EPA

NATIONAL PESTICIDE SURVEY

Pilot Study Evaluation Summary Report

September 1987

NATIONAL PESTICIDE SURVEY

PILOT EVALUATION REPORT

Office of Drinking Water
Office of Pesticide Programs
U.S. Environmental Protection Agency

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TABLE OF CONTENTS

NATIONAL PESTICIDE SURVEY
PILOT STUDY EVALUATION
SUMMARY REPORT

I. INTRODUCTION

The National Pesticide Survey (NPS) is the first nationwide survey of pesticide contamination in domestic and community water wells in the United States. The NPS is being conducted jointly by the Office of Pesticide Programs and the Office of Drinking Water of the U.S. Environmental Protection Agency (EPA).

The National Pesticide Survey has been designed to yield results that are statistically representative of over 13 million domestic wells and some 51,000 community water systems. EPA expects to sample approximately 1500 drinking water wells in the course of the survey, which will run from the Fall of 1987 through 1989.

In March 1987, EPA launched a pilot study to field test the major components of the survey and to provide an opportunity for any necessary revisions or modifications before the full survey begins. This Pilot Study Evaluation Summary Report reviews EPA's experience with the pilot study and evaluates the need for modifications in current plans for the full survey prior to its implementation. This report is based on the NPS Pilot Evaluation Technical Report, which provides a detailed account of the implementation of the pilot study.

1. THE PILOT STUDY

The pilot study for the NPS was conducted in three States: California, Minnesota, and Mississippi. The States were selected to provide geographic diversity and because of their high level of interest and cooperation. Two of the States, Minnesota and California, had considerable previous experience in State monitoring programs. Mississippi presented an example of a State with strong interest but little prior experience in this area.

Sampling was conducted at 48 wells in the pilot study, including both domestic rural wells and community water system wells. Domestic wells were sampled by EPA's contractor, the Research Triangle Institute (RTI), whose staff also conducted interviews with householders regarding the usage and construction of their wells. In addition, well site observation variables were collected along with information about the area in the vicinity of each well Community water system (CWS) wells in each pilot State were sampled by State health department officials, after training by RTI. Questionnaires on well construction and characteristics were also administered to CWS operators

Because of the heavy emphasis on quality assurance and quality control procedures in the pilot study, an average of 50 bottles of water were taken at each well sampled. Water samples are being analyzed in the pilot study by EPA's contractor laboratories (Battelle Columbus and Southwest Research

Institute) and by four EPA quality control laboratories.

2. EVALUATION APPROACH AND RESULTS

EPA's evaluation of the pilot study focuses on two primary questions:

(1) Will EPA be able to carry out the full National Pesticide Survey more or less as planned?

(2) Can parts of the survey be done better or more efficiently?

The answer to both questions appears to be yes. Overall, the pilot study was both successful and necessary. It confirmed EPA's expectation that most major components of the survey are in good working order and functioning properly. Specific successes include:

-- Sampling has been conducted satisfactorily, both technically and logistically, at selected wells;

-- The nine analytic methods are up and running. Modifications to Methods 3 and 7 were accomplished in mid-study;

-- The statistical methods developed for the survey to select domestic wells functioned appropriately;

-- Agricultural extension agents were cooperative and informative in providing cropping data;

-- Interview questionnaires are straightforward to administer;

-- No difficulties have been encountered collecting observational data around the wells;

-- Survey staff have met a high degree of cooperation and interest on the part of householders, with a participation rate of over 90 percent;

-- Informed consent procedures have been implemented successfully, while maintaining satisfactory participation rates;

-- States have been enthusiastic and cooperative, assuming a major role in sampling CWSs.

The pilot study was also of inestimable value in providing a learning period for trying different approaches and getting the "bugs" out of the system. Changes were made during the course of the pilot study to improve procedures and techniques. Numerous minor refinements will also now be made in the interview questionnaires, training manuals, and sampling and communications procedures, in anticipation of the full survey.

In addition, the pilot study has indicated a need to modify or reconsider several components of the survey in order to meet Agency objectives, maintain the statistical accuracy of the survey, and accomplish the data collection in a cost-effective manner. Major issues/components requiring further study include:

-- The need to modify the well selection method for community water systems because of inaccuracies in the number of wells listed in the Federal Reporting Data System.

-- The amount of attention to be given to 2nd stage stratification for domestic well selection. Alternatives that could simplify the procedures and cut costs include: reduced data gathering for the entire county; more focused data collection in the area surrounding the selected wells; and the use of geographic information systems for recording and mapping hydrogeological data.

-- The difficulties of obtaining accurate information on well depth from well owners and available records. EPA is examining alternative methods of obtaining estimates of well depth and aquifer tapped for the sample wells.

-- The ability of the survey to produce sufficient data to support analyses of the relationships of pesticide contamination to ground-water vulnerability and pesticide usage. Costs of data collection and the quality of the data will need to be considered in evaluating options, which include relying on 2nd stage stratification data, increasing the number of wells sampled, and collecting more information around each well.

-- The effect on the sampling results of temporal variations (seasonality) during the two-year survey period. EPA is investigating methods of accounting for seasonal changes in pesticide contamination in the survey design.

-- The stability of certain pesticide and other chemical analytes in water samples during transportation to and storage at the laboratory (for up to two weeks prior to analysis). EPA is examining the need for and feasibility of conducting time storage studies prior to and during the full survey to provide more data on this problem, as well as other means to address the problem.

-- Additional analytical methods issues, including further defining the reporting limits, reducing analytical costs, final design of the quality control program, finalizing the list of analytes, dealing with false negative results, and resolving the audit program to be used. Work is underway on each of these issues.

The remainder of this Summary Report discusses the components of the pilot study in more detail. Readers are referred to the Technical Report for additional details on the design and implementation of the pilot study. The appendices to the Technical Report contain copies of the questionnaires, data collection forms, and other technical material.

Two aspects of the pilot study and the survey as a whole are not evaluated in this report. The first is the statistical design of the entire National Pesticide Survey (1). The pilot study was not intended to test the merits of the survey design as a whole; rather, the pilot study was intended to test the feasibility of implementing the design and procedures developed for the survey. To the extent that implementing the pilot study has indicated a need for revising parts of the survey design, this report explains the specific problems encountered and the recommended modifications.

Second, this report does not discuss the sampling results for the wells sampled in the pilot study. The analytic results for each well are being provided to each CWS operator and domestic well owner involved. The sampling results for community water systems are available from the appropriate State water supply agency, as a matter of the public interest. However, since the well water sampled in the pilot study is not necessarily representative of contamination conditions at any level -- county, state, region, or nation--no purpose can be served in discussing these isolated results.[1] Furthermore, the results are too few to allow EPA to test whether data analyses planned for the survey are feasible. EPA will be convening a Subpanel of the Scientific Advisory Panel which will be charged with the task of examining the entire pilot study and the feasibility of the data analyses planned for the survey.

II. OVERVIEW OF THE NATIONAL PESTICIDE SURVEY

The National Pesticide Survey has two principal objectives:

(1) to determine the frequency and concentration of pesticide contamination in the drinking water wells of the nation; and

(2) to improve our understanding of how pesticide contamination is associated with patterns of agricultural pesticide usage and the vulnerability of ground water to pollution.

Thus, the survey is intended to provide, for the first time, a statistically accurate assessment of the extent and severity of pesticide

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[1] Note that the full survey is intended to evaluate pesticide contamination of wells across the nation and in some subsets of the national picture (but not necessarily at the county or state level).

contamination in well water nationwide. Additionally, if strong relationships exist among the presence of pesticide residues in well water, the use of pesticides for agricultural purposes, and certain hydrogeologic characteristics, then the survey should provide descriptive information about the nature of those relationships.

The National Pesticide Survey represents a major component of the Agency's overall effort to understand and characterize the presence of agricultural chemicals in ground water, and to involve the States in ongoing drinking water protection activities. The information to be collected in the survey will support the evaluation of current regulations related to drinking water and pesticides under the Safe Drinking Water Act (Sections 1442 and 1445) and the Federal Insecticide, Fungicide, and Rodenticide Act (Section 20C). The information may also indicate the need for new or better targeted regulations.

The conceptual design of the National Pesticide Survey is portrayed in Exhibit 1. The survey design includes four major components: (1) a statistical design to select a sample of domestic wells and community water systems; (2) analytic methods to measure the types and amounts of possible pesticide contamination of water samples; (3) health advisories that establish the levels at which pesticide concentrations may pose a health problem; and (4) questionnaires and data collection forms to collect key information on factors potentially associated with pesticide contamination.

(1) Statistical Design. Two separate statistical designs were developed by the Research Triangle Institute (RTI), one each for the domestic and community water system sides of the survey. The first step, common to both the domestic and community water system components, was to stratify all 3,137 counties in the United States in order to properly account for major differences in pesticide usage and ground-water vulnerability in different parts of the country. Thereafter, on the community water system (CWS) side, the Federal Reporting Data System (FRDS) -- a list of all community water systems in the country -- was used to select a sample of about 500 systems (estimated to have a total of about 750 wells).[2]

The domestic side of the survey required a three-stage statistical design because there is no similar comprehensive tabulation of private (rural domestic) wells in the U.S. from which a sample can be selected. The domestic well design focuses successively on counties, intra-county areas such as Census enumeration districts, and finally on individual wells selected for sampling.

In addition, stratification -- with oversampling from selected strata -- is performed at the first and second stages of the domestic well design,

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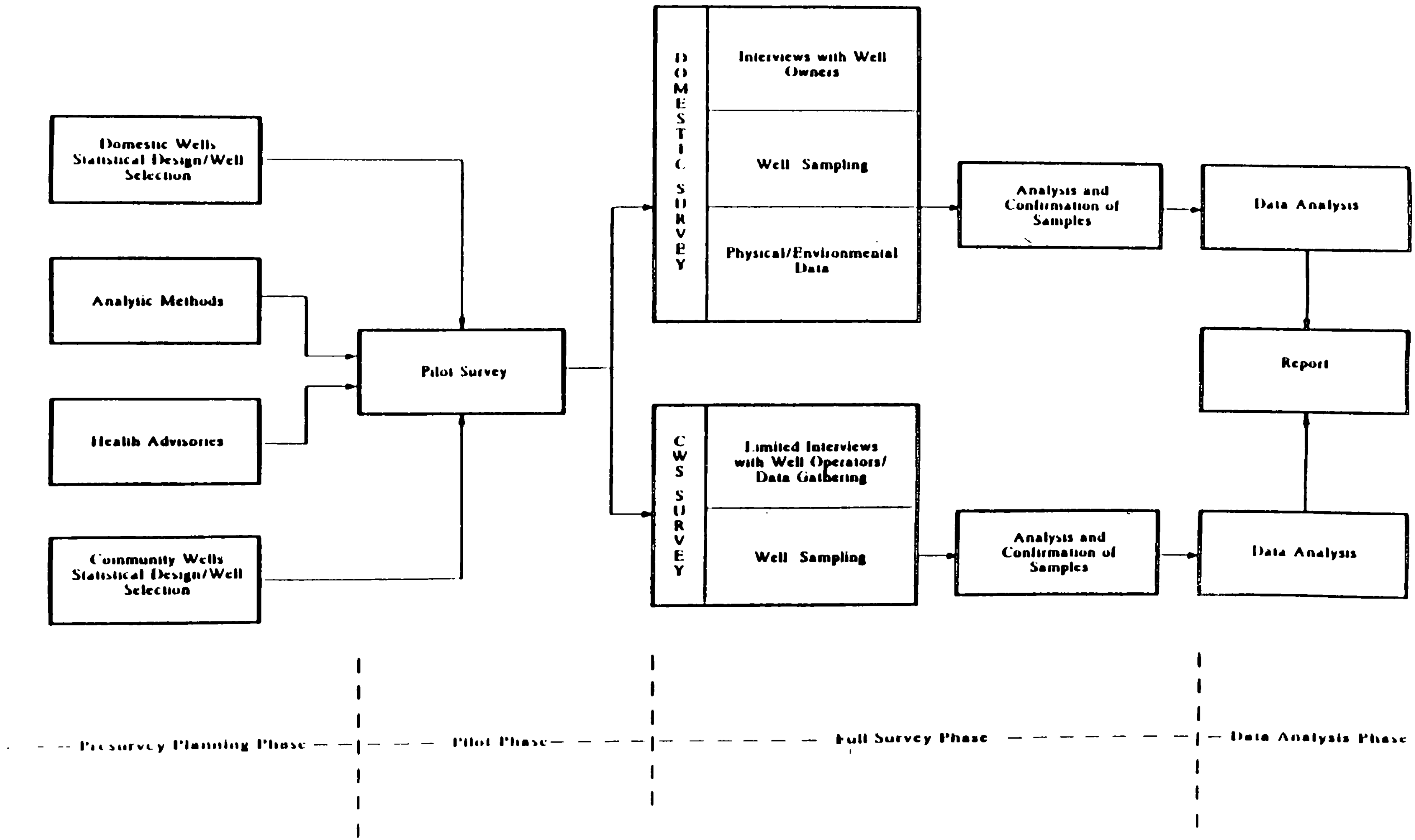
[2] Subcounty level data collection (in support of relational analyses) was not pursued for the community water systems because of budgetary constraints. Well-specific data will, however, still be collected for CWSs

EXHIBIT 1
NATIONAL PESTICIDE SURVEY
CONCEPTUAL DESIGN



to control the distribution of the sample with respect to agricultural pesticide use and ground-water vulnerability. About 750 domestic wells will be selected for pesticide sampling in the full survey.

