

OFF-GAS TREATMENT
OF POINT-SOURCE REMEDIAL AIR EMISSIONS

Policy #WSC-94-150

This Policy concerns air emissions that occur as a result of air stripping of contaminated groundwater, vacuum extraction of soil gases, or any other remedial activity conducted pursuant to MGL Chapter 21E that creates a point-source discharge of contaminants to air. The intent of this Policy is to articulate when off-gas treatment of point-source remedial air emissions may be necessary to eliminate significant risks to human health, safety, public welfare, or the environment.

Date

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1.0 Background and Purpose

Remedial actions at sites contaminated by a release of oil and/or hazardous materials frequently involve the collection and treatment of groundwater and/or soil gases. Common treatment technologies often result in the emission of contaminated vapors to the ambient air. Emissions of this nature generally result from the operation of "air strippers" or soil vapor extraction (SVE) systems, designed to volatilize or "off-gas" contaminants from soil and/or groundwater to the atmosphere.

The purpose of this policy is to (1) describe the regulatory jurisdictions and procedures that govern emissions of this nature, (2) delineate and explain the required performance standards applicable to remedial emissions, (3) articulate details of a Best Response Action Management Approach (BRAMA), and (4) provide a simplified methodology for determining when off-gas controls should be considered.

The information contained in this document is intended solely for guidance. This document does not create any substantive or procedural rights, and is not enforceable by any party in any administrative proceeding with the Commonwealth. The regulations related to remedial air emissions contain both specific and general requirements. In addition to summarizing specific requirements, this document also provides guidance on what measures the Department considers acceptable for meeting the general requirements set forth in the regulations. Parties using this guidance should be aware that there may be acceptable alternatives to this guidance for achieving compliance with such general regulatory requirements.

Additional copies of this policy may be obtained by calling the DEP InfoLine at (617) 338-2255 or 1-800-462-0444.

2.0 Applicability

This policy applies to remedial actions being conducted at any disposal site as defined and regulated by the Massachusetts Department of Environmental Protection (DEP)/Bureau of Waste Site Cleanup (BWSC) under MGL c.21E and 310 CMR 40.0000, the "Massachusetts Contingency Plan", including disposal sites with waivers.

The guidance contained in this policy applies to any point-source remedial air emissions, such as, air discharges from packed-tower or diffused aeration air strippers, bioreactors, and SVE systems, except as described below.

This policy is neither designed nor intended to apply to the following:

- (1) Well-head treatment systems at public water supply wells that are operated in conformance with the provisions of DEP Policy # DWS-88-01 and/or in conformance with requirements specified by the DEP Division of Water Supply.
- (2) Sub-Slab Depressurization Systems installed at residential dwellings, schools, or commercial buildings to prevent the migration of subsurface vapors into living/working spaces, provided the total air emission rate of all volatile contaminants is less than 100 pounds/year.

- (3) Point-source remedial air emissions temporarily authorized by DEP to prevent or abate an imminent hazard to health, safety, public welfare, or the environment, as described in 310 CMR 40.0040(4). In such cases, treatment devices, when necessary, must be installed as soon as possible.

However, DEP reserves the right to require off-gas controls on the above discharges should such emissions (1) presently or potentially exceed significant risk level concentrations or (2) create odorous or adverse health, safety, or environmental conditions downwind of the discharges.

3.0 Regulatory Jurisdictions

While point-source remedial air emissions are regulated primarily by DEP/BWSC under MGL c.21E and 310 CMR 40.0000, remedial air emissions **that will exceed 1 ton/year** (with or without off-gas treatment/controls) are also subject to the regulatory provisions specified by DEP/Bureau of Waste Prevention (BWP) under MGL c.111, section 142 A-K and 310 CMR 7.00, the "Massachusetts Air Pollution Control Regulations." Under these provisions, two options exist to satisfy BWP requirements:

- (1) the proponent of the remediation may file an appropriate permit/plan application, as specified in 310 CMR 7.02; or
- (2) the proponent of the remediation may, under the "permit by rule" provisions of 310 CMR 7.03, elect to apply off-gas control treatment (if not already required by BWSC requirements under 310 CMR 40.0040) for groundwater or soil venting systems that ensures 95% removal of volatile emissions, and implement specified monitoring and documentation procedures.

At most disposal sites remediated under MGL c 21E, remedial air emissions are less than 1 ton/year (even without treatment), and in most cases, will not require an air discharge permit from BWP. Regardless of emission levels, however, BWP has the authority to require a plan application or permit if such emissions create or contribute to a condition of air pollution.

4.0 Performance Standards for Determining When to Apply Off-Gas Controls

4.1 Background

Under the provisions of 310 CMR 40.0000, DEP/BWSC has established requirements and procedures for conducting remedial actions at contaminated sites in a manner which is protective of human health, safety, public welfare, and the environment. Specifically, 310 CMR 40.0040 ("Remedial Air Emissions") stipulates that point-source air emissions from remedial systems must be treated by control devices prior to their discharge to ambient air, unless the person undertaking the response action submits a Licensed Site Professional (LSP) Opinion to DEP prior to commencement of the remedial action stating that such emissions, if not treated, would be at or below a level of No Significant Risk to health, safety, public welfare, and the environment.

Once installed, off-gas controls must be maintained until such time that an LSP Opinion is submitted stating that such off-gas controls are no longer needed.

4.2 No Significant Risk

In order to achieve compliance with 310 CMR 40.0040, emissions from remedial systems must be at or below a level of No Significant Risk to health, safety, public welfare, and the environment. "No Significant Risk" exists when all of the following conditions are met:

Human Health

A condition of No Significant Risk to human health shall exist if the risk of harm to persons exposed to remedial air emissions meet the risk management criteria specified in 310 CMR 40.0902(2):

- using a cumulative risk approach, the risk associated with the remedial air emissions must be equal to or less than the Cumulative Cancer Risk Limit (an Excess Lifetime Cancer Risk of one-in-one hundred thousand), and the Cumulative Noncancer Risk Limit (a Hazard Index of 1.0); or
- using a chemical-specific approach, the receptor concentration resulting from each oil or hazardous material emitted must be equal to or lower than either the concentrations of that chemical which are associated with an Excess Lifetime Cancer Risk of one-in-one million and a Hazard Index of 0.2, or equivalent concentrations identified by DEP to meet the objectives of the chemical specific risk approach.

