analysis unless it is inapplicable. The check list should be used as a guide for organization of an Air Quality Analysis portion of a Draft Environmental Impact Statement (DEIS) or an Environmental Assessment (EA).

AIR QUALITY CHECKLIST

1. Traffic Volume
2. Co Concentration
3. Topography
4. Meteorology
5. Land Use
6. Sensitive Receptors

*7. Urbanization

*8. Highway Geometry

*9. Signalization

*10. Congestion

* Include when needed to characterize the possible air quality impact.

Figure 103.1-1 Level One Analysis

The asterisked items in Figure 103.1-1 are used when applicable.

103.2 <u>Development of a Level One Analysis</u>. A Level One Analysis is a brief statement provided to substantiate a relatively low level of air quality impact. In performing a Level One Analysis, the following information should be assessed: Existing and Design Year traffic volume, topography and meteorology restricting dispersion of pollutants, current and proposed land use adjoining the project, highest carbon monoxide concentration calculated to occur along the right of way including estimated background concentration, CO concentration at sensitive receptors, and for EIS's a standard statement about conformity with the SIP.

Below is an example of a Level One Analysis summarized in an environmental document (EA or EIS):

> "Farm to Market Highway 486 is a low-volume highway with an existing estimated annual Average Daily Traffic of 1600 vehicles per day with 2200 vehicles per day at the design year. Neither the topography nor the meteorology seriously restrict dispersion of air pollutants. Current land use along the proposed Farm to Market improvement is restricted to farming and ranching and this is not expected to change in the near future. There are no sensitive receptors near the roadway. The local concentration of carbon monoxide under absolute worst meteorological conditions is not expected to exceed 1.5 parts per million along the right-of-way line at any time. The background concentration is assumed to be 0.5 parts per million. This 2.0 ppm is 5.7% of the National Ambient Air Quality Standard for one hour. Farmdale is classified as a attainment area under the Federal Clean Air Act.

By urbanization in the Level One checklist we mean proposed intensification of land use such as the development of high rise commercial and residential areas. Highway geometry refers to the addition of grade alignment, ramps, or interchanges. Signalization refers to the addition of signalized intersections either on or near the roadway. Congestion refers to anything which could cause interference with the future flow of traffic or significantly increase its volume. Some estimate of average speeds during congested periods should be made and the expected duration of the congestion.

103.3 Development of a Level Two Analysis. This portion describes the development of each item in the Air Quality Check List in Figure 103.3-1 analysis. A Level Two Analysis is the most detailed analysis required and is reserved for those projects likely to approach or exceed the standards, become controversial, or possibly involve litigation. A Level Two Analysis is used for projects which are predicted to have CO concentrations exceeding 50% of either the one hour or the eight hour National Ambient Air Quality Standard (NAAQS). See Table 103.3-2 for a list of one-hour concentrations which could qualify for a Level Two Analysis because the eight-hour standard will be 50% of the NAAQS of 9 ppm. The eight-hour concentration may be omitted if the one-hour standard is less than the numbers in this table.

One of the two conformity statements below should be included in every Environmental Impact Statement.

The following statement should be made in EIS's for all counties which do not require a conformity statement under 23 CFR 770: "This project is in a area where the State Implementation Plan does not contain any transportation control measures. Therefore, the conformity procedures of 23 CFR 770 do not apply to this project." For counties which do require a conformity statement, the following statement should be made: "This project is in an air quality nonattainment area which has transportation control measures in the State Implementation Plan which was conditionally approved by the Environmental Protection Agency on March 25, 1980, and the conditions which applied to transportation control measures were satisified August 8, 1980. It has been determined that both the Transportation Plan and the Transportation Improvement Plan conform to the SIP. This project is included in the Houston-Galveston Regional Transportation Study Plan. Therefore, pursuant to 23 CFR 770, this project conforms to the State Implementation Plan."

AIR QUALITY CHECKLIST

1. Project Description
2. Conclusions
3. Background Discussion
    a. Historical Air Quality
    b. Historical Meteorology
    c. Influence of Local Topography
    d. Influence of Highway Design
    e. Existing and Proposed Point & Line Sources
    f. Existing & Proposed Sensitive Receptors
    g. Land Use
    h. Construction Phase
4. Field Studies
5. Mathematical Analysis
    a. Traffic Estimates
    b. Emission Factors
    c. Winds and Stability
    d. Background Co Concentration
    e. Alternatives
        (1) Primary Route
        (2) No Build Option
        (3) Alternative Corridors
        (4) Public Transit
        (5) Influence of Other Alternatives or Options
    f. CO Concentration
    g. Systems Analysis

Figure 103.3-1 Level Two Analysis

A. Project Description

A complete project description is needed if a separate analysis is submitted prior to a DEIS. When a Level Two Analysis is summarized in the DEIS, the project description portion and any other items already included in the DEIS may be omitted. If the proposed project has been made a part of an Urban Transportation Plan or TIP, this fact should be included in the Project Description.

TABLE 103.3-1

ONE HOUR CONCENTRATION

EQUIVALENT TO ONE-HALF

EIGHT HOUR STANDARD

	PPM (Including Background)
Houston	9
Dallas	9
El Paso	9
Fort Worth	10
San Antonio	10
Austin	11
Corpus Christi	11
Beaumont	11
Smaller Cities	11
Rural Areas	11

B. Conclusions

The purpose of the conclusions portion is to summarize the quantified results of the Background Discussion and the Mathematical Analysis portions. The use of graphs and summary tables is encouraged since results can be presented with greater clarity. Strive to make the conclusions as understandable as possible to a lay person.

The conclusions also provide a major part of the information needed in an Environmental Impact Statement. The complete Air Quality Analysis is usually kept on file in the District Office and summarized in the EIS.

A DEIS should contain the following:

1. An identification of the relevant microscale air quality impacts of the highway section. This should include predicted estimates of total CO concentrations at logical receptor sites (business or residence) for various alternatives. These concentrations should be rounded off to the nearest whole part per million.

   Compare the estimated total CO concentrations for all alternatives with applicable National Ambient Air Quality Standards (NAAQS) expressing the CO concentration in parts per million as well as a percentage of the standard. See Figure 103.3-3 and 103.3-4 for an example of the type of graph which might be used.

