Chapter 3

THE 2002 BIOSOLIDS PUBLIC KNOWLEDGE AND PERCEPTION SURVEY

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3.1 Background

The nation's dependence on effective wastewater treatment requires an increasing capacity for the management of sewage sludge and biosolids. The amount of municipal sewage sludge generated annually continues to rise. The U.S. Environmental Protection Agency (1999) estimates that more than seven (7) million dry tons of sewage sludge are generated each year, compared with four and one half (4.5) million dry tons in 1972, and that U.S. municipalities will produce more than eight (8) million dry tons annually by the year 2010.

Approximately sixty (60) percent of the sewage sludge produced today is applied to land as biosolids fertilizers or soil amendments, an increase from thirty-three (33) percent in 1988. This trend, in conjunction with the increasing amount of biosolids produced, mean that more land application sites are being proposed to meet a growing demand.

Many of these sites are surrounded by neighbors whose perceptions of biosolids are largely unknown.

The purpose of the 2002 Biosolids Knowledge and Perception Survey, therefore, was to find out

- what these potential neighbors know about biosolids,
- how they perceive biosolids recycling as a public policy,
- how they perceive biosolids in the context of their lives, and
- what kinds of information influences their decisions about biosolids management.

The survey questionnaire and a summary of the collected raw data appear in the Appendices.

3.2 Methods

3.2.1 Survey Domains

The selection of survey domains (topics for survey questions) and development of the survey itself were dictated by the information obtained through the literature review, case studies, and discussion with project reviewers and other key stakeholders. On the basis of those discussions, the project team agreed to test the following hypotheses and concepts:

- Few people know much about wastewater treatment or biosolids recycling;
- Certain lifestyle choices and experiences are likely to influence a person's knowledge, perception, and opinion regarding biosolids recycling—these traits include whether or not a person;
  - lives in a rural, suburban, or urban area;
  - has lived in a farming or ranching community;
  - does any farming or gardening;
  - uses fertilizers (and what kind of fertilizer?);
  - chooses organic foods; or
  - considers himself/herself and environmentalist.
- Some demographic or social characteristics are likely to influence a person's knowledge, perception, or opinion regarding biosolids recycling, including:
  - age;
  - gender;
  - race or ethnicity;
  - level of income;
  - whether or not children live in the household;
  - level of educational attainment
  - ways in which they obtain news or information;
  - working in or having received education in a scientific field; or
  - region of the country in which they live.
- Most people have some negative reaction to the concept of using treated sewage sludge / biosolids as a fertilizer or soil amendment, although they are accepting of using animal manures;
- The personal proximity to biosolids affects the way in which they are perceived;The messages that introduce people to a new or innovative technology, such as biosolids recycling, influences the formation of their opinions on the subject;
- There are certain factors about biosolids recycling programs that heighten concerns, including whether or not the biosolids come from big cities, whether they have industrial inputs, whether they are free to the farmer, etc.;
- The public's comfort or unease over biosolids recycling is linked to certain lifestyle choices, life experiences, or demographic characteristics;
- There are certain positive and negative messages about biosolids that are more convincing than others (past survey work by Powell-Tate, 1993, and Frederick Schneiders Research, 1998, had tested some similar messages);

- Certain types of individuals are more turstworthy than others as a source of information about environmental issues such as biosolids (e.g. it was hypothesized that university researchers are considered more credible than a government regulator);;
- There are certain institutional sources of information that are more credible with the public than others (e.g. government agencies, academic institutions, companies with an interest in land application, etc.);or
- Biosolids recycling is often viewed as more risky than it actually is—i.e. perceived risk is often high in comparison to other known and perceived risks.

These were the hypotheses tested. As will be discussed below, the findings from the survey supported many of these hypotheses, but did not support others.

The survey was designed to obtain information in the following domains:

- information on what people know about wastewater treatment and biosolids management;
- initial impressions of the wastewater treatment process and the use of its byproducts;
- specific knowledge of biosolids;
- how respondents react to the language that describes solids from wastewater treatment;
- how respondents obtain information about technical/environmental issues;
- what factors increase or decrease the level of concern about biosolids recycling;
- what types of information influences their opinions regarding biosolids recycling;
- which sources of information are most trustworthy; and
- how respondents rank the comparative risk of biosolids recycling to other activities in their daily lives.

