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Washington DC 20460

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Technology Transfer Needs Assessment

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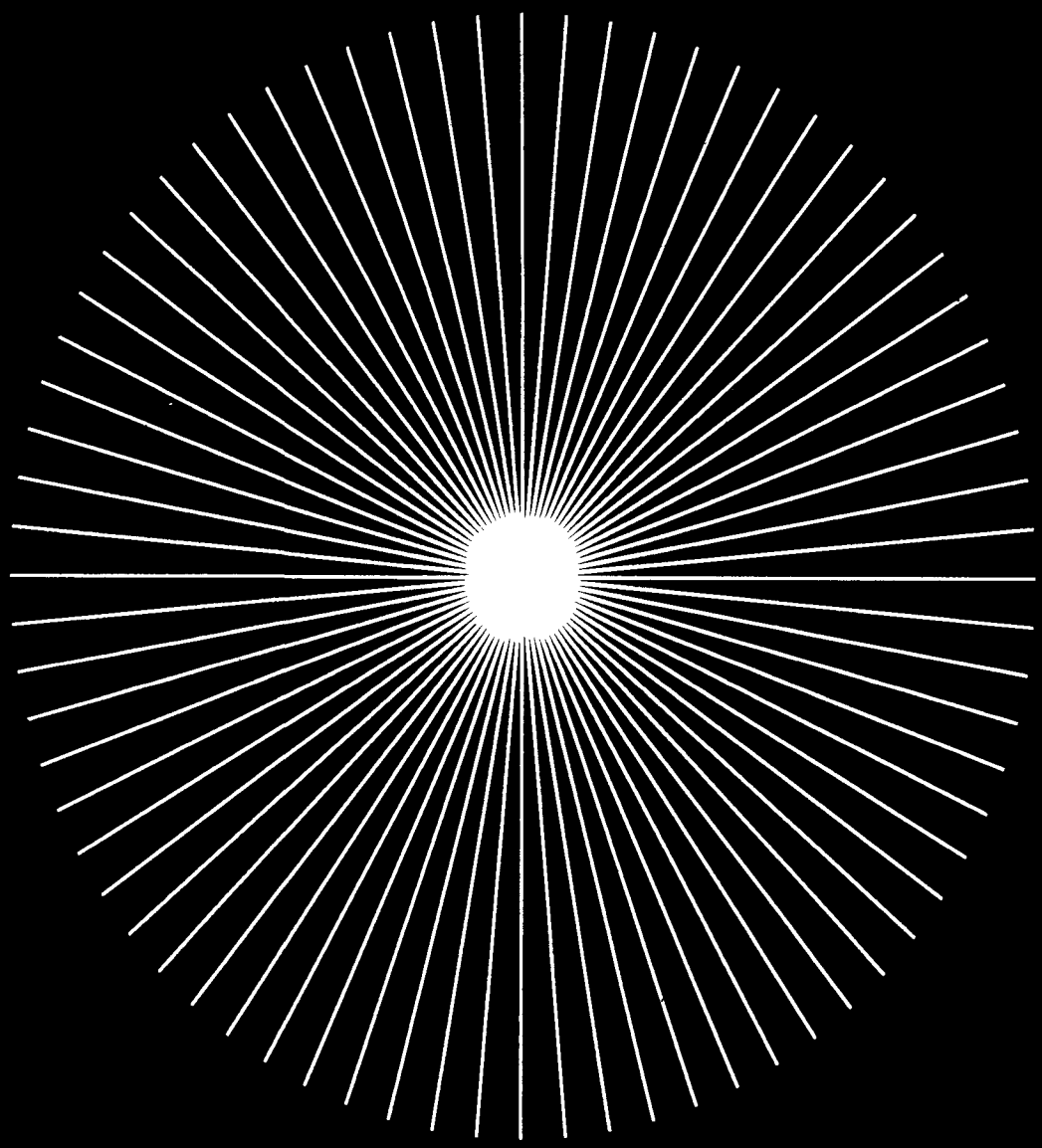

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Technology Innovation Office
Office of Solid Waste and Emergency Response
United States Environmental Protection Agency
Washington, DC 20460

Walter W. Kovalick, Jr., Ph.D., Director

Chicago, IL 60604

April, 1990

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Preface

Technology transfer is an urgent and continuing need throughout the Office of Solid Waste and Emergency Response (OSWER). As field operations and regulations keep pace with technological innovations, the amount and complexity of technical data, methods, and models continue to grow. Staff turnover also contributes to a constant demand to anticipate and provide technical information in an appropriate format.

Working closely with their counterparts in the Office of Research and Development, OSWER and Regional Office staff annually identify and rank priority needs based on emerging regulatory and legislative mandates, technical innovations, and work force changes. Periodically, OSWER steps back for a longer-term view of requirements and emerging trends. This report supplements a 1986 assessment by the Superfund Office and extends it to include solid waste, underground storage tanks, and related issues. The data reported in this assessment will assist OSWER and ORD develop technology transfer and technical information priorities over the next several years. In addition, the report provides a baseline of Regional Office requirements and expectations against which to measure information transfer activities.

I encourage headquarters and Regional Office managers throughout OSWER to read and apply the recommendations in this document. I also encourage laboratory and ORD headquarters staff to read it in order to better anticipate mid-term research needs.

Walter W. Kovalick, Jr., Ph.D.
Director, Technology Innovation Office

Acknowledgements

The authors would like to express their appreciation to the many people in Headquarters and the Regions who gave their time and consideration to this project. While there are too many people to name individually, we would especially like to thank the management and staff of the hazardous waste divisions in Regions III, V, VI, and VIII for their hospitality and courtesy during our visits with them. To the 239 individuals who further took the time to thoughtfully complete and return the questionnaire, we hope that your efforts will be rewarded by improved technology transfer products and training. Finally, we wish to thank Tom Pheiffer and Rich Steimle of the Office of Solid Waste and Emergency Response and Cal Lawrence and his staff in the Office of Research and Development for their direction, advice, and support.

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EXECUTIVE SUMMARY

This report summarizes the results of the Office of Solid Waste and Emergency Response (OSWER) Technology Transfer Needs Assessment of FY 1990. The needs assessment was conducted during August through November, 1989, at the request of the Technology Innovation Office (TIO) and the OSWER/ORD Technical Support Subcommittee of the Hazardous Waste/ Superfund Research Committee. It is intended to assist the TIO, Office of Research and Development (ORD), and OSWER Program Offices in planning technology transfer products for the next three to four years.

This effort extends and updates a 1986 needs assessment conducted for the Superfund program and previous ORD studies on Regional research and technology transfer needs. This is the first time a fully coordinated technology transfer needs assessment has been conducted for all OSWER-related programs. It encompasses the Superfund (CERCLA), Hazardous Waste (RCRA), and Underground Storage Tank (UST) programs, including OSWER enforcement. Regional Environmental Service Divisions (ESDs) and Superfund Technical Support Project Forum members were also included in the survey. Although the Needs Assessment focuses on technology transfer needs and distribution mechanisms for Regional personnel, it also addresses the technical needs of other end-user audiences (*i.e.* States and regulated community) across OSWER's hazardous and solid waste programs. It does not address potential research needs associated with the technical topics.

Unlike previous needs surveys, the study attempts to explore actual and future needs, to the extent possible, rather than perceived preferences for extant or proposed technology transfer activities. It further provides guidance for selecting technology transfer delivery methods, including electronic and other advanced media for information distribution, based on specific needs and audience characteristics. Reported constraints to accessing technology transfer products and activities and typical sources of technical information are also considered. The results indicate the priority of technical needs across program areas and Regions, and provide previously unavailable data regarding OSWER audiences.

While the needs assessment identified effective distribution mechanisms for all of OSWER and related preferred delivery systems to observed needs, no attempt was made to directly evaluate the effectiveness of currently offered technology transfer products and activities. Although some current technology transfer products and activities are discussed in the report, no attempt was made either to inventory technology transfer products and activities, or to identify gaps in technology transfer information.

The study design incorporated personal interviews and a Regional survey questionnaire. Preliminary interviews with headquarters branch chiefs in all OSWER program offices provided decisive information for development of the Regional questionnaire and for identifying survey populations. Regional interviews with CERCLA, RCRA, and UST staff were conducted in Regions III, V, VI, and VIII to gain detailed information about technology transfer needs and

audiences and to address problems that may not have been anticipated while the questionnaire was being prepared. The questionnaire provided data for drawing general conclusions regarding the priority technical needs and preferred delivery systems of Regional respondents.

The target audience included Regional technical staff working in OSWER program areas. Of the approximately 530 questionnaires sent to all 10 Regions, roughly 300 were distributed to CERCLA staff, by far the largest program with the most sections, 177 to RCRA, and 51 to UST and others. This provided an overall sampling ratio of about 44%. It was intended that the sample population include a wide range of OSWER end users with broad experience levels enveloping RCRA permitting, compliance, and corrective action; CERCLA removal, remedial action, and enforcement; UST; and others providing technical support to the hazardous and solid waste programs.

Two hundred thirty-nine questionnaires were returned, representing an overall response rate of about 45%. Of the questionnaires distributed to CERCLA staff, the response rate was about 43%, the RCRA response rate was about 48%, and the UST and others response rate was about 47%. Response rates around 40 to 45% are comparable to those typically received from mail surveys within OSWER. Regional response rates across all program areas ranged from about 23% for Region IX to 70% for Region VII.

The major conclusions and recommendations include:

- A significant proportion of technology transfer products and activities designed for EPA Regional employees should be geared for a relatively sophisticated technical audience.

- Technology transfer products on hazardous waste remediation should address both legislative programs whenever possible.

- Technology transfer should focus on alternative and innovative treatment technologies, risk assessment, ground water, remedy selection, field monitoring, and data requirements.

RCRA Technical Needs

- Technology transfer products and activities are needed to support RCRA corrective action.

- Technology transfer products should be targeted to meet specific needs of certain RCRA audiences.

- State agency staff and the regulated community should be considered when developing technology transfer products for RCRA.

CERCLA Technical Needs

- CERCLA technology transfer efforts should address: 1) establishing cleanup standards, 2) selecting and applying treatment technologies, 3) ground water, and 4) field sampling and analysis.

- EPA contractors, State agency staff, and the regulated community should be considered when developing technology transfer products for Superfund.

Technology Transfer Delivery Systems

- Printed technology transfer documents and workshops/seminars must be brief and clearly applied to audience job responsibilities.

- Training in electronic media and expert systems will be necessary to ensure their use.

- Developers of technology transfer products should consider providing technical information in more than one format whenever it is practical to do so.

- Regional technology transfer networks should focus on professional staff within the Regional Waste Management Division.

- Regional efforts at coordination of technology transfer should be supported.

- Continuing problems with access to and familiarity with computers, modems, and communications software should be addressed.

- Technology transfer products and activities must be evaluated to determine whether technical needs are being met in the most effective and efficient manner for specific audience segments.

1. INTRODUCTION

1.1 Overview

This report summarizes the results of the Office of Solid Waste and Emergency Response (OSWER) Technology Transfer Needs Assessment of FY 1990. The Needs Assessment was conducted during August through November, 1989, at the request of the Technology Innovation Office (TIO)[1] and the OSWER/ORD Technical Support Subcommittee of the Hazardous Waste/ Superfund Research Committee. It is intended to assist the TIO, Office of Research and Development (ORD), and OSWER Program Offices in planning technology transfer products for the next three to four years.

This effort extends and updates a 1986 needs assessment conducted for the Superfund program[2] and previous ORD studies on Regional research and technology transfer needs. This is the first time a fully coordinated technology transfer needs assessment has been conducted for all OSWER-related programs. It encompasses the Superfund (CERCLA), Hazardous Waste (RCRA), and Underground Storage Tank (UST) programs, including OSWER enforcement. Regional Environmental Service Divisions (ESDs) and Superfund Technical Support Project Forum members were also included in the survey. Although the Needs Assessment focuses on technology transfer needs and distribution mechanisms for Regional personnel, it also addresses the technical needs of other end-user audiences (*i.e.* States and regulated community) across OSWER's hazardous and solid waste programs. Both management and staff personnel are included.

The Needs Assessment was conducted through a series of interviews with OSWER management at headquarters, a questionnaire survey of all Regions, and four Regional site visits. Interviews with OSWER branch chiefs were used to assist in development of the Regional questionnaire and in interpretation of the data. The interviews were also used to identify needs driven by program changes and requirements and to supplement those needs identified by field personnel. Four Regional site visits were used to pilot test the questionnaire and to gather more in-depth knowledge of Regional needs and perspectives. The questionnaire contains sections dealing with respondent profiles, technology transfer topics based on present and future-oriented program priorities, and end-user audiences and delivery systems.

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[1]Formerly the Office of Program Management and Technology (OPMT). OPMT was abolished and its technology transfer and training functions were passed to the TIO, which was created in March, 1990.

[2]*Report on Results of the Technology Transfer Needs Assessment*, EPA Office of Emergency and Remedial Response, January, 1987.

The purpose of the Needs Assessment is to identify high priority Regional technical information needs over the next three to four years, key OSWER audiences, and effective distribution mechanisms for all of OSWER. Unlike previous needs surveys, it attempts to explore actual and future needs, to the extent possible, rather than perceived preferences for extant or proposed technology transfer activities. It further attempts to develop, in broad terms, guidance for selecting technology transfer delivery methods, including electronic and other advanced media for information distribution, based on specific needs and audience characteristics. Reported constraints to accessing technology transfer products and activities and typical sources of technical information are also considered.

By focusing on actual needs over the next few years, the survey provides a means of validating technical needs determined through other means, such as the annual OSWER training needs assessments, the Technology Transfer Advisory Committee, various OSWER/ORD technical assistance programs, and formal and informal ORD-Regional interactions. The results indicate the priority of technical needs across program areas and Regions, and provide previously unavailable data regarding OSWER audiences.

Questions about technical topics were separated from those eliciting data on delivery mechanisms in order to isolate topics from treatments. No attempt was made to directly evaluate the effectiveness of currently offered technology transfer products and activities. The data suggest that some important technical areas may not be adequately addressed by the extant technology transfer program and these are highlighted in the findings. Present activities that may address identified needs were solicited during discussions with headquarters and Regional managers, and these are also discussed where appropriate.

A few limitations on the findings of the study should be kept in mind when reviewing the results and conclusions:

- Although the study design was intended to survey a wide variety of OSWER Regional personnel at management and staff levels, the findings suggest that the sample population favors experienced staff—those with at least three to five years in the Agency—rather than new, less-experienced staff. This may have resulted from the survey distribution scheme in which Regional section chiefs were asked to complete one questionnaire themselves and to distribute two additional questionnaires to those on their staff whom they felt were most knowledgeable of their offices' technical needs.

- The survey relied on OSWER Regional personnel to identify professionals (end-users) outside the Agency who are important in helping OSWER accomplish its mission. It did not independently survey these additional audiences because of the constraint on survey size established by the Office of Management and Budget. While this is unfortunate, it is not considered a major limitation. There is no apparent reason why OSWER Regional personnel cannot satisfactorily represent their key audiences; however, there is also no proof that their assessments are valid.

- Regional response rates varied, leaving little confidence in representativeness of data for a single Region. It was also not possible to stratify findings within program areas (such as

RCRA permitting and corrective action, or CERCLA removal and remedial programs) because of the large degree of overlapping responsibilities of Regional respondents.

Chapter 1 of the report describes the methods used in conducting the study and provides an overview of the overall sample results. Chapters 2, 3, and 4 summarize the results separately for RCRA, CERCLA, and other OSWER programs, recognizing that there is a strong correspondence of technical needs across program areas. Presentation and discussion of the results on technology transfer delivery systems constitutes Chapter 5, and Chapter 6 provides the major conclusions and recommendations of the study. Appendices include a copy of the Regional questionnaire, headquarters interview questions, and a list of interviewees.

1.2 Methods

Design

The study design incorporated personal interviews and a Regional survey questionnaire. Preliminary interviews with headquarters branch chiefs in all OSWER program offices provided decisive information for development of the Regional questionnaire and for identifying survey populations. Regional interviews with CERCLA, RCRA, and UST staff were conducted in Regions III, V, VI, and VIII to gain detailed information about technology transfer needs and audiences and to address problems that may not have been anticipated while the questionnaire was being prepared. The questionnaire provided data for drawing general conclusions regarding the priority technical needs and preferred delivery systems of Regional respondents.

Approximately 530 questionnaires were distributed to Regional OSWER staff in all ten Regions. Each Regional section chief in the CERCLA and RCRA programs was sent three questionnaires, as were Regional UST coordinators. Section chiefs were asked to complete one questionnaire themselves and to distribute the two additional questionnaires to individuals knowledgeable of technical needs in their program who could represent their staff. In addition, questionnaires were sent to Environmental Service Division (ESD) laboratory directors and quality assurance coordinators, and the Superfund Technical Support Project Forum members.

Headquarters Interviews

A series of preliminary interviews was conducted by two members of the survey team with headquarters OSWER branch chiefs and others identified by OSWER management in the Offices of Emergency and Remedial Response (OERR), Solid Waste (OSW), Waste Programs Enforcement (OWPE), and Underground Storage Tanks (OUST). The purpose was to gain insight into major technology transfer plans and activities, priority program responsibilities, objectives for the next three to five years, and the sample population to be surveyed. Information from the interviews was used to develop the list of topical OSWER technical needs utilized in the Regional questionnaire. Headquarters branch chiefs offered useful insight into preferred delivery methods and constraints on their use, and indicated Regions that the survey team might visit. The Appendix contains a list of interviewees and a copy of the interview questions.

Questionnaire Development

The Regional questionnaire consists of a respondent profile, a list of 40 technology transfer topics in 11 categories based on current and future-oriented program priorities, and a section addressing end-user audiences and delivery systems. A copy of the Regional questionnaire can be found in the Appendix.

Demographic and job information regarding respondents' current position, background, and experience were requested in the respondent profile section of the questionnaire. Answers to these questions were optional and remain confidential, and included such items as the respondent's Region, division, and branch; program area in which the employee is currently involved; and high priority job responsibilities. Background and experience questions included time in current job, years employed by EPA, highest level of education, major field of study, job-related EPA training, and technology transfer seminars or workshops attended during the past year.

Forty high-priority technology transfer topics and technical issues encompassing eleven thematic areas were listed in the technical needs section of the questionnaire. The eleven thematic areas are:

- Ground Water
- Monitoring Techniques
- Risk Assessment
- Establishing Treatment Standards
- Selection and Application of Treatment/Control Technologies
- Waste Management
- Alternative and Innovative Treatment Technologies
- Estimating Remediation Cost
- Data Requirements
- Pollution Prevention
- Land Disposal Facilities

Respondents were asked to provide their best estimate of how important the topics within each theme would be to accomplishing their jobs over the next three to four years. All topics were recognized by headquarters branch chiefs as vital to OSWER over the next three to four years. A scale of 1 ("not at all useful"), 3 ("quite useful"), and 5 ("extremely useful") was provided for respondents to use in rating the importance of each topic to their job responsibilities. A zero was used for topics considered "not applicable" to job responsibilities. Additional space was provided to write in topics not on the list. CERCLA, RCRA, and UST topics were intentionally listed together within themes, without obvious distinction, so that respondents would examine all topics and issues, rather than only those within their program area.

The delivery systems section of the questionnaire addresses end-user audiences for technology transfer. Respondents were asked to identify the types of professionals outside their immediate office that are important in helping to accomplish their jobs. The choices offered were State agency staff, EPA contractors, consultants, other federal agencies, academic institutions, regulated community, local government/legislators, and other. Knowledge of these groups is an important

key to providing timely technical information and products to the right audiences in th appropriate format. It should be noted, however, that although the question was intenc identify end-user audiences, such as State agency staff and the regulated community, the que may have been interpreted as referring to sources of information rather than targets ror technology transfer. While this may not be a major problem in interpreting the results of the study, it could have an impact on the relative importance of this information. Additional data regarding target audiences was obtained for the most important (primary) audience among those already identified. Respondents were asked to name the one most important audience in accomplishing their jobs, estimate its size, and list the five top priority technical needs of that "primary" audience. The question on technical needs of the primary audience was open-ended, and responses were coded as representing one of the eleven technical categories listed above or other areas of interest.

Other items in the delivery systems section include: respondent and primary audience preferences for a variety of distribution methods and current sources of technical information on a 1 ("not at all useful") to 5 ("extremely useful") scale; and identification of the most serious constraints experienced by respondents and their primary audience in using OSWER technology transfer products and activities on a scale of 1 ("no problem") to 5 ("serious problem").

Regional Site Visits

The survey team, consisting of a TIO staff member and contractor, visited Regions III, V, VI, and VIII during October and November, 1989, to interview CERCLA, RCRA, and UST staff. Regions were selected based on headquarters branch chief information and recommendations. The purpose of the interviews was to obtain detailed information about Regional responsibilities, problems, technical needs, and audiences that might not be gained from the questionnaire. The survey team pilot-tested the questionnaire during its first site visit in Region III, and, as a result, a minor modification was made to the questionnaire before distributing it to all Regions. Interview questions asked of Regional management and staff during the site visits corresponded closely to those in the written questionnaire, with follow-up questions related to important technical needs, problems, and solutions.

Regional Survey

The target audience included Regional technical staff working in OSWER program areas. Each Superfund and RCRA section chief and UST Regional coordinator was sent three questionnaires with instructions to complete one and distribute the others to staff whom they felt were most knowledgeable of their offices' technical needs. One additional questionnaire was sent to each ESD laboratory director and quality assurance coordinator and each Superfund Technical Support Project Forum member. Those surveyed represent a census of Regional Waste Management Division section chiefs, with a random sampling of staff. The overall sampling ratio approximated 44% of the overall population of about 1200 Regional hazardous and solid waste management staff. However, any survey is necessarily a snapshot of the population at a given period in time. Regional staffing levels are rapidly changing due to the increase of

approximately 500 new Regional Superfund staff now being implemented, and these new positions were not included in the survey.

Of the approximately 530 questionnaires sent to all 10 Regions, roughly 300 were distributed to CERCLA staff, by far the largest program with the most sections, 177 to RCRA, and 51 to UST and others. It was intended that the sample population include a wide range of OSWER end users with broad experience levels enveloping RCRA permitting, compliance, and corrective action; CERCLA removal, remedial action, and enforcement; UST; and others providing technical support to the hazardous and solid waste programs. Based on the advice of headquarters management and the Technology Transfer Subcommittee, OSWER section chiefs became the focus of the survey sample. It was felt that Regional section chiefs were among the most knowledgeable of end-user technical needs and that their participation in the survey would help ensure adequate coverage of the sample population.

Respondents were initially given three weeks to complete the questionnaire, and a followup memorandum from the Technology Innovation Office was distributed at that time to encourage those who had not yet responded to do so. Three more weeks were provided for return of additional questionnaires, yielding an overall six week period for data collection.

Survey Analysis

The survey team received a total of 239 completed questionnaires representing an overall response rate of about 45%. The distribution of responses for each Region and program area is presented in Table 1-1. Of the questionnaires distributed to CERCLA staff, the response rate was about 43%, the RCRA response rate was about 48%, and the UST and others response rate was about 47%. Response rates around 40 to 45% are comparable to those typically received from mail surveys within OSWER. This response was deemed adequate by TIO, and no further follow-up action was taken.

As shown in the table below, response rates per Region varied considerably. Regional response rates across all program areas ranged from about 23% for Region IX to 70% for Region VII. In addition, the actual number of responses within program areas for some Regions is too small to provide a reliable estimate of the population for that Region and program. For these reasons, the data summaries focus on Region or program overall, and not on Regions within program areas. Moreover, the Regional data that is presented must be interpreted carefully. Because of the low response rates for some Regions, we cannot assume that those who did respond are representative of the entire Region.

Data from the questionnaires were compiled and analyzed using database management and statistical software. Respondent profile data were compiled by frequency of response and expressed in terms of percentages. Technical needs were ranked for RCRA, CERCLA, UST, and ESD as well as for each Region based on the arithmetic means of their importance to respondents. In some instances, the means were also compared utilizing a one-way analysis of variance (ANOVA) and the Tukey multiple range test for determining whether significant differences exist between several means. The "other" category includes respondents from Regional UST programs (10 individuals), ESDs (12 individuals), and other offices that provide

Table 1-1. Number and Percentage of Responses from each Region and Program Area

Region	Program Area			Total* (% Total)	Response Rate by Region
	CERCLA	RCRA	Other		
I	9 (6.5%)	5 (5%)	2 (5.5%)	16 (6%)	29%
II	25 (18%)	9 (10%)	2 (5.5%)	36 (14%)	49%
III	21 (15%)	6 (7%)	7 (20%)	34 (13%)	42%
IV	10 (7%)	9 (10%)	5 (14%)	24 (9%)	45%
V	9 (6.5%)	20 (22%)	4 (11%)	33 (12%)	46%
VI	13 (9%)	9 (10%)	2 (5.5%)	24 (9%)	45%
VII	19 (14%)	7 (8%)	3 (8%)	29 (11%)	70%
VIII	14 (10%)	10 (11%)	2 (5.5%)	26 (10%)	63%
IX	8 (6%)	10 (11%)	2 (5.5%)	20 (8%)	23%
X	11 (8%)	7 (8%)	7 (20%)	25 (9%)	58%
Total* (% Total)	139 (52%)	92 (35%)	36 (13%)	267 (100%)	—
Response Rate by Program	43%	48%	47%	45%	—

*Includes individuals who reported working in more than one major program area. Response rates are computed on the basis of actual number of questionnaires returned.

support to the hazardous and solid waste programs, such as the Office of Ground Water Protection. These data are generally grouped due to the relatively small number of responses in each area, but are discussed individually for comparisons among OSWER programs. Also, it should be noted that, in addition to ESD respondents, 28 individuals, or 12% of the overall sample, reported that their work involves more than one major program area (*e.g.*, CERCLA remediation and RCRA corrective action). As their work involves more than one program area, it is assumed that their technical needs are also relevant to both. Therefore, these individuals were included in data summaries for each program.

The frequency with which respondents identified important audiences was determined for all programs and for each Region. Primary audiences were ranked, based on frequency of response, and the technical needs of each primary audience were counted and frequencies determined. Audience data were expressed as percentages for each program area. Arithmetic means, based on the degree of usefulness of various delivery methods, were determined and compared utilizing the one-way ANOVA and Tukey tests. Data regarding sources of technical information and constraints experienced in using technology transfer products were similarly analyzed and reported. Relationships between reported technical needs and delivery system preferences were examined with the use of correlations and covariance analyses.

