Chapter 1
Introduction

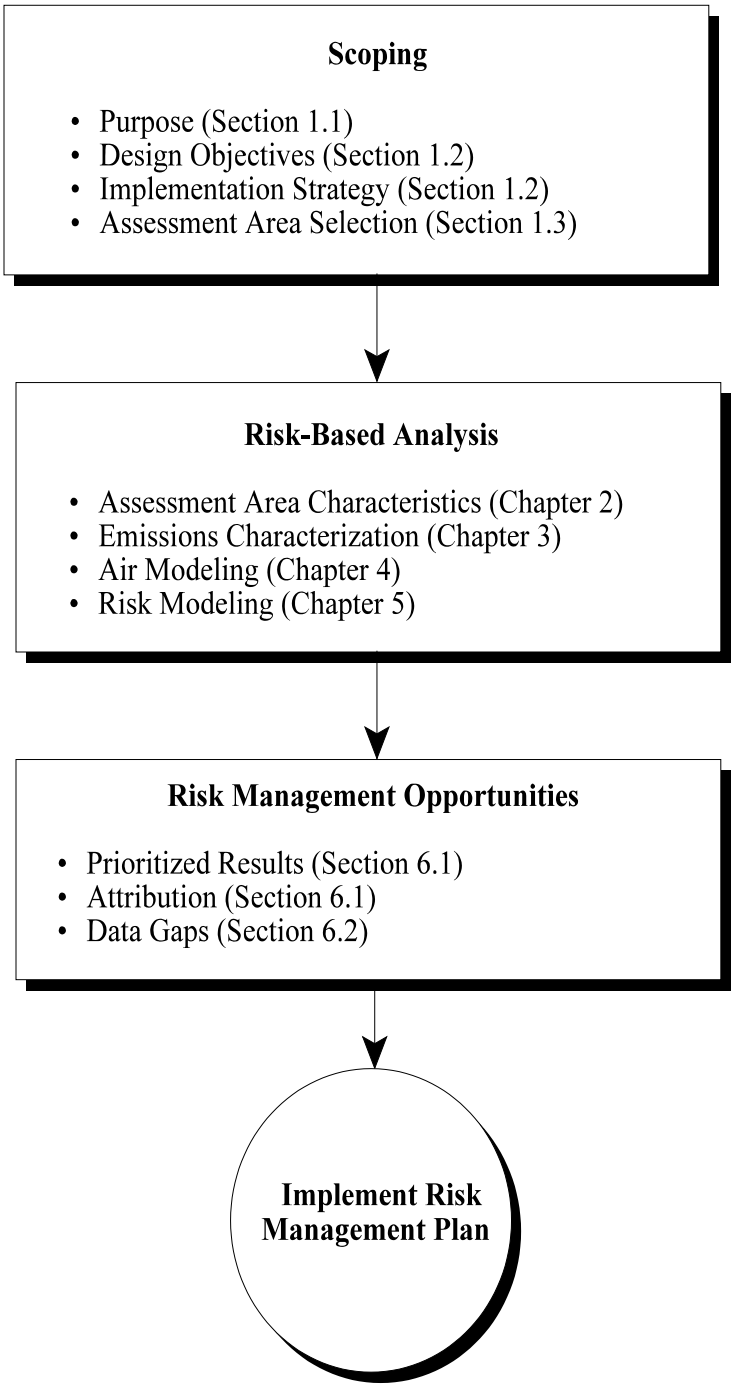
What's Covered in Chapter 1:

- Requirement to Conduct RAIMI Pilot
- Overview of Strategy for Implementation
- Selection of Initial Pilot Study Area
- Pilot Study Problem Formulation

The U.S. Environmental Protection Agency (EPA), Region 6, is considering establishing a Regional Air Impact Modeling Initiative (RAIMI) Program for Region-wide assessment of risks on a community level as a result of aggregate exposure to multiple contaminants from multiple sources and pathways. As a test of the RAIMI methods and approach, a Pilot Study was designed and implemented in a small area in southeast Texas. The Pilot Study was designed to be done in two phases. The first phase was to test methods and develop an approach to provide a prioritization of risk concerns based on initial estimated risks as a result of direct inhalation, while the second phase is to study indirect exposures resulting from air-related sources.