Additional questions helped identify characteristics of the respondents so that experiences and traits could be correlated with responses to questions about wastewater treatment and biosolids recycling. Some of the characteristics being tested in this way are based on assumptions made by people involved in biosolids recycling; for example, it is widely assumed that people with direct experience with farming are more likely to understand and accept the use of biosolids, an assumption that was tested by the survey.

Finally, some questions were developed from two smaller previous national surveys of public opinion, that reported by Powell-Tate (1993) and that of Frederick Schneiders Research (1998).

3.2.2 Survey Language and Interpretation

The specific language of the survey was developed through a consultative process between the Center for Environmental Communications, and Ned Beecher at New England Biosolids and Residuals Association, with the assistance of the Survey Center of the University of New Hampshire. This instrument was subsequently reviewed and commented upon by Elaine Vaughan of the University of California at Irvine and Douglas McKenzie-Mohr of St. Thomas University (New Brunswick) who have conducted extensive research into public perception and participation in environmental programs. The input of the Biosolids Stakeholder Review Panel also guided development of the domains, leading to final survey language.

The beginning of the survey included questions to expose respondents to the survey format and to statistically balance the sample for gender, home ownership, and regional distribution. At the

end of the survey were a number of additional questions intended to obtain demographic information about the respondents such as age, race, level of education, income level, and number of residents per household, as well as some questions used to statistically balance the survey against additional sampling error.

One important caveat needs to be made regarding survey questions and the responses to them. Some questions in the survey may have introduced a negative bias about biosolids recycling. By being as direct as possible, and asking questions about issues that have historically provoked a negative public response to land application of biosolids, respondents may have expressed aheightened sense of caution and concern as the survey progressed. This bias was the inevitable result of conducting such a survey. The survey was designed to minimize bias around key questions (questions that appeared early in the survey) as much as possible, and sampling methods took this factor into account.
One more factor plays a role in introducing possible bias in survey responses: language. The description of materials and processes were reduced to the most simple and universal terms, not all of which were as precise as language used by scientists or industry professionals. For example, the term "sewage" was used rather than "wastewater," and "publicly-owned treatment works" (POTWs) were called "sewage treatment plants" because the survey developers believed that these terms are more clearly understood by most people than the alternatives that may be currently favored by those working in the field. The goal of simplifying the language was to balance precision against the universal understanding of what was being asked. The survey was written in such a way as to be understood by the broadest possible cross-section of the public.

The choice of language is critical. People associate specific terms with personal experiences. Such prior knowledge influences their perceptions of any new information. Therefore, prior knowledge and understanding of terms such as "sewage," "sludge," or "human manure" will influence responses to casual questions about these materials. As noted by the Powell-Tate communications plan for biosolids, the term "biosolids" is generally free of associations. If people come to understand biosolids as a treated, tested material used for fertilizer, then it is possible that the fact that it is derived from sewage sludge will have less of a negative impact on perception.

However, in few (if any) instances where controversy has arisen around biosolids recycling has the discussion been solely about "biosolids." Rather, concerned citizens (and usually the media) talk about "human waste," "sewage sludge," or just "sludge" and include some focus on the origin of the material. The current survey intentionally tested, for example, the perception of recycling "human manure" in Question #6C. Rather than assessing the usefulness of language that hides the sewage recycling process, this survey directly confronted respondents with the concepts in order to observe their visceral responses and to discern their understanding of the pros and cons of using such materials. This approach was taken because it appeared, from the literature and case studies, that people are more likely to accept biosolids recycling when they are fully aware of what biosolids are, how they are made, and how they can be beneficial. Assessing how people get to that level of understanding and perception was one goal of the survey.

3.2.3 Administration of the Survey

The Center for Environmental Communications (CEC) was the primary project team member responsible for the survey. CEC identified four independent organizations that were available to conduct the survey. On the basis of interviews with each of the four, and a review of their credentials and cost proposals, the Survey Center of the University of New Hampshire (UNH) was considered the best qualified to meet the project needs.