In late 1986, a sample of 500+ community water systems was drawn for the full survey, and a first stage sample of 90 counties was selected for the domestic well selection process. These lists were not released to the public because of the possibility that the samples would need to be redrawn after the pilot study.

Pilot study sampling was conducted at 10 of the 500+ CWSs selected for the full national sample, and in 6 of the 90 counties selected for domestic well sampling in the full survey. Because of budgetary and time constraints, water sampling could only be conducted at 48 wells in the pilot study. The distribution of the pilot CWSs and domestic wells (DWs) was as follows:

California		
-- CWSs:	3 systems (in 3 counties)	8 wells
-- DWs:	2 counties	8 wells
Minnesota		
-- CWSs:	4 systems (in 4 counties)	8 wells
-- DWs:	2 counties	8 wells
Mississippi		
-- CWSs:	3 systems (in 3 counties)	8 wells
-- DWs:	2 counties	8 wells

(2) <u>Analytic Methods</u>. In preparing for the National Pesticide Survey, EPA identified and ranked pesticides on the basis of their potential for leaching into ground water, occurrence in ground water, production volume, and other considerations. Water samples taken from each well in the National Pesticide Survey are analyzed for the presence of over 150 contaminants, including 120 pesticides and numerous other volatile organic chemicals.

In order to detect this large number of potential contaminants, water samples are analyzed using nine different analytic methods. Three of these methods (for nitrates, volatile organic chemicals, and EDB/DBCP) were already available. EPA developed six new analytic methods in preparation for the survey One method tests for Ethylene thiourea; the other five are multi-residue methods, each capable of detecting 10 or more analytes. The six new analytic methods have undergone peer review during the summer of 1987 under the auspices of EPA's Environmental Monitoring and Support Laboratory (Cincinnati).

(3) <u>Health Advisories</u>. EPA has developed health advisory levels for 61 "priority" pesticides (i.e., those with the highest leaching potential). The health advisories are formal scientific guidance documents that will help well owners, operators, and the general public to evaluate the results of the well sampling, and to determine whether the contamination levels found warrant further action. As part of EPA's overall effort to improve risk

communication, the Agency has also prepared non-technical summaries of the health advisories to explain the health effects of exposure to pesticides to the owners and operators of the sampled wells, in instances where contamination is found.

Sixteen health advisories were published in June in final form (2). Drafts of the remaining advisories will be released for public review in the Fall of 1987. Draft health advisory levels were completed in time for the pilot study; EPA was prepared to issue them in the event that contamination was found in the pilot study samples. Because these health advisories will be undergoing extensive peer review, and will be modified accordingly, no further discussion of the health advisories is included in this report.

(4) Questionnaires and Data Collection Forms. To meet the second objective of the survey (i.e., improved understanding of the factors associated with pesticide contamination), the survey design calls for interviews with householders and CWS operators, and data collection in the area surrounding each well. Different questionnaires were designed for the community water system operators and the domestic well users. The information sought includes the uses and characteristics of the well water, well construction data, and the presence or absence of various factors (such as abandoned wells or pesticide spills on the property) that could explain the source or route of contamination, if any is found.

III. EVALUATION

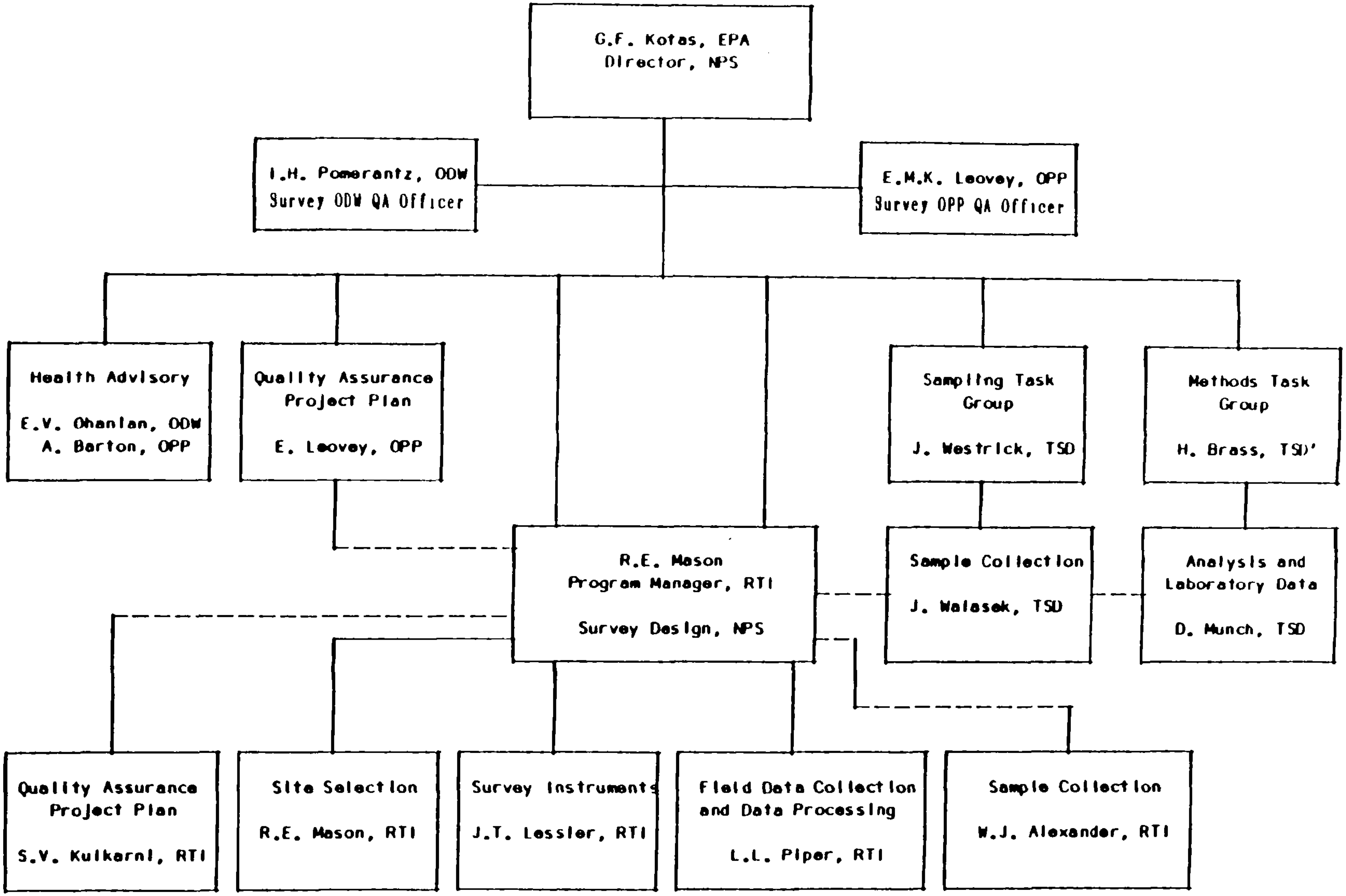
The evaluation presented below is a summary of the more detailed evaluation contained in the chapters of this report. We begin with a review of statistical design issues involved in selecting wells for sampling, first for community water systems, then for domestic wells. Subsequent sections discuss the questionnaires used in the pilot study, other data collection efforts, water sampling and transport, analytic methods and quality control, communications, and overall quality assurance. An organization chart for the pilot study is provided in Exhibit 2.

1. STATISTICAL DESIGN ISSUES

1.1 Community Water System Design Issues

The community water system component of the National Pesticide Survey is designed as a stratified sample of active community water systems that have at least one well and/or ground-water source of water under the operational control of the system. Stratification is done at the county level in order to control the distribution of the sample with respect to estimated patterns of agricultural pesticide use and ground-water vulnerability; systems in hydrogeologically vulnerable counties are then oversampled to increase the likelihood that existing contamination in such areas will be detected (3).

EXHIBIT 2
ORGANIZATIONAL CHART FOR THE PILOT STUDY



The CWS sampling scheme is intended to provide a 90 percent probability of detecting contamination in the sample if 0.5 percent of all community water systems in the country are contaminated. The precision will be much better if more than 0.5 percent of all CWSs are contaminated. The CWS component of the survey will also examine areas with high ground-water vulnerability, with a 60 percent probability of detecting contamination in that part of the sample if 0.5 percent of all community systems in these areas are contaminated. (See Chapter 1 of the Technical Report for a technical description of the precision requirements of the CWS component of the survey.)

The sample of community water systems for the NPS comes from the Federal Reporting Data System (FRDS), a computer-accessible data base. Although FRDS contains the best and most complete list of community water systems nationally, the pilot study indicates that many data elements in the system have not been maintained consistently. The number of unusable entries in FRDS will likely necessitate changes in the planned approach for selection of community water systems and wells in the full survey. Details on the pilot experience with FRDS are provided below and in Chapters 1 and 3 of the Technical Report.

Community water systems are defined in FRDS as those systems with at least 15 connections and/or that serve a population of at least 25 permanent residents. The first task in constructing a sampling frame of community water systems was to select eligible systems from FRDS. To be eligible for the NPS, a community water system had to be an active system listed in FRDS for the period July 1984 through June 1985, and operating at least one well or ground water source. About 51,000 community water systems listed on FRDS met these criteria. From these 51,000 CWSs, a national sample of 500+ systems was selected, of which 97 were located in the three pilot States (California, Minnesota, and Mississippi).

It was expected that 5 percent of these systems would still be ineligible for inclusion in the survey because of errors in the FRDS information. Two other checks for eligibility were conducted. Officials in the pilot States were asked to review the sample of 97 CWSs in order to identify ineligible listings in their respective States. Then, using computer-assisted telephone interviewing, RTI conducted an additional screening to make contact with these community water systems, obtain their cooperation for the survey, and verify their eligibility and total number of wells.

The first problem encountered was identified by California State officials. The sample of community water systems in California included a large batch of entries (53 of 66) that were non-community rather than community water systems. This problem appeared to be limited to California, and was resolved by drawing a compensating, augmented national probability sample. Of the remaining systems in all three States, only 2 were found to be ineligible after screening, and the 5 percent ineligibility rate is expected to hold for CWSs listed in FRDS in all other States.