In accordance with the provisions of 310 CMR 40.0902(3), concentrations of oil and hazardous materials in ambient air at background concentrations shall be assumed to constitute a condition of No Significant Risk to human health.

Safety

In accordance with the provisions of 310 CMR 40.0960, a condition of No Significant Risk to human safety shall exist if:

- remedial air emissions do not result in the generation and/or accumulation of explosive vapors; and
- access to remedial treatment systems are restricted as needed to prevent physical harm or bodily injury.

Public Welfare

In accordance with the provisions of 310 CMR 40.0900 and 40.0994(2), a condition of No Significant Risk to public welfare exists if:

- remedial air emissions do not result in nuisance odor conditions at downwind human receptors. For the purpose of predicting the occurrence of such odor conditions, the 50th percentile odor recognition concentration should be utilized.

Environment

In accordance with the provisions of 310 CMR 40.0995, a condition of no significant risk to the environment exists if:

- remedial air emissions and/or fallout from remedial air emissions do not result in a deleterious impact to critical habitat, endangered species, or other sensitive ecological receptors.

4.3 Demonstrating No Significant Risk

Prior to the commencement of remedial actions where off-gas controls WILL NOT be applied to systems emitting contaminated vapors, an LSP Opinion must be submitted stating that such emissions will not exceed a level of No Significant Risk at Potentially Impacted Receptors. This Opinion shall be based upon an analysis of the following:

- (1) threshold (non-carcinogenic) and non-threshold (carcinogenic) health risks resulting from each oil and hazardous material emitted to the atmosphere, to evaluate risks to human health;
- (2) potential odor conditions resulting from such emissions, to evaluate risks to public welfare; and
- (3) direct impacts of emissions on ecological parameters to evaluate risks to the environment.

Please note that potential risks to human safety should also be considered when undertaking any remedial action at a disposal site (See Section 4.0 [B]).

To facilitate the demonstration of No Significant Risk, mathematical models may be used to predict increased ambient air concentrations at Potentially Impacted Receptors. The following guidance is provided on the appropriate application of models:

Mathematical models typically calculate (increased) maximum hourly concentration values at a specified down-wind receptor. These computed maximum hourly concentration should be:

- (1) multiplied by 0.40, to obtain an estimate of the average (increased) daily receptor concentration value, in order to evaluate threshold health risks;
- (2) multiplied by 0.08, to obtain an estimate of the average (increased) yearly receptor concentration, in order to evaluate non-threshold health risks; and
- (3) remain unadjusted (maximum hourly concentrations), to evaluate potential receptor odor concerns.

The use of the above multiplying factors are consistent with standard statistical averaging practices, as used and recommended by DEP and the U.S. Environmental Protection Agency (EPA).¹

To evaluate non-threshold health risks, DEP Allowable Ambient Limits (AALs) for Air may be used. If used in this manner, individual AALs may be adjusted to reflect the time period of proposed remedial emissions. To evaluate threshold health risks, DEP Threshold Effects Exposure Limits (TELEs) may be used. The use of a 50th percentile odor recognition concentration should be used to evaluate the potential for odor impacts at Potentially Impacted Receptors.

For chemicals with background concentrations in ambient air exceeding a condition of No Significant Risk or an odor threshold, the required evaluation of potential health and odor concerns should be made on the basis of increased ambient concentration values resulting from the proposed remedial emission. For the purpose this policy, background concentrations of individual or collective VOCs should be determined by site-specific air sampling and analysis, or by citation of appropriate values from scientific literature.

4.4 Definition of and Distance to "Potentially Impacted Receptors"

In order to characterize the risk posed by oil and/or hazardous materials, human and environmental receptors must be identified in accordance with 310 CMR 40.0920. For the purposes of this policy, human receptors or "Potentially Impacted Receptors" include:

- (1) residential properties, schools, daycare centers, or elder-care facilities;
- (2) parks, playgrounds, and recreation areas;
- (3) off-property commercial areas where continuing exposure to a human receptor is likely; or
- (4) on-property areas where continuing non-occupational, exposure to a human receptor is likely (i.e. a former gasoline service station now being utilized as a restaurant).

In applying the recommended "Best Response Action Management Approach" (Section 6 of this policy) and the "Simplified Remedial Emission Evaluation Methodology" (Section 7), distances should be measured from the base of emission stack(s) to the nearest "Potentially Impacted Receptor" as described below:

- (1) the property boundary of the nearest residential dwelling;

¹ "Screening Procedures for Estimating the Air Quality Impact of Stationary Sources, Revised" (EPA-454/R-92-019), October 1992, provides a more detailed discussion of multiplying factors.

- (2) the property boundary of the nearest school, daycare center, elder-care facilities, park, playground, and recreation area; or
- (3) any on or off-property point where continuing exposure to a potentially impacted receptor is likely.

5.0 Performance Standards for the Operation and Monitoring of Off-Gas Control Systems

Except where an LSP Opinion is submitted as specified by 310 CMR 40.0040(6) stating that achievement of a 95% level of emission reduction is not feasible or necessary, or where treatment standards are specified in writing by DEP based upon its review of proposed or ongoing response actions, off-gas control systems (e.g., activated carbon, incineration, catalytic or thermal oxidation, or biotreatment units) must be designed, constructed, and operated in a manner that:

- (1) as specified in 310 CMR 40.0040(5), ensures the continuous reduction of at least 95% of the emitted oil and hazardous material, on a weight basis, or reduction to background level, whichever concentration is higher;
- (2) does not expose down-wind receptors to concentrations exceeding a level of No Significant Risk; and
- (3) does not expose down-wind receptors to nuisance odor conditions.

The following are considered by DEP to be the minimum monitoring procedures for off-gas control systems necessary to ensure compliance with the 95% VOCs reduction performance standard. Proponents should continuously evaluate the need to expand on these minimum requirements during the operation of the treatment system.