The UNH Survey Center is an independent, non-partisan academic survey research organization and a division of the UNH Institute for Policy and Social Science Research. The Survey Center conducts telephone, mail, e-mail, Internet, and self-administered surveys, as well as focus groups and other qualitative research for university researchers, government agencies, public non-profit organizations, private businesses, and media clients. Its senior staff have more than 40 years experience in designing and conducting custom research on a broad range of political, social, health care, and other public policy issues.

In addition to providing the facilities and staff to select the sample and conduct the survey, UNH Survey Center staff, most significantly Dr. Andrew Smith, played an important role in the development of the survey instrument and assisted in the analysis of the resulting data.

3.2.4 How the Sample Was Selected

A sample of households in the United States was selected by a procedure known as “random digit dialing.” The way this works is as follows: First, with the aid of the computer, an area code is selected at random (e.g., 603). Next, one of the three-digit telephone exchanges that are currently used in the area (e.g., 772) is randomly selected. The computer then randomly selects one of the "working blocks"-- the first two of the last four numbers in a telephone number (e.g., 64) -- and attaches it to the randomly selected exchange. Finally, the computer program then generates a two-digit random number between 00 and 99 (e.g., 57) which is attached to the previously selected prefix (772), and the previously selected working block (64) resulting in a complete telephone number -- i.e., 603/772-6457. This procedure is then repeated numerous times by the computer to generate more random numbers, so that there is a sufficient quantity to conduct the survey. The end result is that each household in the area in which there is a telephone has an equally likely chance of being selected into the sample.

The random sample used in the 2002 Biosolids: Knowledge and Perception Survey was purchased from Marketing Systems Group, Fort Washington, Pennsylvania. Marketing Systems Group screens each selected telephone number to eliminate non-working numbers, disconnected numbers, and business numbers to improve the efficiency of the sample; this reduces the amount of time interviewers spend calling non-usable numbers.

Each of the randomly-generated telephone numbers is called by an interviewer from a centrally supervised facility at the UNH Survey Center. If the number called is found not to be a residential one, it is discarded and another random number is called. (Approximately fifty percent of the numbers are discarded because they are found to be businesses, institutions, or not

assigned.) If it is a residential number, the interviewer randomly selects a member of the household by asking to speak with the adult currently living in the household who has had the most recent birthday. This selection process ensures that every adult (18 years of age or older) in the household has an equally likely chance of being included in the survey. No substitutions are allowed. If, for example, the randomly selected adult is not at home when the household is first contacted, the interviewer cannot substitute by selecting someone else who just happens to be there at the time. Instead, he or she must make an appointment to call back when the randomly selected adult is at home. In this way, respondent selection bias is minimized.

Once a designated respondent was reached, several questions were asked to further screen them for inclusion in the survey. First, any respondent who said they were only a seasonal resident was excluded. Second, any respondent who does not currently own their home, or those who rent apartments, were excluded. The final sample consisted of home owners and renters who rent entire houses -- people who are more likely to know and care about fertilizers and how their sewage is disposed of.

The selection of individuals who own or rent homes introduced a demographic bias that is worthy of discussion. First, excluding renters reduced the number of respondents who live in urban communities to twenty (20) percent of the sample. This compares to the 1990 U.S. Census Bureau data that indicates that 75% of the population lives in urbanized areas or places outside of urban centers where there are more than 2500 residents (U.S. Bureau of the Census, 2002, http://factfinder.census.gov). Because such a high majority of respondents to the biosolids survey live in suburban or rural communities, they are more likely than the general public to have experience with farms and gardens, an intentional bias that served the purposes of the survey.

Limiting the sample to those who own or rent houses introduced other potential biases. For example, it reduced the racial distribution of respondents. The sample was disproportionally white—88% (compared to the 2000 U.S. Bureau of the Census estimate that the U.S. population is between 69% to 75% white). The small percentage of minority representation in the biosolids survey made it virtually impossible to compare perceptions between races. It was not possible, therefore, to examine “environmental justice” issues through this survey.

Another distortion caused by the choice of homeowners and house renters as the sampled population was that respondents were somewhat older than the national mean, as fewer young adults own their own homes or rent single family homes. The sample was also weighted toward those with higher incomes: compared to the national median household income of $37,005 (year 2000 estimate, U.S. Bureau of the Census), more than 50% of respondents to this biosolids survey had incomes over $45,000. Finally, levels of educational attainment were also different from the U.S. average: 42% of the biosolids survey respondents have completed college, whereas the national rate is closer to 13% (1990 Bureau of the Census estimate).