1.3 Overall Findings

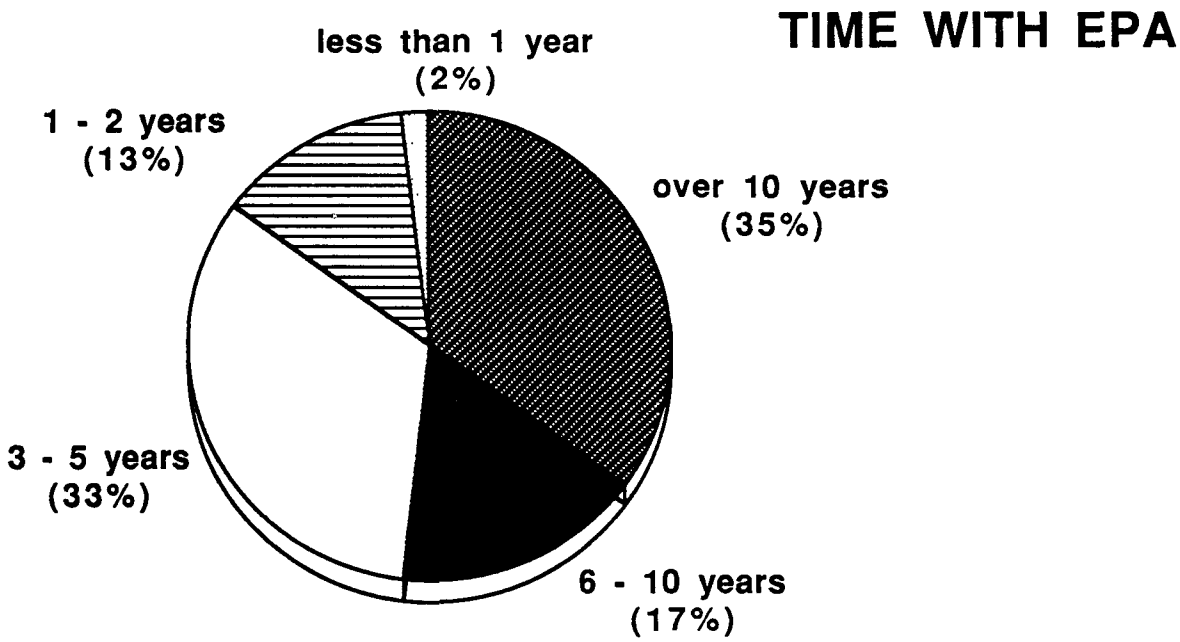
This section of the report provides a brief overview of the sample characteristics and the technology transfer needs identified for the overall sample, with some discussion of differences across program areas and Regions. More detailed results for the RCRA, CERCLA, and other OSWER programs can be found in Chapters 2 through 4. Findings for the questions addressing delivery system preferences, information sources, and constraints are presented in Chapter 5.

Respondent Profiles

The sampling ratio of almost 44% and response rate of 45% provide an actual sample of about 20% of the overall population at the time the survey was conducted. However, as mentioned above, the survey distribution scheme may have resulted in a sample that favored senior staff over those new to EPA's hazardous and solid waste programs. In addition, the survey took place in the Fall of 1989, just prior to the Regions' filling about 500 new positions provided by the Administrator for the Superfund program. Thus, these new hires are not represented in the sample. Figure 1, on the following page, provides a graphical representation of the respondents' tenure with the Agency and in their current position. Eighty-five percent of the sample population have been with EPA for 3 years or more, with over 50% being employed by the Agency for 6 years or more. There were a few differences across program areas, with those in the "Other" category (UST, ESD, and others) reporting even greater seniority with EPA.

However, respondents' time in their current position shows a different pattern. Almost 55% of respondents report being in their current position for 2 years or less, and 20% of those have held their current jobs for under a year. This is similar to the sample drawn for the 1986 Superfund Technology Transfer Needs Assessment in which more than half of the respondents had been in their jobs for 2 years or less. As shown in Figure 1, there are only minor differences between the CERCLA and RCRA programs, with Superfund staff showing slightly greater job tenure.

The discrepancy between time with EPA and time in current position could be due to upward mobility or transfers across program areas. It suggests that even though time in current position may be limited for Regional hazardous and solid waste staff, their technical experience is not necessarily lacking. This conclusion is supported by the educational profile of respondents as well. Figure 2 shows that over 50% of the sample hold graduate degrees, for the most part in engineering or physical science. There is a great deal of similarity in educational level across program areas.



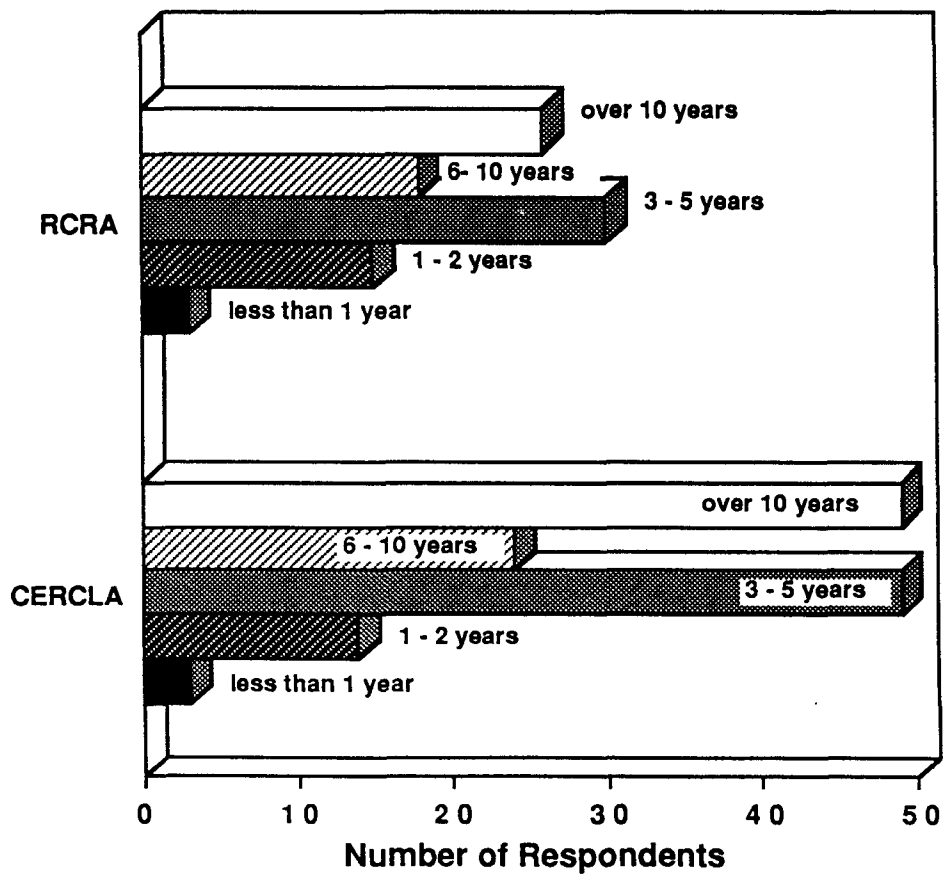
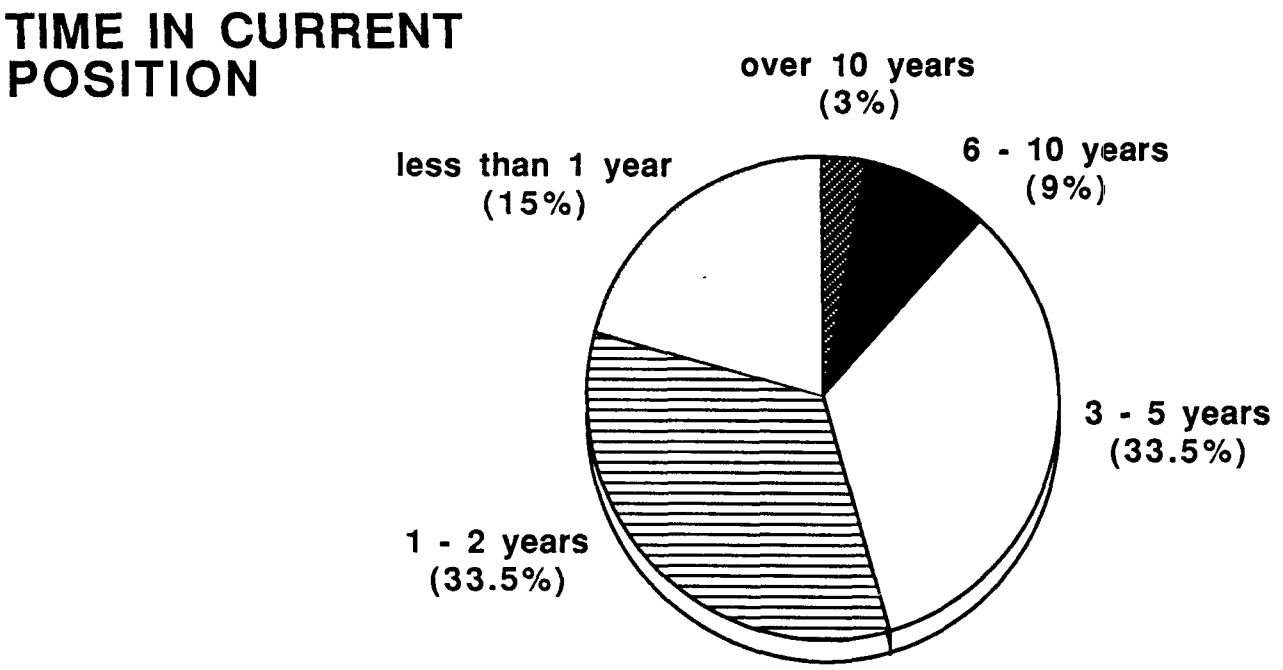


Figure 1. Respondents' tenure with EPA and in current position



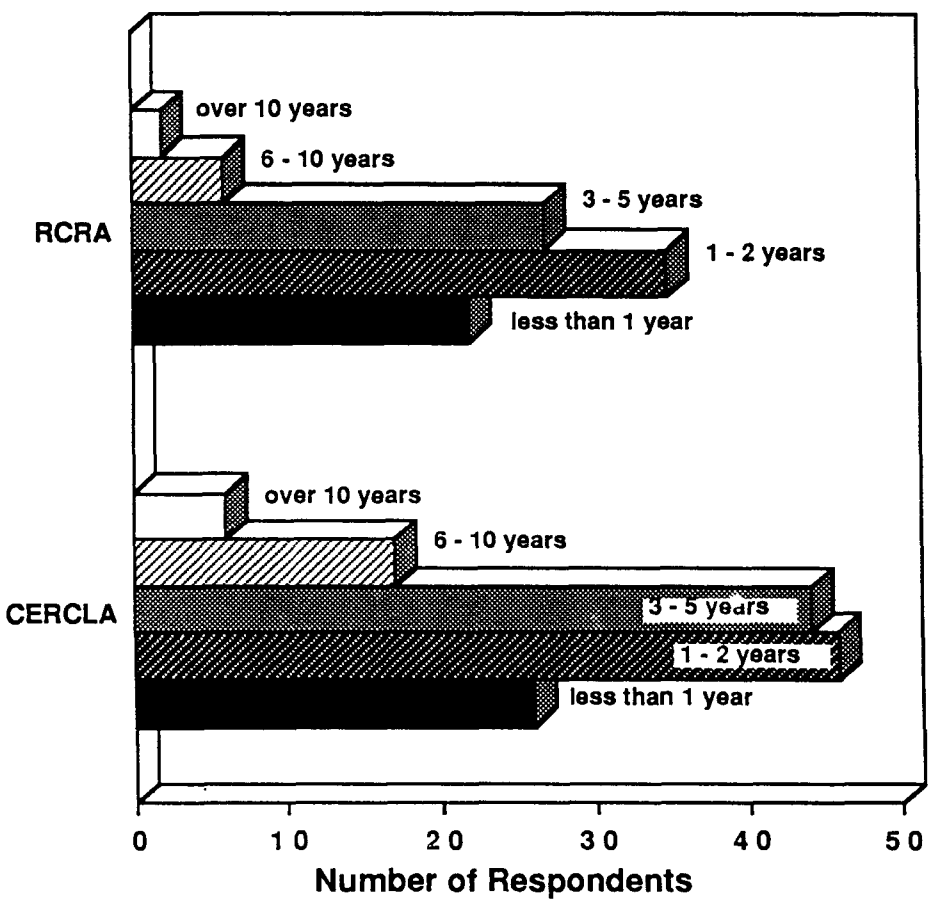


Figure 1. Respondents' tenure with EPA and in current position (Continued)

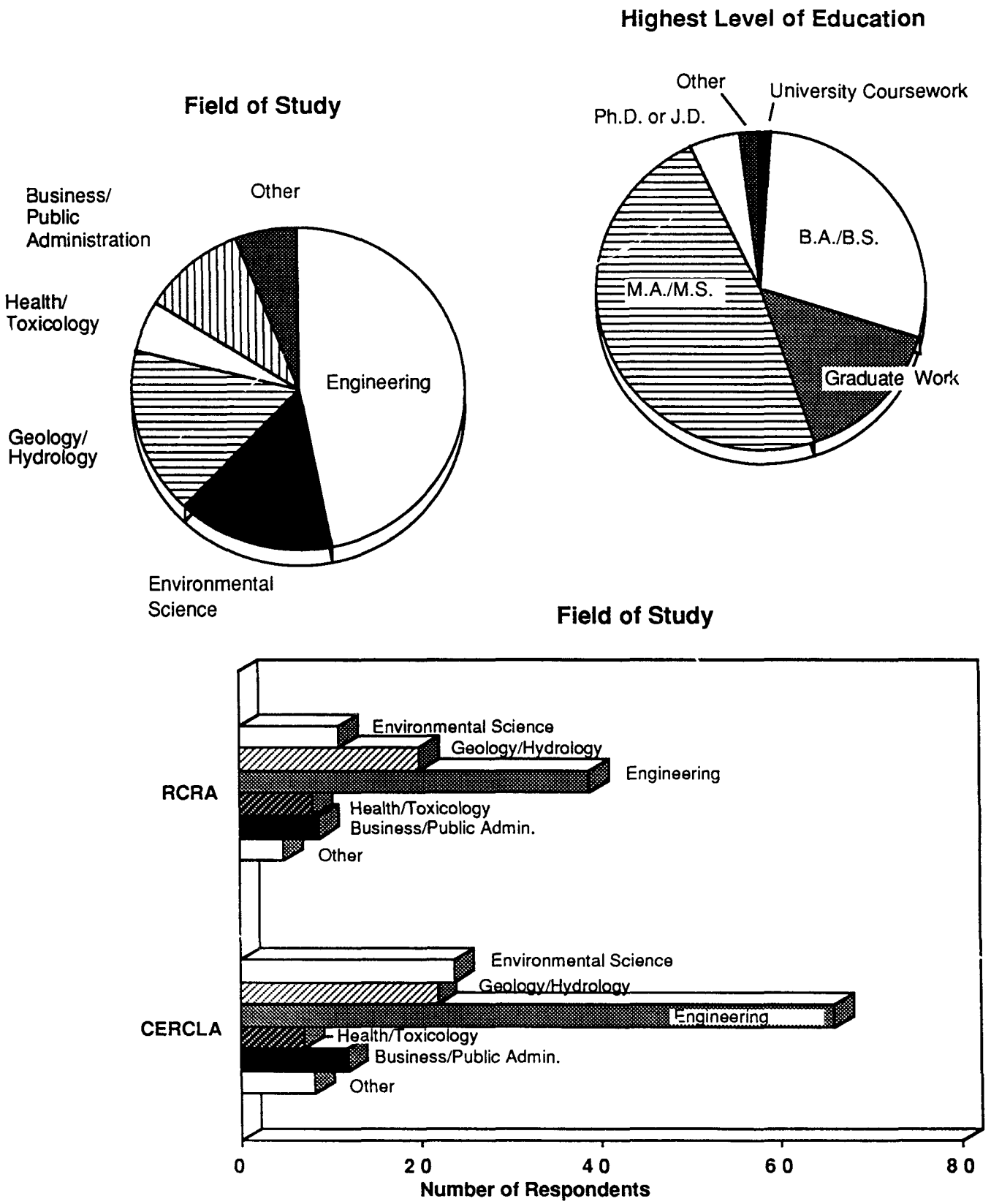


Figure 2. Respondents' highest level of education and field of study

Responses to the item regarding major field of study were coded into fourteen categories that were further combined for presentation here. The Environmental Science category also includes soil science, biology, and chemistry responses; Engineering includes chemical, civil, and environmental engineering; Health/Toxicology includes environmental health, public health, and toxicology; Business and Public Administration also includes economics and planning degrees; and the Other category includes law and liberal arts. Comparisons across program areas (see Figure 2) show all programs with 40% to 50% engineers. The Other category includes relatively fewer geologists/hydrogeologists and health/toxicologists than the CERCLA and RCRA samples.

The background information section of the questionnaire also included questions regarding recent job-related training from EPA, technology transfer seminars or workshops attended, and the approximate number of job-related courses, seminars, or workshops attended each year. Workshops and seminars are a means frequently used to address technology transfer needs, and this item provides information on the extent to which these are used by Regional staff. Responses to the item asking respondents to list recent "job-related training from EPA" included a variety of programmatic, management, and technical courses offered by ORD, OSWER, and the Region. "Technology transfer seminars or workshops" typically included seminars offered by CERI, research seminars and workshops offered by ORD labs and OSWER, or professional association meetings. These two items are summarized with respect to whether or not training and technology transfer seminars or workshops were mentioned by the respondents. As shown in Table 1-2 below, a large percentage of respondents across program areas (80%) report receiving job-related training from EPA, while less than 40% report attending technology transfer seminars or workshops. The two items are not directly comparable, since job-related training covers such a broad range of activities. But this difference may reflect the time and difficulties encountered in traveling away from the office for training. This topic is more fully discussed in Chapter 5, which examines preferred delivery systems and constraints.

Table 1-2. Summary of Training Information by Program Area

Training Item	All Programs	Program Area		
		CERCLA	RCRA	Other
• Average Number of Courses per Year	3.2	3.0	3.7	3.0
• % Participating in Job-Related Training	80%	79%	83%	83%
• % Attending Tech Transfer Seminars	39%	39%	38%	34%

Regional differences in background information from respondents were also examined, and a Regional breakdown is presented in Table 1-3. However, due to the unacceptably low response rates from some Regions and the relatively low absolute number of responses for others, no comparisons were made among the Regions. In general, the responses to "Time with EPA" range from about 5% to almost 30% reporting 2 years or less with the Agency. Those with 2 years or less time in their current positions range from a low of 29% to a high of over 70%. In addition, "Level of Education" varies from 37% to 68% of respondents per Region who hold graduate degrees. While there are some observed differences in "Field of Study," engineers generally predominated followed by geologists/ hydrogeologists and environmental scientists.

Table 1-3. Summary of Background Information by Region

Respondent Profile	All Regions	Region									
		I	II	III	IV	V	VI	VII	VIII	IX	X
• Time in Current Position											
1 Year or Less	21%	27%	17%	26%	19%	22.5%	17%	23%	12%	21%	24%
1 to 2 Years	33.5%	27%	31%	32%	37.5%	45%	50%	23%	36%	50%	5%
3 to 5 Years	33.5%	46%	43%	36%	31%	22.5%	33%	35%	24%	29%	38%
More than 6 Years	12%	<1%	9%	6%	12.5%	10%	<1%	19%	28%	<1%	33%
• Time with Agency											
2 Years or Less	15%	20%	9%	13%	12%	13%	29%	19%	20%	21%	5%
3 to 5 Years	33%	47%	51%	32%	12%	22.5%	38%	27%	28%	36%	33%
6 to 10 Years	17%	13%	11%	10%	12%	35.5%	25%	12%	8%	14%	24%
More than 10 Years	35%	20%	29%	45%	64%	29%	8%	42%	44%	29%	38%
• Education											
University Coursework	1%	<1%	<1%	<1%	<1%	3%	<1%	4%	4%	<1%	<1%
Bachelors Degree	29%	33%	20%	45%	17.5%	26%	46%	31%	12%	29%	24%
Graduate Coursework	15%	13%	11%	13%	12%	13%	17%	23%	16%	7%	24%
Masters Degree	48%	54%	66%	35%	41%	55%	33%	34%	64%	57%	38%
Ph.D. or J.D.	5%	<1%	<1%	7%	12%	3%	4%	8%	4%	7%	14%
Other	2%	<1%	3%	<1%	17.5%	<1%	<1%	<1%	<1%	<1%	<1%
• Field of Study											
Environmental Science	15%	7%	14%	13%	6%	16%	29%	7.5%	20%	21%	24%
Geology/Hydrogeology	17%	13%	20%	22%	6%	29%	21%	27%	16%	<1%	5%
Engineering	47%	67%	60%	39%	64%	29%	42%	50%	36%	29%	52%
Health/Toxicology	5%	13%	<1%	3%	12%	7%	<1%	7.5%	4%	<1%	5%
Bus/Public Administration	10%	<1%	6%	10%	6%	3%	4%	4%	20%	36%	14%
Other	6%	<1%	<1%	13%	6%	16%	4%	4%	4%	14%	1%
• Average No. of Courses/Year	3.2	3.3	3.1	3.5	2.6	2.7	3.4	3.6	3.6	3.7	2.8
• % Job-Related Training	80%	60%	60%	84%	94%	87%	71%	85%	88%	93%	81%
• % Tech Transfer Seminars	39%	53%	46%	23%	29%	39%	42%	54%	52%	29%	19%

Highest Ranked Technology Transfer Needs

This overview section addresses the ratings of the importance of forty technology transfer needs to accomplishing job responsibilities for the overall sample of 239 Regional hazardous and solid waste personnel. A breakdown of importance ratings by RCRA, CERCLA, and UST staff is also provided, along with Regional rankings of needs. Detailed descriptions of the findings for the RCRA, CERCLA, and other programs is presented in the following chapters.

The top 15 of 40 technology transfer needs for the overall sample are presented in Table 1-4. These 15 represent eight different thematic classifications including: Establishing treatment standards, Ground water, Alternative and innovative treatment technologies, Estimating remediation costs, Monitoring techniques, Remedy selection, Risk assessment, and Data requirements—reflecting a pervasive interest in hazardous waste remediation.

Table 1-4. Fifteen Highest Ranked Technology Transfer Topics for the Overall Sample

1. Establishing risk-based cleanup levels for various contaminants and site conditions.
2. Fate and transport of contaminants in the subsurface (*e.g.*,facilitated transport, methods for measuring contaminant mobility, non-aqueous phase liquids).
3. Ground-water monitoring for site inspection and for evaluating the effectiveness of treatment.
4. Use and effectiveness of *biological treatment* processes (*e.g.*, biodegradation or bioremediation).
5. General technical information on the performance, limits, safety, and cost of hazardous waste treatment technologies.
6. Use and effectiveness of *physical treatment* processes (*e.g.*, soil washing, vacuum extraction).
7. Use and effectiveness of *stabilization/solidification.*
8. Use and effectiveness of *chemical treatment* processes (*e.g.*, KPEG).
9. Use and effectiveness of *thermal destruction* (incineration, oxidation).
10. General information on the use and limitations of field sampling and analysis methods.
11. Prototype remedy-selection models for recurrent site situations.
12. Field screening, soil vapor and water sampling for hydrocarbons.
13. Risk assessment information: risk levels for RCRA waste (*e.g.*, incinerator ash).
14. Quality assurance for field operations.
15. Development and application of Data Quality Objectives in sampling and analysis plans.

Establishing risk-based cleanup levels heads the list overall, as well as for both RCRA and CERCLA staff. *Fate and transport of contaminants in the subsurface* and *Ground water monitoring for site inspection and for evaluating the effectiveness of treatment* are the second and third highest rated technical needs, confirming two of the four most important ground water training topics found in the recently completed Ground-Water Training Needs Assessment.[3] Interestingly, these were also the two topics for which Regional staff indicated the greatest need for advanced training in the training survey.

Alternative and innovative treatment technologies of interest to the overall sample include all five of those presented in the questionnaire—biological, physical, stabilization/solidification, chemical and thermal treatment processes. A closely related item that is ranked fifth concerns *General technical information on the performance, limits, safety, and cost of hazardous waste treatment technologies.* The need for *Prototype remedy-selection models for recurrent site situations* is also among the top rated in importance for the overall sample.

The remainder of the 15 most important technical topics include: *General information on the use and limitations of field sampling and analysis methods*; *Field screening, soil vapor, and water sampling for hydrocarbons*; *Risk assessment information/Risk levels for RCRA wastes*; *Quality assurance for field operations*; and *Development and application of Data Quality Objectives.* In terms of the entire list of technical topics presented in the questionnaire, those addressing waste management, pollution prevention, and land disposal facilities are not represented in the top 15. This difference in Regional technical needs between solid and hazardous waste management issues and those of waste remediation is most likely the result of a change in focus of the RCRA program, the addition of corrective action responsibilities, and the delegation of the basic program to the States. See Chapter 2 for a fuller discussion of this topic.

Technology Transfer Needs by Program

The comparison of differences in technology transfer needs for the RCRA, CERCLA, and other OSWER programs is much more notable for the similarities on numerous topics than for the few observable differences that were found. Over half of the 40 technical needs listed are rated "quite" to "extremely" useful by both RCRA and CERCLA. Graphical representations of the means and standard errors for each technical need for the RCRA, CERCLA, and UST programs are presented in Figure 3, on the following pages.

Important similarities emerge when we compare technical topics valued as quite to extremely useful by RCRA and CERCLA respondents. RCRA respondents as a group perceive 27 of the 40 topics in the questionnaire in this category of usefulness, while CERCLA respondents rate 23 topics as highly useful. Twenty topics are valued similarly by CERCLA and RCRA respondents. Thus, of topics rated "quite" to "extremely" useful by both groups, 74% are rated essentially the same by both RCRA and CERCLA. This finding indicates that the top technical needs nationally

[3]Draft report, *Meeting the Ground-Water Training Needs of Regional Personnel*, EPA Office of Program Management and Technology, September 1989.

correspond quite closely across programs. It also confirms the results of a previous OSWER annual training needs assessment, which found that approximately 70% of EPA staff requests for extant technical and programmatic courses were in areas other than their particular programs.

Only three of the topics considered "quite" to "extremely" useful by both RCRA and CERCLA show statistical differences. The first topic—*General information on the use and limitations of field sampling and analysis methods*—is quite to extremely useful to all three programs, but appears to be more valuable to UST and CERCLA than to RCRA. This may be due to the recent emphasis of UST and OERR on site assessment. As OUST enters the post-regulatory cleanup phase of the program, it has realized a major need for real-time site assessment methodologies and guidelines to enable State regulatory staff and the consulting community to accurately determine site conditions and speed cleanup decisions. Similarly, the CERCLA program has just completed an additional 4,700 preliminary site assessments mandated by the Superfund Amendments and Reauthorization Act of 1986 (SARA) and has conducted nearly 300 new remedial investigation/feasibility studies in the past year.