- (1) Influent and effluent vapor samples should be obtained from the off-gas control system 1, 7, 14 and 28 days after system start-up, and monthly thereafter. Vapor samples should be analyzed using a portable GC, or they may be screened for total VOCs (vol/vol) using a photoionization detector (PID) or flame ionization detector (FID).
- (2) All VOC vapor samples should be obtained from "in-line" sampling ports in the vapor treatment system piping.
- (3) Documentation should be maintained detailing the daily instrument calibration procedure if a PID or FID is used; or instrument quality control results along with the influent and effluent analytical data if a portable GC is used.

6.0 Best Response Action Management Approach

To meet the Best Response Action Management Approach (BRAMA) standard (310 CMR 40.0191), remedial action alternatives must be designed and implemented in a manner which is protective of health, safety, public welfare, and the environment. In evaluating whether off-gas controls are necessary to meet a condition of No Significant

Risk, there are certain conditions which cannot be adequately addressed via air dispersion modeling. Moreover, unless continuous emission/ambient air monitoring is conducted, all site-specific remedial emission monitoring programs are subject to significant spatial and temporal data limitations.

Because of these concerns, the DEP considers that a Best Response Action Management Approach for remedial air emissions must take into account the following site and operational factors which could lead to significant emission fluctuations and receptor impacts in order to be protective of health, safety, public welfare, and the environment:

(1) **Gasoline Releases**

Gasoline releases represent a unique contamination profile due to the large and highly variable number of volatile organic compounds (VOCs) present, and cannot be adequately characterized by commonly available analytical and data evaluation techniques. Of particular concern are the potential public welfare problems that may result from the discharge of odorous compounds such as alkenes or biological degradation products. These factors must be considered prior to any decision to allow the untreated emissions of such contaminants.

(2) **Non-Aqueous Phase Liquids (NAPL)**

Release conditions where non-aqueous phase liquids, such as free-phase gasoline, are present represent a unique set of concerns. System failures could result in free-phase liquids entering air emission stacks. Globule/colloidal non-aqueous phase liquid entrainment into aqueous flow systems or volatilization into SVE systems, could result in transient, but potentially significant fluctuations in emission levels. To address these concerns, at sites where the point of groundwater recovery or SVE is within 10 meters of a location where measurable NAPL exists, off-gas controls should be applied to protect against the impact of such potential system failures on ambient air quality. Such a recommendation would not apply to bioventing systems at sites where non-volatile NAPL is present.

(3) **Soil Vapor Extraction Systems**

The recovery rate/air emission rate from SVE systems are unlike those of groundwater air stripping systems. In a typical SVE application, initial operation will produce a high air emission rate, followed by sharply reduced levels tailing off to a asymptotic steady-state condition. In order to effectively capture this initial contaminant mass and guard against transient discharge anomalies that could occur as a result of changing and dynamic vadose-zone conditions, all SVE systems should be initially fitted with off-gas control devices for the first 1500 hours of operation. Following this initial period, off-gas control devices should only be removed if none of the other application conditions articulated in Section 4.0 exist.

(4) **Modeling Limitations**

Because of limitations inherent in most mathematical models, off-gas control devices should generally be applied on any remedial system where the discharge stack height (point of emission) is less than 4.5 meters above ground level, or where the distance to the nearest Potentially Impacted Receptor is less than 20 meters from any emission stack.

7.0 Simplified Remedial Emission Evaluation Methodology

A simplified methodology has been developed by DEP for evaluating the need to apply off-gas controls on remedial air emissions, based upon the air emission rate and distance to Potentially Impacted Receptors. Specifically, a series of emission-distance graphs have been developed to evaluate risks to human health and public welfare, based upon air dispersion modeling. The use of this methodology is optional.²

7.1 Modeling Assumptions/Results

The EPA "Screen" Model (EPA-450/4-88-010) was used to help predict potential ambient air concentration levels of 20 targeted contaminants at varying distances from a point-source air discharge. Modeling inputs were designed to represent reasonably conservative, although not worst-case, site conditions and remedial system operational parameters. Modeling outputs were compared to designated "acceptable" increased ambient receptor concentrations. For the universe of targeted compounds, "acceptable" increased ambient receptor concentrations were defined as the lowest of the following three values: (1) the Allowable Ambient Limit value multiplied by 75/5 (to account for 5 year exposure-duration carcinogenic effects), (2) the Threshold Effect Level, and (3) the odor threshold.

Model output data for air plume "wake" areas were used to formulate a series of emission-rate vs. distance-to-receptor graphs. The 20 targeted contaminants were grouped into 4 categories, based upon commonality of "acceptable" receptor concentration values.

Modeling results indicate the possibility of deleterious air plume "cavity effects" within 20 meters of the emission point. Accordingly, off-gas controls should always be applied for all emission stacks located less than 20 meters from a "potentially impacted receptor."

7.2 Calculating Air Emission Rate

For Air Strippers, the remedial air emission rate should be calculated as follows:

- (1) Unless a pilot study has been undertaken to determine steady-state influent groundwater concentrations, the highest aqueous concentration value for each

² The "Point-Source Air Emissions from 21E Remedial Systems" discussion document, dated June 26, 1992, provides a more detailed description of the air dispersion modelling.

contaminant from within the projected recovery area should be the designated influent concentration level.

- (2) The air emission rate ($\mu\text{g/s}$) may be directly obtained from Figure 1 using the influent concentration(s) determined in (1) above and the proposed process flow rate through the system. Air emission rates corresponding to influent concentrations outside the range provided in Figure 1, should be indirectly calculated for each influent contaminant assuming 100% mass-transfer from the aqueous phase, according to the relationship:

$$E = [C_w * Q_w] / 15.84$$

where:

E = air emission rate, $\mu\text{g/s}$

C_w = aqueous concentration, $\mu\text{g/l}$

Q_w = influent aqueous flow rate, gal/min

For Soil Vapor Extraction (SVE) Systems, the remedial air emission rate should be calculated as follows:

- (1) Stack concentrations should be measured directly from a sampling port in the stack by obtaining a vapor sample for analysis on a portable or laboratory gas chromatograph (GC).
- (2) The air emission rate ($\mu\text{g/s}$) may be directly obtained from Figure 2 or 3 using the effluent vapor concentration(s) determined in (1) above and the proposed process flow rate through the system. Air emission rates corresponding to effluent vapor concentrations outside the range provided in Figure 2 or 3 , should be determined for each contaminant, according to the following relationship:

$$E = [C_a * Q_a] / 2118$$

where:

E = air emission rate, $\mu\text{g/s}$

C_a = air (stack) concentration, $\mu\text{g/m}^3$

Q_a = air (stack) discharge rate, CFM

Air emission rate, in $\mu\text{g/s}$, from other remedial systems should be determined by the most appropriate method(s).