A second problem, also encountered in California but apparently affecting other States as well, is that the FRDS records are a mixture of individual systems and parent companies operating several systems at different locations.

Thus, a single community water system can be associated with more than one FRDS entry. To deal with this problem of "multiplicities," it is recommended that the screening questionnaire be expanded to ask respondents about their parent/affiliate status. The FRDS file would then be checked and the multiplicity factor determined.

The problem of multiplicities contributes to a final and more significant problem with the FRDS data, this time having to do with the number of wells per system. According to the FRDS data base, 83 percent of CWSs have one single well; 7 percent have 2 wells; and only 10 percent have 3 or more wells. Based on that information, the survey was designed to estimate the number of community <u>systems</u> in the country that have at least one contaminated well. The implication was that virtually every well in every selected system would be sampled and analyzed.

In the course of screening the systems for the pilot study, however, it was found that the selected CWSs have many more wells than are shown on FRDS -- on average 5.75 wells per FRDS record rather than the expected 1.5 wells per system.[3] We cannot necessarily generalize from these pilot study systems, and based on other survey information, the average of 5.75 wells appears uncharacteristically high for community water systems in general. Nevertheless, if this average (or any number substantially higher than 1.5 wells per system) holds across other States, then sampling each well in each selected system, as originally planned, would become extremely costly. It would also focus CWS sampling on fewer systems, thereby limiting observations to fewer geographic areas of the country and reducing the precision requirements of the survey.

One method of solving this problem is to develop a list of CWS <u>wells</u> (rather than systems), from which a sample of CWS wells can be selected. The recommended approach is to use a three step design. In step 1, a sample of systems is selected with equal probability from FRDS. (FRDS is stratified using the currently defined stratification variables.) The sample is screened by telephone to determine the number of wells operated by each sample system. This information is used at step 2 to select a subsample with probability proportional to size (number of wells). At the final step 3, a single well is selected from each of the systems in the subsample.

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[3] Almost half the pilot CWSs have 3 or more wells. Additional wells were found during actual field work in the pilot study, over and above those indicated in the screening calls. These discrepancies may be due to the use of different definitions by screening staff and field staff. For example, a well may exist at a CWS but water cannot be collected from it because of a broken pump which is not expected to be repaired. Use of a standard definition that excludes inoperable wells, and additional attention to this issue during training should eliminate the problem in the full survey.

1.2 Domestic Well Design Issues

Domestic wells are defined for purposes of this survey as operable domestic water wells supplying occupied housing units and located in rural areas in the United States excepting government reservations. The statistical survey design used to select a probability sample of domestic wells is a three-stage stratified sample, as illustrated in Exhibit 3. Stratification is done at the first and second stages to control the distribution of the sample with respect to estimated patterns of agricultural pesticide use and ground-water vulnerability.

The three stages are necessary in order to reduce the problem of sampling frame construction to manageable size without sacrificing the ability to draw national level inferences from the data. National inferences from the full survey will be possible because:

1. The 1st stage frame of counties accounts for the spatial (national) reference of the survey;

2. The 2nd stage frame of area household clusters completely accounts for the area contained in any sample of counties; and

3. The 3rd stage frame of domestic wells consists of a complete listing of the domestic wells in any sample of clusters.

A detailed description of the statistical design for domestic well selection is provided in Chapter 2 of the Technical Report, as well as in references (4) and (5).

The domestic well statistical design is intended to yield a range of probabilities of detecting contamination in different domains.[4] Areas of particular concern for pesticide contamination are oversampled in order to yield better, more precise estimates. The survey will have a 97 percent chance of detecting contamination in the sample of domestic wells located in cropped and vulnerable areas of the country (as defined in the 2nd stage of the survey design), assuming that one percent of all U.S. domestic wells are actually contaminated. The likelihood of detecting contamination in the survey sample is expected to be 75 percent in high ground-water vulnerability/ high pesticide usage areas, and 63 percent at the national level. The

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[4] "Domains," in this context, refers to subpopulations of wells defined by any variable of interest. For example, a domain might be defined as "all wells in areas of the country with DRASTIC scores above 148." The five domains for which precision levels have been defined in advance for the survey are: the national level; areas of high pesticide use; areas with high ground-water vulnerability; areas with both high ground-water vulnerability and high pesticide use; and cropped and vulnerable areas (defined in the 2nd stage of the design).

EXHIBIT 3
DOMESTIC WELL SELECTION PROCESS

1ST STAGE

Stratify all U.S. Counties
by:
- Ground-water vulnerability
- Pesticide usage

↓

Select 90 Domestic Well Counties

2ND STAGE

Score subcounty areas using DRASTIC | Determine cropped/non-cropped status of subcounty areas

↓

Stratify subcounty areas:

Stratum 1: Cropped/vulnerable areas | Stratum 2: Non-cropped areas

↓

Select areas for the sample

↓

Count housing units
in each selected area
(subsegment large areas,
if necessary)

↓

List each housing unit
(address or description)

↓

Select sampling clusters
from list (~25 households)

3RD STAGE

↓

Screen households to
develop list of wells

↓

Select wells for sampling
from list of wells

precision of the survey will be greater still if in fact the percentage of pesticide-contaminated domestic wells in the United States is higher than one percent. (See Chapter 2 of the Technical Report and reference (4) for a detailed discussion of precision requirements and sample allocation methods.)

EPA does not expect to see substantial changes in the three-stage approach for domestic well selection in the full survey. However, as discussed below, EPA is considering a number of options to reduce the costs of the 2nd stage stratification effort and enhance the data available from the survey.

1.2.1 1st Stage Frame Construction and Stratification

First stage activities consisted of stratifying each of the 3,137 counties in the U.S. into one of 12 strata, defined by 3 categories of ground-water vulnerability and 4 categories of pesticide usage. Sources of information for this stratification effort were the county vulnerability indexes[5] (6) and pesticide usage data from Doane Marketing Research, Inc. and the Census of Agriculture (7). As noted earlier, the 1st stage sample, consisting of 90 counties, was selected in late Fall 1986. Because the 1st stage work has been completed not only for the pilot study but for the National Pesticide Survey as a whole, EPA does not intend to revisit the design of the 1st stage.

1.2.2 2nd Stage Frame Construction and Stratification

The second stage of the domestic well selection process involves a number of different steps, each of which was carried out in full for the pilot counties. Only a brief overview of the design is provided here, followed by a discussion of specific design issues; see Chapter 2 of the Technical Report for details of the approach.

During the 2nd stage, the focus moves from the county level to selected "clusters," each consisting of about 25 households with wells. To accomplish this progression, first, the county is mapped to identify subcounty areas of relative ground-water vulnerabilities using DRASTIC (see below for details) Interviews are also held with county agricultural extension agents to determine the relative level of agricultural activity in each part of the county (see below for details). The county is disaggregated into enumeration districts and/or block groups (these are areas defined by the Census Bureau, for which 1980 census data on numbers of people and wells are available). Each of these areas of the county is assigned a DRASTIC ground-water score, and a code based on the percentage of its area that is agriculturally cropped.

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[5] The vulnerability indexes are based on the DRASTIC model, developed by the National Water Well Association, which assigns a score to a geographic area based on the following hydrogeologic factors: **D**epth to ground water; net **R**echarge rate; **A**quifer media; **S**oil media; **T**opography, primarily slope; **I**mpact of vadose zone; and hydraulic **C**onductivity of the aquifer.

Next, the enumeration districts (EDs) and block groups (BGs) are placed in two strata, the first stratum consisting of the most cropped and vulnerable areas, accounting for 25 percent of the total number of 1980 households with wells in the county, and the second stratum containing the rest of the county. A statistical sampling allocation method is then used to select EDs and BGs for the sample, oversampling from the first stratum. Based on census information, a large ED or BG selected for the sample may be divided into area segments, only one of which will be included in the sample.

Once the sample of area segments has been selected, survey staff drive through each segment, counting the housing units (e.g., houses, apartments, etc.) and comparing the totals with census information. Where necessary, a large segment may be divided into subsegments, one of which will be selected for the sample. Next, each housing unit in the segment or subsegment is listed (either by address or identifying description). Finally, a sample of housing units (called a compact cluster) is selected from the list of housing units, leading into the 3rd stage screening process.

Stratification: Cropping Data. Cropping information needed for stratification at the 2nd stage was obtained exclusively from county agricultural agent(s) during face-to-face interviews usually lasting 2-3 hours. Only highly recommended and experienced RTI interviewers were assigned to these interviews; interviewers were trained by telephone in a 1 hour session, and were provided with a training manual (8).

County agricultural extension agents were shown detailed county maps and asked the following information for each ED or BG in the county:

(a) which crops (out of a list of 31 crops) are grown in the ED/BG;

(b) the presence or absence of golf courses;

(c) whether more or less than 25 percent of the area of each ED or BG is cropped; and

(d) the relative use of pesticides in each ED/BG compared to the rest of the county.

The agents appeared to be comfortable providing this type of information; they were conscientious and cooperative, and sought additional help when needed. No outside help, however, appeared to be needed from other organizations.

Despite the cooperation of the extension agents, the cropping data involved a number of difficulties in the pilot study. First and foremost, preparing consolidated census maps for the extension agents to use during the interviews turned out to be a much more time consuming and costly task than anticipated. For large counties or counties with large urban areas, consolidating maps at different scales was no easy task. Even after consolidation, interviewers were left with four maps for Ventura County, CA (down from 50) and 14 maps for Kern County, CA (down from about 100 maps) Interviewers were required to be experienced at reading census maps and at moving across multiple maps with ease. (One recommendation coming out of this experience is that interviewers receive training in person in any future work of this type for the NPS.)

A major complicating factor arose in counties containing an urban area. Rural areas contained within or on the fringes of urban areas were simply defined as noncropped in order to keep the work to manageable proportions. Map preparation took anywhere from 2-4 hours for counties with no urban areas to 8-16 hours for counties with urban areas that required multiple maps.

The difficulties involved in obtaining the cropping information for the entire county raises the question of whether this information collection approach represents the best use of survey resources and whether the best possible use is being made of this information resource. At present, the cropping/stratification step serves two functions: (a) it allows the subcounty areas (EDs and BGs) to be stratified by cropping status, and (b) it provides cropping data which can stand as a proxy for pesticide usage data in the relational analyses that the survey is intended to produce (i.e., the analyses of the relationships between pesticide contamination, pesticide usage, and ground-water vulnerability).

The cropping information appears adequate for the first function of stratification. However, for the second function (i.e., to support the relational analyses), the cropping information being obtained is not as specific to the well area as one would wish. One way to obtain more accurate cropping information would be to revisit or telephone the county extension agents or other knowledgeable persons (e.g., Agricultural Soil Conservation Service or Soil Conservation Service agents) after the wells are selected and ask them to focus more specifically on the areas around the selected wells.

An alternative approach is to improve the usefulness of the information by asking county agents to be more specific in classifying cropping status for the ED/BG as a whole. For example, rather than classifying EDs and BGs into two categories (25 percent or less of the area cropped and more than 25 percent cropped), the county agent could use four categories: (1) not cropped, (2) less than 25 percent cropped; (3) 25 to 50 percent cropped; and (4) more than 50 percent cropped. Both approaches will be considered further for the full survey.

Stratification: DRASTIC Scoring. Intra-county ground-water vulnerability patterns were assessed using the DRASTIC model (see references (9) and (10)). Attempts were made to obtain all available Federal, State, and county maps and publications pertaining to the hydrogeologic conditions in the selected counties. Most of this material was obtained in meetings held with State and United States Geologic Survey (USGS) regional representatives.

For the six domestic well counties included in the pilot study, the number of hydrogeologic "settings" per county varied from 3 to 18, depending on the complexity of the hydrogeologic conditions and the size of the county. Stringent quality assurance procedures were established for scoring each setting using DRASTIC, with RTI conducting a three-tiered internal check, and external, independent review provided by the National Water Well Association (11).