Two additional items—*Risk levels for RCRA waste (e.g., incinerator ash, contaminated soil)* and *Use of models for chemical mixture risk characterization*—are "quite" to "extremely" useful to both RCRA and CERCLA, but are perceived as more useful by RCRA than by CERCLA and UST respondents. *Risk levels for RCRA waste* is a topic geared primarily for RCRA, which may explain why RCRA respondents consider this topic somewhat more useful than CERCLA. Why models for chemical mixture risk characterization is significantly more useful to RCRA than CERCLA respondents in this survey is more difficult to explain. OERR has identified the capability to characterize chemical mixtures as an important CERCLA research need. Also, application of the mixture rule under the Land Disposal Restrictions (LDRs) of RCRA applies to Superfund as well as to RCRA sites. The mixture rule (40 CFR 261.3(a)(2)) requires treatment of any mixture of solid waste and a listed hazardous waste, or a characteristic hazardous waste (if the mixture exhibits a characteristic), before placement in a land disposal unit. CERCLA site managers must evaluate whether contaminants at a Superfund site are RCRA hazardous wastes under the LDRs. It is possible that OSW attracted Regional attention to the issue because it is developing treatment variances for mixed waste and a mixed waste training course, scheduled for delivery in FY90.

No differences were found between Regional RCRA and CERCLA program staff for any of the items related to ground water, monitoring techniques, waste management, or alternative and innovative treatment technologies. Overall, only 14 of the 40 technical topics are valued differently by RCRA, CERCLA, or UST. (Those in the "quite" to "extremely" useful category have been discussed). The ten topics presented below are geared primarily for a specific program area, which helps explain why RCRA and CERCLA respondents view their usefulness differently.

<u>Most Highly Valued by UST</u>

- Leak detection and prevention methods for UST
- Application of mitigation, removal, and treatment technologies to LUST

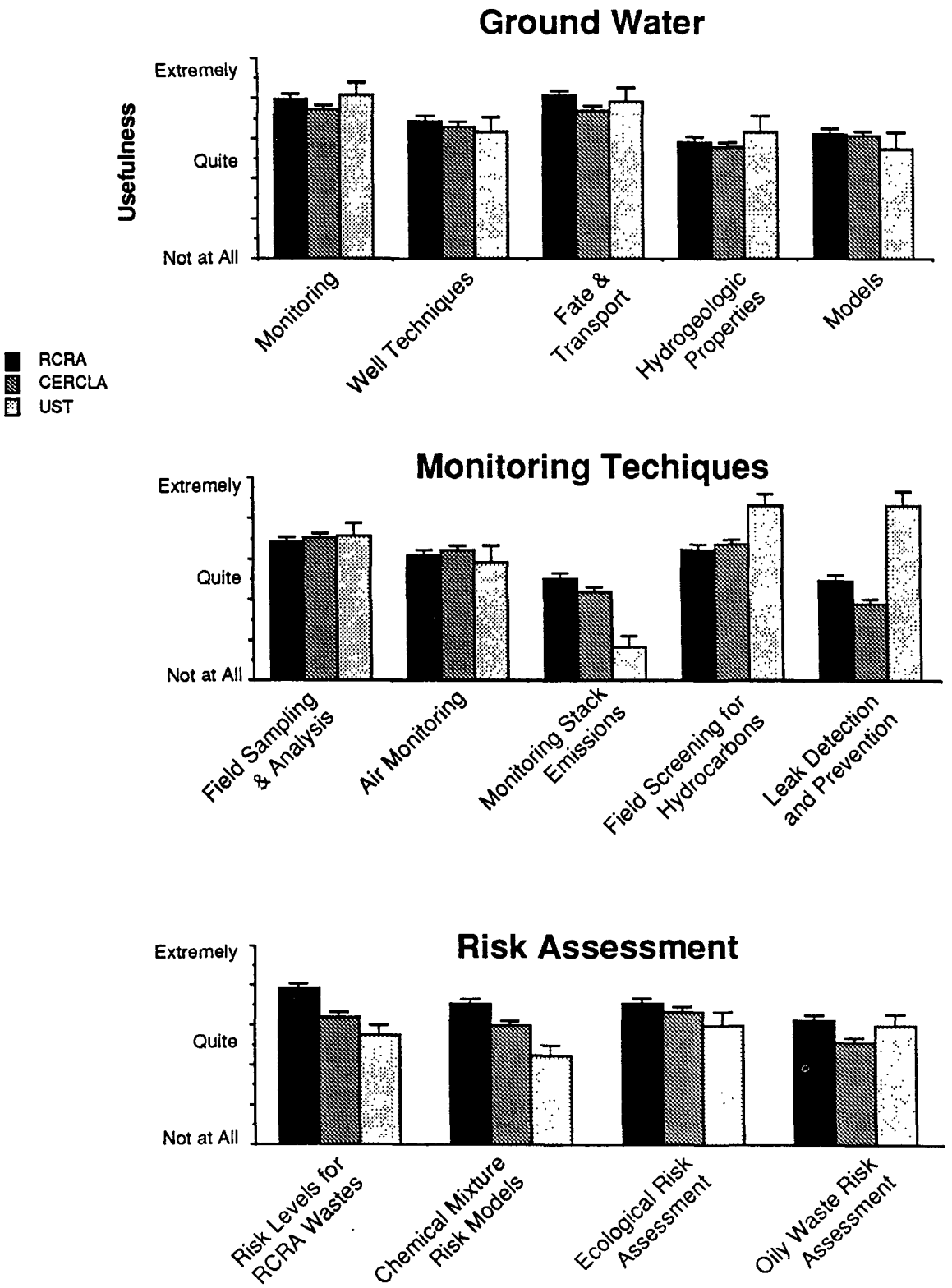


Figure 3. Usefulness ratings for 40 technology transfer needs by program

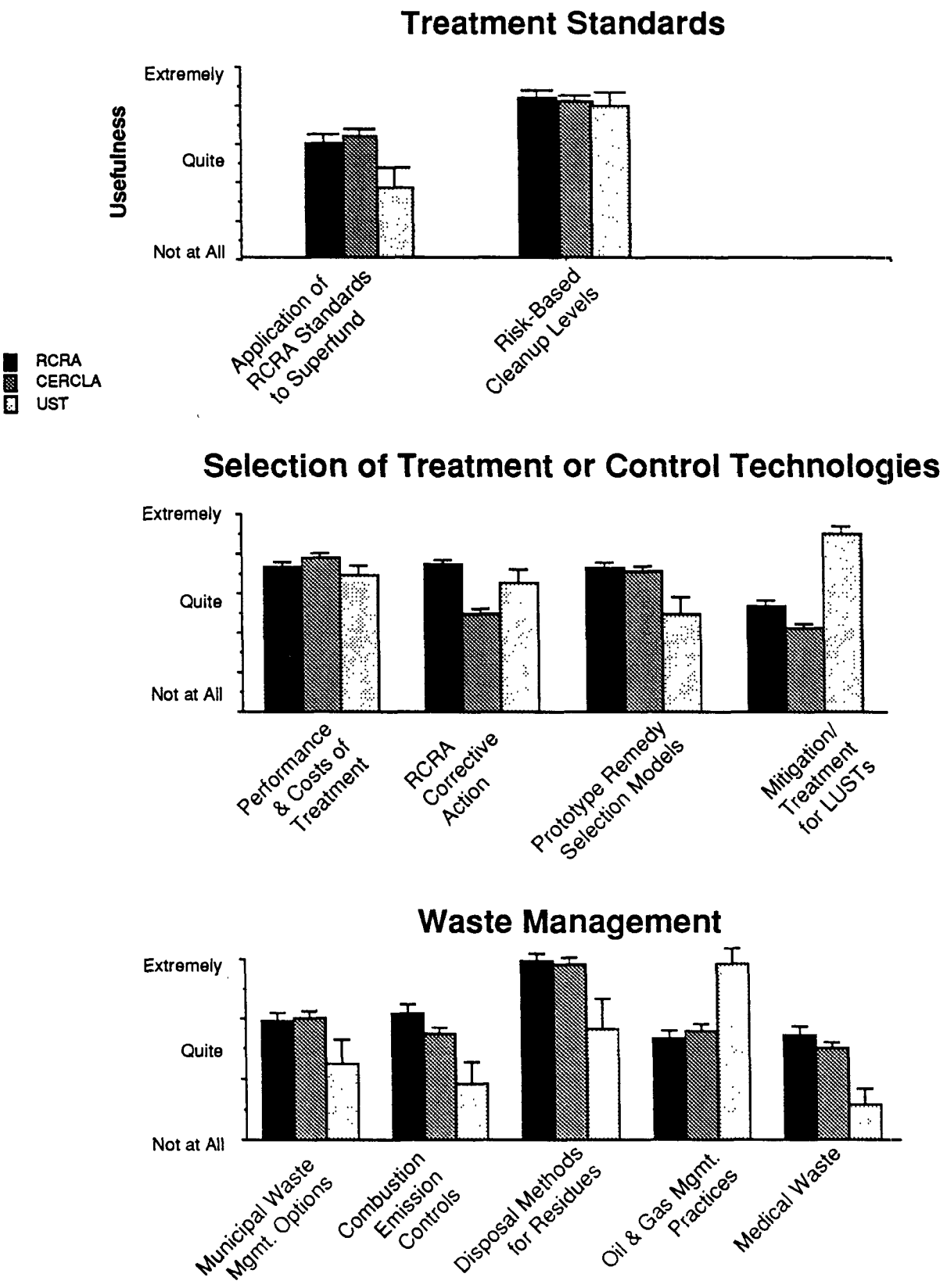


Figure 3. Usefulness ratings for 40 technology transfer needs by program (Continued)

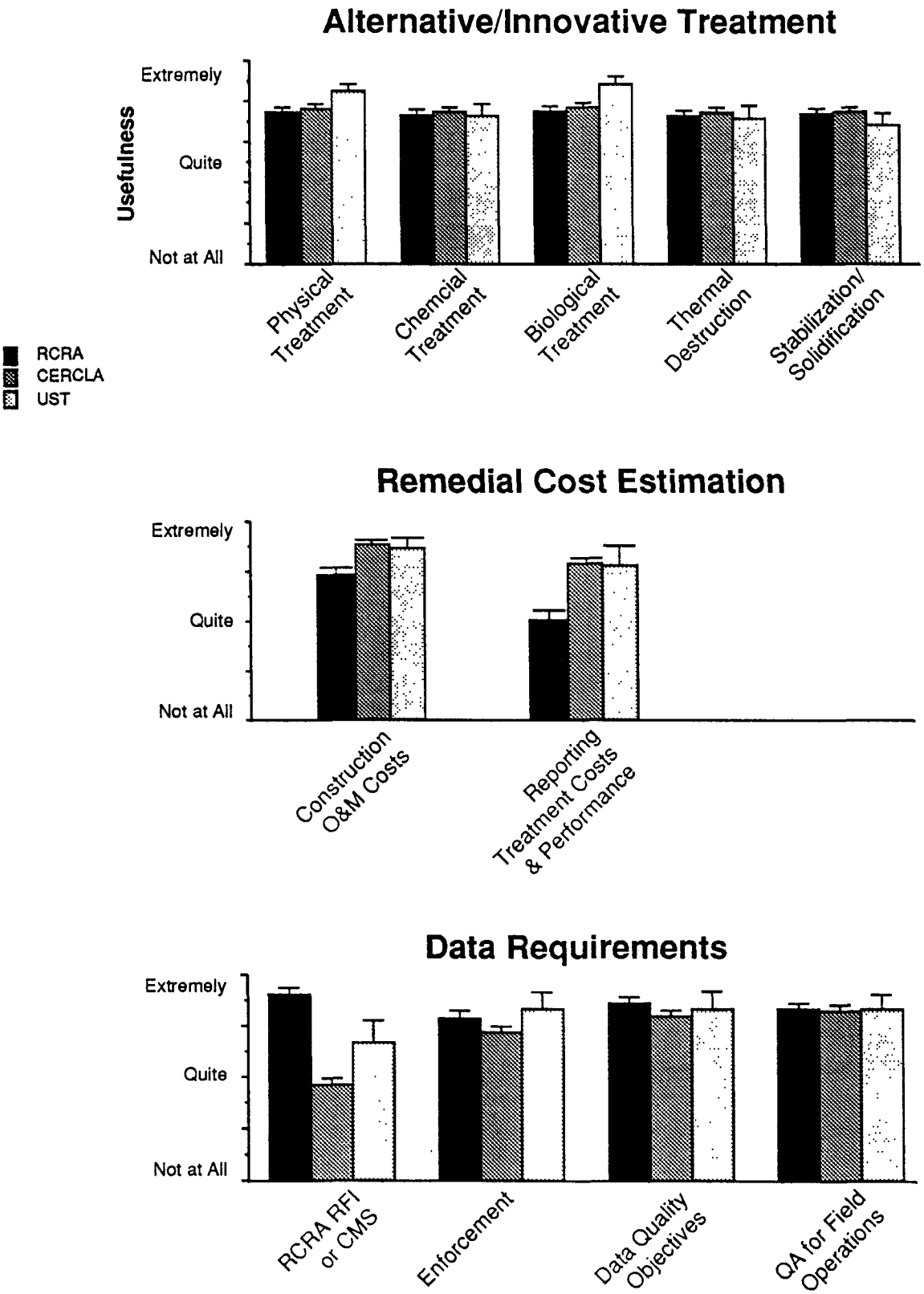
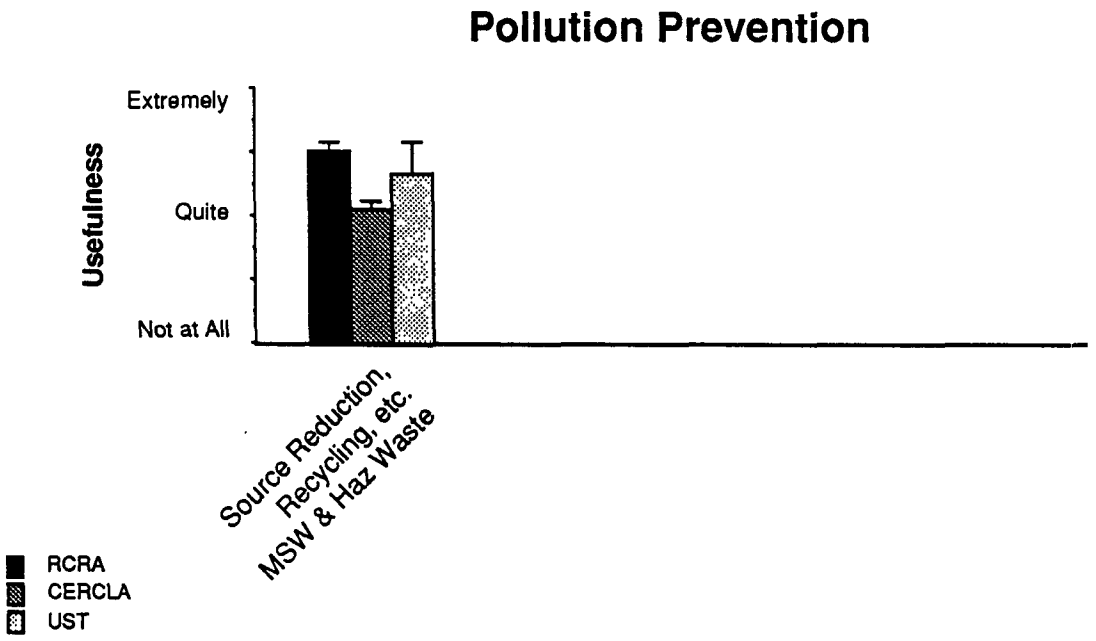


Figure 3. Usefulness ratings for 40 technology transfer needs by program (Continued)



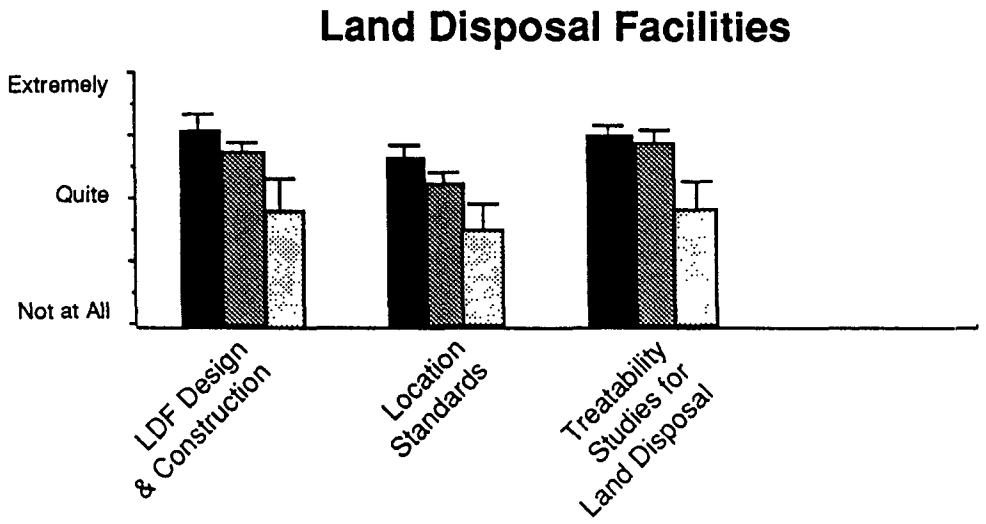


Figure 3. Usefulness ratings for 40 technology transfer needs by program (Continued)

Most Highly Valued by RCRA

- Assessment of oily waste risk and movement
- Minimal data requirements for a RCRA Facility Investigation or Corrective Measures Study
- Selecting and applying release, flow, and source control technologies for RCRA corrective action
- Waste reduction tools for managing MSW and hazardous waste
- Technologies and quality assurance for land disposal facility design and construction
- Location standards for new and existing land disposal units

Most Highly Valued by CERCLA

- Applicability of RCRA treatment standards to Superfund
- Uniform procedures for reporting costs and technical performance for operating treatments at Superfund sites

Procedures for estimating costs of construction, operation, and maintenance of remedies—a highly ranked CERCLA need—is not generally perceived by RCRA respondents to be useful. However, *General technical information on the performance, limits, safety, and cost of hazardous waste treatment technologies* is ranked within the top ten RCRA needs. This apparent discrepancy might be attributed to the wording of the first topic, which includes operation and maintenance of remedies—clearly CERCLA concerns. Nevertheless, cleanup cost is an important consideration in corrective action planning even though it may not have the same prominence that it has for CERCLA. RCRA investigations, corrective measures studies, and treatments are typically funded by the regulated community, not by government. Regional personnel may tend to emphasize the effectiveness and safety of a proposed remedy at least as much as cost.

Technology Transfer Needs by Region

Overall means for each of the 40 technology transfer needs were computed for each Region and then ranked from highest to lowest in order of usefulness. These rankings are presented in Table 1-5 for the 20 needs rated highest by the overall sample. Because of the problems described above with inadequate response rates and small sample sizes for some Regions, no statistical comparisons among Regional means were conducted. The rankings illustrate the relative importance of technical needs across Regions. For example, while six of the ten Regions rate *Establishing risk-based cleanup levels* as their highest or second highest priority, Region III appears more interested in *Field screening for hydrocarbons* and *Field sampling and analysis*; and Region VI's highest priority is *Procedures for estimating costs for construction, operation, and maintenance*. However, it should be pointed out that among the means for all 20 technical needs for all Regions, all but ten (or 5%) are rated as "quite" to "extremely" useful.

Table 1-5. Rankings of Priority Technology Transfer Needs by Region

Technology Transfer Needs	Overall Ranking	Region									
		I	II	III	IV	V	VI	VII	VIII	IX	X
Establishing risk-based cleanup levels	1	4	1	5	1	1	4	2	1	2	4
Fate and transport of contaminants in the subsurface	2	1	7	4	4	8	2	4	4	4	3
GW monitoring for site inspection, trmt. evaluation	3	2	8	3	6	4	3	6	2	5	1
Use and effectiveness of biological treatment	4	6	4	12	2	2	5	3	4	4	6
Information on performance, cost of treatments	5	5	5	11	5	6	8	1	8	1	4
Use and effectiveness of physical treatment	6	6	2	10	4	3	6	6	3	9	7
Use and effectiveness of S/S	7	10	2	15	3	7	8	9	7	6	5
Use and effectiveness of chemical treatment	8	7	6	14	7	5	7	7	6	8	8
Use and effectiveness of thermal destruction	9	8	3	12	4	9	9	10	12	5	7
Field sampling and analysis methods	10	4	11	2	5	19	13	4	9	3	11
Prototype remedy selection models	11	9	11	6	8	8	10	8	16	7	9
Field screening for hydrocarbons	12	10	20	1	11	21	14	5	10	9	2
Risk assessment: risk levels for RCRA wastes	13	12	13	7	16	10	5	14	13	12	8
Quality assurance for field operations	14	4	12	8	15	12	11	15	17	5	14
Development of DQOs in sampling and analysis plans	15	3	14	9	14	18	8	13	17	12	9
Well techniques for determining hydrology	16	8	10	16	10	19	12	12	11	15	10
Applicability of RCRA Treatment Standards to SF	18	15	9	13	12	23	10	18	19	9	12
Air monitoring for site inspection, trmt. evaluation	19	9	16	13	18	16	9	16	20	11	17
Procedures for estimating construction, O&M costs	20	14	15	24	16	22	1	11	14	14	13

Audiences for Technology Transfer

In the delivery systems section of the questionnaire, respondents were asked to identify the types of professionals outside their office that are important in helping to accomplish their job responsibilities. A listing of eight potential audiences was included with the opportunity to specify other audiences as well. Table 1-6 below presents the frequency with which these end-user audiences were selected overall and within program areas. Respondents were also asked to identify one of these audiences as the most important or "primary" audience for technology transfer. The frequency with which each audience was selected as the primary audience is presented in the right hand column for that program area.

Table 1-6. Audiences for Technology Transfer, Overall and by Program

Audience	Overall Sample	Program					
		RCRA		CERCLA		Other	
		An Audience	Primary Audience	An Audience	Primary Audience	An Audience	Primary Audience
State agency staff	86%	86%	53%	85%	21%	80%	38%
Academic institutions	16%	13%	1%	16%	<1%	26%	<1%
EPA contractors	88%	87%	10%	96%	44%	63%	32%
Regulated community	50%	60%	28%	42%	13%	54%	18%
Consultants	45%	37%	2%	50%	2%	51%	3%
Local government	28%	21%	<1%	31%	<1%	29%	<1%
Other federal agencies	54%	34%	1%	69%	5%	54%	<1%
Public	37%	30%	<1%	44%	9%	31%	6%

As can be seen from the table, both RCRA and CERCLA staff consider State agency staff and EPA contractors as important audiences. RCRA staff were more likely to mention the regulated community as an audience for technology transfer, and CERCLA staff noted consultants and other federal agencies as target audiences. When asked to designate their primary audience, approximately half of the RCRA staff chose State agency staff and another 28% selected the regulated community. For CERCLA staff, the largest "primary audiences" include State agency staff (21%), EPA contractors (44%), and the regulated community (13%). Data on primary audience size and technical needs as reported by Regional staff are presented in the detailed findings for each program area provided in Chapters 2 through 4.

2. RCRA FINDINGS

This Chapter contains detailed findings on the technical information needs of RCRA respondents and their end-user audiences in the Regions. The survey results are presented within the context of the RCRA legislative program and include information acquired from headquarters branch chief interviews and Regional site visits, as appropriate.

2.1 Profile of RCRA Respondents

Approximately 80% of the 92 Regional RCRA personnel who responded to the survey report high priority job responsibilities in more than one RCRA program area (permitting, compliance, or corrective action). This important finding indicates there is considerable interweaving of responsibilities among RCRA Regional personnel. Regional personnel oversee State Hazardous and Solid Waste Amendments of 1984 (HSWA) authorization; implement corrective action through permits; review RCRA Facility Investigation workplans and closure plans as well as Subpart X and incinerator permits; assist States in enforcement case development; resolve outstanding permit appeals; settle enforcement orders; participate in inspections; coordinate public participation; track medical waste; manage State grants and contracts; and perform other duties.

The intertwining of permitting, compliance, and corrective action responsibilities among RCRA personnel corroborates an OSW headquarters view that the RCRA Facility Investigation (RFI), Corrective Measures Study (CMS), and Corrective Measures Implementation (CMI) phases of the corrective action process are fully integrated. The complete corrective action plan incorporates site-specific, corrective action requirements and compliance schedules into permits (§3004(u) and (v)) and Corrective Action Orders (§3008(h)). This is done, in part, for enforcement purposes and to improve quality throughout the process.

The typical RCRA respondent has been in his or her current job less than 2 years (61%) and has been an EPA employee 3 to 10 years (52%). She or he also has a masters degree (47%) and is an engineer (42%). These characteristics are quite similar to those for CERCLA respondents and for the sample as a whole. Table 2-1 presents a summary of the respondents' job experience and backgrounds.

About 61% of RCRA respondents have been in their current jobs less than 2 years, suggesting a high personnel turnover rate in the RCRA program. However, there are no significant differences in perceived technical needs between respondents with less than 2 years experience in their jobs and those who have been in their current positions for longer periods (CERCLA findings are similar). The reasons for this may be due to the technical backgrounds of most RCRA personnel and to retention of experience within the Agency by recruiting primarily from within EPA rather than from outside.

About 85% of respondents have degrees in technical areas, and 74% have at least graduate course work experience—the majority hold masters degrees. Almost 50% of RCRA respondents have been employed by EPA 6 or more years (81% for 3 or more years). Thus, it appears that those who are new on the job are neither technically naive nor less perceptive of the technical requirements of their jobs. This finding generally holds for time at EPA as well, although there is a statistically significant tendency for employees with 3 to 5 years in the Agency to perceive technical needs as more useful than those who have been with the Agency for either shorter or longer periods. The 3 to 5 year group includes employees hired immediately following enactment of HSWA in 1984.

RCRA respondents each attended an average of three or four courses during the past year. Approximately 38% attended technology transfer seminars or workshops; 83% attended job training offered by OSWER, ORD, or the Region.

Table 2-1. Experience and Education of RCRA Respondents

Respondent Profile		<1 Year	1-2 Years	3-5 Years	6-10 Years	>10 Years
Time in Current Position		24%	37%	30%	6%	3%
Time with EPA		3%	16%	33%	20%	28%
Highest Level of Education	University Courses	Bachelors Degree	Graduate Courses	Masters Degree	Ph.D. or J.D.	Other
	1%	25%	19%	47%	6%	2%
Major Field of Study	Environmental Science	Geology Hydrogeology	Engineering	Health Toxicology	Bus/Public Administration	Other
	12%	22%	42%	9%	10%	5%

2.2 RCRA Technology Transfer Needs

The highest priority technical information needs (top 15 of 40) for all RCRA respondents can be categorized into six thematic areas:

- Establishing Treatment Standards
- Ground Water
- Risk Assessment
- Alternative and Innovative Treatment Technologies
- Selection and Application of Treatment/Control Technologies
- Data Requirements

The 15 highest ranked technical needs for all RCRA respondents are presented in Table 2-2. Although only the top 15 are listed, technical needs ranked 1-27 are perceived by RCRA respondents as "quite" to "extremely" useful (see Table 2-3 for complete ranking of technical topics):

Table 2-2. Fifteen Highest Ranked Technical Needs for RCRA

* 1. Establishing risk-based cleanup levels for various contaminants and site conditions.

* 2. Fate and transport of contaminants in the subsurface (*e.g.*, facilitated transport, methods for measuring contaminant mobility, non-aqueous phase liquids).

* 3. Ground-water monitoring for site inspection and for evaluating the effectiveness of treatment.