3.2.5 Who Was Surveyed and When

For the 2002 Biosolids Knowledge and Perception Survey, the UNH Survey Center placed calls to contact seven thousand, two hundred and forty-six (7246) respondents nationwide. Table III-1 shows the percentage of these contacts which resulted in *completed* interviews (15%); *refusals* (18%); *failures* to interview because the telephone was busy, the phone was not answered, the

telephone was answered by an answering machine, appointments were broken, or the respondent was away on business, on vacation, or otherwise unavailable during the interviewing period (35%); *failure* to interview because the number was changed, disconnected, was a computer or FAX line, or was a business (22%); and where there was *no eligible respondent* (apartment dweller or seasonal resident) (10%). These completion rates were well within the expected values for telephone surveys of this type.

Respondents to the biosolids survey were interviewed between February 14 and March 13, 2002. The telephone interviews were conducted between 10:00 a.m. and 9:30 p.m. local time.

TABLE 3.1
Response Rates for The 2002 Biosolids Public Knowledge and Perception Survey

	NUMBER	PERCENTAGE
Completed Interviews	1069	15.0
Refusals	1285	17.7
Failure to Interview -- (no answer, busy, answering machine, broken appointment, or the respondent was away on business, vacation, illness, etc.)	2542	35.1
Failure - Disconnect, Changed Number, Business, Computer/FAX	1616	22.3
No Eligible Respondent	714	9.9
TOTALS	7246	100.0%

3.2.6 Survey Data Compilation

The UNH Survey Center interviewers who conducted the survey recorded responses on prepared forms. For open-ended questions, they wrote down verbatim answers. After the telephone survey interviews were completed, all verbatim responses were coded in order to facilitate computer analysis of response data. Data analysis was conducted by the UNH Survey Center and CEC using the computer software *Statistical Package for the Social Sciences (SPSS).*

3.2.7 Sampling Error

The Biosolids Public Knowledge and Perception Survey, like all surveys, is subject to sampling error due to the fact that all appropriate U.S. homeowners and house renters were not interviewed. For those questions asked of one thousand (1000) or so respondents, the error is +/- 3.1%. For those questions where fewer than 1000 persons responded, the sampling error can be calculated as follows:

$$\text{Sampling error} = +/- (1.96) \sqrt{\frac{P(1-P)}{N}}$$

where *P* is the percentage of responses in the answer category being evaluated and *N* is the total number of persons answering the particular question.

For example, suppose you had the following distribution of answers to the question, "Should the state spend more money on road repair even if it means higher taxes?" Assume 1,000 respondents answered the question as follows:

YES	- 47%
NO	- 48%
DON'T KNOW	- 5%

The sampling error for the "YES" percentage of 47% would be

$$+/-(1.96) \sqrt{\frac{(47)(53)}{1{,}000}} = +/-3.1\%;$$

for the "NO" percentage of 48% it would be

$$+/-(1.96) \sqrt{\frac{(48)(52)}{1{,}000}} = +/-3.1\%;$$

and for the "DON'T KNOW" percentage of 5% it would be

$$+/-(1.96) \sqrt{\frac{(5)(95)}{1{,}000}} = +/-1.4\%;$$

In this case we would expect the *true* population responses to be within the following ranges:

YES	43.9% - 50.1% (i.e., 47% +/-3.1%)
NO	44.9% - 51.1% (i.e., 48% +/-3.1%)
DON'T KNOW	3.6% - 6.4% (i.e., 5% +/-1.4%)

3.2.8 Weighting of the Data

To avoid biasing the sample in favor of households that can be reached through more than one telephone number, each case was weighted inversely to its probability of being included in the sample. In addition, the data were weighted to correct for sampling biases due to size of household (i.e., number adults living in the household). The data were also weighted to correct for potential sampling biases on the sex of the respondent using 2000 U.S. Census figures.

Finally, the data were weighted to reflect the region of the country where the respondent lives, so that regions of the country are proportionally represented. When data were analyzed at the U.S. level, CENSUSWT was applied for all analyses. When data were analyzed within regions, REGIONWT was applied.