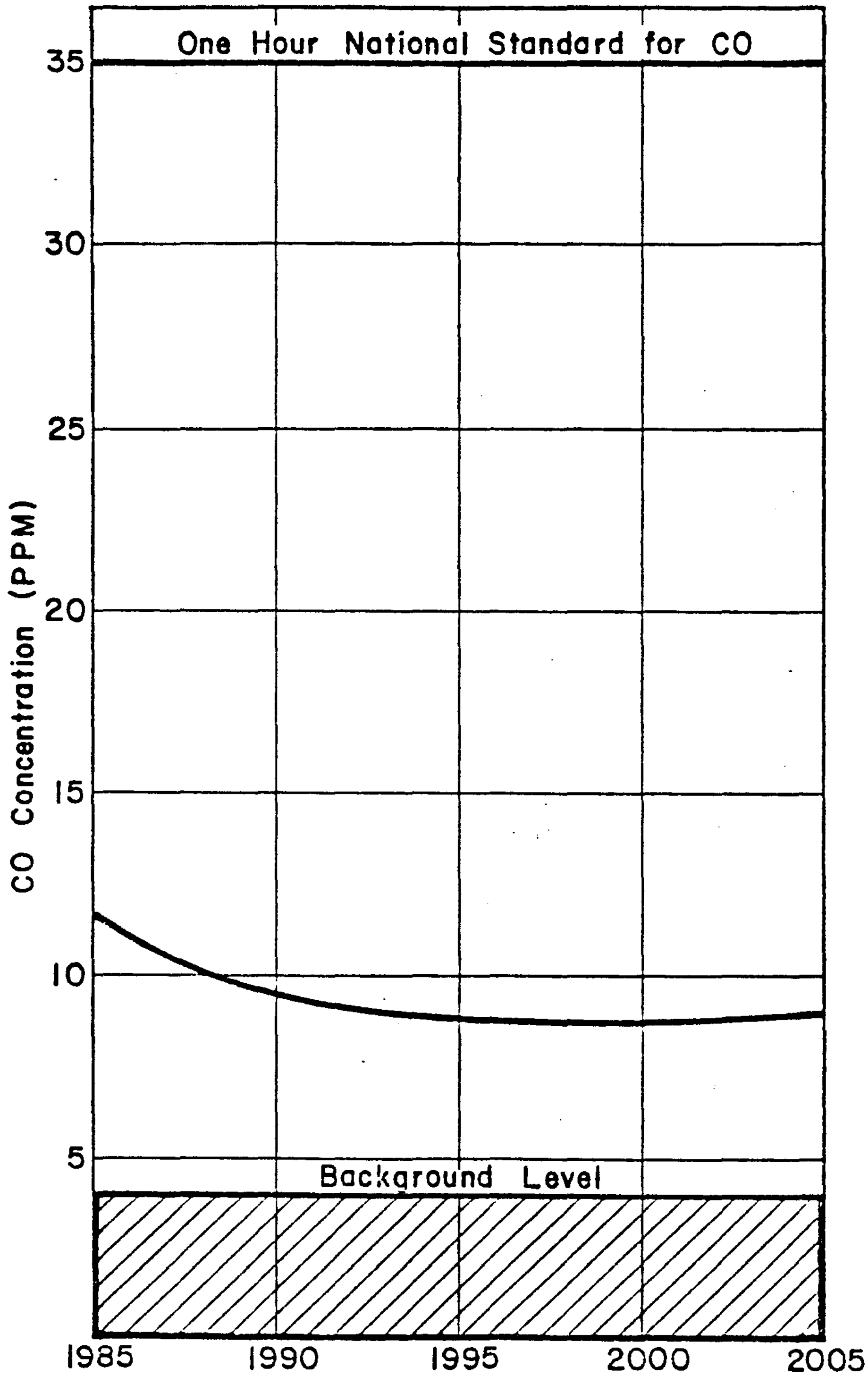


FIGURE GRAPH 103.3-2
EXAMPLE GRAPH

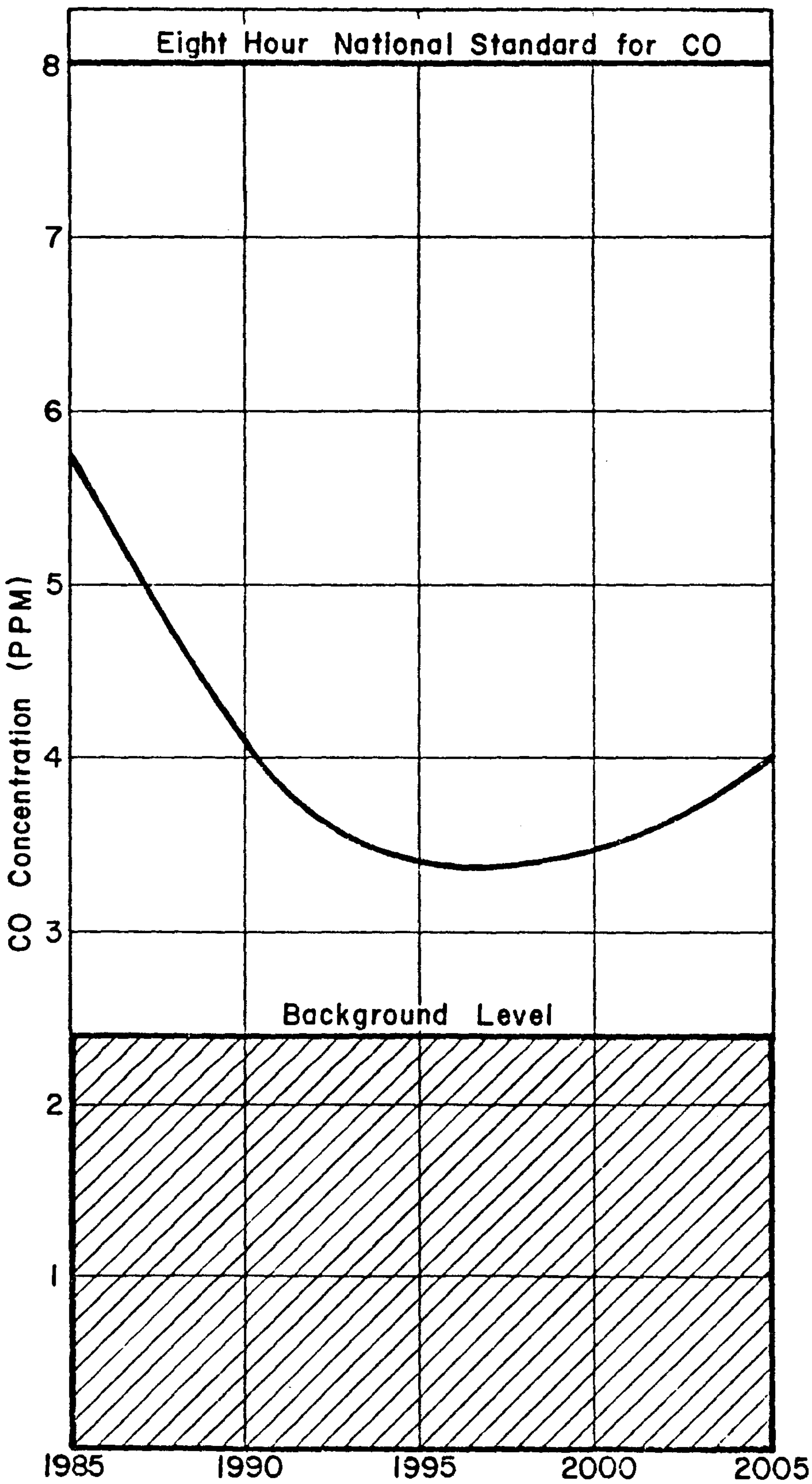


FIGURE GRAPH 103.3-3
EXAMPLE GRAPH

2. A discussion of the relationship of the Urban Transportation Plan to areawide pollutant levels for nonattainment areas or areas where there is a Air Quality Maintenance Plan.

3. An identification of the analysis methodology and brief summary of assumptions used. Specify the models used, source of traffic data, and assumptions made for worst or typical case.

4. A brief summary and documentation of early consultation, if any, and any comments from the State/local air pollution control agency.

5. A statement on the relationship between each alternative under consideration and transportation control measures in the State Implementation Plan (SIP).

Each District has been supplied with a copy of the SIP and subsequent revisions. This should be reviewed to determine its applicability to the air quality impact of highway projects both during the construction phase and throughout the operation of the highway section. Among items of importance are comparison of pollutant concentrations with the National Ambient Air Quality Standards throughout the design life of the system. One of the best ways to quantify this is to present the predicted concentration in terms of percentage of the standard.

Other important considerations are existing levels of ambient air quality. Any quantified data should be summarized factually. Air quality is only one of the tradeoffs that will determine an environmental clearance. All aspects of the project need to be considered in perspective for a judgment of the tradeoffs to be made. Considerations other than air quality may be of overriding importance. Construction specifications should comply with the SIP. This refers to compliance with Texas Air Control Board Regulations or open burning and State Department of Highways and Public Transportation specifications to mitigate air pollution by controlling dust during construction.

C. Background Discussion

1. Historical Air Quality and Field Studies. There are two important areas in the discussion of ambient air quality. One is the existing ambient air quality at the project or in the local area as compared with the National Ambient Air Quality Standards. The other is estimation of current and future background levels of carbon monoxide concentration.

First, consider existing ambient air quality. If a Texas Air Control Board "Connie" (continuous monitoring) station is located anywhere in the area, the latest annual summary of these data may be used for establishing ambient air quality levels of carbon monoxide, nitrogen oxides, and photochemical oxidants (ozone).

If bubbler type data are used, the method of analysis should be described. Bubbler data are measured over a 24-hour period and therefore, cannot be directly compared with standards for some other time period.

If short term air monitoring studies are available, these can be cited. This includes studies done by the TACB, EPA, local pollution control districts, and the State Department of Highways and Public Transportation. Comparisons should be made with longer term data in the same locale. Document in the analysis the data selected and how it was averaged.

The monitoring site location and exposure is of utmost importance when evaluating ambient air quality. The ambient air quality of an area is defined as that air quality to which the public is exposed. Monitoring data should include the worst possible case. Monitoring site exposure, type of equipment, sampling height, and averaging techniques should be described when ambient air quality data are included in an analysis.

If air quality measured at the monitoring site is not representative of that at the highway project location, this fact should be mentioned. When land use along the highway is already fully developed, the ambient air quality may not deteriorate further.

Trends in ambient air quality should be evaluated when enough good data are available, usually from the same site. Large annual variations in air quality frequently occur. Running monthly or quarterly means can sometimes be useful when several years of representative data are available. An evaluation of all available ambient air quality data for the more important pollutants is necessary for a complete Air Quality Analysis.

Carbon monoxide ambient air quality is the sum of three factors: background values of CO, transported CO, and locally produced CO. The urban background value is that value measured at least 300 feet away from the nearest street or highway carrying an appreciable amount of traffic. It is a base value on which local influences are added. Although the backgound value is theoretically equal everywhere within the wholly urban area at the same time, it does vary with time and locale. Peak values of background usually occur during periods of peak traffic. Background values also vary from day to day depending on local meteorological conditions. Generally, the lighter the winds in the mixed layer over an urban area and the lower the capping inversion, the higher the background level.

The peak one-hour background concentration is the highest one-hour concentration of background to be expected under worst meteorologi cal conditions. It will usually occur during either the morning or afternoon period of peak traffic volume, but sometimes occurs in early evening hours. See Table 103.3-1 for estimated CO background estimates. The peak eight-hour concentration estimate is the highest eight-hour average concentration under worst conditions.

Peak background levels vary linearly with city size or number of automobiles throughout Texas with one exception, the city of El Paso. El Paso has unusual topography and meteorology which sometimes restrict the dispersion of pollutants and lead to higher peak background values than a city its size would normally expect.

TABLE 103.3-2

ESTIMATES OF CARBON MONOXIDE

BACKGROUND CONCENTRATIONS FOR

TEXAS CITIES AND RURAL AREAS

City or Area	One-Hour Average PPM	Eight-Hour Average PPM
Houston	4.5	2.8
Dallas	3.7	2.3
Ft. Worth	1.8	1.2
San Antonio	1.7	1.1
El Paso	4.9	3.0
Austin	0.7	0.4
Corpus Christi	0.6	0.4
Beaumont	0.6	0.4
Smaller Cities	0.5	0.3
Rural Areas	0.4	0.3

2. Historical Meteorology. The meteorological information most valuable for an Air Quality Analysis is that which characterizes dispersion of pollutants. This includes frequency of occurrence of air stagnation advisories, heights and frequencies of inversions, mixing heights, wind speed frequencies and wind direction frequencies. See weather charts in Appendix 104C.

   The minimum wind information for any Level Two Analysis should consist of wind speed and wind direction frequencies from TAPESTAR or WINDROSE for the most frequent stability class and the worst stability class, as well as percentage of calms and the frequency of occurrence of air stagnation advisories. TAPESTAR and WINDROSE results should be on file in each District Office. The use of wind roses is encouraged, although wind information displayed in tabular form is acceptable.

   The mixing height at different seasons and the frequency of inversions below 500 feet are also useful. Any climatological variable which may affect pollutant dispersion or the quantity of photochemically produced pollutant should also be included.

3. Influence of Local Topography. Local topography needs to be discussed in all reports. The topography should be characterized by percentage of slope and general character of topography. The question is whether or not the topography can, under some meteorological conditions, influence air quality by restricting

dispersion. Of particular interest is topography which might restrict wind movement or influence wind speed and direction along valleys or up or down slopes. Where topographic influence are strong, a meteorological survey may be necessary to establish wind patterns under different meteorological conditions.

A city can have an important topographic influence on wind speeds and directions by aerodynamically guiding flow around and over buildings and reducing wind speed through frictional effects. In some cases tall buildings can create strong gusts at street level.

4. Influence of Highway Design. Highway design criteria which can influence air quality along the highway right of way and were considered in planning the proposed project should be discussed. An ideal section would be a wide median with no areas to disrupt traffic flow and no cut sections. The ideal situation can seldom be incorporated into the plans because of other limiting factors. The final plan is usually a compromise position in which air quality is only one of the tradeoffs.

If the influence of highway design factors on Air Quality can be quantified, this should be done. For example, if a cut section was chosen for safety, economy, or some other reason, the worst condition CO concentration in the cut section can be compared with that at grade. Another example would be the decrease in congestion expected due to construction of the proposed facility and its net impact on CO concentration estimates. A highway interchange should result in a significant improvement in air quality over a signalized intersection where long queues of idling vehicles may develop during rush hours.

Even where highway design factors cannot be quantified, they should be covered in a qualitative manner. Anything which speeds the flow of traffic will reduce exhaust emissions of carbon monoxide and hydrocarbons, especially when traffic volumes are high. On the other hand, nitrogen oxides will usually increase with increased speed. When the wind flow is relatively unobstructed, natural dispersal of the highway line source plume is usually unimpeded and concentrations along the right of way are relatively low. Street canyons and deep valleys tend to trap and concentrate pollutants, especially under light wind conditions.

5. Existing and Proposed Point Sources. The degradation of air quality by significant point (industrial) sources near highway projects needs to be discussed when applicable. Where point sources appear critical, the pollutant concentration present at the highway project under typical and worst meteorological conditions can be modeled using a point source model. The CO concentration determined from the model can then be added to both the estimated background level and and the influence of local traffic determined by the line source model.

Adjustments may need to be made in any calculations for point sources for changes in pollutant discharge due to the expansion and contraction of plant production or the application of pollutant controls. As a minimum, major nearby point sources need to be identified, described, and assessed in terms of pollutant emissions in tons per year. A more thorough analysis will estimate CO concentration in parts per million at the roadway under worst meteorological conditions.

6. Existing and Proposed Sensitive Receptors. Sensitive receptors are defined as rest homes, schools, and hospitals built near existing or proposed highways where a large number of the aged, young, and infirm may be subjected to pollutants from motor vehicles traveling the highway. Individual homes or businesses are not sensitive receptors. However, when Level Two analyses are produced, the pollutant concentration at a typical residence or business, may need to be analyzed.

Air quality analyses should itemize sensitive receptors within the influence of the highway, generally within 300 feet of a travel lane, with an estimate of the number of individuals exposed and their distance from the highway right of way or nearest travel lane. An estimate should be made of CO concentrations under typical and worst conditions at the edge of the sensitive receptor.