As illustrated in Figure 1-1, this document presents an overview of the initial phase of the RAIMI Pilot Study, including approach and current findings, for the Port Neches Assessment Area of Jefferson County, Texas. The following subsections provide background as to why EPA Region 6 is considering conducting the RAIMI, the process for selection of Jefferson County,Texas as the location for the Pilot Study, and an overview of the overall strategy and implementation of the Pilot Study.

FIGURE 1-1
RAIMI PILOT STUDY REPORT



1.1 REQUIREMENT TO CONDUCT RAIMI PILOT

Movement toward establishing the RAIMI program is being driven by several program initiatives on a nationwide basis. Some of these national programs include the Cumulative Exposure Project (CEP), the Residual Risk Report to Congress, and the Integrated Urban Air Toxics Strategy. More specific to EPA Region 6, the U.S. EPA's CEP identified potentially unacceptable risks to the public in counties and parishes within EPA Region 6. These findings were based on county-wide concentrations, and as a result contained considerable uncertainty at the more local level (U.S. EPA 1999a). Therefore, as recommended in the findings of the U.S. EPA CEP study, EPA Region 6 initiated design of RAIMI in 1999 to evaluate potential risks resulting from multiple sources and contaminants, but on a more refined spatial level (i.e., community level of resolution).

During the initial planning and implementation stages of the RAIMI pilot, EPA Region 6 recognized that this effort complements concurrent federal air toxics programs in many ways, including some of the following:

- Complements the CEP study by providing neighborhood-level assessment of potential risks from air shed as a whole by using facility-reported source-specific emissions data;
- Allows a means to rapidly assess source category specific risks before and after the implementation of maximum achievable control technology (MACT) standards; and
- Provides an active and flexible risk management tool, as envisioned by the Integrated Urban Air Toxics Strategy, to support monitoring activities, identify risks, focus resources, prioritize corrective actions, and track progress toward risk reduction goals.

In addition to the need to further assess CEP findings, EPA Region 6 also identified the potential for RAIMI to be used as a permitting tool to support EPA, state, and local permitting authorities who evaluate and demonstrate protectiveness of cross program permitting decisions. Permitting authorities could use a standardized and consistent means to account for and assess aggregate health effects to multiple contaminants from multiple sources, which are often subject to multiple permitting schemes, but often cumulatively impact the same neighborhood(s).

The following subsections provide a brief overview of U.S. EPA's CEP, as well as, additional current federal cumulative risk initiatives that are consistent with the RAIMI design. It should be noted that these discussions are not intended to provide a complete description of the national programs, but to describe the importance and necessity of the RAIMI in view of these other programs.

1.1.1 Cumulative Exposure Project

The CEP is self described as a broad-based evaluation of multiple pollutants in various environmental media. In contrast with the air pollutants known under the Federal Clean Air Act (CAA) as "criteria pollutants," such as ozone, particulate matter, and carbon monoxide, the CEP focused on hazardous air pollutants (also known as "air toxics"). There is little known about the national distribution of "air toxics" concentrations, and availability of measured data is limited. The stated objectives of the CEP include:

- Estimate exposure levels for a wide variety of toxic pollutants;
- Characterize the national distribution of these estimated exposure levels across communities and demographic groups;
- Identify the types of communities and demographic groups which appear to have the highest exposure levels; and
- Identify potentially important (based on risk) emissions sources and pollutants for which information is most uncertain.

The CEP used preliminary national estimates of 1990 hazardous air pollutants (HAPs) emissions from all source types to predict long-term average ambient concentrations at the county level (not applicable at the local scale) for HAPs (U.S. EPA 1999a). To achieve an efficient, nationally-consistent, emissions model, the CEP used a top-down emissions inventory approach, which emphasized comprehensive accounting of all emissions using county-wide inventories and source category estimates.