One product of the DRASTIC scoring process in the pilot study was a map for each county, delineating the hydrogeologic settings and their associated vulnerability scores, accompanied by a list of reference materials for each State. As an example, Exhibit 4 shows a DRASTIC map for Clay County, Minnesota. The maps generated by the survey are intended to be made available to the States and other interested parties, for a variety of uses. Once the hydrogeologic settings had been scored, they were transferred onto census maps of enumeration districts and block groups, with each ED/BG receiving a DRASTIC score.

The process of scoring counties using DRASTIC is time-consuming. After the scoring is completed, additional time is needed to average the scores and transfer them to the enumeration districts and block groups, and to prepare the final maps. In the pilot study, these tasks required from 2.5 weeks (102 hours) for Clay County, MN to over 8.5 weeks (347 hours) for Kern County, CA. This level of effort is roughly consistent with DRASTIC scoring activities carried on in various independent studies (by other investigators) in individual States. If the same scoring procedures are followed in the full survey, DRASTIC scoring of the remaining 84 counties would take an average of about 160 hours (or about one person-month) per county.

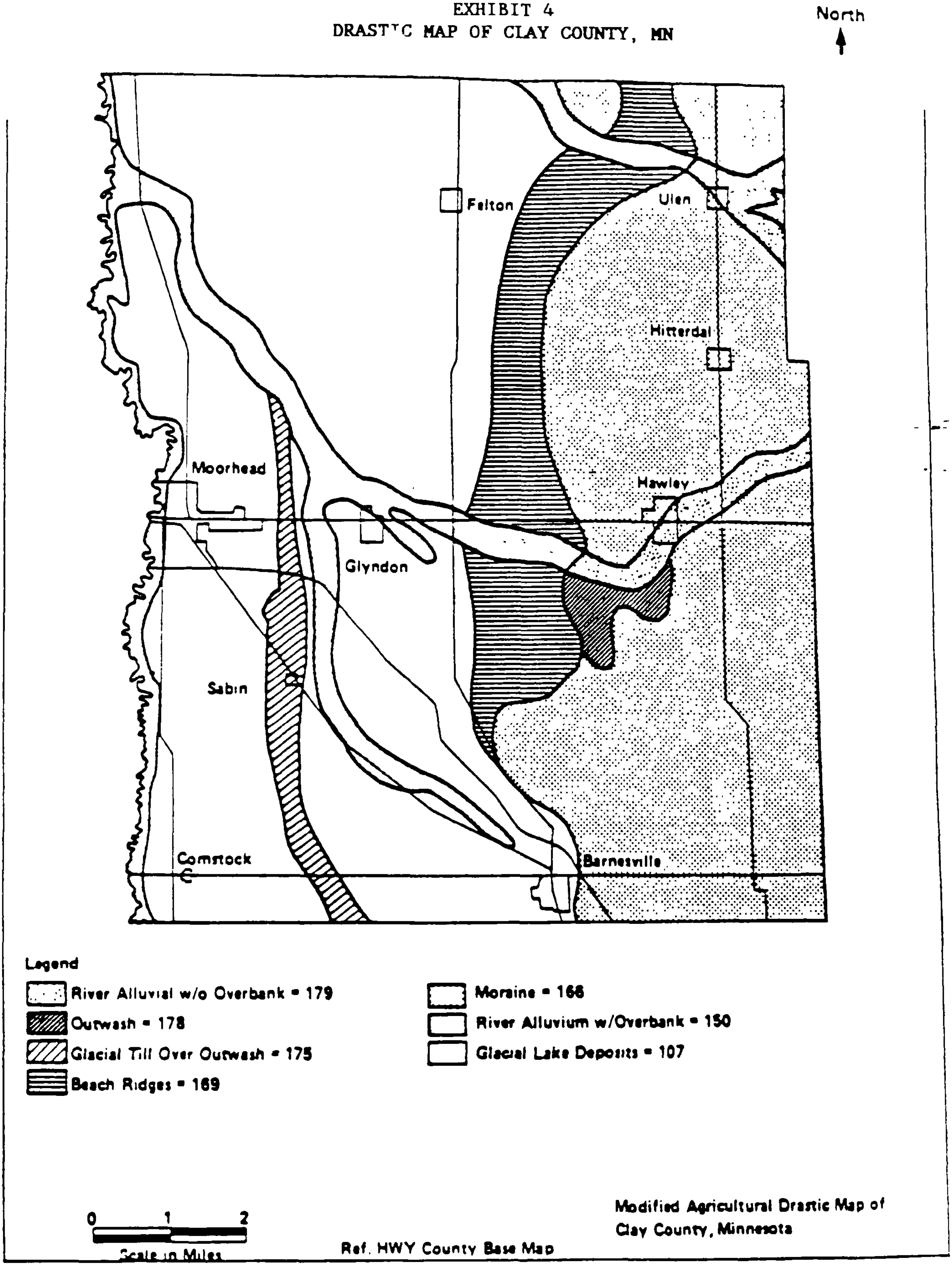
Although the DRASTIC information is important for the survey's relational analyses, and hydrogeological information is important for the 2nd stage stratification, the level of effort involved in DRASTIC scoring may require reevaluation. Options that EPA will be considering (alone or in combination) for the full survey include the following:

(1) Reduced hydrogeologic data gathering to direct the 2nd stage stratification. EPA could rely more heavily on "type settings" developed by the National Water Well Association, or a simplified set of hydrogeological characteristics (such as topsoil, slope, and depth to water) to categorize high, moderate, and low vulnerability areas within each county.

(2) Use of a geographic information system (GIS) to save time and money in averaging the DRASTIC scores and transferring them to individual enumeration districts. GISs are now being used by Nebraska, Florida, and California in their own DRASTIC efforts, as well as by the U.S. Geological Survey (USGS).

(3) Apply DRASTIC to the selected well area only, rather than to the entire county, thus providing the hydrogeologic data required for the relational analyses, but not for the 2nd stage stratification.

EXHIBIT 4
DRAST^C MAP OF CLAY COUNTY, MN



Concurrently with the NPS pilot study, USGS is digitizing some of the pilot county information using their geographic information system, to determine whether this approach could be feasibly used in the full survey. More details on the options discussed above and the USGS effort are included in section 2.6.3 and Appendix L of the Technical Report.

Other on-going State and Federal activities will provide additional perspectives on these issues. For example, the State of Iowa is currently analyzing survey data on pesticide contamination in two counties, which, coupled with DRASTIC scoring of the counties, could provide an independent corroboration of the utility of the DRASTIC effort.

In addition, as part of its National Water Quality Assessment (NAWQA), USGS is considering computing DRASTIC scores around each of the approximately 450 wells to be sampled in the NAWQA pilot study, to help examine relationships between pesticide contamination and hydrogeologic vulnerability. Finally, DRASTIC scoring activities will need to be evaluated in the context of options for collecting cropping information at the 2nd stage, the need for cost-effective stratification at the 2nd stage, and the types of relational analyses that can be supported with each approach.

Sample Construction Activities. As indicated earlier, sample construction at the 2nd stage involves a host of activities in addition to stratification. Among the tasks required are the following (see also Exhibit 3):

-- extracting the 1980 census information for enumeration districts and block groups;

-- excluding EDs and BGs in places with a population over 2,500 persons and in urban fringe areas;

-- combining enumeration districts and block groups that have too few domestic wells, in order to ensure a complete area frame;

-- selecting a sample of ED/BGs (subdivided into area segments, where necessary), based on the sample allocation method and subcounty stratification;

-- counting the housing units in each area segment by driving through the entire area and verifying the results with census data;

-- dividing each large segment, where necessary, into subsegments with a minimum of 40 housing units and at least one well, and selecting one subsegment for the sample;

-- compiling a list of all housing units in each selected segment or subsegment; and

-- selecting a sample (compact cluster) of housing units from each list.

These activities involve well known procedures and were implemented smoothly in the pilot study. However, listing the housing units took longer than expected, due to certain characteristics of rural areas (e.g., large areas to cover, unnamed and unmarked roads, houses without street numbers, and houses that cannot be viewed from the road). In-the-field subsegmenting was required in 40 percent of the segments.[6] Carrying out these activities also required the recruitment and hiring of local interviewers, preparation of hand-drawn enlarged maps of area segments, staff training, and development of an instructional manual (12).

1.2.3 3rd Stage Frame Construction

The third and final stage of the statistical design has as its final output the sample of about 750 individual wells (for the full survey). The main activity in the third stage is household screening interviews, aimed at getting a complete and non-duplicated list of domestic water wells in each sample cluster of housing units. For the pilot study, 755 screening interviews were completed in order to select a sample of about 60 domestic wells.

Interviews were conducted in person with an adult member of each household in a cluster; if no household member could be reached after repeated attempts, then neighbors were asked for the information about the presence or absence of a well at the house. (See Appendix C of the Technical Report for a copy of the screening questionnaire.) Interviewers were recruited from the local area, trained in person in a 4-5 hour session, and supplied with a detailed training manual (12).

Each screening interview took about 10 minutes (from the time someone at the household answered the door until the interviewer left). All screening activities in each county were generally completed three weeks after training. RTI supervisory staff reviewed the completed screening forms; problems identified were resolved by telephone with the interviewer or with the household respondent. In addition, 10 percent of the screening interviews were validated by telephone. The validation interview asked respondents whether they recalled being interviewed, and verified whether or not their household used well water, whether their well was part of a community system, and whether the interviewers had conducted themselves in a professional manner.

Screening went quite smoothly in the pilot study, with better than 96 percent participation by eligible households. The chief problem encountered was with short-term renters who knew little or nothing about the source of

[6] A higher percentage of subsegmenting is likely to be required in the full survey. The pilot rate was lower because Mississippi is entirely "blocked" (i.e., divided into census blocks) and required no subsegmenting.

their water supply. The only solution to this problem is to interview the property owner, but the owner may be difficult to locate or may live far from the sampling area.

1.3 Temporal Variation

One statistical design issue that could affect the interpretation of the survey results for both the community water system and the domestic well components of the survey is the temporal or seasonal variation of pesticide contamination. The survey is expected to be conducted over a two year period, but it is not designed to provide a random sample over time, and it does not "control for" seasonality. Because of laboratory capacity constraints, it does not appear feasible to eliminate any effects of seasonality by condensing all the sampling into a small time period (say, three months). On the other hand, the cost implications of correcting for temporal variation by selecting a survey sample from a jointly defined spatial and temporal frame could be significant.

Among the options available to EPA are (a) to develop a statistical method to incorporate temporal variation into the sampling schedule, if this can be done at a reasonable cost; (b) to develop a compromise approach that would factor some measure of seasonality into the survey schedule; (c) to consider temporal variation in the survey data analyses, but not in the sampling schedule; and (d) not to pursue this issue further because of scientific uncertainties and the nature of the survey design.

EPA is currently investigating these options. The issue of temporal variation and whether and how it should be treated in the National Pesticide Survey will be presented to the Scientific Advisory Panel Subpanel. For additional discussion of this issue, see Appendix K of the Technical Report.

2. QUESTIONNAIRES

2.1 Community Water System Questionnaires

In conjunction with the water sampling at community water systems, the NPS is designed to collect information about CWS wells, such as their construction characteristics, water treatment at the well, and the use of pesticides or the existence of abandoned wells in the vicinity of the sampled well. This information was collected through a 6-page interview questionnaire (see Appendix B1 of the Technical Report), and administered by pilot State representatives to the CWS operator either by telephone or in person.

On the first day of the two-day training session for community water system sampling, State representatives were provided with a training manual (13) and one hour of training by RTI in administering the questionnaires. On-site training on the second day included actual administration of the questionnaire to a CWS operator. After early problems in Mississippi, where not enough time for training had been allotted, subsequent training sessions went smoothly and were well attended by the State personnel involved in the field work.