4. Risk assessment information: Risk levels for RCRA waste (*e.g.*, incinerator ash, contaminated soil).

* 5. Use and effectiveness of *biological treatment* processes (biodegradation or bioremediation).

6. Selecting and applying release and flow control, and source control technologies for RCRA corrective action.

* 7. Use and effectiveness of *physical treatment* processes (*e.g.*, soil washing, vacuum extraction).

* 8. Use and effectiveness of *stabilization/solidification.*

* 9. General technical information on the performance, limits, safety, and cost of hazardous waste treatment technologies.

* 10. Use and effectiveness of *chemical treatment* processes (*e.g.*, KPEG).

* 11. Prototype remedy-selection models for recurrent site situations.

* 12. Use and effectiveness of *thermal destruction* (incineration, oxidation).

13. Minimal data requirements for a RCRA Facility Investigation or Corrective Measures Study.

* 14. Standardized methods for ecological risk assessment.

15. Use of models for chemical mixture risk characterizations.

* *Appears on both CERCLA and RCRA lists.*

Overall, the technical needs indicate fairly extensive Regional involvement in corrective action. *Establishing risk-based cleanup levels for various contaminants and site conditions* is the highest ranked need for RCRA and ranks within the top six needs across all ten Regions. *Selecting release and source control technologies for RCRA corrective action* ranks sixth. And the *Use and effectiveness of biological, physical, stabilization/solidification, chemical, and thermal treatment and control technologies* all rank nationally within the top 12 RCRA needs. Nearly all of these top-ranked RCRA needs are among the top ten CERCLA needs, indicating that these two programs (as well as the UST program) are converging on cleanup problems. This finding also suggests wide concurrence with OSWER's priorities regarding risk-based cleanup.

As more States are authorized to permit hazardous waste facilities under HSWA, Regional and State permit writers and compliance officers are becoming increasingly involved in evaluating RCRA Facility Investigations (RFI) and Corrective Measures Studies (CMS). This involvement is expected to grow as increasing numbers of RCRA facilities are required to meet corrective action requirements under §3004(u) and Subpart F of HSWA.

The strong need for technical corrective action information by RCRA respondents confirms current OSWER emphasis on developing corrective action technology transfer products and training. Some of the highest ranked technical topics perceived by RCRA respondents in the survey closely match those identified by OSW's Corrective Action Workgroup, which convened in January, 1989, to discuss corrective action training. Regional members of the Workgroup felt that to make sound decisions in the corrective action process, Regional personnel need site-specific data requirements to evaluate the selection of a proposed corrective measures technology (*e.g.*, contaminant source control, flow control, and treatment). They also need to know the performance evaluation criteria, limitations, and quality assurance requirements of the proposed technology. These technical areas closely match three of the highest ranked technical needs perceived by RCRA respondents in the survey. They are *Selecting and applying release, flow, and source control technologies for RCRA corrective action*; *Minimal data requirements for RCRA Facility Investigation (RFI) and Corrective Measures Study (CMS)*; and *Development and application of Data Quality Objectives in sampling and analysis plans.* OSW has incorporated its Workgroup's suggestions into a RFI/CMS workshop, which will be conducted once in each Region this year.

Headquarters management conceived several technical needs that Regional respondents indicate are "quite" to "extremely" useful for accomplishing their jobs. OSW branch chiefs pointed out that establishing risk-based cleanup levels for various contaminants and site conditions is a major need for both listed and non-listed wastes including incinerator ash. They stressed the need for ground-water evaluations, field sampling and analysis techniques, and risk assessments that are consistent with Superfund. They also recognized a major need for practical technical information on selecting and applying hazardous waste thermal and non-thermal treatment options, including release-and-flow and source control technologies, for corrective action.

However, not all high priority topics identified by headquarters management rank high by respondents in the Regions. For example, the *Waste management topics on oil and gas, medical waste, hazardous waste treatment residues and MSW,* as well as *Location standards for new and*

existing land disposal sites rank relatively low among respondents but are considered important by headquarters management and are addressed in the *OSWER Strategic Plan FY 1992-1995.*

Reasons for these differences in perspectives may reflect the different priorities of headquarters and Regional staff. For example, OSW headquarters is developing location standards for new and existing land disposal sites and expects these standards will impact the Regions over the next three or four years. However, Regional respondents do not perceive *Location standards for new and existing land disposal sites* to be as useful as *Technologies and quality assurance information for land disposal facility design and construction* and *Results of treatability studies for land disposal.* There appears to be a tendency for Regional respondents to value topics of immediate concern more than those that may affect them in the future.

The situation is somewhat different when we analyze the oil and gas management topic. OSW has submitted a Report to Congress on oil and gas and is studying management practices and the effectiveness of State controls before making a regulatory determination. These actions have involved only a few Regions, such as Region VIII, which includes oil and gas producing States. Therefore, it is not surprising that Regions with specific waste concerns indicate sharply defined technical information needs, which are not generally perceived by other Regions to be important.

Medical waste is even more complex because it involves some personnel in every Region. In response to recent medical waste legislation, the Agency issued rules last year establishing a demonstration medical waste tracking system for States that elect to participate. The results of the demonstration will be compiled, a Report to Congress prepared, and a regulatory determination will be made. As a State program, relatively few Regional personnel are involved at this time, although some Regions—such as Regions I and II that have several participating States—are more active than others. Consequently, the technical needs of only a few personnel in each Region, while important, may not be highly ranked overall.

Management options for MSW is a low-ranked topic, but *Waste reduction tools such as source reduction, recovery, and recycling for managing MSW and hazardous waste* is rated as "quite" to "extremely" useful. Reasons for this discrepancy might be attributed to Agency emphasis on pollution prevention, as well as to the small numbers of Regional personnel assigned MSW responsibilities. Congress recognized that State and local governments have primary responsibility for MSW management, although it gave EPA some regulatory and assistance responsibilities. At present, EPA is promoting an integrated MSW program of source reduction including reuse, recycling, and energy recovery at the local government level. Waste minimization is emphasized in the *OSWER Strategic Plan FY 1992-1995* as well.

RCRA respondents also rank *Combustion emission controls from MSW incinerators* low, concurring with Agency emphasis on pollution prevention of MSW rather than treatment. However, this finding does not imply that incineration, in general, is not an important issue. RCRA respondents rank the *Use and effectiveness of thermal destruction (incineration, oxidation)* 12th among their high priority needs. ORD's Center for Environmental Research Information (CERI) appears to have accurately diagnosed needs for technology transfer products on incineration and waste minimization. CERI offered incineration products and ten well received workshops on waste minimization methods and procedures last year.

Write-in technical needs were added by approximately 15 RCRA respondents. In general, most of the write-ins reflect broad technical needs, but some, such as Subpart X wastes, are very important to some Regions. Nearly all write-ins are elaborations of topics already listed in the questionnaire:

- Five write-ins from Regions V, VI, and VIII address Subpart X explosive and reactive wastes and include topics such as reducing air emissions produced by open burn detonation and materials that should not be open burned but incinerated in popping furnaces.

- Five write-ins are ground-water topics and include a field seminar with hands-on installation for monitoring wells and detailed information on single ground-water models.

- Four write-ins relate to treatment standards, such as BDAT-based cleanup standards, cleanup criteria for sediment, and establishing air criteria for corrective action during soil and ground-water remediation when inhalation toxicity data are scarce.

- Four write-ins address data requirements, such as site-specific data requirements and geochemical interpretation of ground-water data quality.

- Two write-in topics are on monitoring techniques and include methods of analysis of waste and environmental samples, and statistical soil sampling.

- One risk assessment topic cites the need for information to evaluate both site-contamination risk and risk associated with the use of available technologies.

- One request is for information on the use and effectiveness of treatment technologies to meet land disposal restrictions.

- One waste reduction topic focuses on the application of waste minimization technologies to Department of Defense activities and other specific industries.

- One topic, offered by a person with CERCLA and RCRA federal facility responsibilities, addresses treatment techniques for radioactive soils and ground water, and related to this, another person listed *in situ* vitrification information.

- Two write-ins address non-technical programmatic needs.

2.3 Regional Technical Needs

Comparisons across Regions reveal widespread concurrence in technical needs. Topics highly useful to respondents in each Region are similar to those highly valued by RCRA respondents as a whole. Topics of interest to all Regions relate to establishing treatment standards, ground water, risk assessment, alternative and innovative treatment technologies, selection and application of treatment/control technologies, and data requirements. Eight Regions also highly value *General information on the use and limitations of field sampling and analysis methods*, and five

Regions indicate that *Disposal methods for residues such as ash from treated hazardous waste* is "quite" to "extremely" useful.

Although the most important finding is the similarity of technical needs across Regions, two topics appear to be more important to some Regions than others. Region VIII, which is actively involved with the major oil and gas producing States in the west, is the only Region that distinguishes *Effective oil and gas management practices* as a "quite" useful topic. Based on write-in topics, Subpart X (munitions/explosives) appears to be a very important topic in some Regions, including V, VI, and VIII, but not necessarily all Regions. Staff of the OSW Assistance Branch at headquarters, which receives Regional requests for information on Subpart X, also stressed the need for up-to-date technical information on Subpart X technologies and guidance for determining the minimal technology for disposing of explosives and other munitions. Table 2-3 provides a ranking of RCRA technical needs by Region.

2.4 RCRA Audience Needs

RCRA respondents are involved with a variety of professionals outside their offices to accomplish their jobs, but their most important (primary) end-users are State agency staffs and the regulated communities. Approximately 53% of respondents report that State agency staffs are their primary audience, and about 29% identify regulated communities as their primary audience. The overall size of these end-user groups is difficult to assess. Estimates range from 1,500-2,000 for State agency staffs and several hundred thousand for the regulated communities. There are an estimated 500-1000 Regional and State permit writers. There are approximately 5,700 owner/operators of hazardous waste landfills; 50,000 hazardous waste generators, but only a few companies account for most of the generated waste; 5,000 treatment facilities; 20,000 hazardous waste transporters; and 800,000 oil/gas wells.

The technical needs perceived by RCRA respondents as important for State agency staff correspond closely to those for the regulated community. They are also among the highest ranked needs of RCRA respondents. Table 2-4 presents the highest ranked topics that RCRA respondents feel their State and regulated community audiences need. The ranking is based on the frequency with which respondents mentioned topics for each audience.

For both primary user audiences, more non-technical, programmatic needs are mentioned than any other category of technical needs. Programmatic needs include topics such as training to conduct HSWA and non-HSWA corrective action, RFI guidance, understanding land ban restrictions and how they relate to closures and corrective action, general information on RCRA regulations, and information to produce quality RFIs and CMSs.

Table 2-3. Rankings of RCRA Technology Transfer Needs—Overall and by Region

Technology Transfer Needs	All RCRA	Region									
		I	II	III	IV	V	VI	VII	VIII	IX	X
Establishing risk-based cleanup levels	1	2	1	6	1	1	5	1	1	2	3
Fate and transport of contaminants in the subsurface	2	1	2	3	1	6	1	3	4	4	1
GW monitoring for site inspection and evaluation of treatments	3	1	3	3	3	4	3	6	3	4	1
Risk assessment: risk levels for RCRA wastes	4	3	4	1	2	3	2	2	7	3	6
Use and effectiveness of biological treatment	5	5	5	10	5	9	7	5	2	4	4
Release and source control technologies for RCRA corrective action	6	3	6	9	5	3	3	5	7	11	3
Use and effectiveness of physical treatment	7	5	5	10	5	7	6	6	2	9	5
Use and effectiveness of S/S	8	7	3	10	5	5	6	7	5	5	5
Info on performance and cost of hazardous waste treatment	9	3	7	8	9	8	7	6	7	1	5
Use and effectiveness of chemical treatment	10	6	5	10	8	9	5	5	3	8	5
Prototype remedy selection models	11	6	6	9	6	4	6	3	12	6	2
Use and effectiveness of thermal treatment	12	6	2	10	4	10	6	8	8	5	4
Minimal data needs for RFI and CMS	13	6	11	4	2	2	5	7	9	12	5
Standardized methods for ecological risk assessment	14	4	12	11	2	12	7	6	8	3	5
Use of models for chemical mixture risk characterization	15	2	8	2	6	15	7	6	10	7	7
Development of DQOs in sampling and analysis plans	16	2	10	4	12	14	7	8	9	8	7
Well techniques for determining hydrologic properties of aquifers	17	2	6	5	7	20	4	8	7	15	7
Use and limitations of field sampling and analysis methods	18	2	10	4	5	22	9	4	10	4	12
Quality assurance for field operations	19	3	11	5	17	11	12	5	13	5	8
Field screening, soil vapor, and water sampling for hydrocarbons	20	5	16	5	11	23	9	5	10	10	3

Table 2-3. Rankings of RCRA Technology Transfer Needs—Overall and by Region (*Continued*)

Technology Transfer Needs	All RCRA	Region									
		I	II	III	IV	V	VI	VII	VIII	IX	X
Data requirements for enforcement	21	7	19	7	19	13	4	8	9	11	12
Validated ground-water models	22	5	9	7	2	20	9	11	15	16	10
Assessment of oily waste risk and movement	23	7	15	8	10	16	13	11	6	14	8
Multimedia monitoring for inspection and evaluation of treatments	24	3	13	5	15	18	11	11	16	9	10
Tech & QA for land disposal facility design and construction	25	12	11	14	10	21	8	9	11	11	8
Waste reduction tools for MSW and hazardous waste	26	14	15	11	11	17	16	13	10	7	4
Treatability study results for land disposal	27	15	12	15	11	19	10	11	6	15	9
Applicability of RCRA standards to Superfund	28	8	14	12	8	25	13	15	11	7	9
Disposal methods for ash and other treated waste	29	7	19	14	16	17	12	12	11	4	12
Hydrologic properties of difficult areas (*e.g.*, karst terrain)	30	10	17	6	6	24	11	7	13	20	11
Procedures for estimating construction, O&M costs	31	13	20	17	18	27	4	9	12	13	10
Application of LUST treatments	32	6	17	9	10	28	19	10	17	14	15
LDF location standards	33	17	14	16	14	26	14	11	14	14	14
Monitoring stack emissions	34	8	21	13	16	29	18	14	17	12	13
LUST leak detection and prevention	35	11	18	10	13	30	19	12	18	17	13
MSW combustion emission controls	36	13	22	18	16	33	15	16	19	18	15
Uniform procedures to report cost/performance SF site treatments	37	16	22	17	20	31	17	18	17	19	15
General info on limits and safety of MSW management options	38	9	23	19	20	32	17	17	19	19	16
Medical waste management options	39	11	24	16	21	34	21	17	20	17	18
Oil and gas management practices	40	17	25	20	21	35	20	19	11	20	17

Table 2-4. Ranking of Needs of Primary RCRA Audiences

State Agency Staff	Regulated Community
Other (non-technical)	Other (non-technical)
Selection of Cleanup Technologies	Risk Assessment
Monitoring	Monitoring
Risk Assessment	Selection of Cleanup Technologies
Risk-Based Treatment Standards	Ground Water
Data Requirements	Risk-Based Treatment Standards
Pollution Prevention	Data Requirements
Waste Management (MSW, Medical)	Pollution Prevention
Ground Water	Land Disposal Facilities
Land Disposal Facilities	Estimating Remediation Cost
Alternative Treatment Technologies	Waste Management
Estimating Remediation Cost	Alternative Treatment Technologies

3. CERCLA FINDINGS

One hundred thirty-nine Regional respondents indicate that they are currently involved in one or more of the CERCLA removal, remedial, enforcement, or other programs. This chapter presents the survey results for CERCLA respondents drawing upon the interviews with headquarters branch chiefs, and Regional management and staff for comparisons and explanations when appropriate.

3.1 Profile of CERCLA Respondents

The typical CERCLA respondent has been with the Agency for 3 to 5 years, has held his or her current position from 1 to 2 years, and has a masters degree in engineering. These "typical" characteristics are quite similar to those for RCRA respondents and for the sample as a whole. A summary of the experience, highest level of education, and field of study for CERCLA respondents can be found in Table 3-1 below.

Table 3-1. Experience and Education of CERCLA Respondents

Respondent Profile		<1 Year	1-2 Years	3-5 Years	6-10 Years	>10 Years
Time in Current Position		19%	33%	32%	12%	4%
Time with EPA		2%	10%	35%	18%	35%
Highest Level of Education	University Courses	Bachelors Degree	Graduate Courses	Masters Degree	Ph.D. or J.D.	Other
	1%	28%	14%	50%	5%	2%
Major Field of Study	Environmental Science	Geology Hydrogeology	Engineering	Health Toxicology	Bus/Public Administration	Other
	17%	16%	47%	5%	9%	6%

Respondents were asked to indicate programs in which they are currently involved. For CERCLA, the choices included CERCLA removal, remedial, and enforcement programs, and an opportunity to specify other program areas. Because the remedial and enforcement programs in most Regions have been integrated, some overlap between these areas was expected. In fact, 65% of respondents indicate that they are currently involved in two or more CERCLA program areas. Of the 139 respondents, 11 (8%) mentioned only the removal program, 28 (20%) indicated the remedial program only, and 12 (9%) checked only enforcement. Among the others, 24 (17%)

said they are involved in all three CERCLA program areas, 52 (37%) represent remedial and enforcement, and 4 (3%) claim both removal and enforcement responsibilities. Eight respondents (6%) specified either the preremedial program or federal facilities. Because of the extent of overlap among program areas within CERCLA, it is not possible to examine technical needs separately for the three programs.

For the sample of CERCLA respondents, 52% have been in their current positions for 2 years or less, supporting the general perception of a relatively "new" workforce. However, only 12% have been employed by EPA for that short a period. This suggests that there is a good deal of mobility in the Regions, either across program areas or within a program. In addition, almost 60% hold a graduate degree, 85% of which are in a related technical field. During the Regional site visits, interviewees were asked about the difficulty of maintaining technical skills among RPMs, and they provided a variety of answers. One approach by Regional management was to support as much training and personnel development for RPMs as was possible. In other Regions, the proposed solution was to recruit individuals with strong backgrounds in project management, and to back them up with technical assistance. Most of the Regions visited had established a Regional technical support group, or were considering doing so.

While the CERCLA respondents in this survey show a relatively strong technical background, this may not be the case for the almost 500 new staff being added to the Regional workforce. Region III indicated that most of their new FTEs would fill RPM positions (26 new RPMs), Region IV will have 18 new RPMs and 10 new attorney positions in support of Superfund. In Regions VI and VIII, the new FTEs will be used largely for management or support positions, such as contracts administration. Technology transfer needs for these new positions will have to be determined at a later time.

With respect to training, CERCLA respondents attended an average of three training courses during the past year. Seventy-nine percent report recent job-related training from EPA (including the Region, OSWER, or ORD sponsored courses), and 39% report attending technology transfer seminars or workshops. The latter includes both ORD Technology Transfer seminars and professional conferences.

3.2 CERCLA Technology Transfer Needs

The highest priority technical information needs (top 15 of 40) for all CERCLA respondents can be categorized into the following areas:

- Establishing Treatment Standards
- Ground Water
- Risk Assessment
- Alternative and Innovative Treatment Technologies
- Selection and Application of Treatment/Control Technologies
- Monitoring
- Estimating Remediation Costs

The 15 highest ranked technology transfer needs are presented in Table 3-2. Although only the top 15 are listed here, 23 technical needs are perceived by CERCLA staff as "quite" to "extremely" useful (see Table 3-3 for a complete ranking of technical topics).

Table 3-2. Fifteen Highest Ranked Technical Needs for CERCLA

* 1. Establishing risk-based cleanup levels for various contaminants and site conditions.

* 2. General technical information on the performance, limits, safety, and cost of hazardous waste treatment technologies.

* 3. Use and effectiveness of *biological treatment* processes (biodegradation or bioremediation).

* 4. Use and effectiveness of *physical treatment* processes (*e.g.*, soil washing, vacuum extraction).

* 5. Use and effectiveness of *chemical treatment* processes (*e.g.*, KPEG).

* 6. Use and effectiveness of *stabilization/solidification.*

* 7. Use and effectiveness of *thermal destruction* (incineration, oxidation).

8. Applicability of RCRA Treatment Standards to Superfund.

* 9. Ground-water monitoring for site inspection and for evaluating the effectiveness of treatment.

* 10. Fate and transport of contaminants in the subsurface (*e.g.*, facilitated transport, methods for measuring contaminant mobility, non-aqueous phase liquids).

* 11. Prototype remedy-selection models for recurrent site situations.

12. General information on the use and limitations of field sampling and analysis methods.

13. Procedures for estimating costs for construction, operation, and maintenance of remedies.

14. Field-screening, soil vapor, and water sampling for hydrocarbons.

* 15. Standardized methods for ecological risk assessment.

* *Appears on both RCRA and CERCLA lists.*

Ten of the top 15 Superfund needs are related to progress in moving sites into the remedial design phase, and SARA requirements that permanent solutions and alternative treatment technologies be used "to the maximum extent practicable." Eleven of the top fifteen rated technical needs also appear on the RCRA list of highest rated technical needs. As discussed in Chapter 2, Regional RCRA staff rate alternative and innovative treatment technologies and risk-based cleanup levels among their top technical needs as well. In implementing RCRA's new corrective action program, as well as the UST program, Regional hazardous and solid waste programs are converging on cleanup problems.

The list of 40 technology transfer needs included in the questionnaire contained two items related to establishing treatment standards—*Establishing risk-based cleanup levels for various contaminants and site conditions*, and *Applicability of RCRA treatment standards to Superfund.* These items rank first and eighth for CERCLA respondents overall, and both rank within the top nine for all ten Regions. The selected level of cleanup will drive most other decisions at the site including which alternatives will be considered and which have a chance of succeeding. SARA and the NCP require that on-site removal and remedial actions attain applicable or relevant and appropriate regulations (ARARs) to the extent practicable. RCRA's Land Disposal Restrictions place specific restrictions (*e.g.*, treatment of waste to concentration levels) on RCRA hazardous wastes prior to their placement in land disposal units. Problems arise in determining when LDRs are applicable to CERCLA response actions. Regional CERCLA respondents need technical information to assist in applying LDRs to Superfund sites and in establishing cleanup levels.

Two items in the top 15 address the selection and application of treatment and control technologies: *General technical information on the performance, limits, safety, and cost of hazardous waste treatment technologies* and *Prototype remedy-selection models for recurrent site situations*. Superfund has been criticized for inconsistency in remedy selection at NPL sites. It is possible that both the consistency and quality of remedy selection can be improved by technical information on the applicability, limitations, and costs of alternative and innovative technologies. However, differing site conditions, statutorily required State regulations, PRP negotiations, unresolved policy issues, and other non-technical factors also contribute to this issue. In addition, in many cases, complete technical information on alternative and innovative technologies does not yet exist. OERR has recognized these problems and is addressing them through policy guidance; programs to improve the development and application of new technologies; and recommendations for conducting treatability studies during the RI/FS.

Procedures for estimating costs for construction, operation, and maintenance of remedies is also listed among the top technical needs. The Administrator's *Management Review of the Superfund Program* recommended the development of prototype RI/FS and remedy-selection models for recurrent site situations to speed the RI/FS process and limit the number of remedial alternatives that must be considered during the remedial process. OERR and ORD are moving forward to address this need through the development of protocols for landfills, soil washing, and stabilization/solidification. Efforts are also underway to develop automated databases of treatability information and expert systems for estimating remediation costs.

Section 121(b) of CERCLA mandates EPA to select remedies that "utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent

practicable" and to "prefer remedial actions in which treatment permanently and significantly reduces the volume, toxicity, or mobility of hazardous substances, pollutants, and contaminants as a principal element." Items 3 through 7 in the list of highest ranked technical needs focus on alternative and innovative treatment technologies, including: *biological, physical, chemical, and thermal treatment processes*, and *stabilization/solidification.* In scoping the RI/FS, literature surveys are conducted to gather information on a potential alternative technology's applicability, performance, implementability, relative costs, and operation and maintenance requirements. RPMs may also consider the types of response actions selected for other sites with similar problems or contaminants to identify those remedial alternatives that carry high potential of being an effective solution for site problems. If practical candidate technologies have not been sufficiently demonstrated or cannot be adequately evaluated on the basis of available information, treatability testing is performed. Evaluation reports developed on the basis of treatability tests provide information that may be quite valuable to other project managers with similar problems.

OSWER and ORD are taking several steps to encourage treatability testing on alternative and innovative technologies, and to make performance and cost information broadly available. Regional management emphasized this need, and suggested that efforts be made to incorporate information from treatability tests conducted by PRPs as well. ORD's Center for Environmental Research Information (CERI) has begun to address technical information on treatment technologies through handbooks and workshops on stabilization/solidification, bioremediation, and physical and chemical treatment. OERR and OSWER have arranged frequent meetings on technologies to discuss the most current information and experiences. Although some progress is being made in collecting and summarizing available information, and demonstrating new techniques (*e.g.*, through the SITE program), much remains to be accomplished in developing and disseminating technical information in this area.

The two ground-water related items rated highest by CERCLA respondents are: *Ground-water monitoring for site inspection and for evaluating the effectiveness of treatment* and *Fate and transport of contaminants in the subsurface.* At most hazardous waste sites ground-water contamination is a major concern. Ground-water monitoring methods are needed for site characterization, determining the location and concentrations of contaminants, developing adequate data to support risk assessment and the analysis of remedial alternatives, defining the risks posed by a site, demonstrating the need for remedial action, and supporting the rationale for selecting a remedial action alternative. Analyses of contaminant fate and transport involve determining the actual and potential magnitude of releases from sources and the mobility and persistence of source contaminants. This analysis frequently involves numerical models to interpolate among and extrapolate from isolated field samples to areas and times not sampled. Ground-water monitoring and fate and transport analyses are also very important to the evaluation of treatment performance. Long-term monitoring and evaluation of treatment are essential to negotiations with States and responsible parties who will be involved in the continuing operation and maintenance of remedies. OERR has recently begun investigations of the applicability of traditional pump-and-treat remediation as applied to Superfund sites, and has recently published new ground-water guidance. CERI and the R.S. Kerr Laboratory have offered training in basic ground water and fate and transport. OSWER has recently completed a detailed analysis of the ground-water related tasks that must be completed by Regional CERCLA and RCRA staff and the training now available to meet these needs.

Field sampling and analysis methods are also of major concern to CERCLA staff. The two items under the monitoring topic in the questionnaire most highly rated by CERCLA respondents are: *General information on the use and limitations of field sampling and analysis methods* and *Field-screening, soil vapor, and water sampling for hydrocarbons.* Field monitoring, sampling, and analysis are also considered quite important by both headquarters and Regional management. Region III indicates that this is their biggest technical problem at present as does Region VIII—and this is borne out in the Regional rankings of needs. Field sampling and analysis is critical in preremedial activities as well as in data collection during the RI/FS. Statutory requirements in the revised NCP and the new Hazard Ranking System (HRS) will increase the need for field sampling and analysis at a time when no new resources are available and efforts to reduce the time allotted for field work are underway. For example, the new HRS will require that numerous new measurements and additional steps in the preliminary assessment/site investigation (PA/SI) process be applied to the backlog of 25,000 sites to be assessed. There is a need for development and dissemination of information on small scale, accurate, and efficient field methods.