The CEP findings indicate that HAPs are broadly distributed nationwide, and that for some HAPs in specific locations, estimated concentrations are higher than those associated with an upper bound lifetime excess cancer risk of one-in-one-million, sometimes by an order of magnitude or more, provided that individuals breathed those concentrations 24 hours per day for their lifetime. Historically, the EPA has frequently used a one-in-a-million (1×10^{-6}) lifetime cancer risk as a "floor," and beneath this level, it is rare that action has been taken to reduce risk (Travis et al. 1987). Risk levels between one-in-a-million and one-in-ten-thousand (1×10^{-4}) fall into an area where sometimes action is taken and sometimes not, depending on many specific aspects of the situation. By that measure, CEP identifies several counties and parishes located within EPA Region 6 as having particularly elevated levels of air toxics that might be associated with potentially unacceptable risks to the public on a county-wide basis. Because of the

uncertainties of the CEP analysis, these CEP estimates can not indicate that an actual health risk exists in these counties, but only that these areas, which are predominantly urban areas, should be more closely evaluated (U.S. EPA 1999a). As the first major study to undertake a national-scale assessment of air toxics, the CEP laid the groundwork for the current National Air Toxics Assessment (NATA) (see Section 1.1.4), which is the technical component of EPA's National Air Toxics Program.

1.1.2 Residual Risk Report to Congress

Section 112 (f) of the CAA, as amended, requires EPA to prepare a Residual Risk Report to Congress on the methods to be used to assess the risk remaining (i.e., the residual risk) after MACT standards applicable to emissions sources of HAPs have been promulgated and applied (U.S. EPA 1999g). The Residual Risk Report to Congress (U.S. EPA 1999g), identifies two objectives for residual risk activities:

- Assess any risks remaining after MACT standard compliance;
- Set additional standards for the identified source categories, if necessary. For the necessary additional HAP emission reductions, provide an ample margin of safety to protect public health or, taking into account cost, energy, safety, and other relevant factors, to prevent an adverse environmental effect.

The Residual Risk Report to Congress does not have any regulatory consequences, but it does present EPA's general framework for assessing residual risk. This framework includes a description of the air toxics risk assessment process, but it does not specify particular methods. Instead it allows for the flexibility to use current techniques and incorporate new methods as they are developed.

1.1.3 Integrated Urban Air Toxics Strategy

Section 112(k) CAA, as amended, requires EPA to develop a strategy to identify and address risks to the public in urban areas. As part of its National Air Toxics Program, EPA published its Integrated Urban Air Toxics Strategy on July 19, 1999 (U.S. EPA 1999f). The strategy generally consisted of; (1) rule making elements, (2) conducting certain studies and developing tools, and (3) involving various stakeholders in the decision making process. The goals of the Integrated Urban Air Toxics Strategy are to:

- Attain a 75 percent reduction in incidence of cancer attributable to exposure to HAPs emitted by stationary sources;

- Attain a substantial reduction in public health risks posed by HAP emissions from area sources; and
- Address disproportionate impacts of air toxics hazards across urban areas.

To achieve these goals, the Strategy consists of four main components:

- Source-specific and sector-specific standards (regulations) to address sources of air toxics at both the national and local level;
- National, regional, and community-based initiatives to focus on multi-media and cumulative risk, including conducting pilot studies;
- National Air Toxics Assessments to develop analytical tools (models) and support activities (monitoring) to identify risks, track progress toward risk goals, and prioritize efforts to address emissions and risks from air toxics; and
- Education and outreach, working with cities, communities, state, local, and tribal agencies, and other groups and organizations that can help implement an approach to reducing toxics emissions.

The schedule for Implementation of the Integrated Urban Strategy extends into 2005, and includes beginning pilot studies in 2000.

1.1.4 National-Scale Air Toxics Assessment

The National Air Toxics Assessment (NATA) for 1996 is the initial component of the National Air Toxics Assessment, the technical support component of EPA's National Air Toxics Program. The goals of the initial assessment are to assist in:

- Identifying air toxics of greatest potential concern, in terms of contribution to population risk;
- Characterizing the relative contributions to air toxics concentrations and population exposures from different types of air toxics emissions sources;
- Setting priorities for the collection of additional air toxics data for use in local-scale and multi-pathway modeling and assessments, and for future research to improve estimates of air toxics concentrations and their potential public health impacts;
- Establishing a baseline for tracking trends over time in modeled ambient concentrations of air toxics; and
- Establishing a baseline for measuring progress toward meeting goals for inhalation risk reduction from ambient air toxics.