One recommendation for the full survey is that the State personnel receive the training manual well in advance of the training session so that they will be better briefed on their role in the process. EPA may also examine the usefulness of developing a video training program for training State personnel in questionnaire administration.

State personnel estimate that the amount of time required to administer the questionnaire ranged from 0.5 to 2 hours, including the time spent making initial contacts with the CWS operator, administering the questionnaire (by phone or in person), and in some cases, reviewing existing State well records. Travel time is not included in this estimate. The questionnaire appeared to be easy and fairly straightforward to administer. Some tracking problems were experienced when States did not forward the questionnaires to RTI as they were completed, but held onto them until all the questionnaires were in hand.

Questionnaires were administered at 10 community water systems for a total of 28 CWS wells. Responses to the questionnaires were reasonably complete. Judging from the sources of information indicated on the forms, some of the questions involved a fair amount of effort, requiring the interviewers to look for responses in records located outside the community water system. Despite the difficulties, interviewers were able to obtain a good response rate for virtually all the questions, except one. On the key question (Question #7), "At what level does the well draw water?" the response rate was only 46 percent. However, respondents were able to answer other important questions, such as the total depth of the well, the depth of the casing materials, and the type of aquifer system tapped.

Based on an analysis of the responses received (see Chapter 4 of the Technical Report), it is recommended that the CWS questionnaire be revised to consolidate or eliminate many of the well construction questions. These changes would cut the questionnaire approximately in half, making it even easier to administer. The remaining questions on pesticide usage and storage, water treatment, etc., were answered adequately in the pilot and should be retained on the revised questionnaire.

2.2 Domestic Well Questionnaires

To obtain information relevant to potential pesticide contamination of a well, questionnaires were also developed for the domestic well side of the pilot study. The domestic well questionnaire (see Appendix D of the Technical Report) includes questions on the uses and characteristics of the well water, well construction characteristics, existence of abandoned wells, whether the property is farmed, and the possibility of pesticide or fertilizer storage, disposal, or spills near the well.

To administer the questionnaire, personal interviews lasting 10-15 minutes each were held with householders whose wells were selected for the survey. Depending on the circumstances, parts of the questionnaire were also administered to the owner of the well and to the person farming the property.

Because of the concurrent well depth validation study (see below), the domestic well questionnaire was administered to about 100 households in the pilot study.[7] Prior to administration of the questionnaire, well owners were asked to sign a form indicating their permission to sample the well and their understanding that the data and results associated with their well would be provided to the State agency responsible for water quality. (See Chapter 5 of the Technical Report.)

Interviewers were trained to conduct these interviews by RTI survey specialist staff in the course of telephone training sessions lasting 1 to 1.5 hours. Interviewers were also provided with a detailed procedural manual(14) for training and reference purposes.

In general, interviewers found the householders to be highly cooperative, although enthusiasm to participate in the survey varied across the States (as expected). Approximately 90 percent of eligible households agreed to participate. No major problems were encountered when call-backs to a household were needed to find an eligible respondent.

Interviewers discovered that 6 of the 102 households contacted were not on domestic wells, despite having responded to the screening questionnaire to the contrary. Some difficulties also occurred in trying to reach well owners living outside the sampling area. Where necessary, telephone contacts were made to obtain permission to sample. In addition, since the pilot study only sampled a portion of the selected wells, it was always possible to find enough wells to sample in each area. However, in the full survey, where all selected wells must be sampled, difficulties may be encountered in locating non-resident owners. It may also be difficult to obtain permission to sample when wells are located on properties owned by corporations (such as real estate firms) rather than individuals.

Despite the general interest on the part of the public, questions dealing with well construction were not satisfactorily answered for purposes of the survey. Renters in particular and persons not living in the house when the well was constructed could only rarely provide the necessary information. As a result, substantial changes in the domestic well questionnaire instrument may be necessary in the full survey. Recommendations on changes will be made in a subsequent version of this report, once analyses of the well construction data have been completed.

The importance of well construction information for the National Pesticide Survey is related to the survey's objective of examining associations between pesticide contamination and ground-water vulnerability. Without the necessary information on the depth of the well (particularly the screened portion of the well), it may be difficult to determine from which aquifer the well is drawing (potentially contaminated) water, to determine if

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[7] The survey design called for approximately 60 householder interviews, the additional interviews were needed for the validation study. Due to laboratory and funding constraints, only 24 of the 60 domestic wells were actually sampled in the pilot study.

the contamination reached the ground water through the geologic media or directly through the sampled well, and to assess the role of different hydrogeological conditions in pesticide contamination of well water.

2.3 Well Depth Validation Study

Because of the importance of well construction data, and because of EPA's suspicion that information on well construction would be difficult to obtain, a separate "well depth validation study" was conducted during the pilot study. The validation study was intended to seek out and examine a variety of well construction records available from the well owner, State archives, well drillers, and the WATSTORE data base maintained by USGS.

The purpose of the study was to determine the extent to which records with information on well depth are available; the location of these records; and the cost of locating them. In addition, by asking householders specific questions during the interview, the study aimed to determine the accuracy of householders' information recall on questions of well construction, as compared to the information in records (and to a lesser extent, the degree to which householders can predict the accuracy of their own recall). Of primary importance was information that would allow EPA to determine which aquifer is being tapped by a particular well.

Results of the well depth validation study were mixed (see Chapter 9 of the Technical Report). Overall, only 54 percent of the well owners provided information on the depth of their wells, and only 5 percent of the well owners were able to provide a record. Records were located at a total of 40 percent of the wells (primarily from State records and driller records). At least one estimate of well depth (either from the well owner or a record) was obtained for 69 percent of the wells in the study.

The availability of State records on well construction varies across the States, but most appear to have some well construction records, and can provide information on well construction in the areas of the sample wells relatively easily. In the absence of more direct data, information on the surrounding wells may be useful for inferring the likely aquifer tapped by a sample well. EPA is currently considering options for estimating well depth, and will raise the issue with the Scientific Advisory Panel Subpanel.

3. ADDITIONAL DATA COLLECTION

Two additional types of information were collected at both domestic and community water system wells during the pilot study -- observational data around the well site itself and local area information within a half mile vicinity of the well (see Chapters 6 and 7 and Appendices B2, E1, E2, and F of the Technical Report).

Observational Data

Observational data were collected in order to identify obvious conduits for direct contamination as well as types of treatment systems associated with the well and water sample. Information collected includes the soil and rock type within 100 feet of the well, the existence of drainage ditches or bodies of water, and whether the well is open or protected at the land surface.

Community Water Systems. A one-page data collection form, the Well Observational Record, was completed by the State representative at the time of water sampling. The form required less than 10 minutes effort, and in only two cases were forms returned without all questions answered (the unanswered questions appeared to be simple omissions). Slight modifications in the Well Observational Record may be recommended for the full survey; overall, it appears to be working well.

Domestic Wells. For domestic wells, the hydrogeologists conducting the sampling were required to complete the 3-page Hydrogeologist Questionnaire, which contained additional questions on water usage and septic tanks. Because the survey staff conducting this data collection effort had formal hydrogeology training with experience in water well system design, minimal additional training was needed for this effort.

About 10 to 30 minutes were needed to complete the questionnaire, with the bulk of the extra time being spent obtaining householders' responses to the additional questions on water usage and septic tanks. Because the sampling is usually done under the pressure of strict deadlines (e.g., meeting Federal Express delivery schedule), it is recommended that any questions that do not involve simple observation by the hydrogeologist be added to the domestic well (household) questionnaire instead.

A high response rate was received on these forms, including questions asked of householders, although householders were not always sure of the location of the septic systems. One problem revealed by the pilot study was that in California, many of the well were at a distance (a half mile to a mile) from the house, and could not be readily visited.

Suggested revisions to the Hydrogeologist Questionnaire are outlined in Chapter 6 of the Technical Report. In general, the Hydrogeologist Questionnaire should be shortened and made more comparable to the Well Observation Record used for community water systems. Given the ease of obtaining the data and its usefulness in identifying potential direct conduits of contamination and characterizing the water samples, EPA recommends continuation of this data collection effort in the full survey.

Local Area Data

Data on characteristics of the local area were sought to help explain potential sources of well contamination, such as the proximity of a well to a waste disposal site. A separate questionnaire was used to record possible influences on ground water within 1/2 mile of the well site, including farming/agricultural operations, golf courses, waste treatment facilities, dumps or landfills, water bodies, manufacturing operations, and chemical spills. This type of information is necessary to provide at least a preliminary explanation of the sampling results at a well, and to assist in developing public and private management responses when contamination is found.

Community Water Systems. A discussion of this data collection effort will be provided when all questionnaires have been reviewed and evaluated.

Domestic Wells. The Local Expert Data Collection Form was designed so that more than one individual could contribute responses. Two approaches were taken by the interviewers at domestic wells. Some interviewers sat down with a single local expert, such as a county official, and filled in the forms for all sample wells in the county. Other interviewers used a combination of their own observation, supplemented by householder responses at the end of the regular domestic well interview. Completing the data collection forms required approximately 10 minutes with a household respondent, or 30-45 minutes with a local official to cover all selected wells in the county. In either case, a personal interview was needed because the respondent had to visualize the location of the well on a map. Both approaches appear to have worked well and no problems were encountered in obtaining information.

4. WATER SAMPLING AND TRANSPORT

Water sampling in the pilot study was conducted at a total of 48 wells: 8 community water system wells and 8 domestic wells in each of the 3 pilot States. As shown in Exhibit 5, over 2,500 samples were taken in the pilot. EPA placed a heavy emphasis on quality control, particularly in the early sampling in Mississippi. Exhibit 6 shows the breakdown of the types of water samples taken. Over 50 percent of the samples taken in the pilot study were quality control samples. The emphasis on quality control (QC) was necessary because six of the analytic methods used were developed specifically for the NPS and had never been applied in actual field studies.

The number of samples taken per well is expected to drop in the full survey from the current average of 50. However, it is not yet clear how many samples will still be required. The number of samples per well will have implications not only for the cost of the survey and the length of time required for the analyses to be completed, but also for the complexity of the sample collection effort in the field.