The final technical need in the list of the top 15 is *Standardized methods for ecological risk assessment.* Cleanup goals must be addressed to protect both human health and the environment. OSWER's *Strategic Plan FY 1992-1995* recognizes the importance of determining the ecological risks at Superfund sites and commits the office to investigating measures of ecotoxicity and the propensity of contaminants to bioaccumulate. OERR and OWPE have recently reemphasized the importance of environmental assessment through the establishment of a work group, and the development of policy and guidance.

Although for the large majority of items, headquarters branch chiefs and Regional CERCLA respondents concur on the most important technical needs, there are a few items emphasized by headquarters that do not appear among the most important topics for the Regions. These include more general risk assessment information, data interpretation, technical support for enforcement case preparation, and hydrologic properties of difficult areas such as Karst. The item on risk information for RCRA wastes, while not among the top 15, is rated as "quite" to "extremely" useful by Regional CERCLA respondents. All of the Regions employ toxicologists who can provide technical support to RPMs in risk assessment, and in several Regions the ESD provides this type of support. It is possible that the survey did not tap the specific individuals responsible for risk assessment support. A similar situation exists with respect to data interpretation. Both *Quality assurance for field operations* and *Development of Data Quality Objectives in sampling and analysis plans* are ranked among the top 20 for CERCLA staff and both are considered "quite" to "extremely" useful.

The only item included in the questionnaire directly related to technical support for enforcement is *Technical data requirements for enforcement case development.* It is possible that the phrasing of this item, with its emphasis on data requirements, was overly specific and that a more general item on technical support for enforcement would have elicited a stronger response. Regional management emphasized the need for training and technical support for enforcement, especially with regard to the integration of RPM responsibilities for both Fund-lead and enforcement-lead sites. A final need that headquarters felt would be extremely important and that was not highly valued by the Regions concerns *Hydrologic properties of difficult areas*, such

as Karst. A possible explanation for this discrepancy can be found in the results of the recent ground-water training study. In a survey directly related to technical training needs for ground water, it was found that hydrology was a topic that has been extensively covered in available training. However, Region V did note problems in this area during the Regional site visits; it is possible that the topic is of importance to only a few sites, and therefore is not highly rated overall.

Twenty individuals in the CERCLA sample suggested additional topics as extremely important to accomplishing their job responsibilities. Many of these were elaborations on topics presented in the questionnaire, some were additional technical topics, and still others concerned policy or programmatic areas. Some of the most frequently mentioned technical needs suggested by respondents include:

- Quick turnaround field sampling and analysis (3 write-ins)
- Applied geophysical methods (2 write-ins)
- Scoping and costs of RI/FS (3 write-ins)
- Experience in removal techniques (4 write-ins)
- Treatment of munitions waste (2 write-ins)
- Statistical analysis, data interpretation (2 write-ins)
- Remediation of fractured bedrock (2 write-ins)
- Evaluating Regions' experience in treatability studies (3 write-ins)
- Controlling air emissions during remediation (2 write-ins)
- Treatment techniques, assessment, and analytical requirements for radioactive wastes (3 write-ins)

3.3 Regional Technical Needs

Ratings of the importance of the 40 technical needs were averaged for each Region and ranked from most important to least important. These rankings are presented in Table 3-3. Needs with the same average value are given the same ranking, so that for some Regions a number will appear more than once. The relatively low response rates from Regions I and IX allow less confidence in the representativeness of the sample for those Regions.

In general, there is a great deal of consistency in technical needs across Regions. *Establishing risk-based cleanup levels*, ranked number one overall, is also ranked first or second for all ten Regions. *Technical information on the performance, limits, safety and cost of treatment technologies* is also among the top five for all Regions. Alternative and innovative treatment

technologies including biological, chemical, physical, thermal, and stabilization/solidification are among the top five needs for five or more of the Regions, as is the *Applicability of RCRA treatment standards to Superfund.*

The additional topics written in by respondents are also somewhat revealing regarding Regional CERCLA needs. Regions II and III suggest additional topics in field sampling, geophysical methods, and scoping and costs for RI/FS. Region VI stresses short-term versus long-term risks, evaluation of treatability study experience, air emissions during remediation, DNAPLs, and Data Quality Objectives in RD/RA. Region VII needs include munitions waste, statistical analyses, and treatability protocols. Region VIII suggests field analytical techniques, field assessment for radiation sites, air emission controls for air stripping, and emerging technologies. Region X's additional needs are related to federal facilities (including radioactive wastes), enforcement topics, and data requirements related to specific remedial technologies.

3.4 CERCLA Audience Needs

CERCLA staff identify State agency staff, EPA contractors, and the regulated community as important audiences for EPA technology transfer. EPA contractors are selected as the primary audience by 44% of respondents (96% selected them as an audience), while State agency staff are considered the primary audience by 21% of respondents (85% selected them as an audience). The regulated community (presumably Potentially Responsible Parties) is also identified as the primary audience by 15% of respondents (42% designate this group as an audience). All other groups are considered to be the primary audience by less than 10% of respondents. The question on audience size received a wide range of responses; for example, EPA contractors and State agency staff are estimated by 76% of respondents as including less than 100 persons, or less than 500 persons by 91% of respondents. In addition, some respondents estimate audiences sizes for the regulated community in the thousands.

Respondents were asked to list the five top priority technical needs of their primary audience. Responses to this item were coded as representing one of the 11 thematic areas used to organize technical needs in the questionnaire. Eighty percent of responses to this question could easily be categorized in this fashion, the remaining 20% are for programmatic training or guidance. Technical needs for the three main CERCLA audiences are summarized and listed in rank order in Table 3-4. These closely parallel CERCLA staff technical needs in general. Among the most frequently mentioned needs for State agency staff are ground water, monitoring techniques, selection and application of treatment/control technologies, and alternative and innovative treatment technologies. EPA Contractor technical needs include selection and application of treatment and control technologies, alternative and innovative treatment technologies, and monitoring techniques. Technical needs for the Regulated Community include monitoring, risk assessment, and selection and application of treatment/control technologies.

Table 3-3. Rankings of CERCLA Technology Transfer Needs, Overall and by Region

Technology Transfer Needs	All CERCLA	Region									
		I	II	III	IV	V	VI	VII	VIII	IX	X
Establishing risk-based cleanup levels	1	2	1	2	1	2	1	2	1	2	3
Information on performance, costs of treatments	2	1	3	8	8	3	3	1	4	3	1
Use and effectiveness of biological treatment	3	6	4	10	2	1	2	2	9	4	4
Use and effectiveness of physical treatment	4	6	2	9	4	1	5	3	5	4	5
Use and effectiveness of chemical treatment	5	6	7	10	4	3	4	4	6	4	5
Use and effectiveness of S/S	5	8	4	11	2	4	5	5	3	5	5
Use and effectiveness of thermal destruction	6	7	5	9	3	4	6	6	9	3	4
Applicability of RCRA treatment standards to Superfund	7	6	6	5	5	4	2	9	7	5	7
GW monitoring for site inspection and evaluation of treatments	7	2	11	4	9	4	3	7	2	7	1
Fate and transport of contaminants in the subsurface	8	1	8	1	7	5	6	8	6	5	7
Prototype remedy selection models	9	6	13	3	6	6	6	5	10	8	9
Use and limitations of field sampling and analysis methods	10	5	10	7	6	8	11	7	3	3	11
Procedures of estimating construction, O&M costs	11	6	9	13	17	7	2	4	5	10	6
Field screening, soil vapor, and water sampling for hydrocarbons	12	7	20	6	11	9	12	7	12	6	2
Standardized methods for ecological risk assessment	13	6	15	18	10	8	8	14	12	1	3
Well techniques for determining hydrologic properties of aquifers	14	6	11	12	11	6	12	10	14	10	13
Quality assurance for field operations	15	4	12	11	14	9	6	17	11	6	13
Air and other media monitoring for site inspection and evaluation	16	8	19	15	15	8	4	15	8	8	8
Risk assessment: risk levels for RCRA wastes	17	13	15	11	13	10	7	13	13	12	7
Development of DQOs in sampling and analysis plans	17	5	16	14	16	14	7	14	14	9	7

Table 3-3. Rankings of CERCLA Technology Transfer Needs, Overall and by Region (*Continued*)

Technology Transfer Needs	All CERCLA	Region									
		I	II	III	IV	V	VI	VII	VIII	IX	X
Procedures for estimating costs and performance for treatments	18	8	14	19	14	42	2	13	18	13	10
Valid GW models and expert systems	19	3	18	14	11	10	15	15	16	13	11
Models for chemical mixture risk characterization	20	14	21	16	13	9	10	19	15	6	8
Results of treatability studies for land disposal	21	8	17	21	11	14	9	11	19	15	12
Disposal methods for residuals from treated waste	22	12	26	17	12	8	10	16	20	12	14
Technical data requirements for enforcement case development	23	9	23	19	18	11	13	15	18	10	19
Hydrologic properties of difficult areas (*e.g.*, Karst)	24	15	22	12	12	15	14	12	23	16	16
Tech & QA for land disposal facility design and construction	25	6	25	24	15	6	13	21	25	15	15
Assessment of oily waste risk and movement	26	17	27	17	13	16	12	18	24	14	18
Source control technologies for RCRA corrective action	27	10	24	23	22	13	19	22	21	19	11
Location standards for land disposal	28	16	28	25	20	15	17	23	26	18	24
Continuous & static monitoring of stack emissions	29	17	29	26	19	20	16	26	22	17	20
Mitigation, removal, & treatment for leaking USTs	30	21	30	21	19	17	22	20	28	14	22
Managing MSW and hazardous waste through prevention	31	19	32	27	17	18	18	25	27	11	17
Limits and safety of municipal waste management options	32	11	31	27	20	17	21	26	29	18	23
Leak detection and prevention for USTs	33	20	29	20	23	19	24	24	32	18	27
Minimum data requirements for RFI or CMS	34	13	30	29	21	18	23	27	31	17	25
Effective oil and gas management practices	35	18	34	22	23	20	24	26	30	20	26
Combustion emission controls for metals, PICs, NOx, etc	36	18	33	30	18	20	23	27	33	19	21
Medical waste management options	37	20	35	28	22	21	20	28	34	21	26

Table 3-4. Ranking of Needs of Primary CERCLA Audiences

State Agency	EPA Contractor	Regulated Community
Selection of Cleanup Technologies	Other (non-technical)	Selection of Treatment Technologies
Other (non-technical)	Selection of Treatment Technologies	Risk Assessment
Monitoring	Monitoring	Other (non-technical)
Ground Water	Alternative Treatment Technologies	Monitoring
Alternative Treatment Technologies	Data Requirements	Ground Water
Data Requirements	Ground Water	Estimating Costs
Risk Assessment	Risk Assessment	Waste Management
Estimating Costs	Treatment Standards	Alternative Treatment Technologies
Treatment Standards	Estimating Costs	Treatment Standards
Waste Management	Land Disposal	Data Requirements
Land Disposal	Waste Management	Land Disposal

4. UST & ESD FINDINGS

This chapter presents the survey results on the technical information needs of Regional Underground Storage Tank (UST) respondents and Environmental Services Division (ESD) respondents, including the needs of their respective end users. Thirty questionnaires were distributed to the Regional UST Program Mangers, and ten Regional UST employees responded. Approximately 20 questionnaires were sent to ESD laboratory directors and quality assurance coordinators, and 12 ESD employees responded. Because of the small survey sizes of each group, statistical analysis of the data was considered inappropriate. Nevertheless, the results reflect some important Regional needs, which are described in the following summary.

4.1 Underground Storage Tanks

Ten Regional UST employees responded to the questionnaire, representing about one tenth of the total number of UST employees in the Regions. Approximately 70% of the respondents have been in their current positions for 3 to 5 years and with the Agency for 11 years or more. The majority of UST respondents are engineers or geologists (70%) and hold masters degrees (60%). UST respondents report that their highest priority job responsibilities involve State oversight of UST regulatory implementation and cleanup. These include a wide variety of duties: LUST Trust Fund contracts and grants management; review and approval of State financial assurance funds; State program review and approval; technical support to the States particularly for leak detection technologies; distribution of detailed information to a variety of people impacted by the program; and oversight of UST cleanup, enforcement, and cost recovery. Table 4-1 summarizes the respondents' experience and educational profiles.

Table 4-1. Experience and Education of UST Respondents

Respondent Profile		<1 Year	1-2 Years	3-5 Years	6-10 Years	>10 Years
Time in Current Position		10%	10%	70%	0%	10%
Time with EPA		0%	10%	20%	0%	70%
Highest Level of Education	University Courses	Bachelors Degree	Graduate Courses	Masters Degree	Ph.D. or J.D.	Other
	10%	10%	10%	60%	10%	0%
Major Field of Study	Environmental Science	Geology Hydrogeology	Engineering	Health Toxicology	Bus/Public Administration	Other
	0%	20%	50%	0%	20%	10%

UST respondents indicate that their highest priority technical needs are in the application of treatment technologies, alternative and innovative treatment technologies, monitoring techniques, and ground water. Table 4-2 presents the 15 highest ranked technology transfer needs of Regional UST respondents. Although only the top 15 are listed here, UST respondents perceive 22 topics as "quite" to "extremely" useful.

Table 4-2. Fifteen Highest Ranked Technical Needs for UST

1. Application of mitigation, removal, and treatment technologies to leaking underground storage tanks.
2. Use and effectiveness of *biological treatment* processes (biodegradation or bioremediation).
3. Field screening, soil vapor, and water sampling for hydrocarbons.
4. Leak detection and prevention methods for underground storage tanks.
5. Ground-water monitoring for site inspection and for evaluating the effectiveness of treatment.
6. Use and effectiveness of *physical treatment* (e.*g.*, soil washing, vacuum extraction).
7. Establishing risk-based cleanup levels.
8. Fate and transport of contaminants in the subsurface.
9. Use and effectiveness of *chemical treatment* (e.*g.*, KPEG).
10. Use and effectiveness of *thermal destruction* (incineration, oxidation).
11. General information on the use and limitations of field sampling and analysis methods.
12. General information on the performance, limits, safety, and cost of hazardous waste/petroleum treatment technologies.
13. Use and effectiveness of *stabilization/solidification.*
14. Selecting and applying release and flow control, and source control technologies for UST (RCRA) corrective action. (Nearly all UST respondents added "UST" to this item.)
15. Development and application of Data Quality Objectives in sampling and analysis plans.

The seven other technical needs that UST respondents rate as "quite" to "extremely" useful include:

- Two topics on data requirements—*Quality assurance for field operations* and *Technical data requirements for enforcement case development including extraordinary circumstances*;

- Two ground-water topics—*Well techniques for determining hydrologic properties of aquifers* and *Hydrologic properties of difficult areas such as Karst terrains and aquifers*;

- Two risk assessment topics—*Assessment of oily waste risk and movement* and *Standardized methods for ecological risk assessment*; and

- One topic on estimating treatment costs—*Uniform procedures for reporting costs and technical performance for operating treatments at UST (RCRA) sites.*

These findings reveal a major interest in technology that improves corrective action, and they concur with UST headquarters objectives for improving speed and quality, and reducing costs, of corrective actions. Regional UST respondents perceive the need for technology transfer products on topics related to cheaper treatment alternatives designed specifically for cleaning up leaking underground storage (LUST) sites, aqueous waste streams, and vapors. The most highly valued topic on alternative treatments is biological treatment processes, which ranks second among all UST respondent needs. This suggests an interest in *in situ* alternatives that go beyond more conventional methods such as pump and treat technologies. Regional and headquarters personnel also recognize the importance of technology transfer topics related to real-time site investigation and characterization methods. Site information is used to confirm the release of contaminants, investigate a site for remediation, assess progress in cleanup, and confirm cleanup.

Regional UST respondents wrote in several technical topics, which are somewhat revealing of their strongest needs. Generally all the additional write-ins are elaborations on topics listed in the questionnaire. They stress the need for technology transfer on petroleum treatment alternatives, including uniform procedures for reporting the technical performance and costs of operating treatments at LUST sites. They also emphasize the need for a wide variety of waste minimization topics, such as pollution prevention through tank upgrade, case studies, and demonstrations of successful practices. Additional write-ins are related to minimal data requirements for LUST, health and safety training, UST inspector training, and disposal methods for treated petroleum/hazardous substance contaminated soil.

UST respondents acknowledge several important end-user audiences in helping them accomplish their job responsibilities. Although State and local governments are the most frequently mentioned audience, UST respondents indicate that responsible parties and others in the regulated community, including contractors and consultants, are also critical technology users. Based on respondent estimates, there may be 200 to 300 State agency personnel active in UST in each Region. Nationally, there are several hundred thousand UST owner/operators.

Approximately, 90% of UST respondents identified State agency staffs as their most important user audience, and 10% listed the regulated community. But again, some respondents pointed

out that because the cleanup process is complex and the critical target audiences can be different depending on the site situation, technology transfer must be designed to meet performance improvement needs of a number of specific target groups.

The OUST is currently conducting State pilot studies of the corrective action implementation process at selected UST sites. A major objective of these pilot studies is to identify specific problems in the corrective action process, define the causes, and demonstrate performance improvement. The effort entails work with personnel at all levels of UST corrective action from State personnel to emergency personnel and contractors. The results will eventually be made available to all States with the intention that they use the pilots as models for analyzing and improving their own UST programs.

In general, the most frequently mentioned technology transfer topics that UST respondents feel their State agency staffs need are rapid site assessment and petroleum cleanup technologies, other than pump-and-treat technologies. Additional technology transfer needs include the following:

- Standards for petroleum cleanup levels that are justifiable and applicable on a site specific basis.
- Standards for qualified tank regulation experts and a means of identifying these experts.
- Waste disposal options (where to send) for contaminated soils and tank systems.
- Information to correctly perform leak detection testing.
- UST investigating procedures.
- UST inspection techniques for upgraded tank systems already in use.
- Information to approve leak detection options, investigation results, remediation plans, and installation and removal plans.
- Technical UST cleanup, enforcement, field measurement, and health and safety training that meets OSHA requirements.
- LUST Trust Fund accounting/cost recovery.
- Uniform cost reporting for compliance with UST rules.

4.2 Environmental Services Division

Twelve ESD personnel responded to the questionnaire, which was sent to laboratory and quality assurance directors. The respondents indicate that their job responsibilities cut across all Agency programs. Responsibilities include in-house sampling analyses, management of Contract Laboratory Program, methods development and implementation, review of project-sampling plans for CERCLA and RCRA activities, technology evaluation and matching of technologies to sites,

design and implementation of the hazardous waste quality assurance programs, data validation, analytical support to program offices, technical consulting to EPA personnel on priority sites, human and ecological health risk assessment, and others.

The majority of ESD respondents have been in their current positions for 3 to 5 years (58%) and have been EPA employees for 11 years or more (67%). Approximately 84% are environmental scientists (chemistry, biology, ecology) and engineers, and most hold a bachelors degree. Table 4-3 presents the ESD respondents' experience and educational profiles.

Table 4-3. Experience and Education of ESD Respondents

Respondent Profile		<1 Year	1-2 Years	3-5 Years	6-10 Years	>10 Years
Time in Current Position		17%	8%	58%	17%	0%
Time with EPA		0%	0%	25%	8%	67%
Highest Level of Education	University Courses	Bachelors Degree	Graduate Courses	Masters Degree	Ph.D. or J.D.	Other
	0%	42%	25%	25%	8%	0%
Major Field of Study	Environmental Science	Geology Hydrogeology	Engineering	Health Toxicology	Bus/Public Administration	Other
	42%	8%	42%	0%	8%	0%

The most useful technology transfer topics identified by ESD respondents are categorized in four thematic areas: Monitoring techniques, data requirements, ground water, and risk assessment. In general, there is a tendency for ESD respondents to value all the questionnaire topics on monitoring techniques more than either RCRA or CERCLA respondents. This is especially true of *General information on field sampling and analysis methods*, listed among the top technical needs for all three groups.

Many of the highest ranked ESD technical topics address quality assurance issues, analytical methods, and sampling designs. Some emphasis on quality assurance was expected; OSWER has recently required the ESD to design and implement quality assurance programs, and the survey targeted the quality assurance coordinators in the laboratories. However, these findings are consistent with the total measurement process outlined last year by Regional ESD Directors. The process includes analytical methods development, criteria to evaluate the significance of data, designing a monitoring/sampling plan, collecting representative samples, and determining and reporting data quality. Table 4-4 presents the 15 highest ranked technology transfer needs of ESD respondents, and includes all topics rated "quite" to "extremely" useful.

Table 4-4. Fifteen Highest Ranked Technical Needs for ESD

1. General information on the use and limitations of field sampling and analysis methods.
2. Field screening, soil vapor, and water sampling for hydrocarbons.
3. Development and application of Data Quality Objectives in sampling and analysis plans.
4. Fate and transport of contaminants in the subsurface.
5. Quality assurance for field operations.
6. Air and other media monitoring for site inspection and for evaluating the effectiveness of treatment.
7. Validated ground-water models and expert systems that support sampling plans and statistical analyses.
8. Ground-water monitoring for site inspection and for evaluating the effectiveness of treatment.
9. Technical data requirements for enforcement case development including extraordinary circumstances.
10. Minimal data requirements for RCRA Facility Investigation or Corrective Measures Study.
11. Use of models for chemical mixture risk characterization.
12. Risk assessment levels for RCRA waste (*e.g.*, incinerator ash, contaminated soil).
13. Technologies and quality assurance information for land disposal facility design and construction.
14. Continuous and static monitoring of stack emissions from all types of incinerators.
15. Well techniques for determining hydrologic properties of aquifers.

Some respondents wrote in additional technology transfer topics. The following list summarizes the major ones:

- Emerging and existing analytical methods.
- Statistical applications for site investigations.
- Statistical methods for environmental monitoring.

- Analytical methods differences between program areas.
- Analytical options and requirements under new QA/QC programs.
- Uniform methods for analysis of environmental samples (all programs).
- Efficient use of remote sensing.
- Dissolved *vs.* total metals in ground water.

ESD respondents indicate that they work with Regional EPA program personnel, other federal agencies, private laboratories, State agency staffs, academic institutions, and the public to accomplish their jobs. Their most important (primary) technology users/clients are EPA contractors in CERCLA and RCRA as well as some responsible party contractors in the regulated communities (50%), State agency staffs and other federal agencies (25%), EPA Regional project officers (17%), and the public (8%). Respondents estimate the size of the contractor audience in each Region to range from about 30 to 150, and from 100 to 300 per Region for State agency staffs.

In general, ESD respondents report similar technology transfer needs for contractors, State agency staffs, and EPA project managers. For these audiences, respondents emphasize data requirements, ground-water topics, and statistical analyses to confirm cleanup. The following list is a summary of contractor and State agency needs:

- Field sampling requirements and quality assurance.
- Establishing data quality objectives.
- Information to evaluate and chose analytical options.
- Statistical evaluation of data collection methods.
- Various treatment technologies, including pumping and treating ground water, and DNAPLs treatment technologies.
- Subsurface fate and transport; and validation of ground-water models.
- ESD laboratory capabilities, and program review and requirements.
- Monitoring and new analytical field techniques.

Technology transfer topics identified for the regulated community include matrix assessments to facilitate selection of remedial measures; information on how to confirm remedial effectiveness and determine the economic efficiency of remedial technologies (life cycle costing); and information on how to maintain remedies over the long term. Topics identified for the public relate to understanding risk assessments.

5. TECHNOLOGY TRANSFER DELIVERY SYSTEMS

This chapter presents the results of the technology transfer delivery systems section of the questionnaire, drawing upon comments from headquarters interviews and Regional site visits as appropriate. Survey respondents' ratings of the utility of various delivery systems are presented first, followed by a discussion of important sources of technical information, and relevant problems or constraints in the use of technology transfer products and activities. These findings are discussed with respect to OSWER programs and Regions. Recommendations for combinations of delivery systems, improvements in current systems, and the use of technology transfer products from other federal agencies as reported by respondents are also included. The final section addresses the relationship between technology transfer needs and preferred delivery systems, and makes recommendations regarding the most appropriate delivery methods for important technical needs.

5.1 Preferred Delivery Systems

Respondents were provided with a list of 15 potential technology transfer delivery methods and asked to rate their usefulness on a scale of 1 ("not at all useful") to 5 ("extremely useful"), and to indicate unfamiliar delivery methods with a zero. The zero rating is included in the calculation of usefulness ratings on the assumption that unfamiliar delivery methods are not very useful. The list of delivery systems, their average ratings, and rank are provided in Table 5-1. As indicated in the table, the overall sample ratings and those for the RCRA, CERCLA, and other program areas are strikingly similar. The top six delivery methods—*Guidance manuals, Technical reports/handbooks, Seminars and workshops, Technology summaries/bulletins, Conferences and symposia, and Technology demonstrations*—are all rated above average in usefulness by all program areas. A one-way ANOVA by program for each delivery method revealed no differences in usefulness ratings. Respondents prefer print media (manuals, reports and handbooks, summaries and bulletins) or direct interaction (seminars, workshops, conferences, and demonstrations) to electronic or automated media.

This finding is consistent with the Superfund Technology Transfer Needs Assessment conducted in 1986. In that study, training courses, technical reports and handbooks, and conferences and seminars were rated as the most effective delivery techniques. Interestingly, technical summaries (or abstracts) and automated databases both were viewed as less effective at that time. On the basis of the weight of other evidence; however, the 1986 study did recommend that OERR develop technical summaries for broad distribution. This strategy apparently is working, as usefulness ratings of technology summaries/bulletins are now comparable with traditionally favored delivery methods.

The findings could also be interpreted as indicating that respondents prefer more familiar to less familiar delivery methods. Although the preference for print media is not surprising, especially in light of the tendency to be more comfortable with that with which one is familiar,

Table 5-1. Average Usefulness Ratings of Technology Transfer Delivery Systems by Program Area

Technology Transfer Delivery System	Overall	CERCLA	RCRA	Other
Guidance manuals	3.98 (1)	3.89 (1)	4.14 (1)	4.00 (1)
Technical Reports/Handbooks	3.89 (2)	3.86 (2)	3.87 (2)	3.86 (2)
Seminars/workshops	3.76 (3)	3.71 (3)	3.83 (3)	3.57 (3)
Technology summaries/bulletins	3.50 (4)	3.52 (4)	3.25 (5)	3.54 (4)
Conference/symposia	3.41 (5)	3.32 (6)	3.38 (4)	3.53 (5)
Technology demonstrations	3.33 (6)	3.34 (5)	3.17 (6)	3.35 (6)
Hotlines	2.95 (7)	2.67 (8)	3.08 (7)	3.29 (8)
Automated databases	2.87 (8)	2.90 (7)	2.53 (10)	3.34 (7)
Technology videotapes	2.77 (9)	2.55 (9)	2.69 (9)	3.21 (9)
Job aids (*e.g., checklists, nomograms*)	2.64 (10)	2.38 (12)	2.84 (8)	2.91 (10)
Teleconferencing	2.54 (11)	2.54 (10)	2.40 (11)	2.68 (13)
Electronic information transfer	2.53 (12)	2.48 (11)	2.33 (14)	2.82 (11)
Expert systems/PC-based models	2.49 (13)	2.37 (13)	2.33 (13)	2.74 (12)
Computer-assisted/interactive training	2.31 (14)	2.12 (14)	2.34 (12)	2.59 (14)
Videoconferencing	1.88 (15)	1.79 (15)	1.90 (15)	1.85 (15)

Key: Average rating
(Rank)

preferences alone do not determine the most appropriate delivery methods. Regional management and staff consistently report that staff are overloaded with information and do not have time to assimilate it all. Regional respondents also rate seminars, workshops, and conferences as very useful; however, as discussed in a later section, Regional staff frequently have problems with travel funds and scheduling time away from the job.