The NATA methodology draws heavily from that of the CEP, but several important methodology changes were incorporated into NATA. First, NATA is based on a more current emissions inventory, the 1996 National Toxics Inventory (NTI). Second, NATA incorporates human demographics and behavior into the development of exposure estimates–that is, the use of microexposure scenarios. And third, NATA is developing a comprehensive risk characterization that includes estimating cumulative risk associated with multiple air toxics.

EPA acknowledges that NATA results will not be used to make specific regulatory decisions for air toxics; while regulatory priority-setting may be informed by this and any future national-scale assessments, risk-based regulations will be based on more refined and source-specific data and assessments. Other important limitations in the scope of NATA include the following:

- NATA evaluates average population risks; NATA was not designed, and is not appropriate specifically, for identifying local- or regional-scale air toxics "hot spots", nor is it appropriate for identifying localized risks or individual risks from air toxics. Thus the NATA results cannot be used to identify exposures and risks for specific individuals, or even to identify exposures and risks in small geographic regions such as a specific census tract.

- NATA evaluates ambient air concentrations, exposure, and risks from 32 air toxics and diesel particulate matter, but does not address 156 other air toxics listed in section 112(b) of the Clean Air Act (CEP considered 148 air toxics).

- NATA does not include risks due to non-inhalation exposure pathways.

NATA draft emissions inventories and modeled ambient air concentrations are currently available to the public; exposure and risk estimates are currently undergoing peer review (U.S. EPA 2001).

1.2 OVERVIEW OF STRATEGY FOR IMPLEMENTATION

The overall strategy for the RAIMI Program is to efficiently maximize the usefulness of existing guidance, risk-based assessment tools, and emissions databases to support the following project design goals:

- Useful as a permitting tool to support EPA, state, and local permitting authorities–independently or combined–evaluate and demonstrate protectiveness of cross program (e.g., RCRA, CAA, exempt) permitting decisions and support holistic, tailored permit strategies with the flexibility to be either area (i.e., industrial complex), facility, or source-specific;

- Provide a standardized and consistent means by which all permitting authorities could account for and assess aggregate health effects to multiple contaminants from multiple sources, which are often subject to multiple permitting schemes, but cumulatively impacting the same receptor neighborhoods;

- Provide the necessary level of detailed information to prioritize, and simultaneously begin identifying potential solutions, for sources resulting in potentially unacceptable risks by estimating combined health effects resulting from multiple contaminants and sources. This should be done at a community level of resolution, and generated in a fully transparent fashion such that aggregate risk levels are completely traceable to each contaminant, each pathway, and each source;

- Calculate and track potential risks from literally hundreds of sources and contaminants based on actual emissions data submitted by facilities to the state agency. As new or refined data become available, it can be directly incorporated into the assessment to obtain revised risk estimates on practically a real time basis;

- Serve as a versatile and dynamic project platform, allowing for the rapid identification, characterization, assessment, and management of aggregate environmental exposures that pose the greatest health risks to the public.

The RAIMI Pilot Study was crafted to meet these design goals. It was also designed so that the initial findings of the Port Neches analysis can easily be refined as source and contaminant emission data sets become more complete, and as risk management efforts are implemented. Likewise, uncertainties are also expected to be reduced and better quantified with better data. EPA acknowledges that these design goals would only be *fully* achieved, in the Pilot Study or in other applications of the RAIMI methods and approach, with input data of appropriate quality commensurate with the permitting or risk management decision being made. In most cases, given the current availability of data, this will be realized – for more costly or controversial risk management or permitting decisions – not at the stage of using "readily available data," but only after inclusion of additional site-specific information that results in refinement of the analysis specific to highest risk concerns and significant data gaps. However, the process of identifying and focusing on significant risk concerns based on available data is a first and necessary step in prioritizing risk management opportunities.

Based on the outlined project goals, as well as, considering the stated objectives of current federal air toxics programs, the initial phase of the Pilot Study was designed to focus first on direct inhalation risks within a neighborhood resulting from the combined concentrations of multiple contaminants from multiple emissions sources within the assessment area.