A detailed account of the NPS pilot study's sampling effort is provided in Chapter 8 of the Technical Report, including the coding system, labels, tracking forms and procedures, kit preparation and assembly, bottle cleaning and preparation, and sampling protocols and training. Full descriptions of sampling protocols and quality assurance (QA) measures can be found as well in the NPS Sampling Manual (13) and the NPS Quality Assurance Project Plan (15) The complexity of the effort derives from the numbers of pesticides to be tested for; the number of analytic methods required to test for these pesticides; and the number of laboratories involved. (See section 6 below)

EXHIBIT 5
WELL WATER SAMPLING BY STATE -- NPS PILOT STUDY

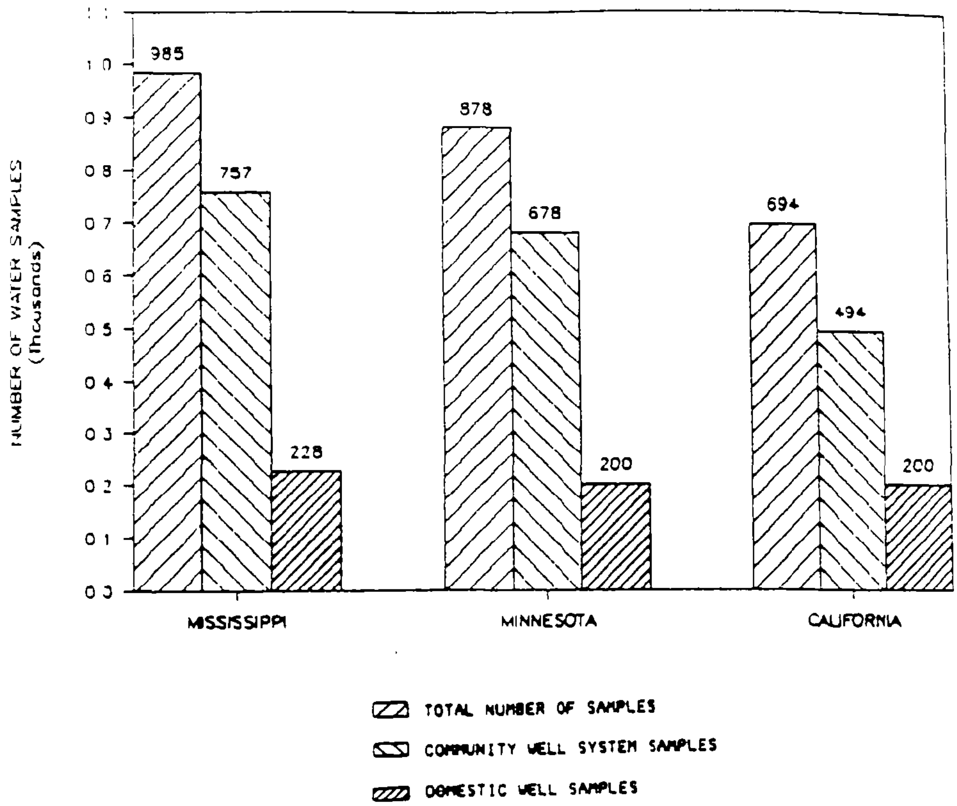
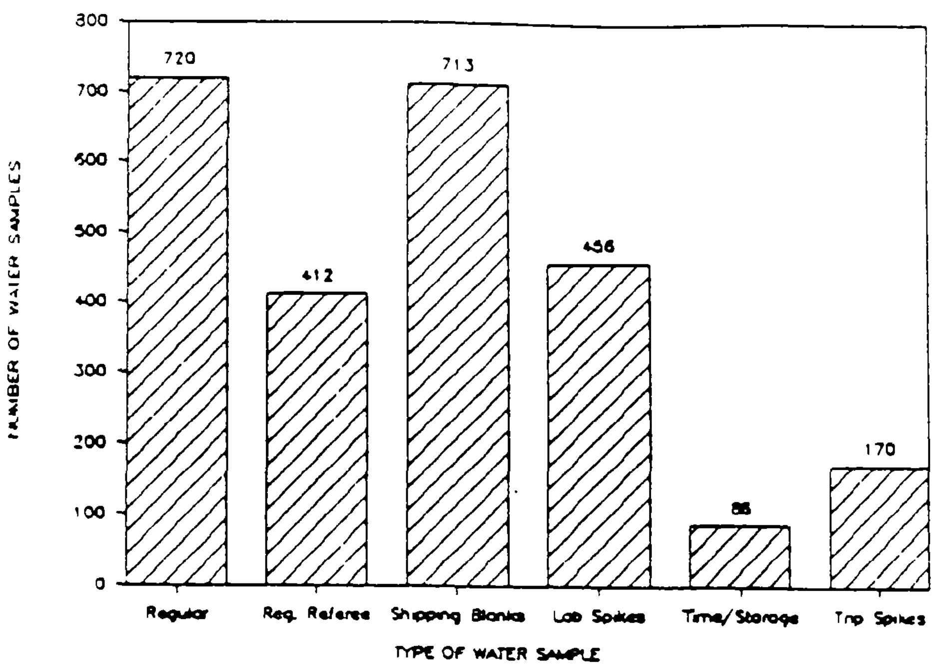


EXHIBIT 6
WATER SAMPLE DISTRIBUTION -- NPS PILOT STUDY



<u>Field Experience</u>. Water sampling at domestic wells required approximately 1 hour in the field. At community water systems, interviewing and water sampling took over 3 hours. In the course of conducting the pilot study, experience gained in the field led to a number of changes and refinements.

One issue encountered involved sampling the water prior to treatment. It was found that about 10 percent of CWSs do not have a tap from which samples can be taken prior to treatment. Following sampling in Mississippi, RTI checked with each CWS to ensure that a tap was available for sampling raw, untreated water. (Where it was not possible to take a water sample before treatment, the sample was taken after treatment.) Domestic wells usually did not have any treatment (just water softeners in some cases). Samples were usually taken before treatment, at outside spigots in the back yard of the home or from taps near the well housing.

To ensure that water samples taken were representative of the ground water in the vicinity of the well, well pumps were typically run for 5-10 minutes; samples were taken when the temperature of the water stabilized to within 1 degree Fahrenheit.

One major issue that has not yet been resolved is the aeration of samples taken from the raw sampling source. At a number of the CWS sites, the sample collection tap was so close to a high speed well pump that aeration of the sample occurred, likely resulting in losses of volatile organic compounds (Method 7 and 8 analytes). Options for resolving this issue are now under investigation. For budget reasons, EPA is also considering whether or not to retain Method 8 (VOCs) as part of the survey analyses.

<u>Logistics</u>. As a result of the early field experience in Mississippi, numerous changes were made in the coding, tracking, and kit assembly procedures. Changes included sending certain materials and the manifest under separate cover from the sampling boxes; color coding bottles; and completing forms in advance of the sampling wherever possible to cut down on the amount of time required in the field.

To handle the logistics of the operation, RTI developed and implemented a computer based tracking system, linking together each bottle, kit, box, and well ID. Because all tracking forms, labels, assembly guides, and shipping guides were generated from the same computer data base, the possibilities of duplication or loss of samples were greatly reduced. Also, because of the flexibility of the computer system, it was possible to quickly modify sample bottle label and tracking forms when changes were made in the sampling protocol or in the laboratories performing the analyses. The computer tracking system was also used for tracking Federal Express air bills, scheduling the field sampling, and maintaining the names and addresses of State samplers, community water systems, and well owners.

A clear sign of the success of the tracking system is the fact that, out of the 2,557 samples collected in the pilot study, not a single box was lost The numbers of broken bottles (2), broken boxes (4), lost bottles (2), and wrongly labeled samples (14) were minimal. In one case, samples were sent to the wrong laboratory, and two shipments of iced water samples were delayed for more than 24 hours and arrived at the laboratory with little or no ice in the sample kit (the fault of the air carrier). Federal Express was used exclusively in the pilot study, since it is the only air carrier that services many of the rural areas involved in the pilot and that will carry packages weighing over 50 lbs. overnight. In general, Federal Express provided excellent service throughout the pilot study.

In general, samples were received at the laboratories in satisfactory condition on the day following sample collection. Occasional minor difficulties occurred at the laboratories with the shipping blanks; frozen bottles bursting in the lab (Method 5 bottles require freezing); and an overheated refrigerator at one referee lab, which invalidated a small number of California samples.

More serious logistical problems arose with sample flow and communications between samplers and the laboratories. Sample flow during the early pilot study was somewhat erratic (several samples received one week and none for the next week or two), causing difficulties in scheduling laboratory analysis. In addition, because of delays in receiving tracking form data, airbills, and questionnaires from the field (which were supposed to be sent by overnight letter back to RTI's tracking system), the laboratories could not be notified precisely what shipments they were to expect each day from the field.

Clearly, in the full survey, where many more States and laboratories will be involved, these logistics will require considerable attention. States will need to be encouraged to schedule their sampling activities well in advance, with the implementation contractor conducting domestic well sampling during the slack times.

To achieve a smooth flow of samples, good communications will also be needed between the samplers and the laboratories. One recommendation is that the computer tracking system include "real time" information to track sample flow. For example, at the end of each day of sampling, each sampler (State or implementation contractor) could call in to the computer tracking system and list the samples (and air bill numbers) that were shipped that day. The tracking system staff would call the appropriate laboratories; if the expected samples did not arrive on time, tracing procedures could be initiated to find the sample box before all the ice inside the box melted.

Another recommendation is that sufficient lead time be allowed for the design of the full survey tracking system, between the time that the sampling protocol and bottle counts are determined and the time that field sampling begins. The full set of sampling specifications must be built in at the start in order to achieve a smooth-running, integrated computer control system. Other recommended changes in coding, bottle and kit preparation, kit assembly, sample collection, determination of ice requirements, and transportation procedures are discussed in Chapters 8 and 10 of the Technical Report.

5. ROLE OF THE STATES

The three pilot States played an essential role in the pilot study and EPA expects to rely heavily on the knowledge and participation of States in the full survey as well. In general, two State agencies are involved in the National Pesticide Survey -- the State agency with primary enforcement responsibility for water supply and the State department of agriculture, in most instances the agency with pesticide enforcement responsibilities.

The State water supply agencies are requested by EPA to play the following role in the survey:

-- to conduct water sampling and other data collection (questionnaire administration) at the community water systems selected for the survey (water sampling at domestic wells is conducted by the contractor);

-- to notify domestic well owners and community water system owners/operators of the results of the well sampling;

-- to provide a point of contact for communications with other State agencies, with interested parties and the media, and with EPA on survey matters; and

-- to provide follow-up to the survey, including technical assistance to communities and CWSs, and expert advice on technical and health related issues.

EPA requests the State departments of agriculture to assist in:

-- handling intra-State communications and information dissemination to interested parties; and

-- conducting follow-up investigations where contaminated wells are found by the survey, and providing technical assistance and information to well owners, householders, nearby residents, and the media relating to the contamination.

To assist the States in carrying out their roles, EPA will provide these agencies with relevant technical and health-related information pertaining to the survey. Both of these agencies will also receive the well sampling results from the survey. In some States, other agencies (such as the State department of natural resources or geological survey or the State planning agency) may become involved in the NPS as well, because of the nature of the survey or their particular responsibilities in the State.

For the full survey, the State agencies' roles will be further clarified and discussed during a one-day meeting to be held in the Fall of 1987 in each EPA Regional Office, with regional EPA representatives and representatives of each of the States in the region. EPA will attempt to arrange with the States, as soon as possible, a sampling schedule for CWS wells covering at least one year of sampling. States will be encouraged to begin work early to develop their communications plans for handling all necessary contacts relating to the survey. EPA regions will be prepared to assist the States in developing these plans.

In order to conduct the sampling and data collection in a consistent manner across States, State staff are trained in the survey protocols. In the pilot study, representatives from the State water supply agencies were trained by RTI staff during a day-long training session. The following day, State staff received hands-on training, accompanying RTI staff for the first day of CWS sampling in the State. In the full survey, States conducting the sampling will receive the training manual in advance. Cost saving measures to be investigated for the full survey include providing only a single day of training, and using a videotape and conference calls to supplement or replace some of the in-person training.

During the pilot study, EPA and the States agreed that any well showing pesticide contamination would be resampled by the State, with EPA providing the sample analysis if the State requests. If resampling becomes necessary in the pilot, a discussion of it will be included in the final version of this report. EPA expects to offer the same resampling program for the full survey; final policy on this issue is still, however, under consideration.

Sampling at each CWS well required approximately one full day including travel time, with 2-3 State representatives present. Significant costs were incurred by the States in the pilot study because of heavy quality control requirements, which required many samples per well, large boxes for shipping the samples, a large amount of ice, and a large (rented) van for transporting the boxes. Sampling in the full survey will require significantly lower per well costs, because fewer samples will need to be taken at each well, meaning that smaller boxes will be used, less ice will be needed, and State vehicles can be used for transporting the boxes. Total State costs in the full survey will depend on the number of CWS wells sampled in the State.

6. ANALYTIC METHODS/QUALITY CONTROL

The laboratories involved in the pilot study, and the analytic methods that each lab performed, are shown in Exhibit 7. A primary and a referee laboratory were designated for each method, with the primary lab usually being a contract laboratory. The primary laboratory analyzed samples from all wells.. The referee laboratories analyzed samples for half the sites. The primary laboratories for the full survey have yet to be determined.