7.3 Using Emission-Distance Graphs

Five emission-distance graphs are provided.

- (1) The emission-distance graphs (Figures 4 through 8) should, in most cases, address potential impacts to human health and public welfare; project

proponents must still satisfy the safety and environmental performance standards specified in Section 4.

However, due to the high degree of uncertainty in predicting odorous conditions at downwind receptors, DEP may require off-gas treatment at locations where odors are present, regardless of the need for such treatment as determined using the simplified graphical approach.

- (2) For each **individual** site contaminant, select the appropriate graph and plot the calculated air emission rate ("x" axis) against the distance to nearest "potentially impacted receptor" ("y" axis). If **any** coordinate point for **any** individual contaminant is below the designated line, then off-gas controls should be applied.
- (3) Figure 8 should be used for all sites where a gasoline release has occurred to address benzene, toluene, ethylbenzene, and total xylenes (BTEX), and methyl-tertiary butyl ether (MTBE) contaminant levels. In Figure 8, the **collective** air emission rate for BTEX and MTBE is plotted against the distance to the nearest "potentially impacted receptor". If this coordinate point is below the designated line, then off-gas controls should be applied. (Other non-gasoline related contaminants, if present, must also be addressed by Figures 4 through 7).
- (4) Figure 8 SHOULD NOT be used for sites where individual concentrations of benzene, toluene, ethylbenzene, xylenes, or MTBE are present, and their presence is NOT attributable to a release of gasoline. In these cases, the emission conditions should be addressed using Figures 4 through 7.

8.0 Licensed Site Professional Opinions

All LSP Opinions, as described in this policy and 310 CMR 40.0040, must be accompanied by the appropriate level of documentation to support the particular Opinion. Specifically:

- (1) an LSP Opinion submitted to DEP prior to the commencement of the remedial action stating that untreated emissions will present No Significant Risk, as described in 310 CMR 40.0040(3), must be supported by information and reasoning which addresses all of the criteria outlined in 40.0040(3)(a) through (e). As this provision requires the LSP to consider "all relevant policies issued by the Department", i.e., this Policy, the LSP Opinion should address why it is not necessary to apply off-gas controls to meet the conditions outlined in Section 4.0 of this Policy in order to achieve the No Significant Risk standard;
- (2) an LSP Opinion submitted stating that off-gas controls are no longer necessary in order to achieve the No Significant Risk standard, based on the absence of all of the conditions outlined in Section 4.0 of this policy must be supported by an adequate description of why those conditions no longer apply; and

- (3) an LSP Opinion submitted stating that 95% reduction in level of emissions is not feasible or necessary, as described in 310 CMR 40.0040(6), must be supported by the information and reasoning used to reach this conclusion.

Although the LSP Opinions listed above are not required for response actions conducted at sites with approved waivers, an evaluation of the need for controls is necessary and documentation of such an evaluation should be submitted to DEP.