In the event there are no sensitive receptors present, the following statement should be used: "There are no sensitive receptors within 300 feet of the proposed highway right of way."

Proposed sensitive receptors also need to be included when their construction is planned. Although the highway engineer may be unable to control or influence their placement, the air quality impact of the highway on those proposed sensitive receptors is an important part of the Air Quality Analysis.

7. Land Use. Land use has an important influence on traffic levels and background concentrations of CO along highways. Open countryside today may be highly urbanized 20 years from now, especially where the potential for urban growth is already great. Where the area is already heavily urbanized, the highway may have virtually no influence on urban land use. A description should be given of the present land use and anticipated changes in land use.

In some cases there are land use restrictions of one form or another. Where these restrictions serve to exercise control of land use along highways, this should be documented in the Air Quality Report, particularly if it might have an impact on local or regional air quality.

8. Construction Phase. The observance of local, State, and Federal laws during the construction phase is the responsibility of the

contractor as stated in the Department's Standard Specifications for Construction of Highways, Streets and Bridges and special provisions thereto. The engineer should be aware of the content of Texas Air Control Board regulations when they bear on the highway construction process. Special precautions which are necessary to prevent degradation of air quality along highways during the construction phase should be outlined in the Air Quality Analysis. The Texas Air Control Board has approved the State Department of Highways and Public Transportation Specifications as being consistent with the attainment of air quality goals as prescribed in their State Implementation Plan.

D. Mathematical Analysis

This portion explains how to arrive at quantification of carbon monoxide concentration. It includes traffic estimates, calculation of emission factors, selection of the appropriate meteorological conditions, estimation of background concentration, and application of the line source dispersion model to achieve CO concentration.

1. Traffic Estimates. The minimum traffic information needed for mathematical analysis is Design Hourly Volume (DHV). Traffic information should be requested from File D-10 with adequate lead time.

   Average Route Speed is also needed to enter Emission Factor Tables. This should be estimated by the District. The use of a computerized "Level of Service" analysis may be advisable for congested traffic situations in major urban areas.

Traffic estimates should be requested for the existing situation, estimated time of completion (ETC), ETC + 20 years, and as many points in between as necessary to define a reasonably accurate curve. Normally there will be a decrease of emissions due to the increasing effectiveness of pollution control devices applied to larger numbers of vehicles followed by an increase due to the overriding effect of increasing traffic volume. A suitable sample of years might be: Existing, ETC, ETC + 5, ETC + 10, ETC + 15, and ETC + 20.

All of the traffic estimates should be included somewhere in the analysis, either in the Mathematical Analysis Section or the Appendix. The source of the traffic information should be referenced as well as the date the estimate was furnished.

2. Emission Factors. Emission factors are calculated using the latest FHWA approved dispersion model or mobile source emission factor program. When submitting a level two analysis, the Tabular Method may not be accurate enough.

3. Winds and Stability Class. For rural areas use Stability Class "E", wind parallel to the roadway, and 1 meter/second (2.2 miles/hour) wind speed. This is termed the absolute worst

case. For urban areas use Stability Class "D", wind parallel to the roadway, and a wind speed of 3 meter/second. It is advisable to check both parallel and crosswind to see which gives the highest CO concentration. For the typical (most frequent) case use the most frequent stability class for the winter season and the most frequent wind speed and direction. Meterological tables may be used to determine the most frequent stability class and wind.

In the wind section document the winds and stability classes used in the line source dispersion model, the source of the wind information, the assumptions made, and all other line source model input information needed. Explain why the receptor site chosen is representative of the most critical situation.

4. Temperature. A winter temperature should be assumed for CO worst case conditions. See the User Guide for the latest line source dispersion model for recommended temperature estimates.

5. Background CO. The one-hour peak back ground CO estimate is added to the concentration determined from the line source model. The background CO appears to vary linearly with the size of the city and is usually assumed constant within the highly urbanized area for a given set of meteorological and traffic conditions. Actually, background values vary considerably with both of the above factors, with meteorology usually the most powerful and variable factor. Locations that are rural in nature or on the edge

of the built up area have much lower background levels than the inner city. If the mesoscale area is expected to urbanize, the background values should increase with time. As the city as a whole grows, the background levels should be revised upward.

Document the source of the background estimates stating the methodology used, the assumptions made, and the nature of the data base. Label one-hour peak background estimates as one-hour estimates. Eight-hour background estimate are lower than one-hour estimates. See Table 103.3-2 for estimates of one-hour and eight-hour background concentrations at all major cities in Texas.

6. Carbon Monoxide Concentration. One or more "logical receptors" should be chosen for modeling CO concentrations near the roadway. This should be a typical business or residence, or where a business or residence might be located. It is no longer desirable to include the concentration in the mixing cell according to FHWA. The edge of the right of way may be used when concentrations are relatively low.

A special microscale analysis should be performed for sensitive receptors such as rest homes, hospitals, or schools, especially when large numbers of the old, the sick or the very young are within 300 feet of the roadway.

Use the most recent line source dispersion model for calculating CO concentration. It is best to include examples of the input and output data by including an example of the computer output in the Air Quality Analysis. Explain the assumptions made concerning choice of receptors. A reviewer should fully understand the reasoning and be able to reconstruct the results. Use sample calculations whenever applicable. For clarity and consistency CO concentrations should always be expressed in units of parts per million rather than micrograms or milligrams per cubic meter. Round off the results to the nearest part per million. Cross sections showing concentrations at different distances are effective for display of this kind of data.

The eight-hour standard will normally be violated more frequently than the one-hour standard. To convert from one-hour concentration to eight-hour concentration, in the absence of better information, subtract the one-hour background concentration from th one-hour CO concentration, multiply the local one-hour concentration by 0.6 for meteorological persistence factor and by 0.67 for eight-hour average traffic volume adjustment. Meteorological persistence may be verified by air monitoring. Local traffic counts may improve traffic estimate. Finally, add the eight-hour background.

$$CO_8 = (CO_1 - BG_1)\ 0.4 + BG_8$$

where CO_8 = Eight-hour CO concentration

CO_1 = One-hour CO concentration

BG_1 = One-hour background concentration

0.4 = 0.60 (Meteorological persistence) X 0.67 (eight hour traffic factor)

BG_8 = Eight-hour background concentration

7. Alternatives. Each alternative to construction of the proposed highway project, including no-build or high occupancy vehicle options, should be evaluated in term of CO concentration (PPM). The build and no-build CO concentration calculated using the most recent dispersion and emission factor models is the minimum information that should be provided for ETC, ETC + 5, ETC + 10, ETC + 15, & ETC + 20. Plot the results graphically showing background levels and national standards for CO.

For some situations transportation control measures may need to be considered, especially when these can significantly mitigate air quality degradation. Relief of traffic congestion can often upgrade air quality. Where VMT reduction within a corridor is feasible, this fact should be documented along with the expected degree of mitigation. Where the highway project improves air quality, be sure to document this in the Air Quality Analysis.

8. Systems Analysis

In place of a mesoscale analysis which was formerly used to calculate the change in total pollutant load for nitrogen oxides and hydrocarbons over time, an urban transportation systems analysis can be used when available to assess the change in these same pollutants over time. The projected growth in vehicle miles of travel (VMT) or vehicle hours of travel (VHT) will be a critical factor. The influence of individual highway projects on the overall air quality is small for even the largest projects. However, the growth of an area, the type of industry attracted to the area, and cumulative changes in the transportation infrastructure are important. The most recent transportation system updates should be used. When calculations have been made for SIP revisions, these should prove very useful, since a quantification of mobile source emissions is often a part of these submissions.

A key factor in analysis of future air quality impacts is the amount of congestion likely to occur. If congestion increases appreciably, there should be a significant decrease in traffic flow and average speed. This means an increase in CO and hydrocarbons with a decrease in nitrogen oxides.

Where Transportation Control Measures such as car pools, van pools, park and ride lots, HOV lanes, and staggered work hours have been implemented for any reason, this should be documented if it has an effect on air quality. An attempt should be made to estimate the benefit that should incur due to these special measures.

Plans for improvement of public transit in the systems plan should also be covered since this may affect traffic congestion and therefore air pollution. Of utmost importance is how this particular project fits into the overall transportation system.

E. Appendix

The appendix is reserved for voluminous documentary material or source material. Examples of material suitable for the Appendix might be computer printouts or ambient air quality data summaries. Information included in the Appendix should not normally be included in the Draft Environmental Impact Statement or the Final Environmental Impact Statement, although where important, it may be summarized.

NATIONAL AMBIENT AIR QUALITY STANDARDS

Primary Standards:

Carbon Monoxide (CO)	(a) 9 ppm (10 milligrams/m^3) maximum 8 hr. concentration not to be exceeded more than once per year. (b) 35 ppm (40 milligrams/m^3) maximum 1 hr. concentration not to be exceeded more than once per year.
Oxides of Nitrogen (NO_2)	0.05 ppm (100 micrograms/m^3) annual arithmetic mean.
Ozone (O_3)	0.12 ppm (235 micrograms/m^3) expected daily exceedances averaging less than one per year over a three year period.
Suspended Particulate Matter	75 micrograms/m^3 - annual geometric mean 260 micrograms/m^3 - maximum 24 hr. concentration.
Sulfur Dioxide	0.03 ppm (80 micrograms/m^3) - annual average 0.14 ppm (365 micrograms/m^3) - maximum 24 hr. concentration.
Lead	1.5 micrograms/m^3 - average over a calendar quarter.

Notes:

1. The only difference between primary and secondary standards in the above list of highway related pollutants are those for suspended particulate matter and sulfur dioxide. The secondary standard for suspended particulate matter is an annual geometric mean of 60 ug/m^3. The secondary standard for sulfur dioxide is a 3-hour maximum of 0.5 ppm.

2. Federal Standards, other than those based on annual averages or annual geometric means, are not to be exceeded more than once per year.

3. National Primary Standards: The levels of air quality necessary to protect the public health with adequate margins of safety.

4. National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.

5. See Texas State Implementation Plan (Regional Classifications) for priority classifications and priority of regions for each pollutant.