Interviews with OSWER branch chiefs indicated that headquarters is much more likely to endorse alternative delivery methods, such as electronic information transfer and video. Headquarters is generally concerned with broader audiences, including state agencies, the regulated community, and the public. Typically, OSWER program offices are also the source of resources for development of technology transfer products and activities, and must therefore consider the most cost effective means of delivery. The Office of Solid Waste indicated that their target audience for technology transfer includes State as well as Regional permit and compliance staff, the regulated community, numerous trade associations and industry groups, and local municipal solid waste management officials, among others. While they emphasize the importance of guidance, handbooks, workshops, seminars, and symposia for Regional staff, OSW management feels that technical and policy guidance documents are under-utilized because they are usually too lengthy and inconvenient to use; they also are not well publicized.[4] OSW management also feels that other formats, such as videotapes, hotlines, and electronic bulletin boards serve useful purposes and are cost effective for large audiences. The Office of Underground Storage Tanks targets state and local regulators, contractors and consultants, and Responsible Parties at hundreds of thousands of corrective action sites nationwide. Accordingly, OUST has focused on a number of outreach products including technology summaries, handbooks, and videotapes—as they consider conferences, workshops, and hotlines too costly for the size and diversity of the UST audience.

The Office of Emergency and Remedial Response focuses more specifically on Regional staff involved in the Superfund program, EPA contractors, State project managers, PRPs and their contractors. Their preferred delivery systems include guidance manuals and handbooks, conferences and workshops, technology summaries and bulletins, as well as automated databases, expert systems, and electronic information transfer. OERR management also expressed the opinion that it may be necessary to disseminate technical information in a variety of forms or delivery methods, so that the user has the information available in his or her preferred format. Both RCRA and CERCLA audiences are targeted by the Office of Waste Programs Enforcement. While OWPE managers emphasized the importance of guidance manuals, handbooks, and workshops for Regional staff, they also felt that high-quality videotapes and electronic information transfer is useful. OWPE is also working with OSWER in developing EPA's first interactive videodisc training program on Land Disposal Restrictions. OSW and OWPE both stressed the importance of providing workshops or training along with new guidance or manuals, so that Regional staff might use this information appropriately.

[4]Memorandum and attached paper from WMD Director to Director of OSW, October, 1987: Improving the utility of WMD (and OSW) Guidance.

Several respondents at headquarters and in the Regions commented that they do not trust expert systems. Some feel that once they have gone to the trouble to input all the required facts and information, they can reach a better solution using their own judgement; while others question the quality control aspects of developing and maintaining expert systems. Automated databases may be similarity distrusted. Respondents both in headquarters and in the Regions expressed the opinion that currently available databases are incomplete and not kept up-to-date.

Examination of delivery system preferences across Regions shows few differences. *Guidance manuals, Technical reports and handbooks,* and *Seminars and workshops* are the highest rated delivery methods for all ten Regions, as can be seen in Table 5-2. Similarly, *Technology summaries/bulletins, Conferences,* and *Technology demonstrations* are rated above average in utility by all Regions. However, a few Regions also rate some of the remaining delivery systems as above average in usefulness. Regions I, II, IV, and X rate *Automated databases* as useful and *Hotlines* are considered useful by Regions II, III, VI, IX, and X.

Two additional items included in the questionnaire address the topic of combinations of delivery systems and recommendations to improve the utility of existing systems. Respondents were asked to indicate which of the delivery systems listed in the previous question are best used in combination, such as guidance manuals with workshops, or a technology bulletin with a report. Suggestions for combinations of delivery methods were made by 186 respondents (or 78% of respondents). The great majority of these (123 or 52%) recommend that guidance manuals, technical reports, or handbooks be accompanied by a workshop or seminar. (This combination was given as an example in the questionnaire.) Other combinations of interest to Regional respondents include: guidance, reports or handbooks with a technical demonstration (30 or 16%); guidance, reports or handbooks with technical summaries or bulletins (12 or 6%); guidance, reports or handbooks with computer-assisted instruction (9 or 4%); and automated databases with computer-assisted instruction (5 or 2.5%).

Recommendations for improvements in delivery systems were also solicited by asking what could be done to improve the utility of available systems that are not found useful. This short answer question received 142 responses (59% of the overall sample), which were analyzed for content and coded into 8 separate categories. Respondents recommend:

- Improved access to computers or systems (32 individuals or 22.5% of the sample)
- Better targeted or more specific products (14 or 10%)
- Broader dissemination of what is available (13 or 9%)
- Training on the use of computer systems (12 or 8.5%)

Among the other recommendations mentioned by one or more respondents are: improve available training, reduce the amount of paper that must be processed, provide more timely technology transfer, and improve quality assurance of technology transfer products.

Table 5-2. Average Ratings of Technology Transfer Delivery Systems by Region

Technology Transfer Delivery System	Region									
	I	II	III	IV	V	VI	VII	VIII	IX	X
Guidance manuals	4.00 (1)	4.38 (1)	3.90 (1)	4.19 (1)	3.77 (2)	4.17 (1)	3.64 (3)	3.83 (1)	4.14 (1)	3.86 (1)
Technical Reports/Handbooks	3.93 (2)	4.31 (2)	3.87 (2)	3.77 (2)	3.87 (1)	3.96 (3)	3.88 (2)	3.83 (1)	3.14 (4)	3.86 (1)
Seminars/workshops	3.87 (3)	3.81 (4)	3.74 (3)	3.65 (3)	3.84 (3)	4.00 (2)	3.92 (1)	3.83 (1)	3.29 (3)	3.38 (3)
Technology summaries/bulletins	3.60 (4)	4.03 (3)	3.43 (5)	3.12 (6)	3.42 (5)	3.57 (6)	3.52 (4)	3.74 (2)	3.00 (6)	3.14 (7)
Conference/symposia	3.07 (6)	3.61 (5)	3.60 (4)	3.25 (5)	3.48 (4)	3.68 (4)	3.64 (3)	3.08 (4)	2.71 (8)	3.33 (5)
Technology demonstrations	3.13 (5)	3.38 (6)	3.13 (6)	3.25 (5)	3.48 (4)	3.61 (5)	3.20 (5)	3.44 (3)	3.07 (5)	3.43 (2)
Hotlines	2.73 (9)	3.30 (8)	3.07 (7)	2.38 (10)	2.84 (7)	3.05 (7)	2.48 (8)	2.82 (6)	3.36 (2)	3.29 (6)
Automated databases	3.07 (6)	3.34 (7)	2.86 (9)	3.29 (4)	2.55 (9)	2.86 (9)	2.24 (11)	2.74 (7)	2.43 (9)	3.35 (4)
Technology videotapes	2.87 (7)	2.78 (12)	2.80 (10)	3.12 (6)	3.03 (6)	3.00 (8)	2.96 (6)	2.83 (5)	1.50 (12)	2.25 (12)
Job aids (*e.g., checklists, nomograms*)	2.60 (10)	3.00 (10)	2.86 (9)	2.06 (12)	2.77 (8)	3.00 (8)	2.08 (13)	2.55 (8)	2.79 (7)	2.30 (11)
Teleconferencing	1.93 (13)	2.63 (13)	3.03 (8)	2.25 (11)	2.55 (9)	2.81 (10)	2.71 (7)	2.44 (12)	1.71 (11)	2.58 (9)
Electronic information transfer	2.27 (12)	3.16 (9)	2.73 (11)	3.00 (7)	2.30 (11)	2.34 (13)	2.12 (12)	2.54 (9)	1.86 (10)	2.84 (8)
Expert systems/PC-based models	2.79 (8)	2.90 (11)	2.70 (12)	2.75 (8)	2.26 (12)	2.46 (12)	2.32 (9)	2.46 (11)	1.50 (12)	2.43 (10)
Computer-assisted/interactive training	2.50 (11)	2.53 (14)	2.13 (13)	2.44 (9)	2.33 (10)	2.55 (11)	2.28 (10)	2.52 (10)	1.36 (13)	2.10 (13)
Videoconferencing	1.53 (14)	2.06 (15)	1.96 (14)	2.00 (13)	2.19 (13)	1.59 (14)	2.01 (14)	2.08 (13)	0.86 (14)	1.55 (14)

5.2 Important Sources of Information

Respondents were asked to rate the importance of a dozen potential sources of technical information that are available to support staff in hazardous and solid waste. A scale of 1 ("not at all useful") to 5 ("extremely useful") was provided, with zero representing unfamiliar or inapplicable information sources. The overall results of this item are provided in Table 5-3, along with breakdowns for RCRA, CERCLA, and other programs. The top three information sources based on ratings of usefulness include: *Other professional staff in my office; EPA Regional, Headquarters, or Laboratory Library;* and *EPA Headquarters Contacts.* Other sources that rate above average in usefulness include *Supervisor, branch, or division; State agencies;* and *ORD laboratory contacts.* The only significant differences found between programs are that CERCLA respondents find *Other federal agencies* and *Technology vendors* to be somewhat more useful sources of information than do RCRA respondents.

Several of the general comments from respondents addressed the availability of technical information, especially print materials. In general, respondents indicate that sending a single copy of a report to the Division director or branch chief is inefficient, and that they are frequently unaware or unable to locate a copy of important technical documents.

As a followup to the question on information sources, respondents were asked to list examples of technology transfer products from other federal agencies that they use in their work. Thirty-three percent of the respondents did so, also indicating the specific agencies that produced the information they use. The U.S. Geological Survey was by far the most frequently listed source of technical information among other federal agencies, constituting 41 respondents (52% of those listing technology transfer products from other federal agencies). Another 22 respondents (28%) listed technical information from the Occupational Safety and Health Administration, specifically the National Institute for Occupational Health and Safety (NIOSH). The U.S. Army Corps of Engineers and the Agency for Toxic Substances and Disease Registry (ATSDR) are each mentioned as technical resources by 14 individuals (17%), and the Departments of Defense and Energy are each listed by 12 respondents (15%). Other federal agencies mentioned by two or more respondents include the National Institute for Environmental Health Sciences (NIEHS), Department of the Interior (DOI), National Oceanic and Atmospheric Administration (NOAA), and the Nuclear Regulatory Commission (NRC).

Ratings of information sources by Region were also examined. Table 5-4 presents average usefulness ratings and rankings for each of the 12 information sources by Region. Regional ratings correspond quite closely to the overall ratings, and show considerable agreement across Regions. Regions II, III, IV, VI, and X are somewhat more likely to view EPA Headquarters Contacts as useful. Supervisor, branch, or division is rated slightly higher by Regions I, II, III, V, VII, and IX than by the other Regions. Regions II and III rate State agencies as somewhat more useful, and Region II has the highest rating for ORD Contacts.

Table 5-3. Average Usefulness Ratings of Sources of Technology Transfer Information by Program Area

Sources of Technology Transfer Information	Overall	CERCLA	RCRA	Other
Other Professional Staff in my Office	4.02 (1)	4.04 (1)	3.99 (1)	3.69 (1)
EPA Regional, Headquarters, or Laboratory Library	3.10 (2)	2.99 (3)	3.28 (2)	3.18 (3)
EPA Headquarters Contacts	3.04 (3)	2.89 (4)	3.21 (3)	3.20 (2)
Supervisor, Branch or Division	2.98 (4)	3.04 (2)	2.81 (4)	2.41 (6)
State Agencies	2.63 (5)	2.54 (6)	2.72 (5)	2.52 (5)
ORD Laboratory Contacts	2.48 (6)	2.55 (5)	2.24 (6)	2.59 (4)
Other Federal Agencies	2.06 (7)	2.43 (7)	1.56 (9)	2.00 (9)
Technology Vendors	2.30 (8)	2.16 (8)	1.65 (8)	2.15 (8)
ORD Regional Scientist	1.88 (9)	1.85 (9)	1.83 (7)	2.25 (7)
Affiliated Universities	1.53 (10)	1.58 (10)	1.24 (10)	1.82 (10)
Center for Environmental Research Information (CERI)	1.35 (11)	1.40 (11)	1.22 (11)	1.52 (11)
Clearinghouses	1.18 (12)	1.33 (12)	0.91 (12)	1.23 (12)

Key: Average rating
(Rank)

Table 5-4. Average Ratings of Sources of Technology Transfer Information by Region

Sources of Technology Transfer Information	Region									
	I	II	III	IV	V	VI	VII	VIII	IX	X
Other Professional Staff in my Office	4.20 (1)	3.94 (1)	4.23 (1)	3.93 (1)	3.93 (1)	4.39 (1)	3.96 (1)	3.36 (1)	4.15 (1)	4.25 (1)
EPA Regional, Headquarters, or Laboratory Library	3.67 (2)	3.18 (3)	3.58 (2)	2.67 (4)	2.77 (5)	3.00 (3)	2.80 (3)	3.04 (2)	3.00 (3)	3.20 (2)
EPA Headquarters Contacts	2.80 (4)	3.27 (2)	3.45 (3)	3.06 (2)	2.87 (4)	3.30 (2)	2.80 (3)	2.75 (3)	2.54 (5)	3.05 (3)
Supervisor, Branch, or Division	3.33 (3)	3.09 (4)	3.07 (4)	2.75 (3)	3.43 (2)	2.74 (5)	3.24 (2)	2.36 (4)	3.08 (2)	2.58 (6)
State Agencies	2.21 (5)	3.07 (5)	2.90 (5)	2.25 (7)	3.07 (3)	2.77 (4)	2.04 (6)	2.04 (7)	2.77 (4)	2.70 (5)
ORD Laboratory Contacts	2.80 (4)	3.00 (6)	2.65 (6)	2.44 (5)	1.97 (7)	2.55 (6)	2.36 (4)	2.08 (6)	1.92 (6)	2.90 (4)
Other Federal Agencies	2.07 (6)	2.16 (8)	2.47 (7)	2.07 (8)	2.00 (6)	1.96 (8)	1.96 (7)	1.96 (8)	1.39 (8)	2.15 (8)
Technology Vendors	1.93 (7)	2.23 (7)	1.83 (9)	2.38 (6)	1.93 (8)	2.32 (7)	2.08 (5)	2.14 (5)	1.23 (10)	2.00 (10)
ORD Regional Scientist	1.46 (9)	2.07 (9)	2.17 (8)	1.93 (9)	1.73 (9)	1.73 (10)	1.92 (8)	1.60 (9)	1.54 (7)	2.32 (7)
Affilitated Universities	1.71 (8)	1.23 (10)	1.43 (12)	1.47 (10)	1.60 (10)	1.91 (9)	1.50 (10)	1.50 (10)	0.85 (11)	2.06 (9)
Center for Environmental Research Information (CERI)	1.21 (11)	1.17 (11)	1.63 (10)	1.14 (12)	1.45 (11)	1.46 (11)	1.24 (11)	1.22 (11)	1.25 (9)	1.50 (11)
Clearinghouses	1.36 (10)	0.86 (12)	1.55 (11)	1.21 (11)	1.31 (12)	1.46 (11)	1.67 (9)	0.86 (12)	0.69 (12)	1.18 (12)

Key: Average rating
(Rank)

In general, these important sources of information—other professional staff, EPA libraries, and EPA headquarters contacts—suggest networks for coordinating technology transfer information most likely to be successful. Sources not now considered important or typically used by a majority of the respondents could also become coordination points for technology transfer, but additional effort will need to be expended in letting Regional staff know that useful information is available from that source.

5.3 Constraints in Use of Technology Transfer Products and Activities

The final set of items in the questionnaire asked respondents to rate the constraints that they had experienced in the use of technology transfer products and services on a scale of 1 ("no problem") to 5 ("severe problem"). The list of ten potential constraints contained in the questionnaire had been developed on the basis of previous studies, such as the 1986 Technology Transfer Needs Assessment for Superfund and the *Technology Transfer Priorities Study* developed by OSWER and ORD in November, 1988. Ratings of problems or constraints in the use of technology transfer products and activities by program area are presented in Table 5-5.

First among the problems encountered by Regional staff in effectively accessing and using technology transfer information is a lack of sufficient time due to pressing job responsibilities. Thirty-six percent of the overall sample rate this as a "severe problem," and this is consistent across program areas. This issue has been widely recognized in several reviews of the Superfund program (*e.g.*, 1986 Technology Transfer Study, 1988 Technology Transfer Priorities Study, and the recent *Management Review of the Superfund Program*), as well as by OSW management. Approaches to alleviating the problem have ranged from alternative technical information delivery techniques (such as summaries, bulletins, and automated abstracts), to mandatory training, and to proposals for additional technical support and additional FTEs to ease the work load of Regional staff. One of the consequences of this situation is that field staff do not take the time to keep informed of new technical information as it becomes available. Regional staff report that they need to be able locate and access technical information at the appropriate time, indicating that training will be attended or reports read only if they are relevant to an immediate problem.

Two of the most serious problems encountered in utilizing technology transfer products and activities involve awareness of what is available. Seventy-three percent of respondents consider this to be a moderate to severe problem (rating of 3 to 5), while 65% feel that learning about technology transfer activities in sufficient time to take advantage of them is a moderate to severe problem. This finding suggests that greater effort needs to be expended in communicating about technology transfer activities. A technology transfer newsletter to broadly disseminate this information has frequently been recommended, and OSWER will soon begin publication of a technology newsletter which will provide bi-monthly updates on many technology transfer activities. Some Regional staff report that while they have frequently had trouble locating technical and guidance information in the past, recent print and electronic information directories are useful (*e.g.*, OSWER Training Calendar, Electronic Bulletin Board, and Region III's automated technology transfer information directory). Also most Regional Waste Management Divisions are establishing their own information repositories for printed materials and announcements.

Table 5-5. Constraints in Use of Technology Transfer Products and Activities by Program Area

Technology Transfer Constraints	Overall	CERCLA	RCRA	Other
Unable to take sufficient time away from job responsibilities	3.72 (1)	3.67 (1)	3.81 (1)	3.42 (2)
Not aware of available tech transfer products or activities	3.23 (2)	3.02 (2)	3.45 (3)	3.43 (1)
Insufficient travel funds	3.05 (3)	2.50 (6)	3.72 (2)	3.25 (4)
Not aware of tech transfer activities in sufficient time to plan	3.00 (4)	2.86 (4)	3.16 (4)	3.37 (3)
Aware of tech transfer products, but access is too difficult	2.96 (5)	2.97 (3)	3.05 (5)	2.65 (5)
Limited access to computers or modems	2.80 (6)	2.66 (5)	3.01 (6)	2.44 (6)
Need for basic computer training	2.47 (7)	2.35 (7)	2.56 (7)	2.44 (6)
Information is not collected, assembled, or published by EPA	1.92 (8)	1.85 (8)	2.03 (8)	1.97 (7)
Unsure of applicability to job responsibilities	1.81 (9)	1.64 (10)	2.01 (9)	1.64 (8)
Do not trust source of technical information	1.69 (10)	1.67 (9)	1.66 (10)	1.55 (9)

Key: Average rating
(Rank)

A related problem, also among the top five delivery system constraints, concerns situations in which Regional staff are aware of available technology transfer products, but access is too difficult (*e.g.*, problems are encountered in locating reports, or information is too disorganized or difficult to assimilate). A more coordinated technology transfer program at the Regional level, better targeted technology transfer products, and more and better communications within the Agency are called for. Although numerous activities are now underway to address this issue, it continues to be a central problem in technology transfer for OSWER.

The availability of sufficient travel funds is rated as a relatively serious problem in taking advantage of technology transfer activities. This is also the one area in which RCRA respondents report significantly more difficulty than CERCLA respondents. Technology transfer planners in OSWER and ORD are well aware of this problem and are making efforts to bring seminars, workshops, and meetings to the Regions whenever possible. This problem is exacerbated by relatively high turnover rates among Regional staff (estimates range from 15% to 25% and vary by Region), leading to the examination of alternatives, such as videotape or interactive video-conferencing, to ensure that technical information is available when it is needed and to avoid travel restrictions.

Limited access to computers or modems and the need for basic computer training are also considered problems, but less serious than those already mentioned. The Superfund office has made a commitment to "ensuring that all key field staff have immediate access to personal computers, portable computers for the field, related hardware and software, and communications capabilities to access OSWER information systems."[5] Current problems focus on communications software and knowing how to use it, as well as being aware of available automated information systems and developing the skills to access them. The solution to this problem for RCRA staff is less clear.

Table 5-6 displays the average rating of seriousness and the ranking of technology transfer constraints by Region. Although it is difficult to make comparisons among the Regions due to differing response rates to the survey, the data reveal potential differences between the Regions in some areas. For example insufficient travel funds seems to be a more serious constraint for Regions IV, VI, and X. Additionally, limited access to computers and modems is considered more of a problem by respondents in Regions VI and X.

These constraints to the use of technology transfer information should be considered in any attempts to provide useful technical products and activities to the Regions. For example, bringing seminars and workshops to the Regions reduces the time that staff must spend away from their job responsibilities, and alleviates problems with travel funds. The fact that Regional staff are frequently not aware of technology transfer products and activities, or not aware in sufficient time to use them suggests that greater coordination and better advertising of products is needed. Difficulty in accessing technology transfer information could result in the best technical information being ignored by those who need it most. Technology transfer information must be better targeted, more easily located, and succinct if it is to be useful. Finally, continuing problems with access to and skills in using personal computers and electronic information must be considered when these delivery systems are selected for technology transfer.

[5] *A Management Review of the Superfund Program*, EPA, Office of the Administrator, Spring, 1989.

Table 5-6. Constraints in Use of Technology Transfer Products and Activities by Region

Technology Transfer Constraints	Region									
	I	II	III	IV	V	VI	VII	VIII	IX	X
Unable to take sufficient time away from job	3.14 (1)	4.09 (1)	3.30 (1)	3.19 (2)	3.48 (1)	4.27 (1)	3.84 (1)	3.78 (1)	3.69 (1)	4.16 (1)
Not aware of available tech transfer products or activities	3.08 (2)	3.33 (2)	2.08 (3)	3.18 (3)	3.42 (2)	3.24 (6)	3.12 (3)	3.35 (2)	3.36 (2)	3.42 (4)
Insufficient travel funds	2.57 (4)	2.61 (6)	2.07 (7)	3.53 (1)	3.32 (3)	4.19 (3)	2.88 (5)	3.30 (3)	2.54 (5)	3.84 (2)
Not aware of tech transfer activities in sufficient time	2.33 (6)	3.12 (4)	2.67 (5)	3.06 (4)	2.94 (4)	3.43 (4)	3.19 (2)	3.23 (4)	2.77 (3)	3.00 (6)
Aware of tech transfer, but access is too difficult	2.64 (3)	3.31 (3)	2.93 (2)	3.00 (5)	2.90 (5)	2.86 (7)	2.92 (4)	2.81 (5)	2.39 (6)	3.41 (5)
Limited access to computers or modems	2.40 (5)	2.69 (5)	2.70 (4)	2.06 (8)	2.23 (7)	4.32 (2)	2.86 (6)	2.59 (6)	2.62 (4)	3.61 (3)
Need for basic computer training	1.93 (7)	2.03 (7)	2.33 (6)	2.59 (6)	2.58 (6)	3.29 (5)	2.80 (7)	2.44 (7)	2.14 (7)	2.50 (7)
Info not collected, assembled, or published by EPA	1.83 (8)	1.90 (8)	1.70 (9)	2.50 (7)	2.03 (8)	1.75 (8)	2.09 (8)	1.76 (9)	1.42 (9)	2.20 (9)
Unsure of applicability to job responsibilities	1.60 (10)	1.61 (9)	1.77 (8)	1.63 (10)	2.03 (8)	1.43 (10)	1.96 (9)	2.09 (8)	1.77 (8)	2.06 (7)
Do not trust source of technical information	1.64 (9)	1.58 (10)	1.47 (10)	1.88 (9)	1.77 (9)	1.71 (9)	1.63 (10)	1.65 (10)	1.08 (10)	2.50 (8)

Key: Average rating
(Rank)

5.4 Relating Delivery Systems to Technical Needs

One of the major purposes of the Needs Assessment was to attempt to relate specific technical needs with particular delivery systems or methods. In general, the findings of the survey show a great deal of consistency across programs and Regions in both technical needs and delivery system preferences and constraints. Because of the consistency of needs across programs, Regions, and most background items measured in the study, there was little likelihood that these variables would be effective in determining differences in preferred delivery systems.

Other considerations important in selecting the most appropriate delivery system were not measured directly in the study. The size of the audience is an important characteristic, as various delivery methods have different costs depending on the size of the user audience. More expensive development costs can be justified on the basis of lower delivery costs per person. However, for the most part, data collected in the current study is relevant to all Regional hazardous and solid waste program staff. While some information on end-user audiences (such as State agency staff, EPA contractors and the regulated community) was collected from the Regional respondents, they were not the focus of the study, and their needs were not directly measured. In addition, no data was collected on costs, level of presentation/complexity, or characteristics of the available knowledge base. Furthermore, the survey contains no valuative data on success of various delivery methods in providing technical information to the Regional staff. Each of these limits the ability of the study to empirically determine the most appropriate delivery method to meet a given technical need.

The survey data did allow an examination of the relationship between technical needs and preferred delivery systems for Regional respondents. Correlations were computed between each of the 40 technical needs and 15 delivery systems to provide an approximation of which delivery systems should be considered first for meeting the various needs. Partial correlations controlling for program area and Region show some variation in the relationships between needs and delivery systems, suggesting somewhat different patterns for RCRA and CERCLA. However, since the technical needs for the two programs correspond so closely, it was felt that these minor differences in delivery system preferences would be less important than other considerations, such as available resources. Results of the correlational analysis are presented in Table 5-7. For each of the 40 technical needs, the two or three highest correlations are highlighted. These range from a high of about 0.50 to a low of approximately 0.20. Smaller correlations that are nonetheless highly significant are also indicated. Finally, the 15 highest rated technical needs are shaded in the table for easy recognition.

Relationships between ratings of importance for technology transfer needs and specific delivery systems indicate that those respondents demonstrating the greatest need for a technical item are also likely to find the related delivery system useful. This does not necessarily mean that a given delivery method will be most appropriate for meeting that need. Numerous other factors, such as those discussed above, must also be taken into consideration. The remainder of this section discusses recommended and potential delivery methods for the most important needs identified by the survey for Regional hazardous and solid waste personnel.