Figure 1
Air Stripper Emission Rate vs.
Influent Groundwater Concentration

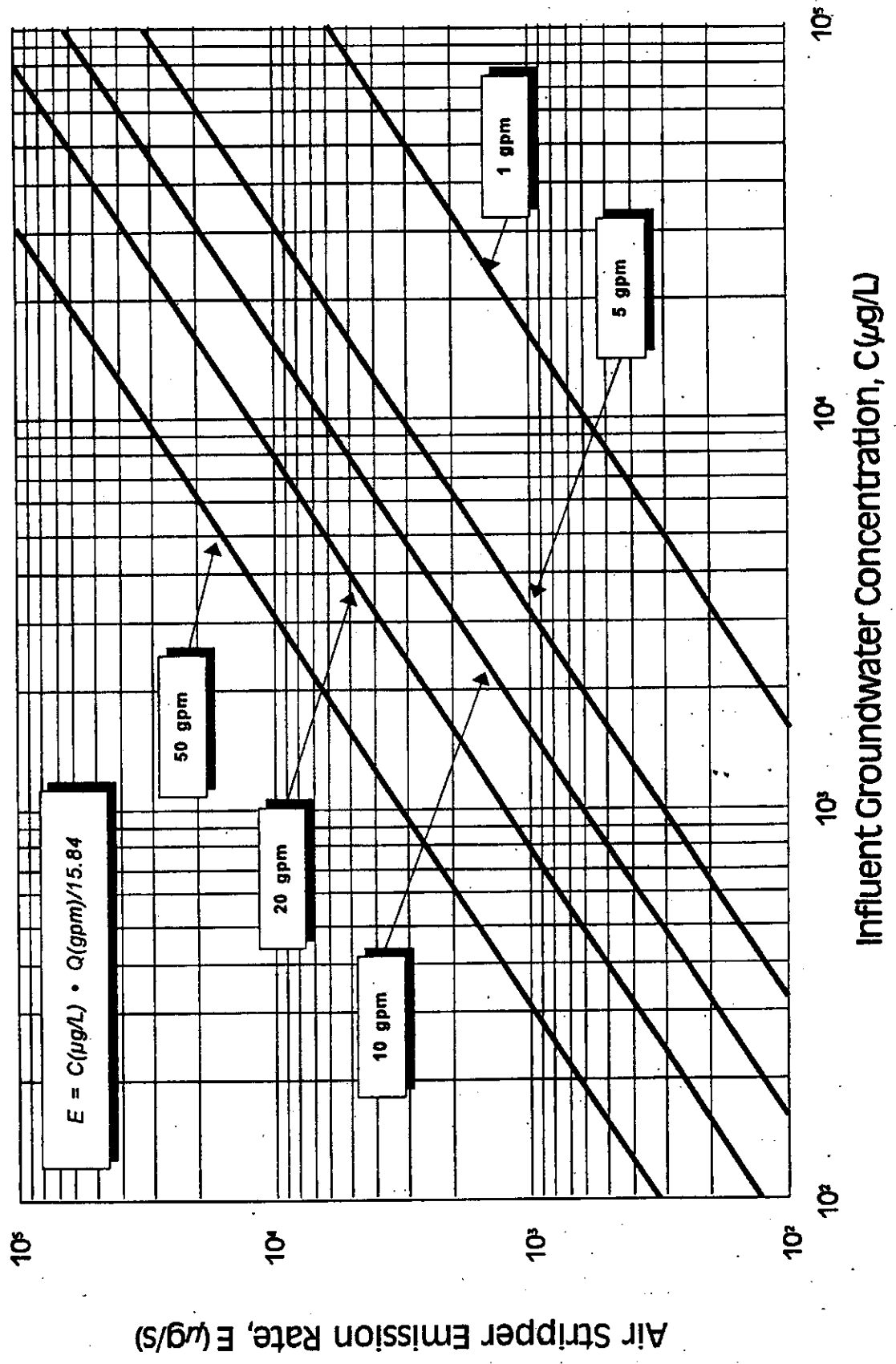


Figure 2
SVE Emission Rate vs. Vapor Concentration