Revised 2/1/85

MARCH 1970 510.42.10

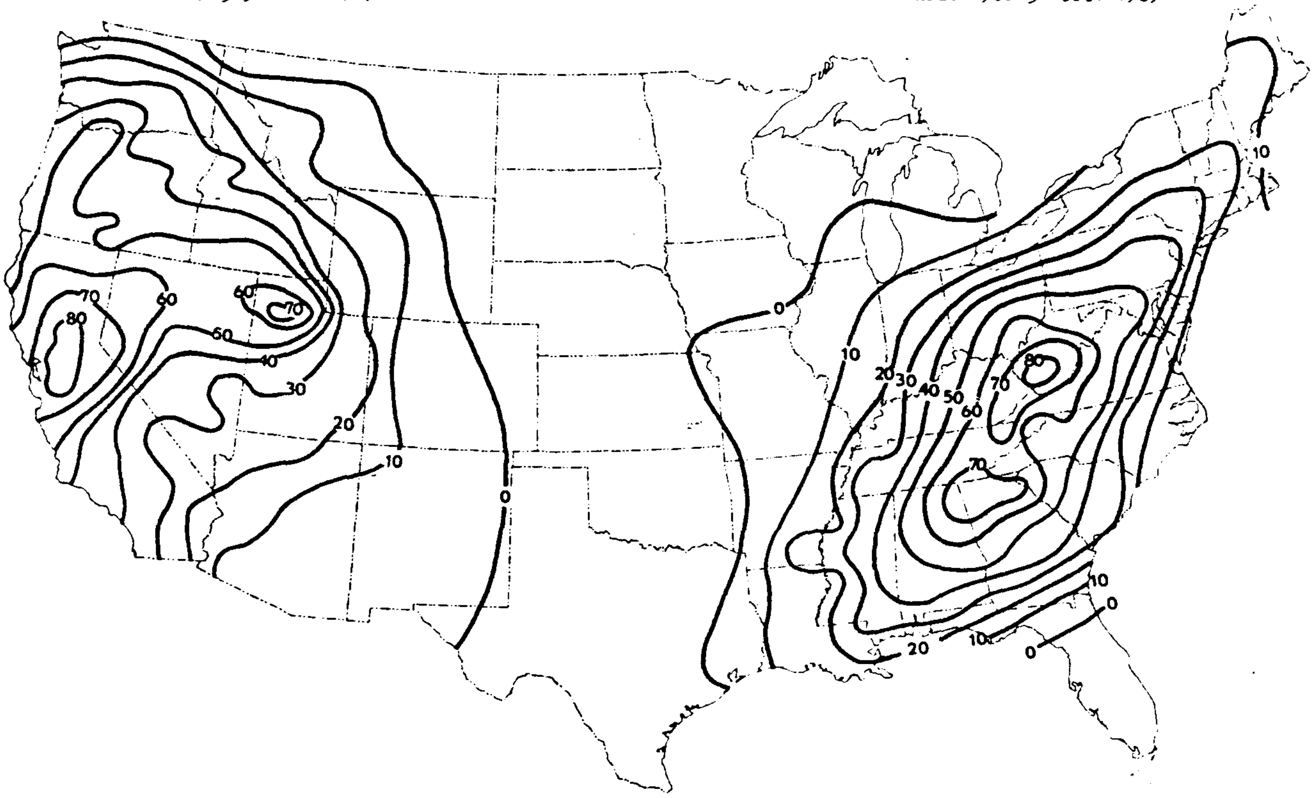
AIR POLLUTION POTENTIAL FORECASTS

During a period when the ability of the atmosphere to transport and dilute pollutants emitted into it is severely reduced, an episode of high air pollution potential is considered to exist. When such a condition is forecast to occur over a large area, the ESSA-Weather Bureau, National Meteorological Center issues an advisory. Because conditions of atmospheric transport and dispersion typically vary with location and with time, the forecasting staff cannot prepare advisories for each city in the United States. For this reason, the ESSA-Weather Bureau meteorologists limit their forecasts to areas at least as large as 58,000 square miles (roughly one-fifth the size of Texas), in which stagnation conditions are expected to persist for at least 36 hours. The boundaries of the forecast areas of high air pollution potential cannot be delineated exactly.

The advisory is disseminated by local ESSA-Weather Bureau offices to agencies concerned with air pollution control. Statements are issued to the public as appropriate.

33 EPISODES WEST
1 OCT. 1963-31 OCT. 1969

74 EPISODES EAST
1 AUG. 1960-31 OCT. 1969



Isolines on the above map show the total number of days that advisories of high air pollution potential have been in effect, both in the East (August 1, 1960 to October 31, 1969) and in the West (October 1, 1963 to October 31, 1969). Of the episodes (advisories on consecutive days for an area) that have been evaluated in detail, most have been well verified by air quality data taken concurrently in the forecast areas.

Since the advisories are issued for a given area only when meteorological conditions warrant, air pollution control agencies in Texas will receive them only rarely.

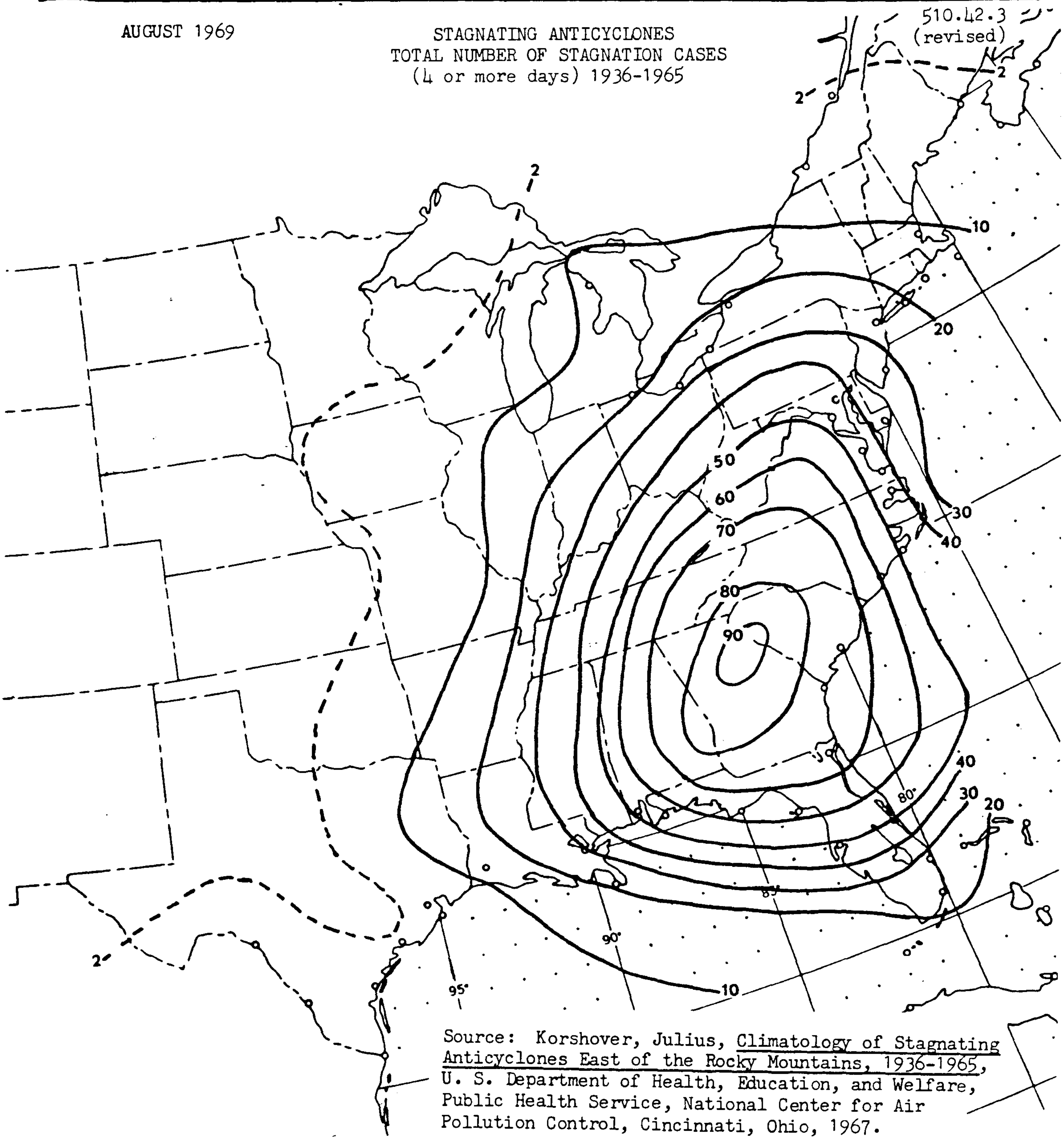
Source of data: George Holzworth, Division of Meteorology, National Air Pollution Control Administration, U. S. Department of Health, Education and Welfare, Raleigh, North Carolina.

ESSA STATE CLIMATOLOGIST FOR TEXAS
AIRPORT ADMINISTRATION BLDG., 3600 MANOR ROAD
AUSTIN, TEXAS 78723

AUGUST 1969

510.42.3
(revised)

STAGNATING ANTICYCLONES
TOTAL NUMBER OF STAGNATION CASES
(4 or more days) 1936-1965

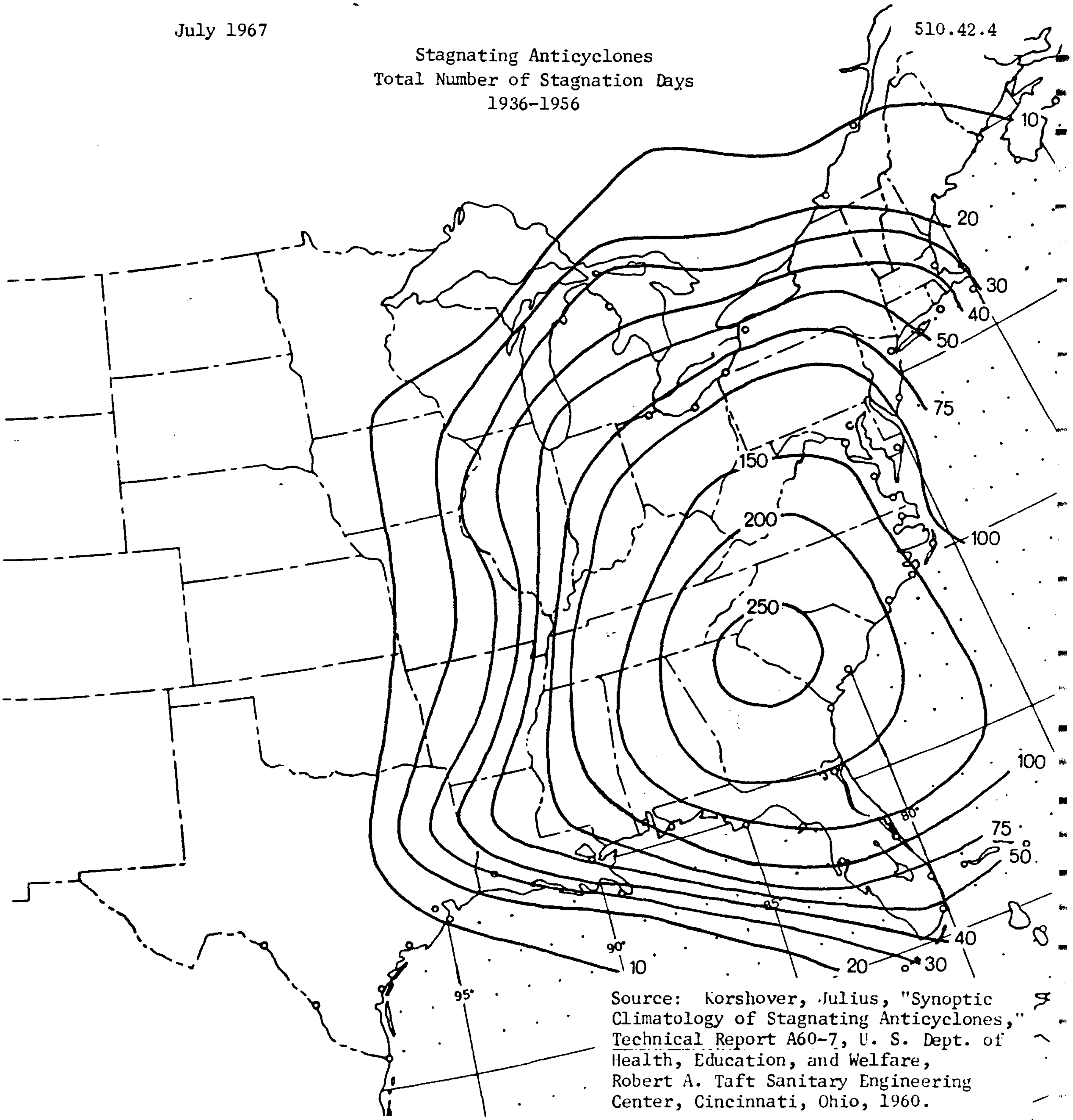


Source: Korshover, Julius, Climatology of Stagnating Anticyclones East of the Rocky Mountains, 1936-1965, U. S. Department of Health, Education, and Welfare, Public Health Service, National Center for Air Pollution Control, Cincinnati, Ohio, 1967.