Focus on the direct inhalation exposure pathway in the initial phase of the Pilot Study enables several efficiencies:

- Release and dispersion of contaminants via the air pathway presents a potential for impacts to a large number of receptors–particularly in areas where heavy industrial activity is located in close proximity to urban populations–more so than potential exposure pathways typically resulting from other types of releases (e.g., spills to soils);
- Several databases maintained by federal and state agencies are available which increases the efficiency of accessing and utilizing facility-reported emissions data to form the basis of a bottom-up emissions inventory, whereas release information for other pathways would likely require extensive facility- and source-specific data acquisition efforts;
- EPA Region 6 can utilize data and methods provided in the recent U.S. EPA guidance *Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities* (HHRAP) (U.S. EPA 1998b), which establishes a protocol for assessing risk from permitted emissions at individual permitted facilities, and can be readily applied to a broad multi-source scenario;
- Extensively reviewed and implemented Industrial Source Complex–Short Term (ISCST3) model (U.S. EPA 1995) can be used to model air dispersion and deposition of emitted contaminants;
- For risk modeling, Industrial Risk Assessment Program–human health (IRAP-*h* View ™) risk modeling software (Lakes Environmental Software, Inc., 1998) can be utilized. This software program was verified to duplicate the risk modeling equations presented in the HHRAP, and accommodates the extensive amount of data generated in simultaneously evaluating large numbers of sources and contaminants. In addition, this software application provides the added flexibility for the user to change exposure parameters to better represent demographic attributes, and to directly enter media concentrations for calculation of estimated risks based on measured data collected by ambient monitoring stations; and
- There exists current State and EPA air permitting initiatives, responsible for regulating existing and future air emissions, that could readily utilize results based on the air pathway.

The initial phase of the RAIMI Pilot Study focuses on prioritization of risk concerns based on potential direct inhalation risks from air emissions sources. The eventual focus of the Pilot Study, after the second phase, will include other migration and exposure pathways from the air releases, such as soil, food chain, groundwater, surface water, sediment, etc. Assessment of risks from contaminants through these pathways has not been completed in this initial phase, and consequently these issues are not addressed in this case study report. However, the consideration of these pathways and media will utilize a similar implementation strategy–that is, use of the latest, most practical and efficient, guidance, databases, and models.

1.3 SELECTION OF INITIAL PILOT STUDY AREA

Selection of a RAIMI pilot assessment area was based on consideration of certain attributes that were deemed desirable for the study. Generally, an optimal study area would be one that combined (1) industrial facilities commonly found within Region 6, (2) human population distributions in neighborhoods close to facilities as well as at a distance, and (3) a moderate number of sources to evaluate in order to provide a meaningful Pilot Study analysis without becoming burdensomely large.

The following factors were considered in identifying the initial pilot assessment area:

- Source considerations:
  - existence of industrial sources, including Resource Conservation and Recovery Act (RCRA) combustion sources, representative of industries in EPA Region 6
  - existence of non-industrial sources, supporting urban areas
  - density/distribution of sources across the area, with some grouping in "corridors"
- Receptor considerations:
  - residences and neighborhoods distributed such that some are very close to industrial and non-industrials sources, in addition to residential areas located away from sources
  - diverse receptor demographics that may influence exposure inputs
- Practical Considerations:
  - size of the study area should be large enough to support diversity of sources and receptors, without being so large as to be burdensome to implementing emissions data for input into the RAIMI pilot
  - emissions characterization data should be sufficient and readily available for the timely generation of results
  - results of this RAIMI pilot should be meaningful, regardless of outcome, to the residents, businesses, permitting authorities, and industries of the study area

Jefferson County was selected because it fit a majority of the considerations listed above for an acceptable pilot study area. Jefferson County was also identified in the findings of the CEP study as having ambient air concentrations of pollutants that may potentially be correlated to unacceptable risks to the public, and that require further evaluation on a neighborhood level.

Jefferson County is located in southeast Texas on the Gulf Coast with the largest populations in the industrialized cities of Beaumont, Port Neches, and Port Arthur. Numerous local industrial complexes are interspersed with surrounding residential areas of single and multi-family dwellings, including schools,

parks, child and elderly care centers, and hospitals. The methodology implemented was to logistically subdivide Jefferson County into several assessment areas to facilitate the evaluation, with each study area correlating with the (1) density of emission sources, (2) receptor locations, and (3) locations of RCRA and combustion facilities. This division resulted in the following five assessment areas:

- Port Neches
- Beaumont
- Port Arthur
- Chem Waste Facility
- Other

Attachment (Figure 1-2) presents the locations of the five assessment areas in Jefferson County.