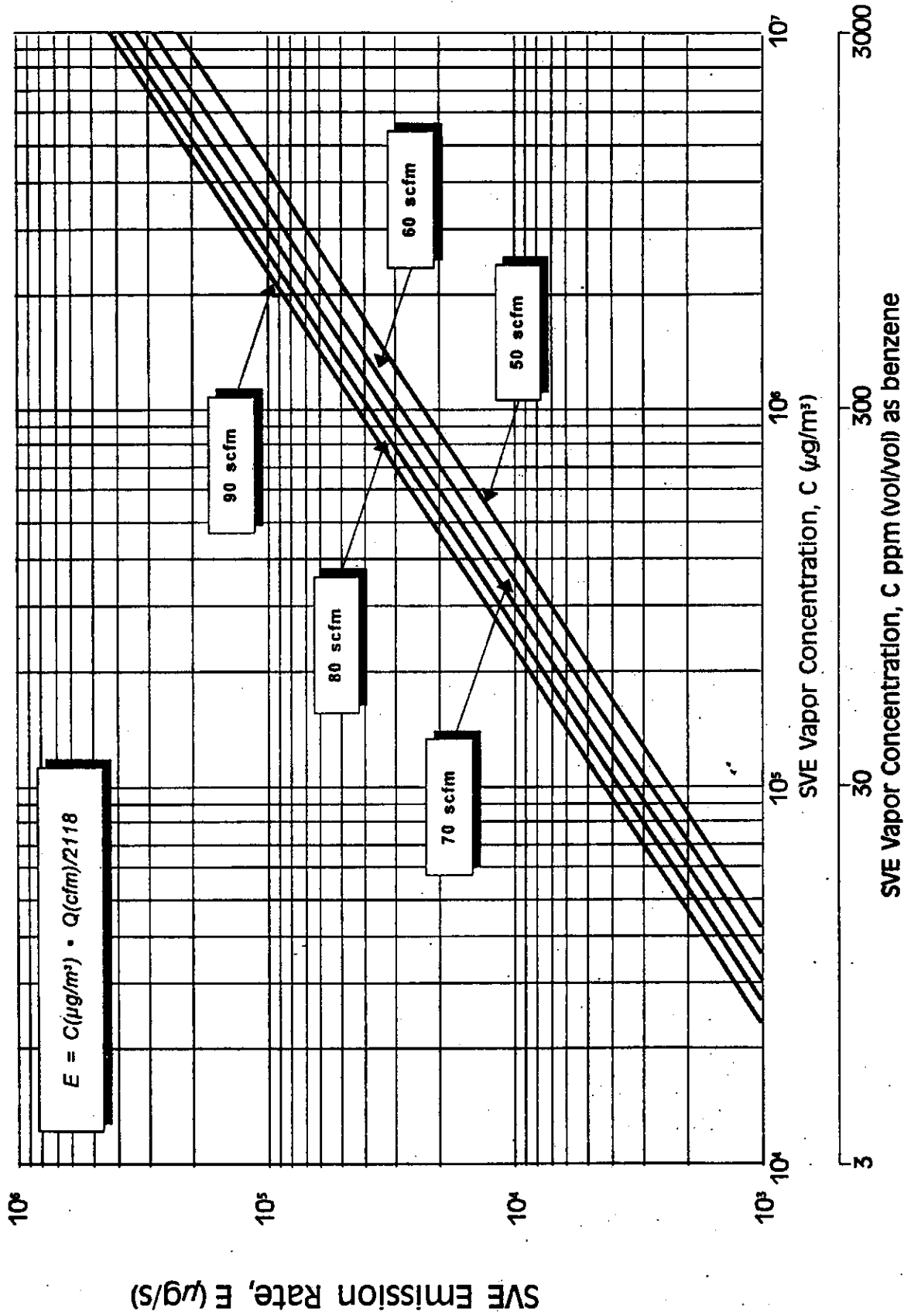


Figure 3
SVE Emission Rate vs. Vapor Concentration

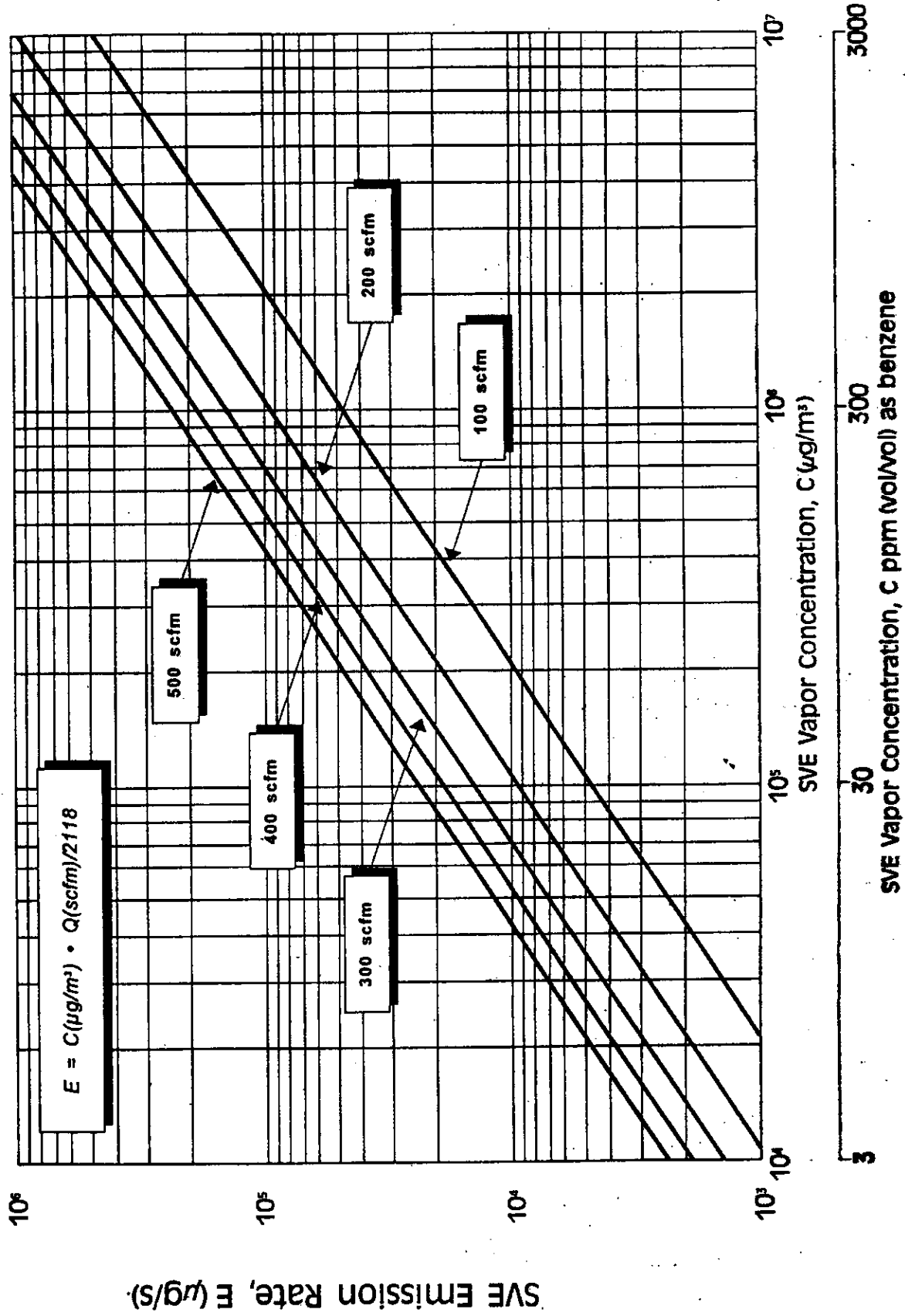


Figure 4
Emission Rate vs. Distance: Group 1