July 1967

510.42.4

Stagnating Anticyclones
Total Number of Stagnation Days
1936-1956

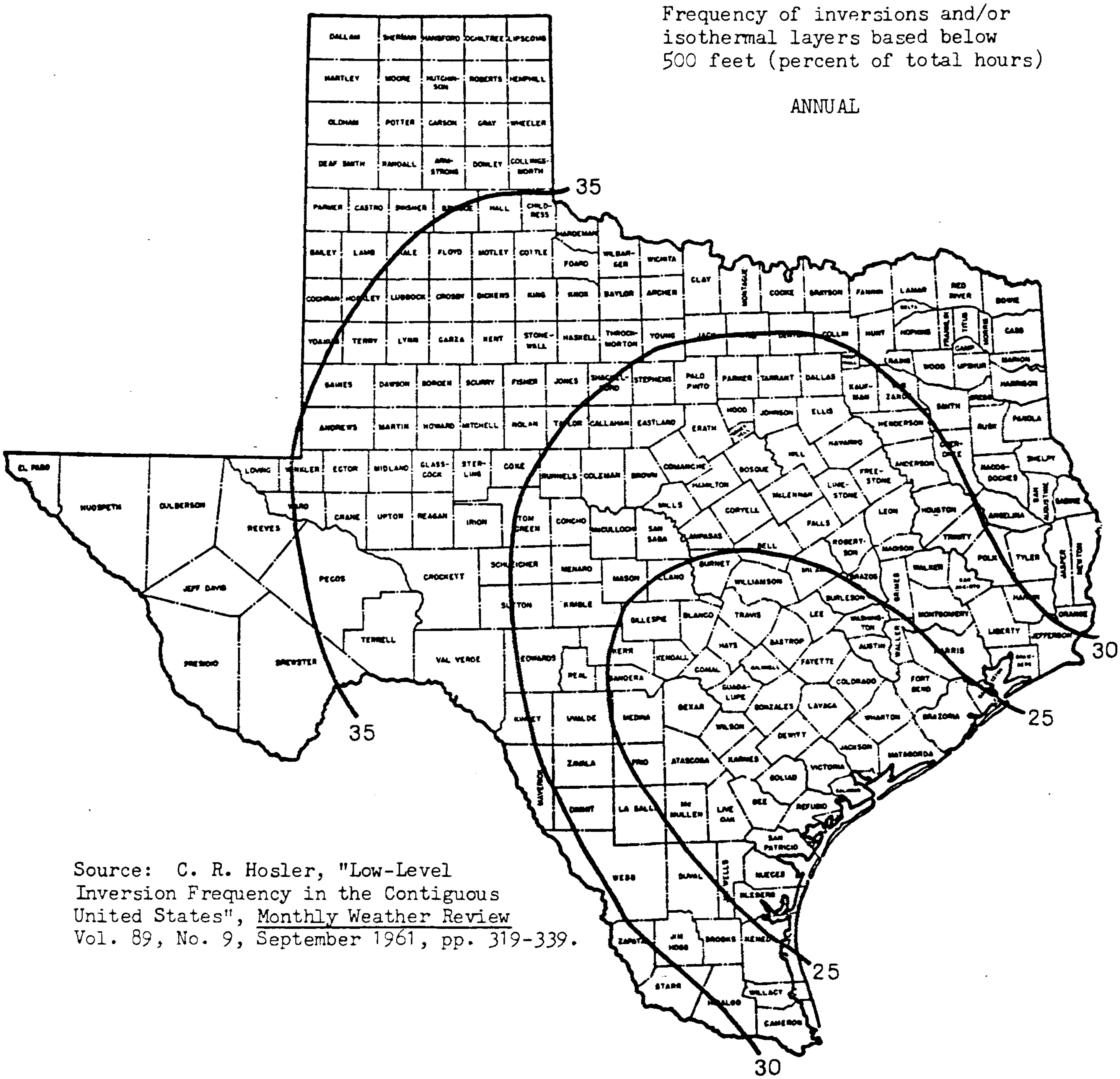


Source: Korshover, Julius, "Synoptic Climatology of Stagnating Anticyclones," Technical Report A60-7, U. S. Dept. of Health, Education, and Welfare, Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio, 1960.

DECEMBER 1969 510.42.9

Frequency of inversions and/or isothermal layers based below 500 feet (percent of total hours)

ANNUAL

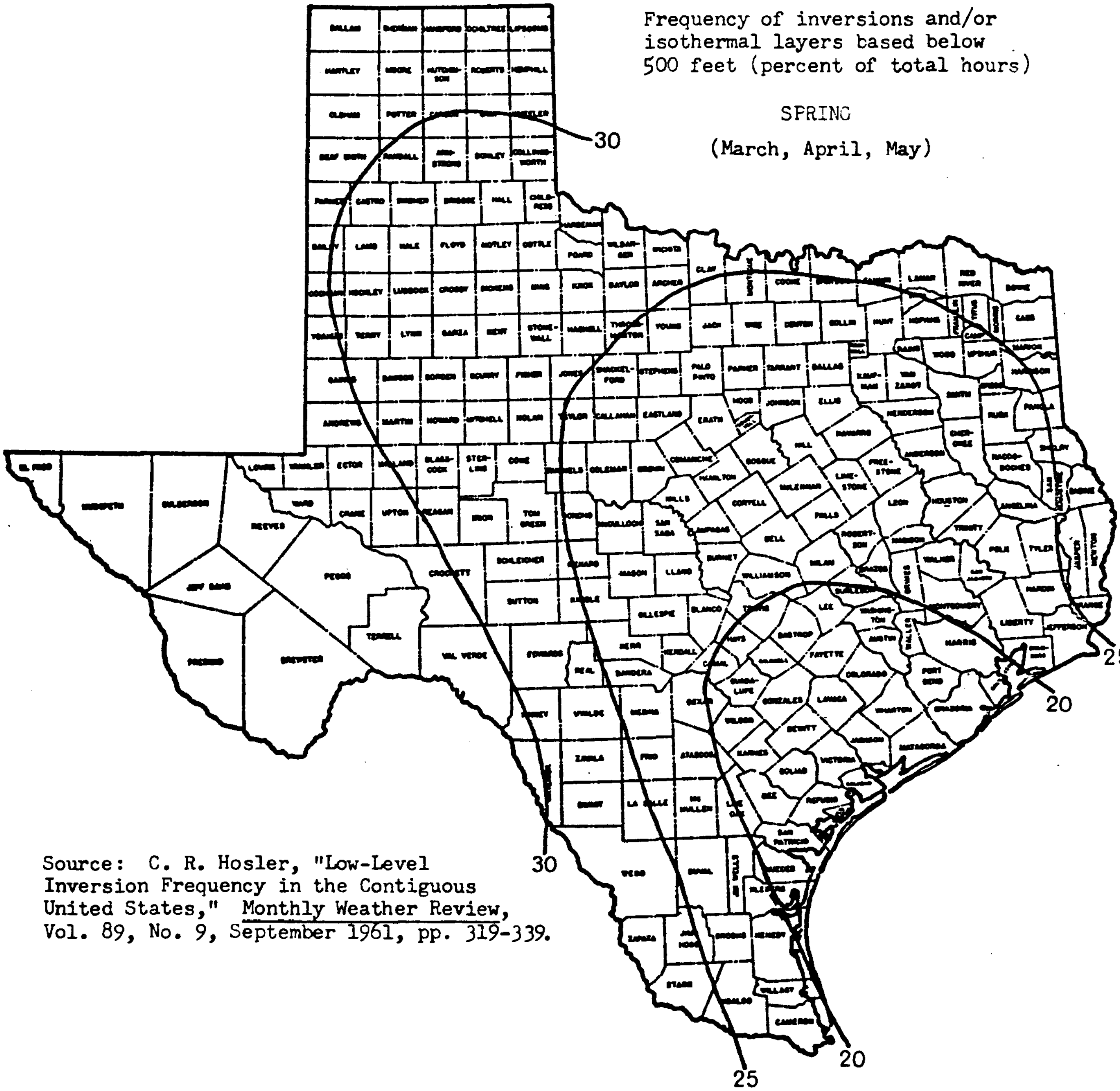


Source: C. R. Hosler, "Low-Level Inversion Frequency in the Contiguous United States", Monthly Weather Review Vol. 89, No. 9, September 1961, pp. 319-339.

Frequency of inversions and/or isothermal layers based below 500 feet (percent of total hours)

SPRING

(March, April, May)