The Port Neches Assessment Area was selected as the first assessment area to be evaluated for the RAIMI pilot study because (1) it contained multiple RCRA combustion facilities, (2) there are two air monitoring stations within the area for which current and historic data are available, (3) multiple industrial and non-industrial source types are present, and (4) significant emissions sources are in close proximity to receptors (neighborhoods). Relevant characteristics of the Port Neches Assessment Area as they pertain to the RAIMI pilot are further discussed in Chapter 2.

1.4 SUMMARY OF PORT NECHES PILOT STUDY PROBLEM FORMULATION

The U.S. EPA's Science Advisory Board (SAB) presents a conceptual framework for integrated environmental decision-making in its report *Toward Integrated Environmental Decision-Making* (EPA-SAB-EC-00-011) (U.S. EPA 2000i). The conceptual framework presented in the SAB report is developed around three phases, the first of which is termed *'Problem Formulation'*, and includes the preliminary analysis and comparison of risks, establishment of goals, and preliminary analysis of risk reduction options. Further, SAB indicates that the '*Problem*' can be defined in terms of either a single risk (e.g., one stressor, but associated with multiple sources with multiple routes of exposure) or multiple risks (e.g., environmental stressors associated with a particular geographic location, possibly including multiple sources, pathways, types of receptors, and effects).

The SAB conceptual framework provides a list of desired outputs from the Problem Formulation phase that clarify the purpose, scope, and conceptual design of the study. Problem Formulation aspects considered relevant to the RAIMI Pilot Study and are identified below in italics:

- ***Initial goals for the decision-making exercise*** - The primary decision to be made is whether the RAIMI approach and methodology provides a practical risk-based tool for examining and prioritizing the potential impacts of multiple emission sources on a localized scale. This will be decided by evaluating how well the Pilot Study on the Port Neches Assessment Area meets the five specified design criteria, as discussed in Section 1.2. Section 7.1 reviews the performance of the Pilot Study in achieving these design goals.

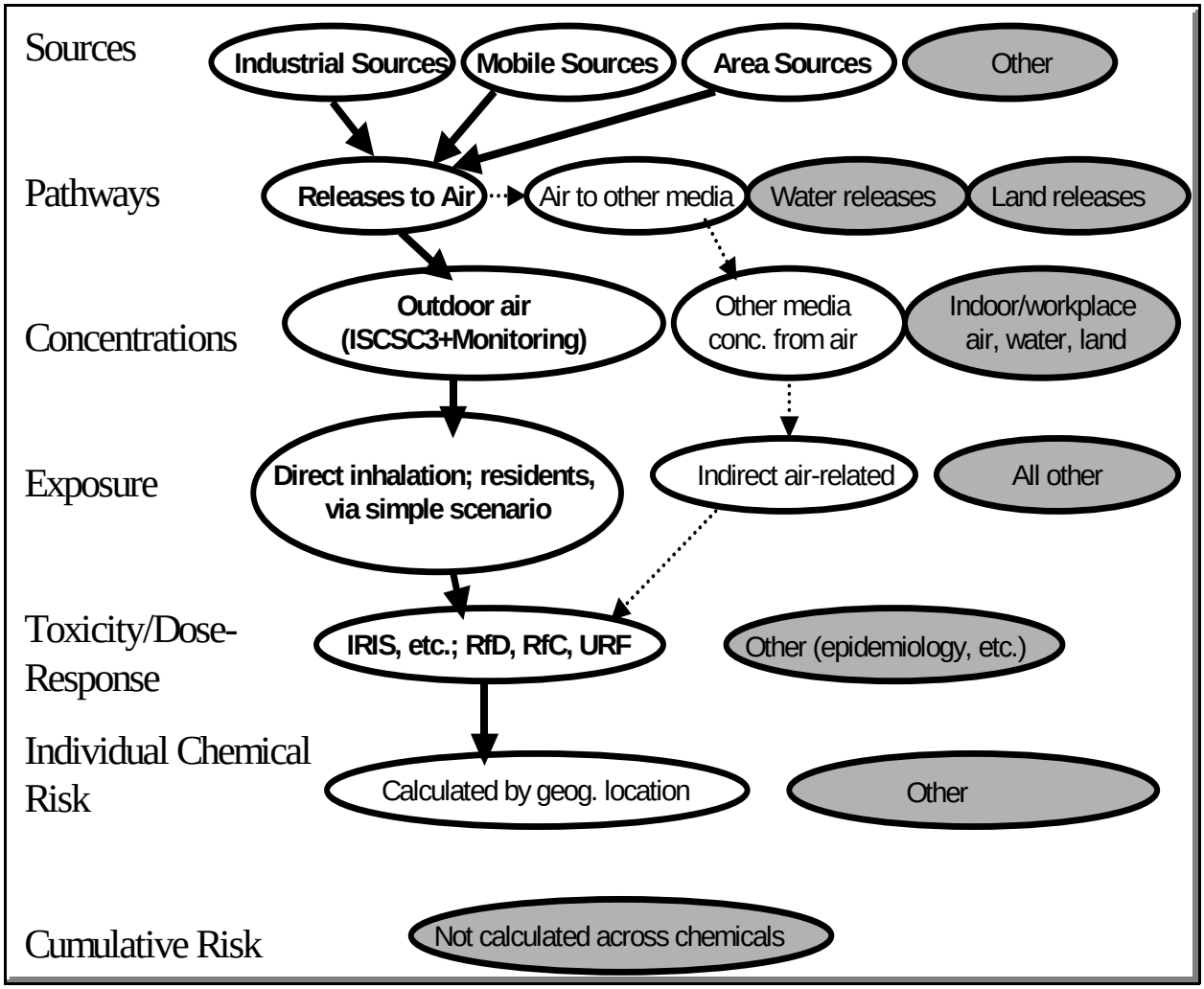
- ***Which environmental problems/stressors will be included and which will not*** - Since RAIMI is an air-related initiative, releases to the environmental media other than air are not considered (see Figure 1-3, a conceptual diagram of the RAIMI Pilot Study that illustrates the makeup of the RAIMI approach). The Pilot Study evaluates emissions of contaminants released to air from industrial and non-industrial sources. All contaminants with available speciated emissions are considered, but some risk-based screening of sources and contaminants with negligible impact is conducted.