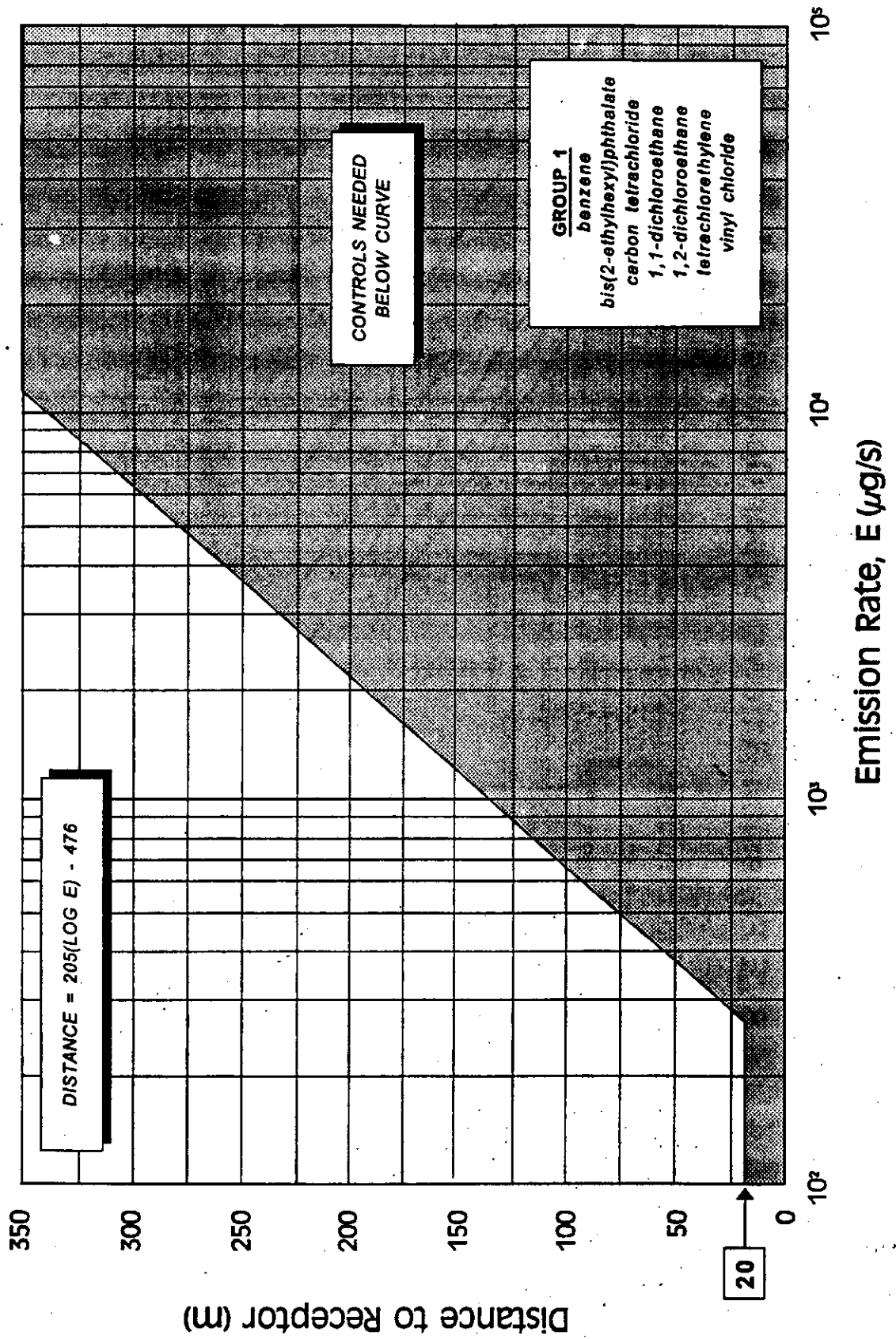


Figure 5
Emission Rate vs. Distance: Group 2

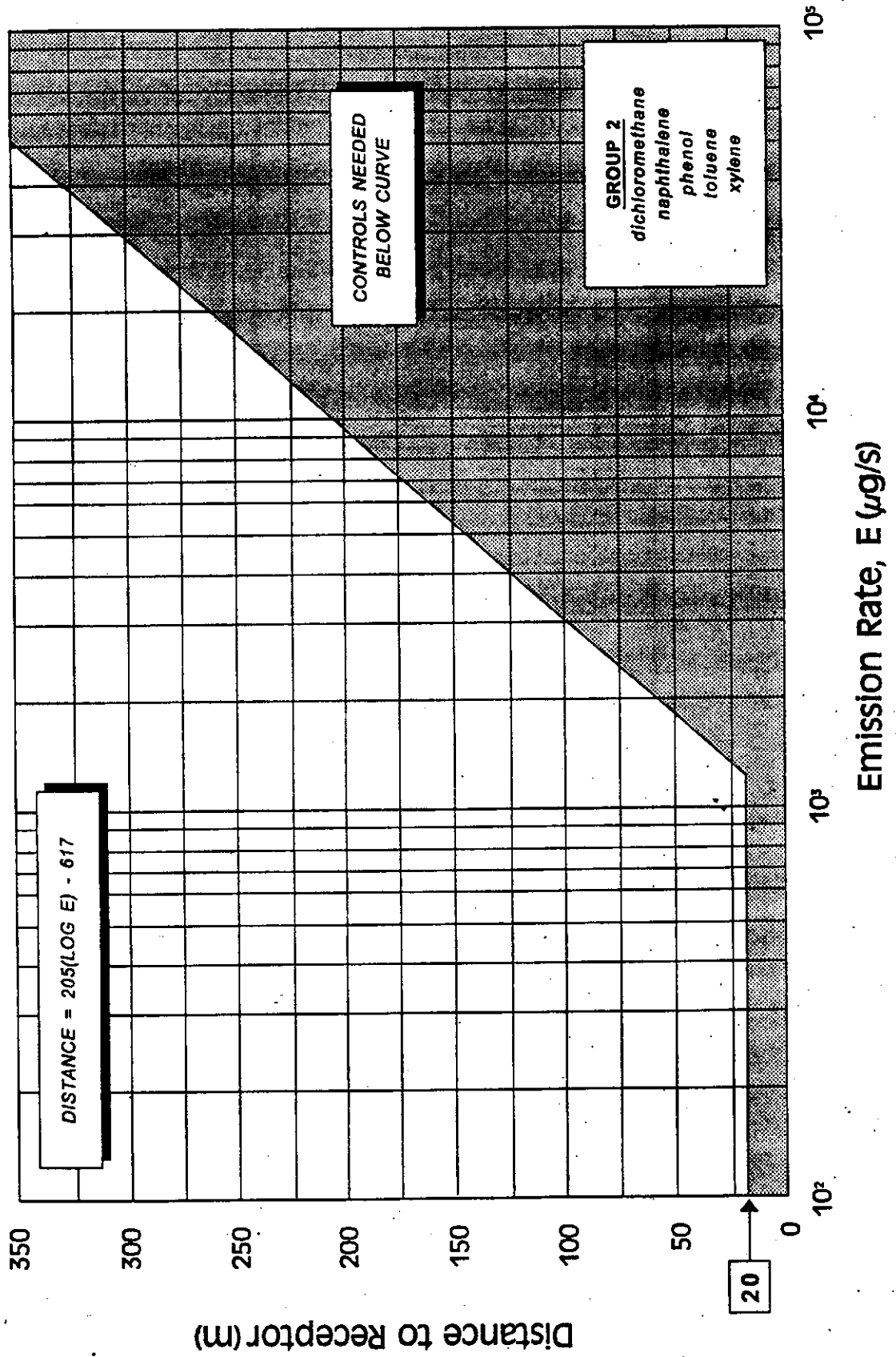


Figure 6
Emission Rate vs. Distance: Group 3