Methods. The nine analytic methods run by the laboratories are producing acceptable recoveries and precision levels for most analytes. However, a full evaluation of the analytic methods will only be possible after all pilot data have been analyzed. In the early pilot, recoveries from sample spikes by the primary lab for Methods 3 and 7 were erratic. Modifications in the protocols of both methods were made in mid-course to correct the problems. Indications are that the revised Method 3 is now yielding better recoveries. Method 7 recoveries at the referee lab, and at the primary lab after

EXHIBIT 7
ANALYTIC METHODS AND LABORATORIES

Method	Analytes	Primary Lab	Referee Lab
1	Nitrogen and Phosphorus Containing Pesticides	Battelle	OPP
2	Chlorinated Pesticides	Battelle	TSD
3	Chlorinated Acids	Battelle	OPP
4	Pesticides	Battelle	TSD
5	N-Methyl Carbamoyloximes & N-Methyl Carbamates	Battelle	TSD
6	Ethylene Thiourea (ETU)	Battelle	OPP
7	EDB and DBCP	SWRI	TSD
8	Volatile Organics	SWRI	TSD
9	Nitrates and Nitrites	WERL	EMSL-CI

Battelle	Battelle Columbus Division, Columbus, Ohio
OPP	Office of Pesticide Programs Laboratory, Bay St. Louis, MS
TSD	Technical Support Division, Office of Drinking Water Laboratory, Cincinnati, Ohio
SWRI	Southwest Research Institute, San Antonio, Texas
WERL	Water Engineering Research Laboratory, Office of Research and Development, Cincinnati, Ohio
EMSL-CI	Environmental Monitoring and Support Laboratory - Cincinnati, Office of Research and Development, Cincinnati, Ohio

modifications to the analytical method, have also been extremely satisfactory. In Method 5, difficulties were encountered in maintaining the pH in field samples to ensure analyte preservation, but this problem was resolved by changing the buffering system.

Quality Control. Laboratory quality control forms part of the larger quality assurance program for the survey, and is detailed in the Quality Assurance Project Plan for the Pilot Study (15). Quality control measures in the pilot study included:

(a) Method blanks with each sample set (each method is run using pure reagent water from the laboratory to verify that the laboratory's reagents and glassware are not contaminated);

(b) exchange of calibration standards between laboratories to verify that data will be comparable (Methods 1-6 only);

(c) quality control standards, when available (solutions of known concentrations of analytes, verified by several laboratories, are used by a laboratory to check its calibration standards, for Methods 7-9 only);

(d) laboratory spiked samples (ground water from the site is spiked in the laboratory with known concentrations of analytes in order to see the effects of different matrices of ground water on each method's ability to recover analytes);

(e) shipping blanks (pure reagent water is shipped to the field, transferred to a sampling bottle, and returned to the lab with the samples, to determine whether any contamination is occurring at the sampling site or during transportation);

(f) time storage studies (samples analyzed at maximum holding times, to determine whether analytes are unstable in a sample while stored in the laboratory); and

(g) confirmation of all positives (to provide added assurance as to the identity and concentration of analytes) by second column confirmation (for all but Methods 8 and 9) and then GC/MS (for Methods 1-3, 6-8).

Changes effected in quality control procedures during the pilot study are discussed in Chapter 10 of the Technical Report.

Initial indications from limited time storage samples are that a number of the pesticide analytes are unstable over time in some ground waters. For a few analytes, results were as dramatic as 100 percent of the contaminant disappearing after 14 days storage. The results are being analyzed statistically to eliminate method imprecision. (See Chapter 10 for a more detailed discussion of this issue.)

Because the pilot study involved relatively few "matrices" of ground water, the pilot time storage studies cannot be relied on solely for the full survey. Whether time storage studies are needed, and the type of study needed, reporting considerations, the use of the data, and other options that may be available for resolving this issue are all currently under discussion. A study design for limited time storage studies is being developed and will be reviewed by the NPS technical staff.

For the full survey, preparation of analytical stock standards by a single source has been proposed. In the pilot study, most of the neat materials (i.e., pure compounds) came from a single source; however, calibration standards were prepared individually by the labs. In exchanges of calibration standards between primary and referee laboratories, wide divergences in the standards were found. Because it is usually not possible to determine which standard is the "correct" one, in the full survey it is recommended that calibration standards be prepared by a single source and supplied to all labs.

Additional details on the analytical accuracy and precision of each analytic method and on the results of quality control (QC) measures undertaken can be found in Chapter 10. Pilot data are still being evaluated in an effort to finalize the QC procedures to be used in the full survey. Preliminary recommendations are that the full survey maintain the following set of QC components:

(a) 1 method blank/set;

(b) 1 laboratory control standard mix/set (pure reagent water is dosed with the analytes for each method, to confirm that the laboratory is performing the method within established control limits);

(c) Contract laboratory analyses to demonstrate initial accuracy, precision, and detection limit capability prior to the full survey;

(d) 30 "blind" (performance evaluation) samples per year at the rate of at least one per quarter per method (test samples with a known concentration of analytes, made up by an independent laboratory to check the performance of another laboratory);

(e) Shipping blanks for Methods 7 and 8 only;

(f) Back-up samples for Method 5 to avoid loss of the sample in the event that the frozen bottles burst;

(g) Sample spikes at a to-be-specified ratio, depending on cost and statistical considerations;

(h) Calibration standards supplied by a single source;

(i) Continued use of referee labs for purposes of continuity and oversight;

(j) 2nd column confirmation of all positives and of blind samples (for Methods 1-7); and

(k) Low resolution GC/MS confirmation of positives, to provide additional assurance that an individual analyte is present (for Methods 1-3, 6-8). (High resolution may be needed for certain analytes due to detection limits.)

__Reporting Limits__. Exhibit 8 provides a list of the analytes included under each of the nine analytic methods, and the reporting limits for each analyte in the pilot study. Most of the reporting limits proposed for the pilot study represent 5 times the estimated detection limit (EDL) achieved by Battelle Columbus Laboratories for Methods 1-4. For Method 5 analytes, the reporting limit represents either the EDL or the upper control limit of the method detection limit, whichever is greater. For Method 6 analytes, the reporting limit is twice the EDL.

Reporting limits to be used in the full survey will be determined after all pilot study data have been analyzed and in light of the performance of the analytical contractor laboratories. A standard definition and technique for determination of detection and reporting limits will be established at completion of the pilot. (See Chapter 10 for additional details.)

Of the 61 analytes for which health effects information is available, 10 currently have minimum reporting levels equal to or greater than one-half the lowest adverse health effect value. Some of these analytes will have their reporting levels lowered; for others, the levels cannot be lowered without an expensive methods development effort; still others may be deleted entirely due to method inconsistencies (the criteria for which are being established).
In addition, where States are achieving significantly lower reporting limits for particular analytes using single analyte methods, EPA is examining the possibility of achieving lower reporting limits for those specific analytes using the NPS multi-residue methods.

7. COMMUNICATIONS

EPA devoted considerable time and attention to communications activities during the pilot study. These efforts bore fruit in the generally high level of cooperation and enthusiasm of participants and parties interested in the survey. Excellent cooperation and assistance was received from the pilot States, the agricultural extension agents, county health officials, and many others, including community water system operators, in the course of the pilot study. Well owners and household users of domestic wells were generally interested in having their wells sampled and participated in the sampling and/or interviewing activities at a sufficiently high rate (90 percent).

EXHIBIT 8
NPS PILOT STUDY ANALYTES AND REPORTING LIMITS

ANALYTES	REPORTING LIMIT (ug/l)[a]
METHOD 1	
Alachlor *	0.38
Ametryn *	2.00
Atraton	3.00
Atrazine *	0.13
Bromacil *	2.40
Butachlor	1.90
Butylate *	0.75
Carboxin *	3.00
Chlorpropham	2.50
Cycloate *	1.30
Demeton-S	1.30
Diazinon *+	0.30
Dichlorvos	13.00
Diphenamid *	3.00
Disulfoton *+	0.70
Disulfoton sulfone *+	3.80
Disulfoton sulfoxide *+	1.90
EPTC	1.30
Ethoprop	0.95
Fenamiphos *	5.00
Fenarimol	1.90
Fluridone	3.80
Hexazinone *	3.80
Merphos	1.30
Methyl paraoxon *	2.60
Metolachlor *	0.75
Metribuzin *	0.75
Mevinphos	5.00
MGK 264	2.50
Molinate	0.75
Napropamide	1.30
Norflurazon	2.50
Pebulate	0.65
Prometon *+	1.50
Prometryn	0.95
Pronamide *+	3.80
Propazine *	0.65
Simetryn	1.30
Simazine *	0.33
Stirofos	3.80
Tebuthiuron *	1.30
Terbacil *	4.60
Terbufos *+	2.50
Terbutryn	1.30
Triademefon	3.30

EXHIBIT 8 (continued)
NPS PILOT STUDY ANALYTES AND REPORTING LIMITS

ANALYTES	REPORTING LIMIT (ug/l)[a]
METHOD 1, continued	
Tricyclazole	5.00
Vernolate	0.65
METHOD 2	
Aldrin	0.38
Chlordane-alpha *	0.02
Chlordane-gamma *	0.02
Chlorneb	2.50
Chlorobenzilate	0.38
Chlorothalonil *	0.03
DCPA *	0.13
4,4'-DDD	0.13
4,4'-DDE	0.05
4,4'-DDT	0.30
Dieldrin *	0.10
Endosulfan I +	0.08
Endosulfan II +	0.12
Endosulfan sulfate	0.23
Endrin *	0.08
Endrin aldehyde	0.13
Etridiazole	0.13
HCH-alpha	0.13
HCH-beta	0.05
HCH-delta	0.05
HCH-gamma	0.08
Heptachlor *	0.05
Heptachlor epoxide *	0.08
Hexachlorobenzene *	0.04
Methoxychlor *	0.25
cis-Permethrin	2.50
trans-Permethrin	2.50
Propachlor *	2.50
Trifluralin *	0.03
METHOD 3	
Acifluorfen *	0.06
Bentazon *	1.00
Chloramben *	0.47
2,4-D *	0.20
Dalapon *	6.50
2,4-DB	5.00
DCPA acid metabolites *	0.10
Dicamba *	0.41
3,5-Dichlorobenzoic acid *	3.10

EXHIBIT 8 (continued)
NPS PILOT STUDY ANALYTES AND REPORTING LIMITS

ANALYTES	REPORTING LIMIT (ug/l)[a]
METHOD 3, continued	
Dichlorprop	1.30
Dinoseb *	0.95
5-Hydroxy Dicamba *	0.10
4-Nitrophenol	0.65
PCP *	0.25
Picloram *	0.70
2,4,5-T *	0.20
2,4,5-TP *	0.40
METHOD 4	
Atrazine, dealkylated *	1.30
Barban	2.50
Carbofuran phenol	9.00
Carbofuran phenol-3KET	1.30
Carboxin sulfoxide *	1.80
Cyanazine *	1.30
Diuron *	0.16
Fenamiphos sulfone *	28.00
Fenamiphos sulfoxide *	5.00
Fluometuron *	0.50
Linuron	1.30
Metribuzin DA *	1.10
Metribuzin DADK *	12.00
Metribuzin DK *+	0.50
Neburon	0.75
Pronamide metabolite *	4.00
Propanil	0.35
Propham *	3.80
Swep	3.80
METHOD 5	
Aldicarb *	1.00
Aldicarb sulfone *	2.40
Aldicarb sulfoxide *	2.00
Baygon *	2.40
Carbaryl *	3.10
Carbofuran *	1.50
Carbofuran 3-OH *	4.40
Methiocarb	4.50
Methomyl *	0.70
Oxamyl *	2.00