- ***The health, ecological, and quality-of-life effects of concern*** - The Pilot Study considers both cancer and non-cancer human health effects only. Other effects may be added to the methodology later.

- ***The spatial, temporal, and organizational dimensions of the problem*** - The Pilot Study focuses on an area of Jefferson County, Texas, as described in Section 1.3. Consideration of the selection criteria in Section 1.3 resulted in the assessment area encompassing the cities of Port Neches, Nederland, and Groves, and also includes

FIGURE 1-3

CONCEPTUAL MODEL



Notes: Solid arrows connect those components that are part of Phase 1. Dotted arrows connect those components that are anticipated for Phase 2. The shaded ellipses indicate components that are not included in the RAIMI Pilot Study.

several large industrial facilities in close proximity to residential neighborhoods. Modeled risk levels are based on calculated annual average air concentrations, with several different calendar years being examined.

- ***Relevant data and models, and possible approaches to data analysis -*** Both emissions estimates from a Texas Natural Resource Conservation Commission (TNRCC) database and monitoring data were used, as well as an air model (Industrial Source Complex Short Term [ISCST3]). The RAIMI methodology can allow for other models to be used in other locations, provided these models are appropriate. Locations of emission sources obtained from the data bases used, were verified and corrected, as necessary. Chapter 3 describes the sources of emissions data used in the Pilot Study, and Chapters 4 and 5 describe the air dispersion and risk models, respectively.

- ***Scoping of the uncertainties involved and research needed to significantly reduce critical uncertainties*** - Some errors in the emission source locations are observed from the data obtained from emissions data bases, and considerable uncertainties are noted with regard to the completeness and accuracy of the reported emissions inventories. Verifying the source locations will help reduce the former, while comparison of modeled concentrations with monitored concentrations may give some indication of the magnitude of the latter. The model uncertainty for the ISCST3 is thought to be less than the uncertainty of the emissions estimates. Additional uncertainties are also acknowledged for dose-response information, exposure assumptions, and chemical specific inputs. Research into verifying the emissions inventory will probably reduce uncertainty most significantly. Uncertainty will be discussed from time to time throughout the remaining chapters of this report.