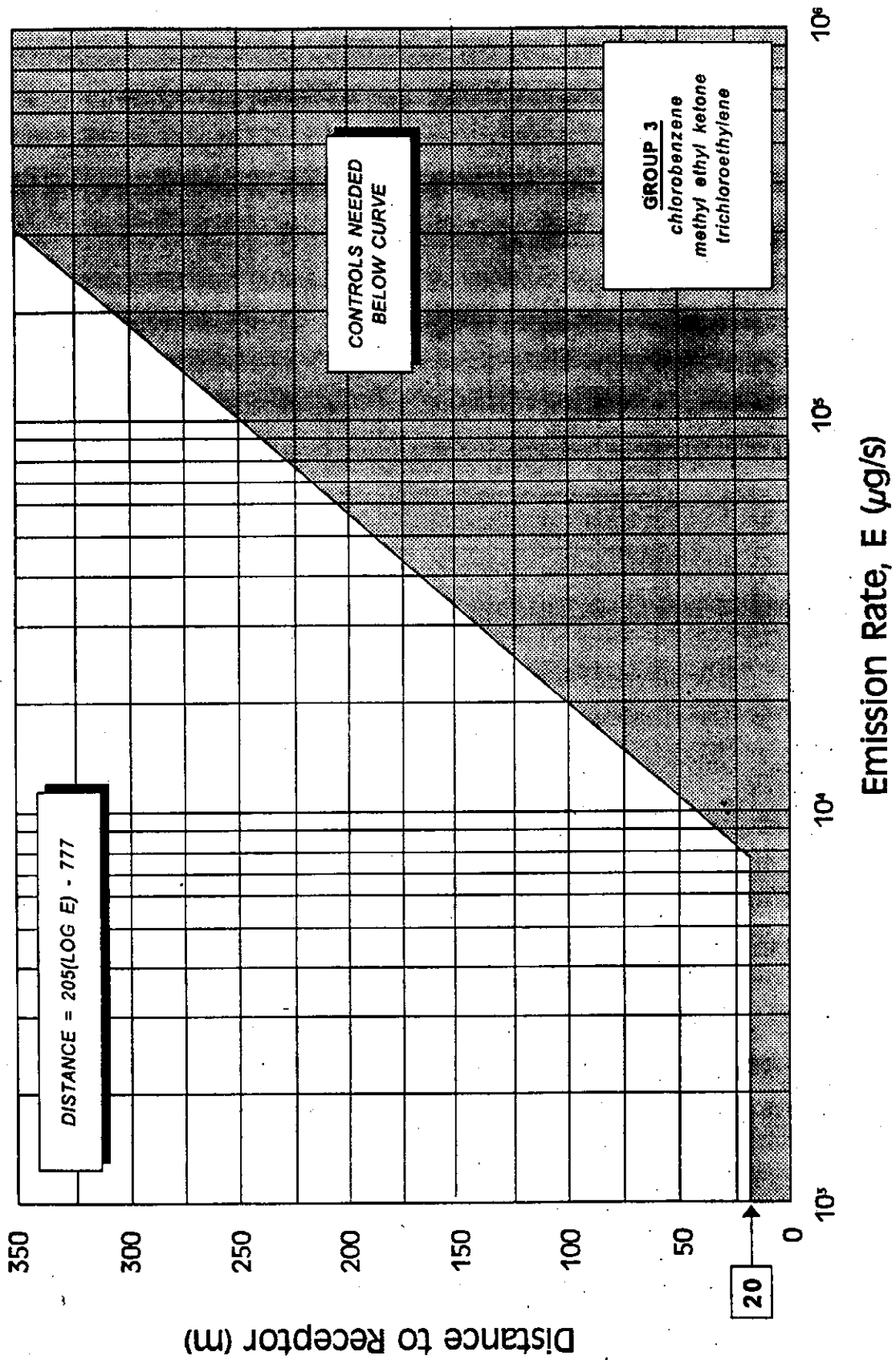


Figure 7
Emission Rate vs. Distance: Group 4

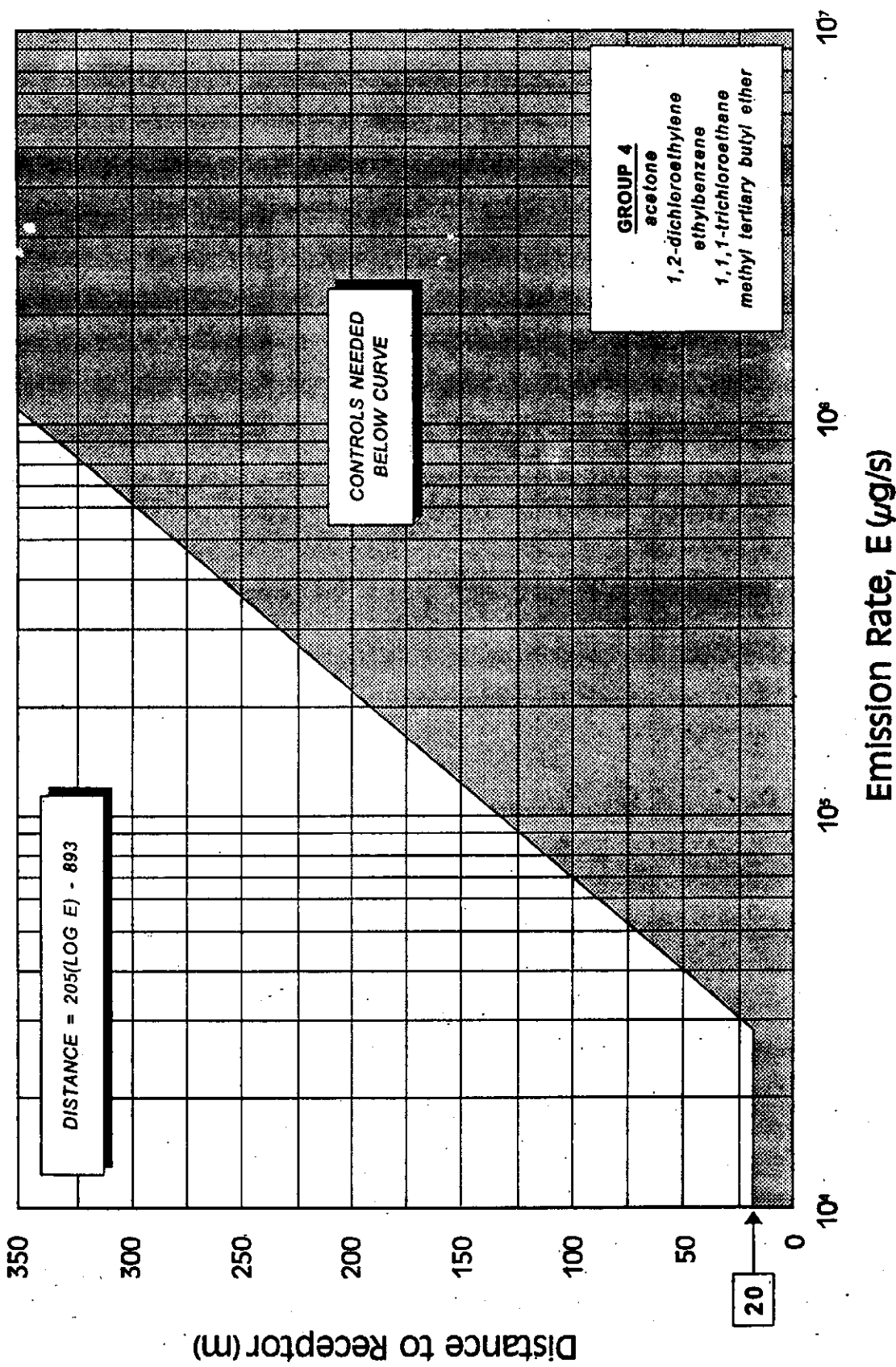


Figure 8
Emission Rate vs. Distance: Group 5