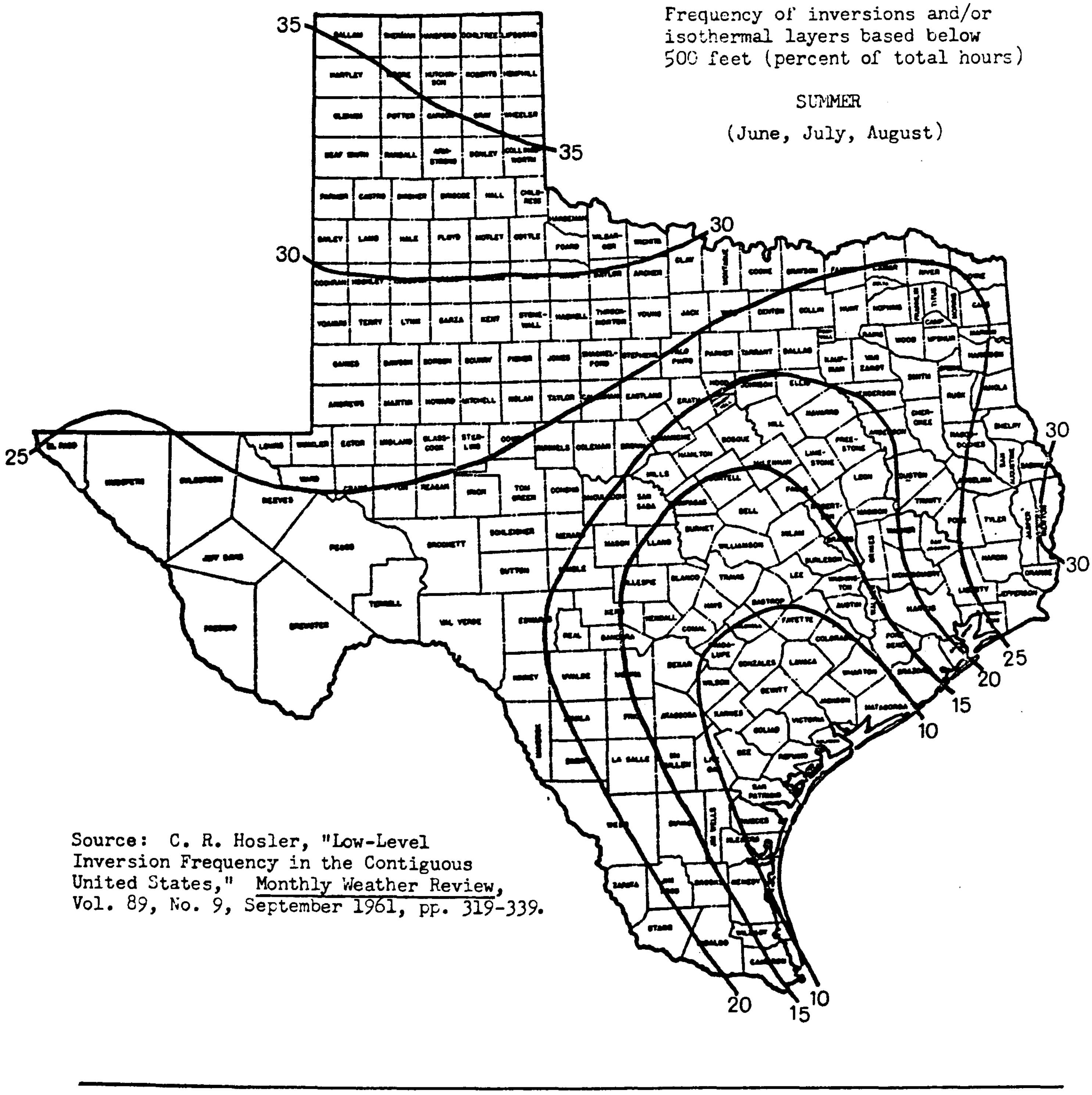


Source: C. R. Hosler, "Low-Level Inversion Frequency in the Contiguous United States," Monthly Weather Review, Vol. 89, No. 9, September 1961, pp. 319-339.

Frequency of inversions and/or isothermal layers based below 500 feet (percent of total hours)

SUMMER

(June, July, August)



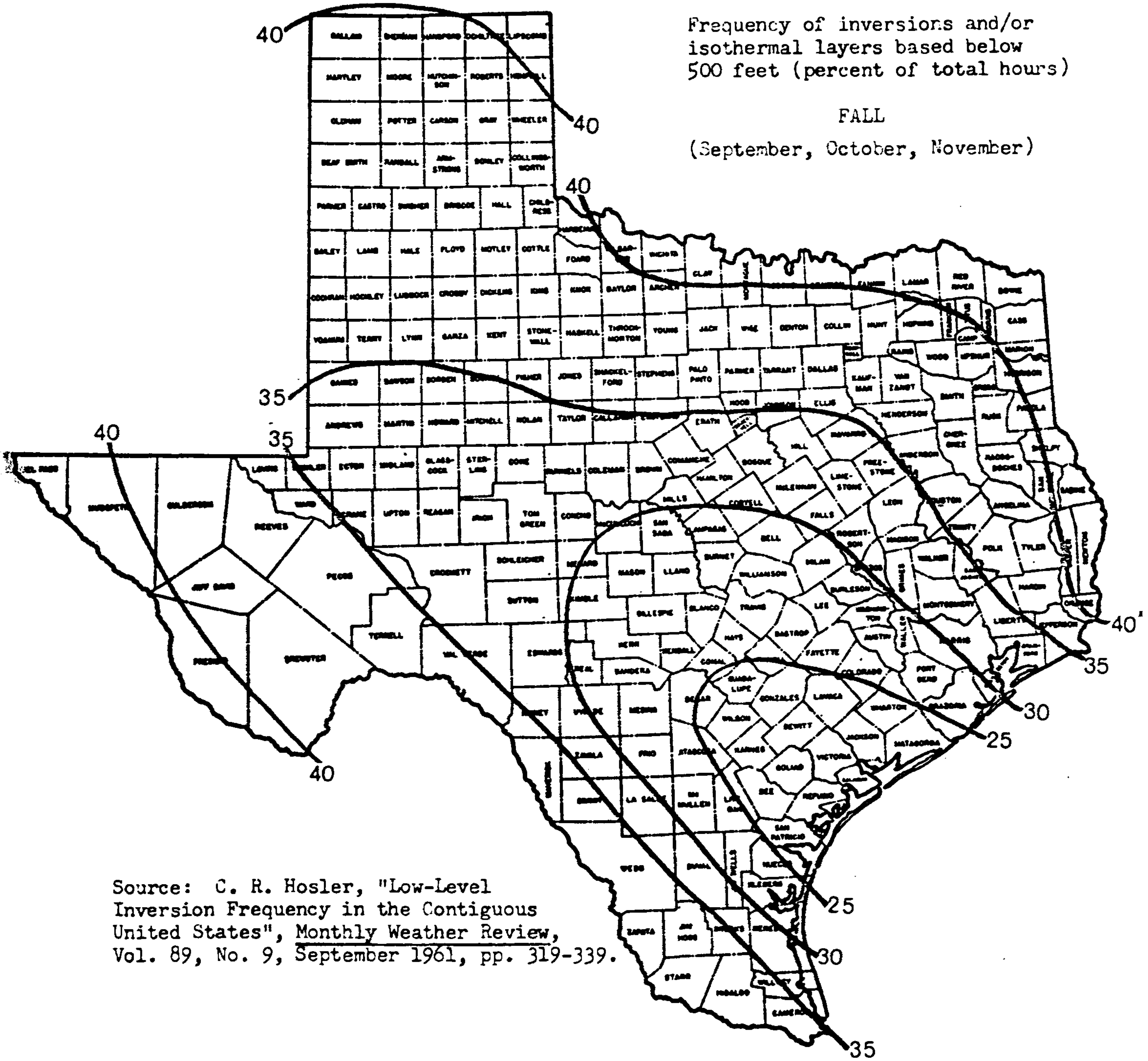
Source: C. R. Hosler, "Low-Level Inversion Frequency in the Contiguous United States," Monthly Weather Review, Vol. 89, No. 9, September 1961, pp. 319-339.

MAY 1969 510.42.7

Frequency of inversions and/or isothermal layers based below 500 feet (percent of total hours)

FALL

(September, October, November)



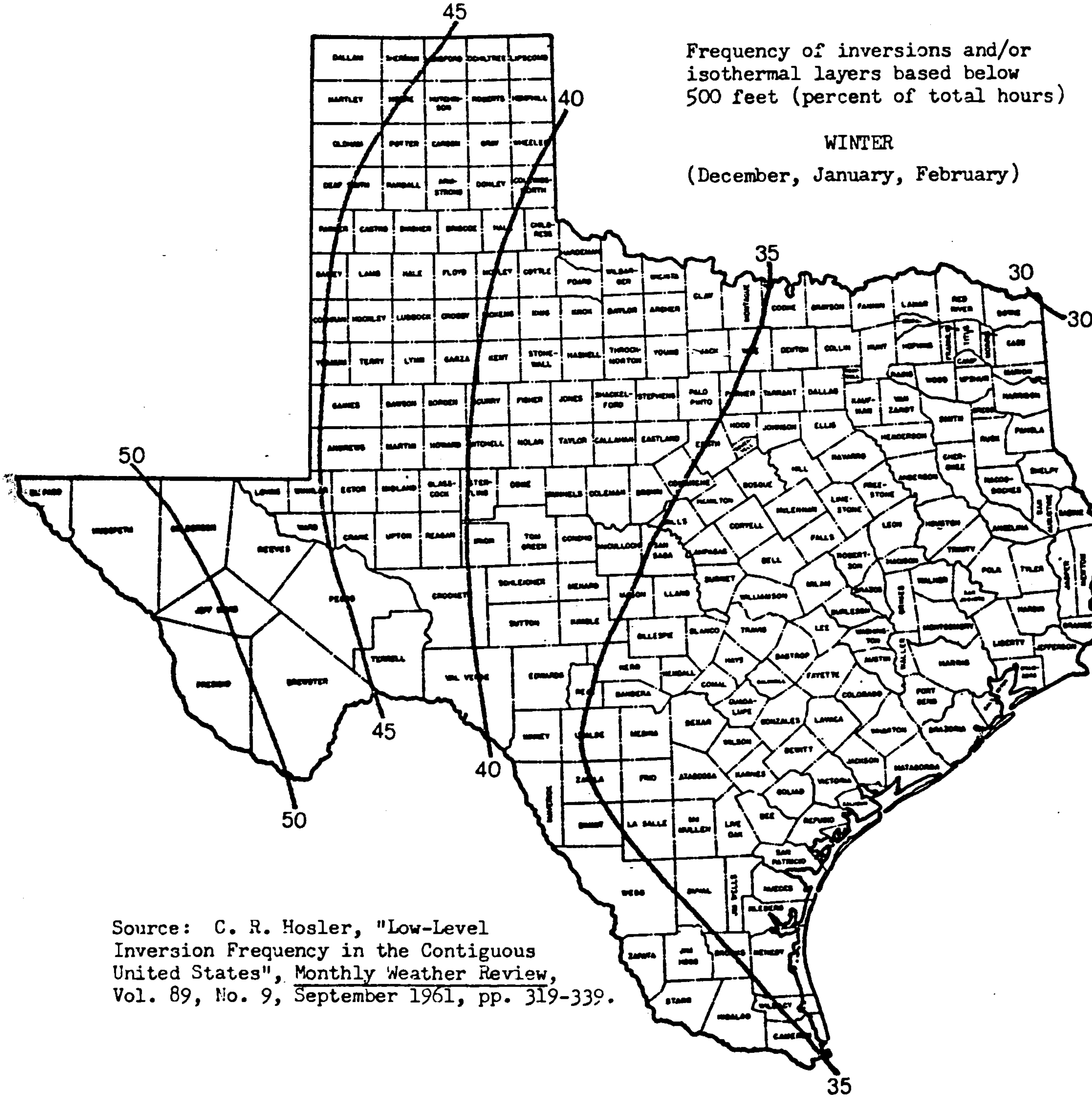
Source: C. R. Hosler, "Low-Level Inversion Frequency in the Contiguous United States", Monthly Weather Review, Vol. 89, No. 9, September 1961, pp. 319-339.