EXHIBIT-8 (continued)
NPS PILOT STUDY ANALYTES AND REPORTING LIMITS

ANALYTES	REPORTING LIMIT (ug/l)[a]
METHOD 6	
Ethylene thiourea *	1.0
METHOD 7	
Ethylene dibromide *	0.017
Dibromochloropropane *	0.013
METHOD 8	
Benzene	0.20
Bromobenzene	0.20
Bromochloromethane	NA
Bromodichloromethane	0.20
Bromoform	0.50
Bromomethane	2.00
n-Butylbenzene	NA
sec-Butylbenzene	NA
tert-Butylbenzene	NA
Carbon tetrachloride	0.20
Chlorobenzene	0.20
Chloroethane	2.00
Chloroform	0.20
Chloromethane	2.00
2-Chlorotoluene	0.50
4-Chlorotoluene	0.50
Dibromochloromethane	0.50
1,2-Dibromoethane	1.00
Dibromomethane	1.00
1,2-Dichlorobenzene	0.20
1,3-Dichlorobenzene	0.30
1,4-Dichlorobenzene	0.20
Dichlorodifluoromethane	NA
1,1-Dichloroethane	0.20
1,2-Dichloroethane	0.20
1,1-Dichloroethene	0.20
cis-1,2-Dichloroethene	0.20
trans-1,2-Dichloroethene	0.20
1,2-Dichloropropane *	0.20
1,3-Dichloropropane	0.50
2,2-Dichloropropane	0.50
1,1-Dichloropropene	NA
cis-1,3-Dichloropropene *	0.20
trans-1,3-Dichloropropene *	0.20
Ethylbenzene	0.20
Hexachlorobutadiene	NA

EXHIBIT 8 (continued)
NPS PILOT STUDY ANALYTES AND REPORTING LIMITS

ANALYTES	REPORTING LIMIT (ug/l)[a]
METHOD 8, continued	
Isopropylbenzene	NA
p-Isopropyltoluene	NA
Methylene chloride	NA
Naphthalene	NA
n-Propylbenzene	NA
Styrene	0.50
1,1,1,2-Tetrachloroethane	0.20
1,1,2,2-Tetrachloroethane	0.20
Tetrachloroethene	0.20
Toluene	0.50
1,2,3-Trichlorobenzene	NA
1,2,4-Trichlorobenzene	NA
1,1,1-Trichloroethane	0.50
1,1,2-Trichloroethane	0.20
Trichloroethene	0.20
Trichlorofluoromethane	0.50
1,2,3-Trichloropropane	NA
1,2,4-Trimethylbenzene	NA
1,3,5-Trimethylbenzene	NA
Vinyl chloride	1.00
o-Xylene	0.20
m-Xylene	0.20
p-Xylene	0.20
METHOD 9	
Total Nitrate/Nitrite *	300.00

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a These are the reporting limits achieved in the pilot study. EPA's ability to achieve these reporting limits in the full survey will depend on the performance of the participating laboratories.

* Priority analyte

\+ Analyte shows apparent instability from the time of collection until analysis. Additional assessments are currently underway.

NA Not analyzed

Among the numerous successes of EPA's communications efforts were the monthly conference calls with Regional Office contacts, the biweekly conference calls with State and Regional contacts involved with the pilot study, formation of the State/EPA NPS Workgroup, EPA's monthly bulletins (Project Updates), Questions and Answers brochures prepared for domestic well users and CWS operators, and one-page non-technical health advisories that explain health advisory information to the householder. In the full survey, a biweekly conference call will be held with those States and Regions involved in the survey at that point.

A number of communications snafus occurred at the start of various implementation activities (e.g., lack of prior notification of State agencies when contractor personnel began DRASTIC scoring). In each case, the problem was corrected for subsequent activities, and corrective measures have been incorporated into the procedures for carrying out the survey. As discussed above, communications issues relating to scheduling and sample flow to the laboratories will require further attention.

The development of various communications materials and policies for the pilot study took somewhat longer than expected, particularly with respect to EPA's policy on confidentiality. However, even though somewhat complicated procedures were instituted to ensure confidentiality (including signed consent forms), the pilot showed no significant drop in participation levels. Some possibility may exist that lower participation rates may result from EPA's decision to share sampling results with the States; however, no indication of such an effect is evident from the pilot study. The current confidentiality policy appears satisfactory in protecting privacy, providing informed consent, maintaining high participation rates, and keeping the States integrally involved in the survey.

Changes in certain communications procedures were made in the course of the pilot study, in response to concerns of the EPA-State Workgroup and the experiences of the implementation contractor. (See Chapter 11 of the Technical Report.) The communications strategy developed for the pilot study(16) will need to be revised to reflect the new procedures, to deal with the demand for accurate information from an increasingly interested and widening audience, and to handle general communications with 50, rather than just three, States. As the full survey begins to generate sampling data, considerable communications efforts will be needed to interpret and disseminate the results. However, EPA believes that all the essential communications procedures have been adequately tested, have been shown to work well, and are now ready to be implemented in the full survey.

8. QUALITY ASSURANCE

To ensure that all environmental data collected in the National Pesticide Survey and used in EPA decision making will meet the standards set by the Agency for quality and consistency, EPA has placed a heavy emphasis on quality assurance (QA) at every point in the design and implementation of the pilot study. In order to ensure that the appropriate QA measures are in place and will be used effectively during the full survey, EPA has placed the NPS pilot study under a Quality Assurance Management Systems Review.

As part of this review, EPA reviewers from the Quality Assurance Management Staff. Office of Research and Development, will examine both the content and the application of various QA functions in the pilot study, including the process used to establish the Data Quality Objectives for the pilot study; the Quality Assurance Project Plan for the pilot study; Standard Operating Procedures developed for the survey, including training manuals and sampling protocols; and QA audits already prescribed for the pilot study.

Results of the review and recommendations for modifications in QA systems for the full survey will be available in late 1987.

IV. SUMMARY OF RECOMMENDATIONS

Following is a summary of recommendations for changes or further consideration for each component of the survey.

1. Statistical Design Issues

Community Water Systems

-- Further investigation of the number of wells per system, and design and implementation of a three-step sampling approach will likely be required in order to select CWS wells for the full survey.

-- The CWS screening questionnaire will need to be revised in accordance with the new sampling design. Problems of eligibility and multiplicities in the FRDS list should be handled through the screening process as well. Particular attention should be paid to potentially ineligible California entries and to parent/affiliate companies.

Domestic Wells

-- To obtain better cropping information at the 2nd stage, county agricultural extension agents should be asked to classify subcounty areas into four categories rather than two. Another approach to be explored is a follow-up visit or telephone call to the county agent or other knowledgeable individual to obtain cropping information more targeted to the selected wells.

-- Interviewers of county agents should receive training in person.

-- Cost-cutting options are under consideration for obtaining hydrogeological information at the 2nd stage.

-- Minor technical changes will be needed on the householder screening questionnaire.

Temporal Variation

-- The effect on the survey results of temporal variability (seasonality) and the need for changes in the survey design should be examined further.

2. **Questionnaires**

-- Questions on well construction in the CWS questionnaire will be consolidated and/or eliminated, cutting the questionnaire roughly in half.

-- Methods of obtaining well construction data using the domestic well questionnaire will require further consideration, given the results of the well depth validation study.

-- Protocols for dealing with out-of-town well owners will need to be developed.

-- State personnel should be advised of the need to transmit the completed questionnaires to the contractor as they are received.

3. **Additional Data Collection**

-- Slight modifications may be needed in the Well Observation Record used at community water systems.

-- The Hydrogeologist Questionnaire should be revised so that it resembles the Well Observation Record. Questions requiring householder response rather than direct observation should be added to the domestic well householder questionnaire.

-- No changes are recommended in the Local Expert Questionnaires.

4. **Water Sampling and Transport**

-- Tracking of samples by means of a "real time" computer tracking system should be considered in the full survey.

-- Sufficient lead time should be allowed for the design of the full survey tracking system once the full sampling protocol has been fixed.

-- Work should proceed on numerous revisions suggested in the kit preparation, sampling, coding, and transport procedures for the full survey.

-- A variety of water sampling and analysis issues still need to be resolved, including the aeration of samples, the number of samples to be taken per well, and whether Method 8 (VOCs) should be retained.

5. Role of the States

-- The commitment of the States to the survey will be an important element in the success of the full survey, and will require continued attention.

-- Early scheduling of State sampling at CWSs (covering about a year at a time) is strongly encouraged, so that State resources can be accommodated and an even flow of samples to the laboratories assured. Once a rough State schedule is available, the implementation contractor should plan to conduct domestic well sampling during the slack times.

-- States should be encouraged to develop communications plans as early as possible, with the assistance of the EPA Regions.

-- State personnel should receive all training manuals well in advance of the training session.

-- EPA will investigate the possibility of using videotapes or alternate means to carry out the State training sessions, particularly in questionnaire administration.

6. Analytic Methods/Quality Control

-- A number of issues still need to be resolved, including the final design of the quality control program, finalizing the list of analytes, dealing with false negative results, definition of reporting limits, and options for dealing with the instability of certain analytes.

7. Communications

-- No changes are recommended in the informed consent procedures at domestic wells.

-- Minor changes are recommended in the format of the State and Regional conference calls.

-- Additional attention will need to be paid to scheduling and communications during the full survey and to dissemination of the results.

8. Quality Assurance

-- Changes in quality assurance management systems may be forthcoming following the QA Management Systems Review now underway.

REFERENCES

1. Background on the development of the survey is provided in Nees, M. and C. Salmons, National Survey of Pesticides in Drinking Water Wells: A Review of the Planning Process and the Data Quality Objectives. Research Triangle Institute, Research Triangle Park, NC. RTI/7801/08-01F, July 6, 1987.

2. Health Advisories for 16 Pesticides. Office of Drinking Water, U.S Environmental Protection Agency. National Technical Information Service, PB87-200176/AS.

3. Mason, R.E., Benrud, C.H., and Iannacchione, V.G., Stratification Proposed for the National Pesticide Survey. Research Triangle Institute, RTI/3030/03-06F, May 2, 1986.

4. Mason, R.E. National Survey of Pesticide Residues in Community System and Domestic Wells -- Sample Allocation Report. In progress. Research Triangle Institute, 1987.

5. Information Collection Request, National Pesticide Survey Pilot Study, U.S. Environmental Protection Agency, December 1986.

6. Alexànder, W.J., S.K. Liddle, R.E. Mason, and W.B. Yeager, Ground-Water Vulnerability Assessment in Support of the First Stage of the National Pesticide Survey. Research Triangle Institute, 1986.

7. Economic Analysis Branch, Office of Pesticide Programs. Derivation of County-Level Pesticide Usage Estimates for Design of the Groundwater Pesticide Survey. U.S. Environmental Protection Agency, September 1985.

8. Field Interviewer Manual for the County Agricultural Agent Interviews, Research Triangle Institute, Nov. 20, 1986.

9. Aller, L., T. Bennett, J.H. Lehr, and R.J. Pelly, "DRASTIC A Standardized System for Evaluating Groundwater Pollution Potential Using Hydrogeologic Settings." U.S. Environmental Protection Agency, 1985

10. Detailed Results of the DRASTIC Scoring Process, Research Triangle Institute, 1987.

11. Aller, L., Director of Research, National Water Well Association, letter to Joe Alexander, RTI, January 7, 1987 (Review of application of DRASTIC in Clay County, MN).

12. Field Interviewer Manual for Household Screening Interview, National Pesticide Survey Pilot Study. Research Triangle Institute, February 1987.

13. Field Well Site Interview and Water Sampling Manual for the Pilot Study of the National Survey of Pesticides in Drinking Water Wells. Research Triangle Institute, RTI 251U-7801-10, May 27, 1987.

14. Domestic Well Household Interviewer Manual. Research Triangle Institute, 1987.

15. Quality Assurance Project Plan for the National Survey of Pesticides in Drinking Water Wells Pilot Survey, Office of Pesticide Programs and Office of Drinking Water, U.S. Environmental Protection Agency, June 26, 1987.

16. Communications Strategy Document, National Pesticide Survey Pilot Study, prepared by Gilah Langner, ICF Incorporated, March 1987.