In general, technical bulletins, demonstrations, videotapes, and technical reports are among the delivery methods most highly correlated with technical needs. Guidance manuals, workshops,

and computer-based models or expert systems also show a number of significant correlations with observed technical needs. Among the top 15 technical needs for the overall sample, all show significant correlations with technical bulletins/summaries, and most are highly correlated with technical demonstrations and technical reports. Other delivery methods correlated with the highest rated technical needs include workshops, technology videos, guidance manuals, PC-based systems, job aids, and videoconferences. On the other end of the scale, conferences, teleconferences, and automated databases may be over-rated mechanisms, at least as far as Regional respondents are currently concerned.

Regional needs for *Establishing risk-based cleanup levels* are most closely associated with technical reports, technical bulletins, and videotape, although preferences for technical demonstrations and workshops also showed significant relationships. Given the broad audience and apparent urgency of this need, it would seem that a technical bulletin and accompanying technical report should be prepared first on this topic. Depending on the level of available resources other potential delivery systems should be considered, such as accompanying workshops and technical demonstrations. A videotape of essential factors in the process would provide access to the information provided in the workshop or demonstration for those unable to attend, and would be useful in addressing the need to disseminate this information to broader audiences among State agencies and the regulated community.

The two highest rated ground-water items are *Ground-water monitoring* and *Fate and transport of contaminants in the subsurface*. Preferences for technical reports and technical bulletins/summaries show strong associations with these needs, suggesting that they should be provided for these topics. Workshops and technical demonstrations should be considered for providing the needed technical information on ground-water monitoring. Computer models or PC-based systems for fate and transport, if available, should be accompanied by demonstrations in their use.

Technical bulletins/summaries and technical demonstrations are the delivery systems most closely associated with needs for information in *Alternative and innovative treatment technologies*. Respondents apparently need to know the basics of how these systems work to determine whether they may be applicable to a given remedial or corrective action problem. Other technology transfer delivery methods closely associated with needs for this type of information include technical reports, workshops, and in some instances, videotape. Needs for *General technical information on the performance, limits, safety, and costs of treatments* and *Prototype remedy selection models* are also highly associated with technical bulletins and demonstrations. While it would also seem reasonable to provide automated databases or electronic methods for specific information on performance and costs of technologies, the survey suggests that the individuals most in need of this type of information would be less likely to use information in these formats. If these systems are to be used, training or demonstrations may be required as well.

Technical information needs for monitoring technologies, including *General technical information on the use and limitations of field sampling and analysis methods* and *Field screening, soil vapor, and water sampling for hydrocarbons* show significant associations with a number of delivery systems. The strongest correlations are with technical reports, demonstrations, and technical bulletins or summaries. Preferences for workshops, guidance

Table 5-7. Relationship of Technology Transfer Needs and Delivery Systems

Technology Transfer Needs	Delivery Systems														
	Tech reprt	Guid man	Tech demo	Conf	Wrk-shops	Tech Bull	Tech video	PCs	CAI	Elect trans	Auto data	Hot-line	Job aids	Tele-conf	Vid-conf
GW monitoring for site inspection and evaluation of treatments	●		o		●	●									
Well techniques for determining hydrologic properties of aquifers	●		o		●	●				o					
Fate and transport of contaminants in the subsurface	●		o			●		●							
Hydrologic properties of difficult areas (*e.g.*, Karst)			o	●		●		●							
Valid GW models and expert systems	●				o	o		●	o	●	o				
Info on use & limitations of field sampling and analysis methods	●	o	●		o	●	o								
Air and other media monitoring for site inspection and evaluation	o	o	●			●	●								
Continuous & static monitoring of stack emissions		●					●						●		
Field screening soil vapor and water sampling for hydrocarbons	●		●			●	o								
Leak detection and prevention for USTs		o	o			o	●	●	●				o		
Risk assessment: risk levels for RCRA wastes		●		o	o	●	o					o	●		o
Models for chemical mixture risk		●				●		o				●			
Standardized methods for ecological risk assessment	●	o			●	●									
Assessment of oily waste risk and movement								●				●			
Applicability of RCRA treatment standards to Superfund			●			●	●								
Establishing risk-based cleanup levels	●		o		o	●	●								
Information on performance, costs of treatments			●			●									
Source control technologies for RCRA corrective action	●	●				●									
Prototype remedy selection models			●			●	●								

● = Recommended Delivery Systems (three highest correlations)
o = Potential Delivery Systems (r significant at .01 level)

Table 5-7. Relationship of Technology Transfer Needs and Delivery Systems

Technology Transfer Needs	Delivery Systems														
	Tech reprt	Guid man	Tech demo	Conf	Wrk-shops	Tech Bull	Tech video	PCs	CAI	Elect trans	Auto data	Hot-line	Job aids	Tele-conf	Vid-conf
Mitigation, removal, & treatment for leaking USTs			●			○	●	○	○						
Limits and safety of municipal waste management options								○	●		○		●		
Combustion emission controls for metals, PICs, NOx, etc						○	●		●				●		
Disposal methods for residuals from treated waste			●			●	●						○		○
Effective oil and gas management practices							●	●	●						
Medical waste management options							●		●						
Use and effectiveness of physical treatment	○		●		●	●									
Use and effectiveness of chemical treatment	●		●		○	●	○								
Use and effectiveness of biological treatment	○		●		●	●									
Use and effectiveness of thermal destruction	●		●		○	●	○								
Use and effectiveness of S/S	●		●		○	●		○							
Procedures for estimating costs for construction and O & M	○		●			●									
Procedures for reporting costs and performance			●			●		○							
Minimum data requirements for RFI or CMS		●													
Technical data requirements for enforcement case development			●				●								
Development of DQOs in sampling and analysis plans	●	○	●			●	○								
Quality assurance for field operations			●			●									
Managing MSW and hazardous waste through prevention							●								
Tech & QA for land disposal facility design & construction	○		○			●	●		○	●					
Location standards for land disposal			○				●	●	●						
Results of treatability studies for land disposal			●			●	○	○							

● = Recommended Delivery Systems (three highest correlations)
○ = Potential Delivery Systems (r significant at .01 level)

manuals, and videotapes are also strongly associated with these needs. It is possible that a number of delivery methods should be developed to meet technical needs of the various audiences requiring this type of information.

Risk assessment: risk levels for RCRA wastes is also among the top rated technology transfer needs of the overall sample. Delivery systems associated with this need include guidance manuals, technical bulletins or summaries, and job aids. A number of other delivery methods, such as workshops and video, also are significantly correlated with ratings of the importance of risk assessment. The choice of specific delivery systems for risk assessment information should include one or more of these methods.

Two additional needs rated in the top 15 for importance are *Development and application of Data Quality Objectives in sampling and analysis plans* and *Quality assurance for field operations*. Both items are highly correlated with technical bulletins/summaries and technical demonstrations. Technical reports, guidance manuals, and technology videotapes are also correlates of the item on DQOs. It is clear that a variety of approaches are available for developing technology transfer information for Data Quality Objectives, but that these should include a technical summary and demonstration or instruction in their application. The need for technical information on QA for field operations would probably benefit from a separate technical summary, but might also be included in technology transfer materials developed in order to meet the need for general technical information for field sampling and analysis.

Most all of the technical needs rated as "quite" to "extremely" important by respondents to the survey are also associated with the most preferred delivery methods, including technical reports, summaries or bulletins, and technical demonstrations. Other important technical needs were also related to alternative delivery methods, such as PC-based systems, technology videotapes, and computer assisted instruction. Choices among these delivery methods and systems must be based on a number of considerations. Some of the most important determinants in addition to user preferences include: the timing of products/urgency of need; resources available; level of detail/complexity required; audience characteristics such as background and experience, turnover rate among the audience, etc. Training or demonstrations in use of new systems is needed to overcome negative attitudes and skill deficiencies regarding automated databases and electronic information transfer. Institutional barriers, such as lack of access to computers and modems, and insufficient travel funds also must be addressed by developers of technology transfer information. Characteristics of the information itself and availability issues (e.g., does the information exist, can it be easily compiled, rate of change in technical information) must be determined by technical experts.

In targeting technical information to specific audiences, the above factors must be taken into account, along with consideration of how the audience will use the technical information. Technology transfer developers must also ensure that products and activities are well advertised and coordinated. Finally, the role of evaluation and feedback can not be overemphasized, otherwise technology transfer developers will not know whether needs are being met, or how to correct problems that persist.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 Considerations and Survey Limitations

The main purpose of the needs assessment was to identify high priority Regional technical information needs over the next three to four years for RCRA, CERCLA, UST, and other OSWER program areas. Since Regional personnel are not the only end-users of technology (State agencies, the regulated communities, contractors, and others have operative roles in the implementation of environmental protection legislation), another objective of the survey was to identify key OSWER audiences and their major technical needs. The final objective of the needs assessment was to identify effective distribution mechanisms for all of OSWER and to relate preferred delivery systems to observed needs. No attempt was made to directly evaluate the effectiveness of currently offered technology transfer products and activities. Although some current technology transfer products and activities are discussed in the report, no attempt was made either to inventory technology transfer products and activities, or to identify gaps in technology transfer information.

The survey corroborates and extends the findings of a 1986 Technology Transfer survey conducted for the Superfund Program. The 1986 survey relied largely on group interviews conducted in the Regions and focused on particular planned or existing technology transfer products, rather than a broader list of technical topics. The previous study was conducted specifically for the Superfund program and did not include RCRA, UST, or other programs. However, it is possible to compare the previous findings with the results of the CERCLA responses in the current study. Both surveys noted that about 50% of CERCLA respondents had been in their current position for two years or less. General technical needs for Superfund identified by both studies focused on treatment technologies, including innovative approaches to remediation. The 1986 needs assessment found that guidance documents, training courses, technical reports and handbooks, and conferences and seminars were considered the most effective delivery methods, as did the present study. However, technology bulletins were rated relatively low in effectiveness, whereas the present study found them to be "quite to extremely" useful. Increased ratings of the effectiveness of this delivery method is probably related to greater experience with technical bulletins and summaries among the Regional staff. The previous study also noted problems in locating, obtaining, and assimilating technical information, and this does not appear to have changed greatly. The previous study strongly recommended that a centralized distribution system, or clearinghouse be established for all technical information; while the present study found more evidence to support Regional information centers.

The needs assessment does not address potential research needs associated with high priority technical topics. The survey listed technology transfer topics identified by headquarters management as important for accomplishing hazardous and solid waste goals. Regional respondents were asked to rate the importance of these needs to accomplishing their job responsibilities and to identify other important technical topics. Whereas the findings of the study may have implications for research needs, the availability of technical information

addressing these topics was not assessed, and no recommendations for research are included in the report.

While the needs assessment did not specifically address training needs, in practice, it is frequently difficult to distinguish training and technology transfer needs. Respondents frequently recommend training to meet specific technical needs, and workshops/seminars are one of the technology transfer delivery methods rated most useful by Regional staff. In this regard, the study has considerable relevance to future training plans, as well as those for technology transfer.

The survey relied on OSWER Regional personnel to identify professionals outside the Agency who are important in helping OSWER accomplish its mission. It did not independently survey these audiences because of the austere constraints on survey size established by the Office of Management and Budget. Nevertheless, OSWER Regional personnel work closely with professionals outside the Agency to implement hazardous and solid waste legislation. This is especially true for State agency staffs, which were most frequently identified by RCRA and UST personnel as their primary audience, and were also frequently considered an important audience by CERCLA and ESD personnel. Regional personnel also have close ties with EPA contractors, which CERCLA and ESD personnel most frequently recognize as their primary audience. Because EPA Regional personnel are the main contact for both State agency staffs and contractors on environmental issues, they are likely to be aware of the most urgent needs of these groups.

It is less clear whether the survey data on the technical needs of the regulated communities accurately reflect these groups' particular needs. The regulated communities are a diverse population including a wide variety of small and large hazardous waste generators, UST owners and operators, potentially responsible parties, transporters, treatment facility operators, and others. In general, Regional personnel who listed technical needs for the regulated community did not specify which subgroups within the community those needs addressed. However, taken as a whole, the Regional perception of the regulated communities' technical needs reveals that they are probably quite similar to those of State agencies and contractors, and to their own as well. Consequently, some technology transfer products designed for State agencies and EPA contractors may serve the regulated community, but further study would be required to link product development with those in the regulated community who would benefit most.

Although the study design was intended to survey a wide variety of OSWER Regional personnel at management and staff levels, the findings suggest that the sample population favors experienced staff—those with at least three to five years in the Agency. This may have resulted from the survey distribution scheme, but it may also be a relatively accurate view of the Regional OSWER population. About half (49%) of the respondents, overall, had been in their current job positions for two years or less. However, 85% of respondents had been at EPA three or more years. This indicates that within the Regions, there are more personnel hired from within the Agency than from outside. While the sample population favors experienced staff, new "inexperienced" staff may be a relatively small part of the total Regional OSWER population. It should be noted that the survey sample did not include representation of the approximately 500 new Superfund staff that are being added to the Regional work force.

Two final dispositions should be kept in mind. Regional response rates varied widely, leaving little confidence in the representativeness of data for a single Region. Finally, it was not possible to stratify findings based on respondents' job responsibilities within legislative program areas (such as RCRA permitting and corrective action, or CERCLA remedial and enforcement programs) because of the extensive overlap of staff responsibilities in these areas.

6.2 Conclusions and Recommendations

A significant proportion of technology transfer products and activities designed for EPA Regional employees should be geared for a relatively sophisticated technical audience. There is a high level of experience, educational background, and knowledge of technical areas among respondents—overall, and across legislative programs. The typical survey respondent has been in his or her current position for two years or less (49%), but has been with EPA for three or more years (85%), and holds a graduate degree (63%) in a technical field (84%). Evidence for a high experience level can be found in the number of years respondents had been with the Agency and the similarity of technical needs between those who had been in their current positions for less than two years and those who had been in their jobs for longer times. In addition, Regional employees generally have a strong technical background as demonstrated by their educational experience. This finding is consistent with a recent OSWER survey of ground-water training needs that identified advanced level training needs for solid and hazardous waste staff. The results are also consistent with the practice among the Regions of providing technical support staff with expertise in specific areas, or of developing "Regional Experts" or one among the staff who concentrates on a specific technical topic. These individuals would also require relatively advanced technical delivery. However, it may not hold for the planned new hires in Superfund.

Technology transfer products on hazardous waste remediation should address both legislative programs whenever possible. The findings of the needs assessment show that the major OSWER programs are converging on cleanup problems. The top ranked technical needs correspond quite closely across RCRA and CERCLA programs. Approximately 74% of technology transfer topics, are ranked "quite" to "extremely" useful by both CERCLA and RCRA respondents. Eleven of the top fifteen technical needs were the same for both RCRA and CERCLA, and no significant differences between the importance ratings of the two programs were found for these items. Additionally, there were very few differences in delivery system preferences for the two major hazardous waste programs, suggesting that similar delivery methods should be successful for both programs. However, the two programs differ in implementation and these specific differences should be addressed in technology transfer products and services targeted to particular audiences.

There is considerable interest in technology transfer on *Establishing risk-based cleanup levels for various contaminants and site conditions*. This is the highest ranked technology transfer topic overall as well as for both RCRA and CERCLA. Other important needs for both programs include *Fate and transport of contaminants in the subsurface, Ground water monitoring for site inspection and for evaluating the effectiveness of treatment*, and *Alternative and innovative treatment technologies*. The alternative and innovative technologies include biological, physical, and chemical treatment processes, stabilization and solidification, and thermal destruction. Two

related items are also among the most needed topics: *General technical information on the performance, limits, safety, and costs of hazardous waste treatment technologies*; and *Prototype remedy-selection models for recurrent site situations.*

Technology transfer should focus on alternative and innovative treatment technologies, risk assessment, ground water, remedy selection, field monitoring, and data requirements. In general, Regional staff in both the RCRA and CERCLA programs need to know how to establish cleanup levels, how wastes move through the subsurface and affect ground water, how to monitor in the field and assure data quality, how to select remedies, and most importantly, which remedies work and which do not in specific situations. The fifteen highest ranked technical needs overall and for CERCLA and RCRA reflect a pervasive interest in hazardous waste remediation. Overall needs include:

- Two items on risk assessment/treatment standards — (#1) Establishing risk-based cleanup levels, and (#13) Risk levels for RCRA wastes.

- Two ground water items — (#2) Fate and transport of contaminants in the subsurface, and (#3) Ground-water monitoring for site inspection and for evaluating the effectiveness of treatment.

- Two items on remedy selection — (#5) General technical information of the performance, limits, safety, and cost of treatments; and (#11) Prototype remedy selection models for recurrent site situations.

- All five items on alternative and innovative treatment technologies — (#s 4, & 6-9) biological, chemical and physical treatment processes, stabilization/solidification, and thermal destruction.

- Two items on field monitoring — (#10) General information on the use and limitations of field sampling and analysis methods, and (#12) Field screening, soil vapor, and water sampling for hydrocarbons.

- Two data requirements items — (#14) Quality assurance for field operations, and (#15) Development and application of Data Quality Objectives in sampling and analysis plans.

Technical needs appearing among the top fifteen for RCRA and not for CERCLA or for the overall sample include *Selecting and applying release and flow control, and source control technologies for RCRA corrective action, Minimal data requirements for a RCRA Facility Investigation or Corrective Measures Study*, and *Use of models for chemical mixture risk characterizations.* For CERCLA, specific needs include *Applicability of RCRA Treatment Standards to Superfund*, and *Procedures for estimating costs for construction, operation, and maintenance of remedies.* While there is clear agreement among the Regions over the highest priority technical needs, there are notable differences in their relative priorities from Region to Region.

A number of technology transfer activities are currently being conducted or are planned to address several of these top technical needs. However, it is beyond the scope of this study to assess whether or not these activities are likely to meet Regional needs. It would be prudent to evaluate these technology transfer activities to determine the extent to which technical needs identified by this needs assessment are being addressed and whether the correct audience segment is being reached.

RCRA Technical Needs

Technology transfer products and activities are needed to support RCRA corrective action. The highest ranked technical needs perceived by RCRA respondents indicate fairly extensive Regional involvement in corrective action. There is a high degree of overlap in responsibilities among RCRA field staff, with 80% of respondents reporting responsibilities in more than one RCRA program area. This intertwining of permitting, compliance, and corrective action responsibilities suggests that RCRA staff have comprehensive needs for technology transfer. Establishing risk-based cleanup levels, selection and application of treatment/control technologies, alternative and innovative treatment technologies, and data requirements are among the topics of greatest importance to RCRA respondents. In addition, RCRA respondents rate ground-water and risk assessment information among their top technical needs. Several of these topics correspond with those identified for Regional personnel by OSW's Corrective Action Workgroup.

Although not a specific focus of the survey, needs for technical assistance as well as technology transfer information were frequently expressed by RCRA respondents. Both headquarters and Regional participants in the needs assessment noted the discrepancy in programs and services for providing technical assistance for CERCLA as compared to RCRA. Given the analogous missions of the two programs and corresponding technology transfer needs, it is reasonable for RCRA staff to expect that similar technical assistance services be made available to them.

Technology transfer products should be targeted to meet specific needs of certain RCRA audiences. Regions with specific waste concerns, such as Subpart X and certain special wastes, indicate sharply defined technical information needs related to those wastes, which are not generally perceived by other Regions to be important. We recommend that these needs not be ignored, even though the target audiences may be small.

Although the survey attempted to explore technology transfer needs over the next three to four years, there was a tendency for respondents to value topics of immediate concern to their jobs more than those that may affect them in the future. This is best demonstrated by RCRA respondents perception of waste management topics (*e.g.*, oil and gas management practices, medical waste, hazardous waste treatment residues, municipal solid waste, and locations standards for land disposal sites). Several technical topics considered quite important by headquarters management rank fairly low among Regional staff.

There is generally widespread concurrence across Regions regarding the most important technical needs. However, within each Region, some areas of technical need, primarily State programs such as medical waste and municipal solid waste, appear to be very important to a

relatively small number of Regional personnel. These also are among the most frequently mentioned State agency staff needs. Thus, there may be important differences in technical needs for headquarters, Regional, and State programs due to differing responsibilities for implementation of the RCRA program. These differences in specific technical needs for various segments of the audience should be explored further and addressed in the development of technology transfer products in order to most effectively meet technical needs.

State agency staff and the regulated community should be considered when developing technology transfer products for RCRA. RCRA's primary end-users for technology transfer, other than Regional staff, include State agency staff (53%) and the regulated community (29%). The most frequently mentioned needs for these groups are in non-technical areas, such as general information on the program and RCRA regulations. The three most frequently mentioned technical needs for both of these primary audiences include selection of cleanup technologies, risk assessment, and monitoring topics, suggesting that these topics should be considered for technology transfer products designed for broad distribution.

CERCLA Technical Needs

CERCLA technology transfer efforts should address: 1) establishing cleanup standards, 2) selecting and applying treatment technologies, 3) ground water, and 4) field sampling and analysis. Ten of the top fifteen CERCLA needs relate to moving sites into Remedial Design/ Remedial Action and to SARA requirements for permanent solutions and alternative treatment technologies. Two items in the top fifteen concern *Establishing risk-based cleanup levels for various contaminants and site conditions*, and *Applicability of RCRA Treatment Standards to Superfund.* Establishing risk-based cleanup levels is rated as the number one technical need overall, and is rated first or second by each of the Regions. *Standardized methods for ecological risk assessment* is also included among the top fifteen needs, reflecting concern with cleanup goals to protect both human health and the environment. Clearly, establishing cleanup levels is the top priority technical need for Superfund.

Alternative treatment technologies and the selection and application of remedies is another critical area for technology transfer for CERCLA. The second ranked technical need for CERCLA is *General technical information on the performance, limits, safety, and cost of hazardous waste treatment technologies.* All five of the alternative and innovative technology items listed in the questionnaire—biological, physical, and chemical treatment, solidification and stabilization, and thermal destruction—are rated among the top seven technical needs for Superfund. In addition, *Prototype remedy selection models for recurrent site situations*, and *Procedures for estimating costs for construction, operation, and maintenance of remedies* are among the most important technical needs for CERCLA. Congressional deadlines for moving sites to construction (*e.g.*, mandated number of remedial action starts each year) will require that this information be provided as soon as possible. Rapid methods and approaches for technology transfer will be required to disseminate information as it develops. For example, information on the success and failure of remedies, and the results of treatability studies must be almost immediately available if they are to be of use in improving Superfund decision making.

Ground-water monitoring for site inspection and for evaluating the effectiveness of treatment, and *Fate and transport of contaminants in the subsurface* are also rated among the top ten CERCLA needs. Although the current needs assessment did not address the level of knowledge of potential technology transfer audiences, other evidence suggests that these topics should be addressed on an intermediate to advanced level. The recently completed Ground-Water Training Needs Assessment found that a considerable amount of basic ground-water instruction is available to the Regions, and that these same two areas are among those for which advanced training is needed. In addition, the background and experience of the Regional staff in this survey would suggest that more advanced levels of presentation of technical information are appropriate.

The area of field sampling and analysis is important to the preremedial program as well as the removal and remedial programs. Two items addressing this topic contained in the top fifteen Superfund needs are: *General information on the use and limitations of field sampling and analysis methods*, and *Field-screening, soil vapor, and water sampling for hydrocarbons*. Shorter time frames for site characterization, additional data needs for Remedial Design, and the revised Hazard Ranking System are all program developments requiring the dissemination of information on small scale, accurate, and efficient methods for field sampling and analysis.

Topics of concern to headquarters management that are not highly rated by Regional CERCLA staff include more general information on risk assessment, quality assurance, and the development and application of Data Quality Objectives. As noted in Chapter 3, these technical areas are frequently addressed by support staff or contractors and may, therefore, be of less concern to the majority of CERCLA staff included in the survey. The survey also did not address a variety of training and technical topics related to increased emphasis on enforcement. In fact, many of the technical topics are the same, and 65% of CERCLA staff indicate that they have responsibilities in both remedial and enforcement areas. However, growth in the Superfund enforcement program and the integration of the remedial and enforcement programs in most Regions have led to a number of challenges for Regional management.

EPA contractors, State agency staff, and the regulated community should be considered when developing technology transfer products for Superfund. CERCLA respondents identified EPA contractors (44%), State agency staff (21%), and the regulated community of PRPs and their contractors (13%) as their primary audiences. These groups' technical needs correspond closely to those of Regional staff. The technology transfer needs listed by respondents for their primary audiences include selection of cleanup technologies, monitoring, alternative and innovative treatment technologies, ground water, and risk assessment. However, 20% of the needs listed in response to this item address nontechnical topics such as programmatic training or guidance. Examination of needs for dissemination of program and policy information are beyond the scope of the needs assessment; however, this finding suggests that this is an area that should be explored further. The emerging trend towards nontechnical Remedial Project Managers (RPMs) will impose a greater burden upon remedial contractors, Environmental Service Division staff, and technical support branches within Regional Waste Management Divisions. This may mean that target audiences for technology transfer will also change from emphasizing RPMs toward these other support staffs.

UST and ESD Technical Needs

The sample sizes for the Underground Storage Tank staff (10 individuals) and Environmental Service Division staff (12 individuals) subgroups of the survey were too small for meaningful statistical comparisons. However, examination of the responses reveal that UST needs closely parallel both CERCLA and RCRA with an emphasis on UST specific technical topics such as *Application of mitigation, removal, and treatment technologies to leaking underground storage tanks*; and *Leak detection and prevention methods for underground storage tanks.* UST respondents were also quite interested in health and safety information and training, especially with respect to their primary audiences—State agencies and the regulated community.

Environmental Service Divisions perform various roles in the Regions, but most have responsibility to support OSWER programs in monitoring, risk assessment, and sampling and analysis. The emphasis for technology transfer needs for ESD respondents correspondingly focuses on topics other than treatment technologies. Their top technical needs include most of the items related to ground water, field monitoring, data requirements, and risk assessment. ESD audiences include Regional staff, EPA contractors, and the regulated community. Technical needs identified for these audiences include subsurface ground-water topics and statistical analyses to confirm cleanup.

Technology Transfer Delivery Systems

Printed technology transfer documents and workshops/seminars must be brief and clearly applied to audience job responsibilities. Respondents prefer print media (*e.g.*, technical reports, handbooks, technical bulletins/summaries) or direct interaction (*e.g.*, workshops and seminars) to electronic or automated media. Ratings of the utility of fifteen delivery systems showed that overall, and for both RCRA and CERCLA, the delivery methods rated most useful include guidance manuals, technical reports/handbooks, seminars/workshops, technology summaries/bulletins, and conferences and symposia. Technology demonstrations, hotlines, and automated databases are considered somewhat useful. Expert systems/PC-based models, computer-assisted/interactive training, and videoconferencing are rated as least useful.

The preference for print as opposed to electronic or other nontraditional media poses a conflict in that the most serious constraint to technology transfer is generally the Regional staff's inability to take sufficient time away from their job responsibilities to read reports or attend workshops or meetings. Many individuals commented that there is an excess of print materials and that they do not have time to read and study technical documents. This contradiction can be partially resolved by technical bulletins/summaries and briefer, targeted documents. More specific products that are directly applicable to respondents job responsibilities are also recommended by Regional respondents. A major reason for low ratings of electronic and computer-based systems lies with the lack of easy access to personal computers and modems. This is particularly true with RCRA Regional staff.