MAY 1969 510.42.8

Frequency of inversions and/or isothermal layers based below 500 feet (percent of total hours)

WINTER

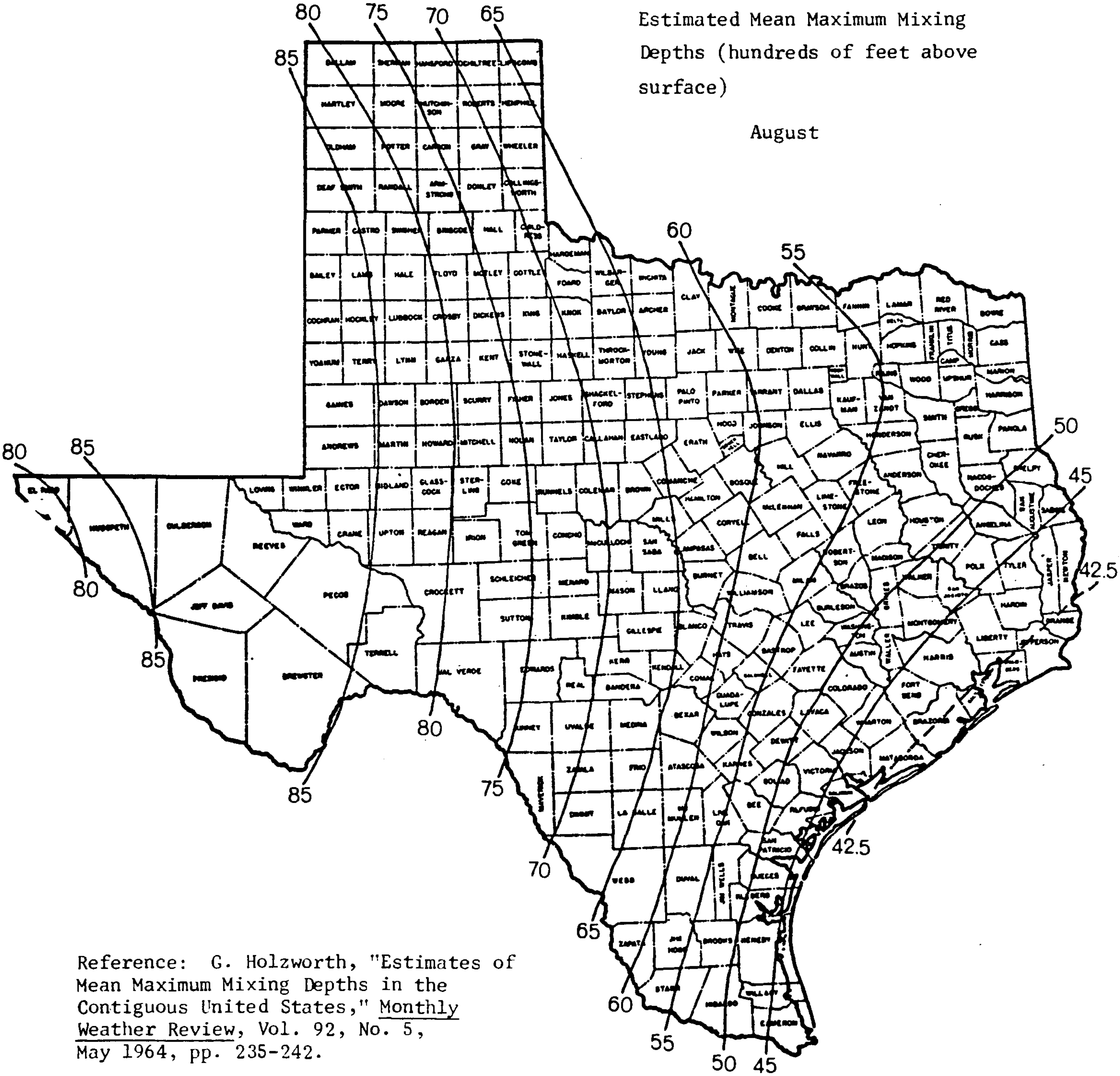
(December, January, February)



Source: C. R. Hosler, "Low-Level Inversion Frequency in the Contiguous United States", Monthly Weather Review, Vol. 89, No. 9, September 1961, pp. 319-339.

Estimated Mean Maximum Mixing Depths (hundreds of feet above surface)

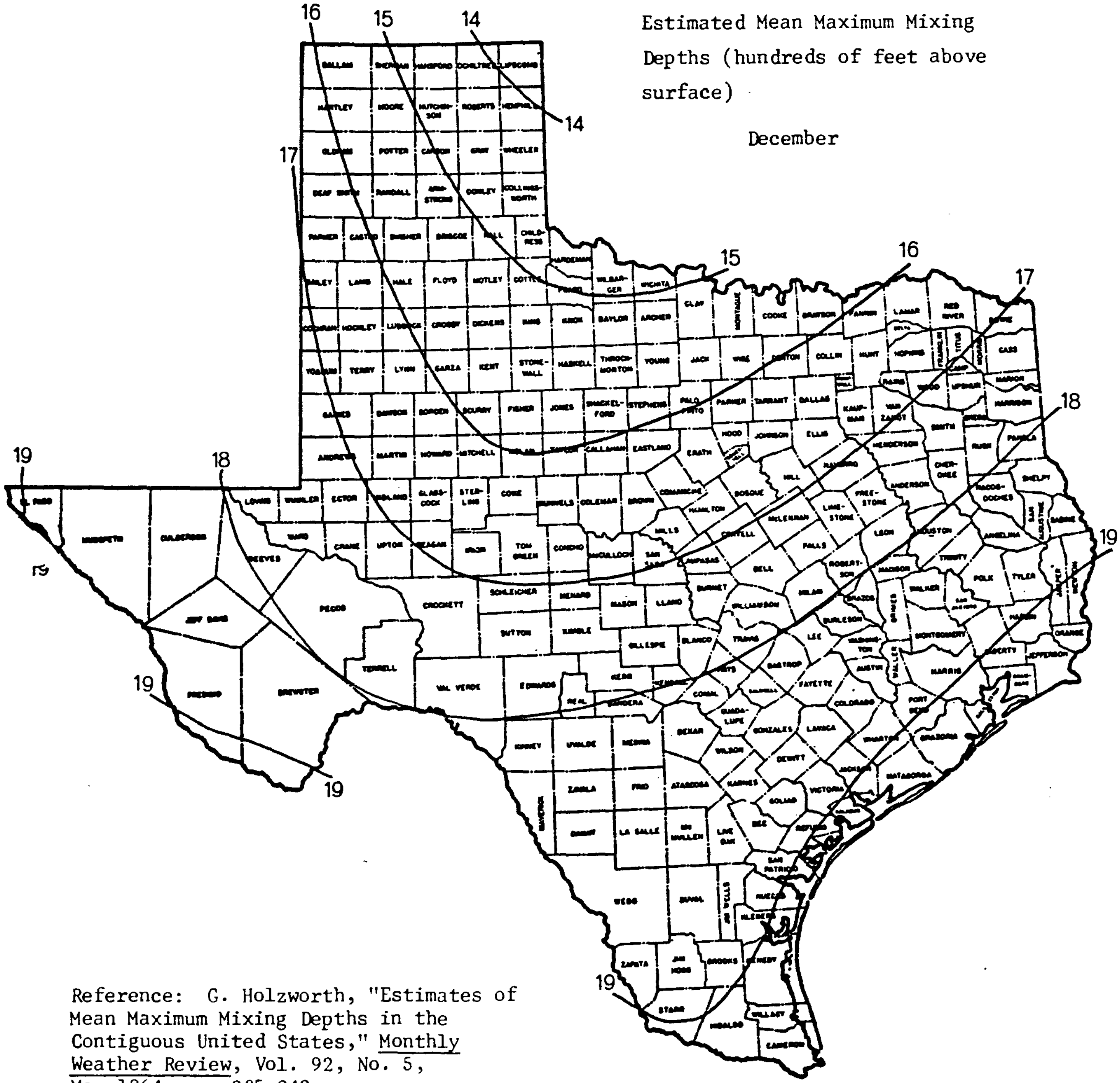
August



Reference: G. Holzworth, "Estimates of Mean Maximum Mixing Depths in the Contiguous United States," Monthly Weather Review, Vol. 92, No. 5, May 1964, pp. 235-242.

Estimated Mean Maximum Mixing Depths (hundreds of feet above surface)

December



Reference: G. Holzworth, "Estimates of Mean Maximum Mixing Depths in the Contiguous United States," <u>Monthly Weather Review</u>, Vol. 92, No. 5, May 1964, pp. 235-242.

TEXAS DEPARTMENT OF HIGHWAYS
AND PUBLIC TRANSPORTATION

TABULAR METHOD FOR PREDICTING
CARBON MONOXIDE (CO)
CONCENTRATIONS

The following Tabular Method is recommended as an effective alternative to computer modeling for estimating CO concentrations for proposed highway projects. This method is based on the CALINE-3 dispersion model, Mobile 2 emission factor model, and 1980 vehicle registration data for Texas. The solutions provided by this method will be reasonably accurate for Texas when conditions approximate the assumptions listed below.

INSTRUCTIONS:

This Tabular Method involves use of the attached five tables (A-E) for emission factors. Three of the tables should be used for projects located in Harris (Table A), Bexar (Table B), and El Paso (Table C) Counties. For all other project locations, either the "Plains Table" (D) or the "Plateau Table" (E) should be used. Use the "Plains Table" for projects at elevations below 1000 feet and the "Plateau Table" for projects at elevations above 1000 feet.

To begin a solution for CO concentration enter the selected table with the appropriate year and average speed to determine the emission factor in grams per mile. The one-hour CO concentrations in parts per million is established by multiplying 0.15 by the emission factor. This 0.15 factor converts the emission factor from grams per mile of vehicular emissions to parts per million of CO concentration using an FHWA graph previously furnished. This concentration is then adjusted for number of lanes, traffic volume in vehicles per hour per lane and median width by interpolating for an adjustment factor taken from Table F for urban areas or G for rural. Then add the background concentration for that area from Table H. Roadways with medians wider than 30 feet need to be treated as separate roadways. The following equation is used to calculate the one-hour concentration of CO:

$$C = 0.15\ EA + B$$

C = one-hour concentration of CO
E = Emission factor (Table A - E)
A = Adjustment factor (Table F - G)
B = Background concentration of CO (Table H)

The one-hour concentration of CO can be coverted to an eight-hour concentration of CO by the following equation:

$$C_8 = 0.4(C_1 - B_1) + B_8$$

Where subscripts refer to one-hour or eight-hour concentrations of CO.

The eight hour concentration of CO is usually a higher percentage of the National Ambient Air Quality Standard than the one-hour concentration. The final CO concentration should be rounded off to the nearest whole part per million.

EXAMPLE:

Calculate the one-hour CO concentration for a receptor at the edge of the shoulder in a Dallas County urban area with a traffic volume of 6000 vehicles per hour moving at 55 mph along a six-lane highway with no median.

Since no separate table is provided for Dallas County and its elevation is below 1000 feet, the Texas plains table should be used to determine the emission factor. From Table D for the year 1985 and 55 mph speed, the CO emission factor is 28.7 g./mi.