Training in electronic media and expert systems will be necessary to ensure their use. Another solution to the problem of time required to assimilate written materials and attend workshops and seminars is to develop and aggressively market alternative electronic media. A

considerable distrust of "expert systems" was evidenced in interviews and comments provided by respondents. While automated databases are considered somewhat useful by Regional staff, expert systems/PC-based models are among the delivery methods rated least useful. Regional respondents to the survey are concerned about the actual ability of such systems to aid in decision making, the amount of effort that may be required to utilize them, the frequency with which they are updated, and the quality control invested in their development. OSWER and ORD have already developed a number of automated databases and expert systems, and are currently developing several more electronic systems to meet some of RCRA and CERCLA's most pressing technical information needs. If they are to be used, it will be necessary to overcome these attitudinal barriers by aggressively "marketing" these products to intended users. Continuing problems with access to computers, modems, and communications software (especially among RCRA staff) will also need to be addressed.

Developers of technology transfer products should consider providing technical information in more than one format whenever it is practical to do so. Most of the recommendations received during the survey regarding improvements in the delivery of technology transfer concern ways to make access easier and provide information in a number of formats. Respondents recommend that guidance documents, technical reports and handbooks be accompanied by a workshop or seminar, technical summary, or demonstration to explain how they are to be used. The use of such combinations of delivery methods will improve understanding of technical documents, provide broader access, reinforce important technical lessons, and allow users to choose the approach that best suits their needs from various delivery systems. Therefore, a variety of approaches to technology transfer delivery will be required to meet needs identified by the needs assessment.

Timing of technology transfer delivery is also a critical issue. Respondents noted that they do not usually have the time to attend workshops or seminars, or to read and study documents unless they address a pressing problem at the present time. Turnover among Regional staff exacerbates the problem of being able to access the right information at the right time. Providing information in a variety of forms will help alleviate the problem of having ready access to technical information when it is needed. Innovative approaches to this problem recommended by respondents include establishing videotape libraries to provide a readily available overview of technical information with references and contacts for more information, and a comprehensive database of technical abstracts to quickly locate appropriate documents.

Regional technology transfer networks should focus on professional staff within the Regional Waste Management Division. Survey findings regarding the most useful sources of technical information indicate that Regional staff are more likely to locate information among other professionals in their office than any other source. EPA libraries, and headquarters contacts are the second and third most useful sources; with supervisor, branch or division typically rated fourth in usefulness. Respondents indicate that, aside from having sufficient time, their most serious problems in utilizing technology transfer information involve being unaware of available information and being unable to locate and easily access information. Comments received from respondents suggest that problems in information distribution schemes continue to exist. Technical staff are frequently unaware of or unable to locate a single copy of a technical report that has been sent to the Division Director or branch chief. Respondents prefer to locate

information within the Region, as Regional interpretation of technical issues may differ in some specifics. In addition, libraries frequently do not have copies of important technical documents.

Distribution schemes for technology transfer information should include Regional resource centers or technical coordinators if at all possible. Other points of coordination might include Regional experts, technology transfer contacts, and technical support staff. It should be noted that Regional staff often do not recognize the source of technical information (e.g., technical reports, bulletins, Technology Transfer seminars provided by CERI) and thus, are unaware of where additional information on a given topic may be located.

Regional efforts at coordination of technology transfer should be supported. Regional offices are fairly large and diverse organizations. Even within the Regional Waste Management Division, there may be problems with interoffice communication and information distribution. Seventy-three percent of respondents consider awareness of what is available to be a moderate to severe problem, while 65% feel that learning about technology transfer products and activities in sufficient time to take advantage of them is a moderate to severe problem. This suggests that greater effort needs to be expended in communicating about technology transfer activities. Headquarters activities such as a technology transfer newsletter have often been recommended, and recently developed directories of technology transfer information and contacts show potential for helping to address these problems. However, some Regional Waste Management Divisions are developing their own library or repository of important technical information, and this approach shows an even greater likelihood of success. Region III has developed an automated technology transfer system to locate technical information and inform staff of upcoming technology transfer activities. A repository of technical information and technology transfer products has also been developed to provide easy access to information located through the system.

Continuing problems with access to and familiarity with computers, modems, and communications software should be addressed. Limited access to computers, modems, and communications software are still considered fairly serious problems in accessing technology transfer information by respondents. Regional staff also noted a need for basic computer training. The issue of computer literacy has not been directly addressed by OSWER, but it likely continues to play a role in limiting the potential utility of electronic and automated systems. For example, in interviews with headquarters and Regional staff, although many respondents expressed fairly positive opinions of the OSWER Electronic Bulletin Board System, none acknowledged using the BBS. The Superfund Office has made a commitment to providing CERCLA staff with access to personal computers, but many had not received these at the time the survey was conducted. Moreover, even those with computers said they had difficulty in communicating with distant systems because of a lack of modems or unavailability of communications software.

Technology transfer products and activities must be evaluated to determine whether technical needs are being met in the most effective and efficient manner for specific audience segments. The study contains recommendations for possible technology transfer delivery methods for the top rated Regional technical needs based on relationships between needs and preferred delivery systems, but also notes that selection of delivery methods must be based on a number of other factors as well. OSWER's relatively recent emphasis on technology transfer that began with the *OSWER Technology Transfer Strategy*, published in 1986, appears to have facilitated technical

information transfer to the Regions. However, as shown by the current study, a number of barriers to technology transfer remain to be addressed, and the transfer of technical information to audiences outside the Agency is just beginning. The success of technical bulletins and summaries (as indicated by increased usefulness ratings since 1986) indicates that it is possible to promote new delivery methods. However, as yet, no systematic evaluation of delivery methods for technology transfer has been attempted. As needs for current, high-quality technical information intensify and more resources are invested in alternative delivery methods, the need for evaluation also becomes more critical.

APPENDIX

- **List of OSWER Headquarters Interviews**
- **Headquarters Interview Guide**
- **Regional Survey Questionnaire**

OSWER TECHNOLOGY TRANSFER NEEDS ASSESSMENT
List of Headquarters Management Interviews

OSW

- Alex McBride, Chief OSW Technical Assistance Branch
- Bob Tonetti, Chief OSW Special Waste Branch and Acting Deputy Director Waste Management Division
- Elizabeth Colsworth, Chief OSW Assistance Branch
- Sonya Stelmack, chemical engineer OSW Assistance Branch
- Steve Levy, Special Assistant OSW Municipal Solid Waste Program
- Mike Petruska, Chief OSW Waste Characterization Branch
- Jim Berlow, Chief OSW Waste Treatment Branch
- Denise Keehner, Chief OSW Permits Branch
- Frank McAlister, OSW Permits Branch
- Dave Fagan, OSW Permits Branch
- Art Day, Chief OSW Land Disposal Branch
- Jon Perry, OSW Land Disposal Branch

OUST

- David O'Brien, Chief OUST Standards Branch
- Venay Kumar, OUST Standards Branch

OERR

- Randy Kaltreider, OERR/HSCD Site Policy and Guidance Branch
- Robin Anderson, OERR/HSCD Site Policy and Guidance Branch
- Bruce Means, Chief OERR/HSED Toxics Integration Branch and Health Effects Program
- Bruce Englebert, Chief OERR/ERD Response Operations Branch
- Sue Janowiak, OERR/ERD Response Operations Branch
- Mike Carter, Section Chief OERR/HSED Analytical Operations Branch
- Pat Wilkshire, OERR/HSED Analytical Operations Branch
- Penny Hansen, Chief OERR/HSED Site Assessment Branch
- Joe Lafornara, Chief OERR/ERD Environmental Response Branch

OWPE

- Frank Biros, Chief OWPE/CERCLA Technical Assistance Branch
- Glenn Hardcastle, Section Chief OWPE/CERCLA Compliance Branch
- Candice Wingfield, OWPE/CERCLA Compliance Branch, Regional Coordination Staff
- Scott Parrish, Chief OWPE/RCRA Enforcement Branch

OSWER TECHNOLOGY TRANSFER NEEDS ASSESSMENT

INTERVIEW GUIDE FOR HEADQUARTERS MANAGEMENT

Interviewee:

Title:

Office/Branch:

Date:

Purpose of Technology Transfer Needs Assessment

One of the major activities planned by the Technology Transfer Subcommittee in implementing OSWER's Technology Transfer Strategy is an assessment of the technology transfer needs of the Superfund, RCRA, and UST Programs. As implementation activities expand and OSWER programs grow and mature, the need for technological solutions to problems in the field and for up to date technical information become more and more apparent. The purpose of the Needs Assessment is to ensure that resources for technology transfer are going where they are most needed.

The objectives of the assessment are to update and expand earlier studies, to include all OSWER program areas, to identify high priority technology transfer needs, and to develop criteria for selecting technology transfer delivery mechanisms. The study is being conducted in two phases: (1) interviews with headquarters program office management and (2) Regional surveys including a questionnaire and site visits to selected Regions. Your responses to this interview will be used in helping define program priorities for technology transfer and in developing the questionnaire to be used in the Regional survey. The interview should require approximately 45 minutes of your time.

1. The *OSWER Technology Transfer Strategy* defines technology transfer as "The development and dissemination of OSWER and ORD technical information, techniques, and products to a pre-selected audience to facilitate EPA's regulatory and/or enforcement functions." The information, techniques, and products are intended to "improve the performance of hazardous waste regulatory and management personnel."
Question:
Does this definition meet with your view of technology transfer?
Answer:

1b. **Question IF needed:**
If not, how would you define technology transfer?
Answer:

2. Technical assistance is different from technology transfer and is defined in the *OSWER Technology Transfer Strategy* as "The person-to-person transmission of technical or scientific information to aid specific users in solving a specific regulatory or enforcement problem in the field."
Question:
Does this meet with your view?
Answer:

2b. **Question IF needed:**
If not, what is your definition of technical assistance?
Answer:

3. Although training and technology transfer respond to specific needs and are intended to improve job performance, they are different. The basic distinction between them is that training is a continuing process of improving requisite knowledge, skills, and abilities, while technology transfer improves or broadens use of tools that are available. For example, conferences, seminars, and workshops are generally considered technology transfer products by OSWER, while established courses fall under training. Training is defined in the *Strategy* as "The development and presentation, <u>on a continuing basis</u>, of curricula designed to improve knowledge or skill required for individual or group performance within the Agency's regulatory or enforcement functions."
Question:
Is this distinction consistent with your thinking?
Answer:

3b. **Question IF needed:**

If not, how would you distinguish training and technology transfer?

Answer:

4. By definition, technology transfer is developed and disseminated to specific audiences.

Question:

Is your primary audience...

RCRA Regional permit writers, compliance officers, and corrective action staff, state and local governments, and private sector owners and operators of RCRA facilities, others? **OR**

SF OSCs, RPMs, enforcement officers, others? **OR**

UST states, regulated community and private sector, others

Answer:

4b. **Question IF applicable:**

Which state and local governmental audiences have a compelling need for EPA technical products and skills in order to implement their part of your program?

Answer:

4c. **Question:**

What about EPA contractors?

Answer:

4d. **Question:**

Would you try to estimate the number of individuals who need technology transfer in each audience?

Answer:

5. **Question:**

What kinds of technology transfer products or activities are being planned by your program office at present?

Answer:

5b. **Question:**

Are these products funded by your office, or jointly with ORD, OPMT, or others? (*e.g.*, OSW technology transfer meeting on ATTIC July 27, 1989)

Answer:

5c. **Question:**

Who will be the audience(s)?

Answer:

5d. **Question:**

What delivery method(s) will you use and why?

(*e.g.*, handbooks and guidance manuals; demonstrations; conferences and symposia; seminars and workshops; technical abstracts, summaries, and bulletins; technical videotapes; and computer-based formats including expert systems)

Answer:

5e. **Question:**

Is the speed of dissemination of technical products an important consideration in selecting the delivery method(s)?

Answer:

5f. **Question:**

How were the needs for these products identified?

Answer:

5g. **Question:**

Do you anticipate that there will be a recurring need for these or other technology transfer activities due to, for example, staff turnover, program growth, greater program delegation, etc.? Why?

Answer:

6. **Question:**

What do you feel are the highest priority program objectives for your branch at present? Do you expect changes in priorities over the next three to four years?

Answer:

6b. **Question:**

Can you foresee the kinds of technical information and skills that your headquarters and Regional personnel and other audiences may need in order to meet both your present and near-term (3-4 year) objectives?

Answer:

7. **Question:**

What do you feel are the priority objectives of the whole program office at present. Do you expect changes in these priorities over the next three to four years because of, for example, Congressional or court-ordered mandates?

Answer:

7b. **Question** **For only RCRA and UST:** What about the upcoming RCRA reauthorization; how do you think it could impact program priorities and technical requirements?

Answer:

7c. **Question:**

Again, what do you foresee are the kinds of technical information and skills that specific headquarters, Regional, or other audiences may need in order to meet the present and near-term (3-4 year) objectives?

Answer:

The remaining questions are on technology transfer delivery systems such as handbooks and guidance manuals; demonstrations; conferences and symposia; seminars and workshops; abstracts, summaries, and bulletins; videotapes; and computer-based formats including expert systems.

8. Question:

What types of delivery systems do you feel are generally most appropriate for disseminating technical methods and information to audiences of interest to EPA? Let me list some possibilities:

- Technical reports, handbooks, and guidance manuals
- Demonstrations of technology applications
- Conferences and symposia
- Seminars and workshops
- Technology notices, summaries, bulletins, abstracts
- Technology videotapes
- PC-based models, automated databases, and electronic information transfer (BBS, E-mail)
- Computer-assisted and interactive training formats
- Hotlines
- Expert systems

Answer:

8b. **Question:**

Are these delivery systems the best ones for your program office? Why?

Answer:

8c. **Question IF electronic/computer methods were not mentioned:**

Why did you not select computer-based or electronic transfer type systems?

Answer:

8d. **Question:**

What overpowering constraints may be encountered in instituting the preferred delivery systems that you mentioned? (*e.g.*, cost, importance of speed in disseminating technology transfer products, personnel time required for development, lack of training)

Answer:

9. **Question:**

What direct experience have you had using or developing the more traditional of these delivery systems, such as workshops and seminars?

Answer:

9b. **Question:**

What direct experience have you had using or developing alternative delivery systems such as expert systems, automated databases, and electronic information transfer?

Answer:

Office of Solid Waste and Emergency Response

Technology Transfer Needs Assessment Questionnaire

OSWER is conducting an assessment of the technology transfer needs of the Superfund, RCRA, and UST Programs through the OSWER/ORD Technology Transfer Subcommittee. As implementation activities expand and OSWER programs grow and mature, the need for technological solutions to problems in the field and for up-to-date technical information become more and more apparent.

> *Technology transfer is defined as "the development and dissemination of technical information, techniques, and products to targeted audiences to faciliate EPA's regulatory and enforcement functions."*

The purpose of the Needs Assessment is to identify high priority technology transfer needs for all of OSWER for the next three to four years to assist in planning for the Hazardous Waste/Superfund Research Committee, Program Offices, and the Office of Research and Development. The survey will also aid in developing criteria for selecting delivery methods for technology transfer products and tools.

Your responses to this questionnaire will be used in helping to establish priorities for technology transfer and in developing guidelines for selection of technology transfer delivery systems. Participating in the survey allows you to influence the recommendations that will be made to OSWER management. The questionnaire should require approximately 20 to 30 minutes of your time to complete. Please feel free to expand upon any of your responses.

Please return the completed questionnaire directly to:

EMS, Inc.
ATTN: OSWER Survey
1010 Wayne Avenue, Suite 200
Silver Spring, MD 20910

Please call (301) 589-5318, if you have questions.

PART 1. RESPONDENT PROFILE

The following demographic and job information is needed to group the data during the statistical analysis phase of the study. For example, generalizations will be made about all employees in a given position. **Your answers to these questions are optional and will be kept completely confidential.**

Current Position

1. In which **Region** are you employed? _____

2. In which **Division and Branch** do you work? (*Example: ERD/ERB*) _____

3. Which **program areas** are you currently involved with? (*Please check all that apply*)
   - ❑ CERCLA Removal
   - ❑ CERCLA Remedial
   - ❑ CERCLA Enforcement
   - ❑ RCRA Permitting
   - ❑ RCRA Compliance
   - ❑ RCRA Corrective Action
   - ❑ UST Program
   - ❑ Other (*Please specify*)_____

4. List three of your current **high priority job responsibilities.**

   _____

   _____

   _____

Background and Experience

5. Approximately how long have you held your **current position?**
   - ❑ Less than one year
   - ❑ 1 to 2 years
   - ❑ 3 to 5 years
   - ❑ 6 to 10 years
   - ❑ 11 years or more

6. Approximately how long have you been **employed by EPA?**
   - ❑ Less than one year
   - ❑ 1 to 2 years
   - ❑ 3 to 5 years
   - ❑ 6 to 10 years
   - ❑ 11 years or more

7. What is your **highest level of education**?
   - ❑ Univ. or College Coursework
   - ❑ Associate Degree
   - ❑ Bachelor Degree
   - ❑ Graduate School Coursework
   - ❑ Masters Degree
   - ❑ Juris Doctorate
   - ❑ Doctor of Philosophy
   - ❑ Other (*Please specify*)

   _____

8. What was your major **field of study** for your highest degree?

   _____

9. Please list the most recent **job-related training from EPA** that you have attended.

_____

10. Please list any **technology transfer seminars or workshops** you have recently attended.

_____

_____

11. Approximately how many technical, job-related training courses, seminars, or workshops do you attend per year? _____

PART 2. TECHNOLOGY TRANSFER NEEDS

This section of the questionnaire focuses on setting priorities for technology transfer needs over the next 3 to 4 years. Please provide us with your best estimate of how the following technology transfer topics and technical issues will affect your job in the hazardous or solid waste program. *Please indicate the importance of each listed topic to your job on a scale of 1 (minimal to no importance) to 5 (extremely important).* ***Be sure to consider topics in other programs, as there is considerable overlap of technical issues.*** *Also feel free to write in topics that we may not have anticipated.*

	N A	Not at All Useful		Quite Useful		Extremely Useful
Ground Water						
Ground-water monitoring for site inspection and for evaluating the effectiveness of treatment.	0	1	2	3	4	5
Well techniques for determining hydrologic properties of aquifers.	0	1	2	3	4	5
Fate and transport of contaminants in the subsurface (*e.g.*, facilitated transport, methods for measuring contaminant mobility, non-aqueous phase liquids).	0	1	2	3	4	5
Hydrologic properties of difficult areas such as Karst terrains and aquifers.	0	1	2	3	4	5
Validated ground-water models and expert systems that support sampling plans and statistical analyses.	0	1	2	3	4	5
Monitoring Techniques						
General information on the use and limitations of field sampling and analysis methods.	0	1	2	3	4	5
Air and other media monitoring for site inspection and for evaluating the effectiveness of treatment.	0	1	2	3	4	5
Continuous and static monitoring of stack emissions from all types of incinerators.	0	1	2	3	4	5

	N A	Not at All Useful		Quite Useful		Extremely Useful
Field-screening, soil vapor, and water sampling for hydrocarbons.	0	1	2	3	4	5
Leak detection and prevention methods for underground storage tanks.	0	1	2	3	4	5
Risk Assessment						
Risk assessment information: risk levels for RCRA waste (*e.g.*, incinerator ash, contaminated soil).	0	1	2	3	4	5
Use of models for chemical mixture risk characterization.	0	1	2	3	4	5
Standaradized methods for ecological risk assessment.	0	1	2	3	4	5
Assessment of oily waste risk and movement.	0	1	2	3	4	5
Establishing Treatment Standards						
Applicability of RCRA Treatment Standards to Superfund.	0	1	2	3	4	5
Establishing risk-based cleanup levels for various contaminants and site conditions.	0	1	2	3	4	5
Selection and Application Treatment/Control Tech.						
General technical information on the performance, limits, safety, and cost of hazardous waste treatment technologies.	0	1	2	3	4	5
Selecting and applying release and flow control, and source control technologies for RCRA corrective action (*e.g.*, selection of source control technologies for ground-water contamination).	0	1	2	3	4	5
Prototype remedy-selection models for recurrent site situations: • wood-treatment facilities • metals contaminated sites • soil and debris contaminated sites • battery-cracking sites • municipal landfills • industrial boilers and furnaces • munitions/explosives • underground injection wells • mining wastes • mixed wastes • pesticides • plating • solvents • multi-source GW • dioxins • PCBs	0	1	2	3	4	5
Application of mitigation, removal, and treatment technologies to leaking underground storage tanks.	0	1	2	3	4	5

	N A	Not at All Useful		Quite Useful		Extremely Useful
Waste Management						
General technical information on the limits and safety of municipal waste management options.	0	1	2	3	4	5
Combustion emission controls for metals, PICs, NOx, and others from municipal solid waste incineration.	0	1	2	3	4	5
Disposal methods for residues such as ash from treated hazardous waste.	0	1	2	3	4	5
Effective oil and gas management practices.	0	1	2	3	4	5
Medical waste management options.	0	1	2	3	4	5
Alternative and Innovative Treatment Technologies						
Use and effectiveness of physical treatment processes (*e.g.*, soil washing, vacuum extraction).	0	1	2	3	4	5
Use and effectiveness of chemical treatment processes (*e.g.*, KPEG).	0	1	2	3	4	5
Use and effectiveness of biological treatment processes (biodegradation or bioremediation).	0	1	2	3	4	5
Use and effectiveness of thermal destruction (incineration, oxidation).	0	1	2	3	4	5
Use and effectiveness of stabilization/solidification.	0	1	2	3	4	5
Estimating Remediation Cost						
Procedures for estimating costs for construction, operation, and maintenance of remedies.	0	1	2	3	4	5
Uniform procedures for reporting costs and technical performance for operating treatments at SF sites.	0	1	2	3	4	5
Data Requirements						
Minimal data requirements for a RCRA Facility Investigation or Corrective Measures Study.	0	1	2	3	4	5
Technical data requirements for enforcement case development including extraordinary circumstances.	0	1	2	3	4	5
Development and application of Data Quality Objectives in sampling and analysis plans.	0	1	2	3	4	5
Quality assurance for field operations.	0	1	2	3	4	5

	N A	Not at All Useful		Quite Useful		Extremely Useful
Pollution Prevention						
Tools for managing municipal solid waste and hazardous waste through source reduction, recovery, and recycling.	0	1	2	3	4	5
Land Disposal Facilities						
Technologies and quality assurance information for land disposal facility design and construction including installing liners and covers.	0	1	2	3	4	5
Location standards for new and existing land disposal sites.	0	1	2	3	4	5
Results of treatability studies for land disposal.	0	1	2	3	4	5
Others?						
_____	0	1	2	3	4	5
_____	0	1	2	3	4	5
_____	0	1	2	3	4	5

PART 3. TECHNOLOGY TRANSFER DELIVERY SYSTEMS

This section of the questionnaire addresses factors for determining which of numerous delivery systems is most appropriate for a given technology transfer need and audience. The key to successful technology transfer is getting the right information to the right person at the right time and in the best format.

Audiences for Technology Transfer

1. What types of professionals outside your office are important in helping you accomplish your job responsibilities? *(Please check all that apply)*
   - ❑ State agency staff
   - ❑ EPA contractors
   - ❑ Consultants
   - ❑ Other federal agencies
   - ❑ Academic institutions
   - ❑ Regulated community
   - ❑ Local government/legislators
   - ❑ Public
   - ❑ Other *(Please specify)* _____

2. Of the audiences identified above, which is your primary audience (your most important)?

   _____

3. Estimate the size of your primary audience *(Please indicate whether the estimate is limited to your Region, state, or other locality)*. _____

4. List the five top priority technical needs of your primary audience.

_____

_____

_____

_____

_____

Delivery Systems

5. Rate the utility of each of the following delivery methods *for **You** and for your **Primary Audience**.* Use a *scale of 1 (not at all useful) to 5 (extremely useful). Use **0** (NA) for unfamiliar information sources.*

	You	Primary Audience
Technical reports/handbooks	____	____
Guidance manuals	____	____
Technology demonstrations	____	____
Conference/symposia	____	____
Seminars/workshops	____	____
Technology summaries/bulletins	____	____
Technology videotapes	____	____
Expert systems/PC-based models	____	____
Computer-assisted/interactive training	____	____
Electronic information transfer	____	____
Automated databases	____	____
Hotlines	____	____
Job aids (*e.g., checklists, nomograms*)	____	____
Teleconferencing	____	____
Videoconferencing	____	____
Other _____	____	____

6. Of the delivery methods listed in question 5, which are best used in combination, such as guidance manuals with workshops, or a technology bulletin with a report?

_____

_____

7. What could be done to improve the utility of available systems you do not now find useful?

_____

_____

8. Rate the importance of each of the following **sources** of technical information that **You** use and that your **Primary Audience** use routinely. Use a *scale of 1 (not at all useful) to 5 (extremely useful), and 0 (NA) for unfamiliar information sources.*

	You	**Primary Audience**
Supervisor, Branch, or Division	____	____
Other Professional Staff in your Office	____	____
EPA Regional, Headquarters, or Laboratory Library	____	____
EPA Headquarters Contacts	____	____
ORD Laboratory Contacts	____	____
ORD Regional Scientist	____	____
Center for Environmental Research Information (CERI)	____	____
Other Federal Agencies	____	____
State Agencies	____	____
Affiliated Universities	____	____
Clearinghouses	____	____
Technology Vendors	____	____
Other _____	____	____

9. If you use technology transfer products from other federal agencies in your work, please list a few examples of the products you use and indicate the agency that produced it (*e.g., DOD, DOE, USGS, NIEHS, NIOSH, ACOE*).

_____

_____

10. Rate the constraints that **You** have experienced in the use of technology transfer products and activities, and those your **Primary Audience** has experienced. Use a *scale of 1 (no problem) to 5 (severe problem), and* **0** *(NA) for constraints that do not apply.*

	You	**Primary Audience**
Limited access to computers or modems for electronic media.	____	____
Need for basic computer training.	____	____
Not aware of available technology transfer products or activities.	____	____
Not aware of tech transfer activities in sufficient time to take advantage of them (*e.g.*, seminar announcements arrive too late).	____	____
Aware of tech transfer products, but access is too difficult (*e.g.*, problems locating reports, information too disorganized or difficult to assimilate).	____	____
Unable to take sufficient time away from job responsibilities to attend technology transfer activities.	____	____
Insufficient travel funds.	____	____
Unsure of applicability to job responsibilities.	____	____
Do not trust source of technical information.	____	____
Information is not collected, assembled, or published by EPA.	____	____
Others _____	____	____
_____	____	____

11. Comments:

_____

_____

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Thank you for taking time to complete this questionnaire.

If you wish us to send you a copy of the final report, please detach this portion and return with your name and complete mailing address. Your anonymity will be preserved. Please return form to:
EMS, Inc., ATTN: OSWER Survey, 1010 Wayne Ave., Suite 200, Silver Spring, Maryland 20910.

NAME:_____

OFFICE:_____

STREET:_____

CITY/STATE/ZIP:_____