For six lanes and 1000 vehicles per lane in an urban area (Table F), the adjustment factor is 1.70. From Table H the one-hour background CO concentration for Dallas County, 3.7 ppm, should be added to arrive at 11 ppm.

$$C = 0.15\ EA + B$$
$$C = 0.15 \times 28.7\ \text{g./mi.} \times 1.70 + 3.7\ \text{ppm}$$
$$C = 11.02 \text{ or } 11.0\ \text{ppm}$$

To calculate the eight-hour concentration, subtract the one-hour background, of 3.7 ppm from 11.0 ppm, take 0.4 of the remainder to arrive at 2.9 ppm, and then add the eight-hour background 2.3 ppm. The eight-hour concentration then becomes 5.2 ppm or 5 ppm when rounded off. This is 63% of the eight-hour standard of 9 ppm.

$$C_8 = 0.4(C_1 - B_1) + B_8$$
$$C_8 = 0.4(11.0\ \text{ppm} - 3.7\ \text{ppm}) + 2.3\ \text{ppm}$$
$$C_8 = 5.2\ \text{ppm or } 5\ \text{ppm}$$

The tabular solution is based on the following assumptions:

ASSUMPTIONS

YEAR:..................................	1980 - 2020
SPEED:.................................	30-55 MPH
COUNTY:................................	Bexar, Harris, El Paso, Plains, Plateau
TEMPERATURE:...........................	31°F (Plateau) or 41° (Plains)
HOT & COLD STARTS:.....................	47-07-47%
WIND DIRECTION:........................	Parallel to roadway
WIND SPEED:............................	1.0 metre/second
STABILITY CLASS:.......................	"D" (urban) or "F" (rural)
SURFACE ROUGHNESS:.....................	175.0 centimetres (Office)
MIXING HEIGHT:.........................	1000 metres
AMBIENT BACKGROUND:....................	0 p.p.m.
LINK LENGTH:...........................	6000 Feet
LINK ORIENTATION:......................	Straight section
TYPE OF SECTION:.......................	At grade
TRAFFIC VOLUME:........................	500, 1000, or 1500 Vehicles/Lane
NO. OF LANES:..........................	2, 4, 6, 8, or 10
MEDIAN:................................	With or without 30 Foot Median
LANE WIDTH:............................	12 Feet
SHOULDER:..............................	10 Feet (mixed zone)
RECEPTOR DISTANCE:.....................	2-4 Lanes: 15 m or 49 ft. from centerline 6-10 Lanes: 1/2 pavement width + 10 foot shoulder

TABLE A

MOBILE 2 EMISSION FACTORS FOR
CARBON MONOXIDE (GRAMS PER MILE)

HARRIS COUNTY

YEAR	AVERAGE SPEED - MPH					
	30	35	40	45	50	55
80	62.2	52.5	46.5	43.8	43.1	40.9
81	57.4	48.3	42.8	40.5	40.0	37.8
82	52.5	44.1	39.1	37.0	36.7	34.6
83	48.0	40.3	35.7	34.0	33.8	31.8
84	44.1	37.0	32.8	31.3	31.2	29.4
85	39.8	33.4	29.6	28.3	28.3	26.6
86	35.6	29.8	26.4	25.3	25.3	23.6
87	32.0	26.8	23.7	22.8	22.8	21.2
88	29.0	24.2	21.5	20.6	20.7	19.2
89	26.7	22.2	19.7	19.0	19.0	17.6
90	24.8	20.7	18.4	17.7	17.8	16.4
91	23.0	19.2	17.0	16.3	16.4	15.1
92	21.7	18.1	16.1	15.5	15.5	14.3
93	20.5	17.1	15.2	14.6	14.7	13.5
94	19.6	16.4	14.5	14.0	14.1	13.0
95	18.9	15.7	14.0	13.4	13.5	12.4
96	18.3	15.3	13.5	13.0	13.1	12.0
97	17.8	14.8	13.1	12.6	12.7	11.7
98	17.4	14.5	12.8	12.4	12.4	11.4
99	17.1	14.2	12.6	12.1	12.2	11.2
00-20	16.8	14.0	12.4	12.0	12.0	11.0

TABLE B

MOBILE 2 EMISSION FACTORS FOR
CARBON MONOXIDE (GRAMS PER MILE)

BEXAR COUNTY

YEAR	AVERAGE SPEED - MPH					
	30	35	40	45	50	55
80	68.4	58.0	51.5	48.3	47.3	45.1
81	63.9	54.1	48.0	45.1	44.3	42.1
82	59.4	50.2	44.5	42.0	41.3	39.1
83	55.1	46.5	41.2	39.0	38.5	36.4
84	51.3	43.2	38.3	36.4	36.0	34.0
85	47.3	39.8	35.3	33.5	33.3	31.3
86	43.2	36.3	32.1	30.6	30.4	28.5
87	39.7	33.2	29.4	28.1	27.9	26.1
88	36.2	30.2	26.8	25.6	25.5	23.7
89	33.4	27.9	24.7	23.6	23.6	21.9
90	31.1	26.0	23.0	22.0	22.0	20.4
91	28.5	24.0	21.1	20.2	20.3	18.7
92	26.9	22.4	19.9	19.1	19.2	17.7
93	25.3	21.1	18.7	18.0	18.0	16.6
94	24.1	20.1	17.8	17.1	17.2	15.8
95	22.9	19.1	16.9	16.3	16.4	15.1
96	22.0	18.3	16.2	15.6	15.7	14.4
97	21.1	17.6	15.6	15.0	15.1	13.8
98	20.4	17.0	15.0	14.5	14.6	13.3
99	19.7	16.4	14.6	14.0	14.1	12.9
00-20	19.2	16.0	14.2	13.7	13.7	12.6

TABLE C

MOBILE 2 EMISSION FACTORS FOR CARBON MONOXIDE (GRAMS PER MILE)

EL PASO COUNTY

YEAR	AVERAGE SPEED - MPH					
	30	35	40	45	50	55
80	80.3	68.1	60.4	56.6	55.3	52.6
81	75.5	63.9	56.6	53.2	52.1	49.5
82	70.9	59.8	53.0	49.9	49.0	46.4
83	66.5	56.0	49.6	46.9	46.3	43.7
84	62.3	52.4	46.5	44.1	43.6	41.1
85	58.0	48.7	43.1	41.0	40.7	38.3
86	53.3	44.7	39.6	37.7	37.5	35.1
87	49.1	41.1	36.4	34.8	34.6	32.3
88	45.0	37.6	33.3	31.8	31.7	29.5
89	41.4	34.6	30.6	29.3	29.3	27.2
90	38.4	32.1	28.4	27.3	27.3	25.3
91	35.0	29.2	25.9	24.8	24.9	23.0
92	32.9	27.4	24.3	23.4	23.5	21.7
93	30.8	25.6	22.7	21.9	22.0	20.3
94	29.3	24.4	21.6	20.8	21.0	19.3
95	27.8	23.1	20.5	19.8	19.9	18.3
96	26.6	22.1	19.6	18.9	19.0	17.4
97	25.4	21.1	18.7	18.1	18.2	16.6
98	24.5	20.4	18.0	17.4	17.5	16.0
99	23.7	19.7	17.5	16.8	16.9	15.5
00-20	23.0	19.2	17.0	16.3	16.4	15.0

TABLE D

MOBILE 2 EMISSION FACTORS FOR
CARBON MONOXIDE (GRAMS PER MILE)

TEXAS PLAINS

YEAR	AVERAGE SPEED - MPH					
	30	35	40	45	50	55
80	64.9	54.9	48.6	45.7	44.7	42.5
81	60.3	50.9	45.0	42.5	41.7	39.6
82	55.7	46.9	41.5	39.3	38.8	36.7
83	51.3	43.1	38.2	36.3	36.0	34.0
84	47.4	39.7	35.3	33.6	33.4	31.5
85	43.2	36.2	32.1	30.6	30.5	28.7
86	39.1	32.7	29.0	27.8	27.8	26.0
87	35.6	29.8	26.5	25.3	25.4	23.7
88	32.5	27.1	24.1	23.1	23.2	21.5
89	29.9	24.9	22.1	21.3	21.3	19.8
90	27.7	23.1	20.5	19.7	19.8	18.4
91	25.3	21.1	18.7	18.0	18.1	16.7
92	23.8	19.9	17.6	17.0	17.0	15.7
93	22.4	18.7	16.6	15.9	16.0	14.8
94	21.3	17.8	15.8	15.2	15.3	14.1
95	20.4	17.0	15.1	14.5	14.6	13.4
96	19.7	16.4	14.6	14.0	14.1	13.0
97	19.1	15.9	14.1	13.6	13.6	12.5
98	18.6	15.5	13.7	13.2	13.3	12.2
99	18.2	15.1	13.4	12.9	13.0	12.0
00-20	17.8	14.9	13.2	12.7	12.7	11.7

TABLE E

MOBILE 2 EMISSION FACTORS FOR
CARBON MONOXIDE (GRAMS PER MILE)

TEXAS PLATEAU

YEAR	AVERAGE SPEED - MPH					
	30	35	40	45	50	55
80	75.3	63.5	56.2	52.8	51.7	49.0
81	70.1	59.1	52.3	49.3	48.5	45.8
82	65.1	54.7	48.4	45.8	45.2	42.6
83	60.0	50.4	44.7	42.4	42.0	39.6
84	55.6	46.6	41.3	39.3	39.1	36.7
85	50.7	42.5	37.7	35.9	35.8	33.6
86	46.0	38.5	34.2	32.7	32.7	30.5
87	42.1	35.2	31.2	29.9	29.9	27.8
88	38.4	32.0	28.4	27.2	27.3	25.3
89	35.3	29.4	26.1	25.1	25.2	23.3
90	32.7	27.3	24.2	23.3	23.4	21.6
91	29.9	24.9	22.0	21.2	21.3	19.6
92	28.0	23.3	20.7	19.9	20.0	18.4
93	26.3	21.9	19.4	18.7	18.8	17.3
94	25.0	20.9	18.5	17.8	17.9	16.5
95	23.9	19.9	17.7	17.0	17.1	15.7
96	23.1	19.2	17.0	16.4	16.5	15.1
97	22.3	18.6	16.5	15.9	15.9	14.6
98	21.7	18.1	16.0	15.4	15.5	14.2
99	21.2	17.7	15.7	15.1	15.2	13.9
00-20	20.8	17.3	15.4	14.8	14.9	13.6

TABLE F

URBAN AREA ADJUSTMENT FACTORS

(STABILITY CLASS D)

NO MEDIAN

Number of Lanes	Pavemt. Width(Ft)	VEHICLES PER HOUR PER LANE				
		500	750	1000	1250	1500
2	44	0.16	0.25	0.33	0.41	0.49
4	68	0.40	0.60	0.79	0.99	1.19
6	92	0.86	1.28	1.70	2.13	2.56
8	116	1.00	1.50	2.00	2.50	3.00
10	140	1.12	1.66	2.20	2.77	3.33

30 FOOT MEDIAN

Number of Lanes	Pavement Width(Ft)	VEHICLES PER HOUR PER LANE				
		500	750	1000	1250	1500
2	74	0.21	0.32	0.42	0.62	0.81
4	98	0.53	0.81	1.09	1.36	1.63
6	122	0.72	1.08	1.44	1.82	2.19
8	146	0.86	1.29	1.72	2.15	2.58
10	170	0.98	1.47	1.95	2.44	2.93

TABLE G

RURAL AREA ADJUSTMENT FACTORS

(STABILITY CLASS F)

NO MEDIAN

Number of Lanes	Pavemt. Width(Ft)	VEHICLES PER HOUR PER LANE				
		500	750	1000	1250	1500
2	44	0.35	0.51	0.67	0.85	1.02
4	68	0.77	1.15	1.53	1.92	2.30
6	92	1.56	2.35	3.14	3.92	4.70
8	116	1.79	2.69	3.58	4.48	5.37
10	140	1.95	2.93	3.91	4.92	5.93

30 FOOT MEDIAN

Number of Lanes	Pavement Width(Ft)	VEHICLES PER HOUR PER LANE				
		500	750	1000	1250	1500
2	74	0.40	0.60	0.79	0.99	1.19
4	98	1.00	1.50	2.00	2.50	3.00
6	122	1.30	2.00	2.60	3.26	3.91
8	146	1.51	2.27	3.02	3.78	4.53
10	170	1.67	2.51	3.35	4.19	5.02