3.3 Results/Discussion

Note that most of the questions in the survey were open-ended, i.e. the respondent was not provided with a list of possible answers from which to choose. If answers were provided, it is clearly indicated in the text of the question.

Results of this nation-wide 2002 Biosolids Public Knowledge and Perception Survey are presented below. Each question appears in bold, beginning with its question number. (A copy of the survey questionnaire also appears in Appendix C.) Text in a question that is printed in **ALL CAPITALS BOLD** is an instruction to the interviewer. For example, in Question 7, the "IF YES, ASK" is an instruction to the interviewer:

Q7. "Do you ever seek out and purchase and eat foods that are specifically labeled as being organically grown?" IF YES, ASK: "Would you say you do that occasionally … frequently … or all the time?"

The verbatim questions and interviewer instructions are included in order to provide the reader with as much information about the interview process as possible.

In the discussion of the results, questions are grouped together under the following topical subheadings:

3.3.1 Key Traits of Survey Respondents (Questions 2 – 8 or "Q2" to "Q8)
3.3.2 Knowledge of Sewage Treatment and Biosolids (Questions 9 – 12)
3.3.3 Testing Opinion of Biosolids Recycling (Questions 13 – 17)
3.3.4 What Affects People's Level of Concern? (Questions 18 – 20)
3.3.5 Testing Arguments In Favor Or Opposed To Biosolids Recycling (Questions 21 – 34)
3.3.6 Identifying Trusted Sources of Information (Questions 35 – 37 and 40)
3.3.7 Perception of Risk (Questions 38 – 39).

For many of the survey questions and responses, the discussion includes information about how the responses to that particular question *correlate* with responses to other questions. Correlations were determined by statistical software. They are included in the discussion because they provide answers to questions such as "Is there a tendency for those people who have lived in a farming or ranching community to know more about biosolids?" There are hundreds of possible correlations that could be teased out of the data from this survey; the project team chose to analyze those correlations that addressed the survey hypotheses. Any significant correlations that were found are included in the discussions of the results, following, and in the subsequent conclusions. Significant correlations are reported either as comparisons of percentages (e.g. 48% of rural respondents had heard of the term "biosolids" versus 36% of urban respondents) or in the narrative that accompanies each question. If no significant correlation was found, none is reported.

Anyone who wants to examine correlations that are not discussed below can conduct their own analysis of the raw response frequencies (see Appendix D). The entire raw frequency data (600+ pages), including interviewer notes of individual responses, is available in electronic format from NEBRA.

3.3.1 Key Traits of Survey Respondents

Survey questions Q2-Q8 focus on determining respondents' traits and their involvement with agricultural and environmental matters. Biosolids managers and the project team believed that some of these traits would correlate with higher levels of knowledge and higher levels of acceptance of biosolids recycling.

Q2. "Would you say that you live in a rural, suburban or urban community?"

Seventy-nine (79) percent of the respondents reside in rural or suburban communities. The remaining respondents live in urban communities. This compares to the 1990 U.S. Census Bureau estimate that 75% of the population lives in urbanized areas or places outside of urban centers where there are more than 2500 residents (U.S. Bureau of the Census, 2002). The surveyed population is far more rural than the U.S. population; this difference was caused by surveying only home owners or house renters. The assumption on the part of the survey team was that homeowners and house renters are more likely to understand and respond to a survey about wastewater and biosolids issues than residents who live in apartments. Residents in multi-family units or apartment buildings are, therefore, underrepresented in the survey.

Respondents who live in rural areas are more likely than suburban or urban dwellers to say they have heard of the term "biosolids:"

CORRELATION (Q2 & Q11)		
48% of rural respondents…	**40%** of suburban respondents…	**36%** of urban respondents…
…answered "yes" to "have you heard of the term 'biosolids?'		

Q3. "Have you ever lived on a farm, ranch, or in a farming or ranching community?" IF YES: "Did you live on a farm, or in a farming community… a ranch… or in a ranching community?"

Forty four (44) percent of respondents state they lived, or had lived, on a farm, ranch, or in a farming or ranching community.

Respondents who live on agricultural land or within agricultural communities are fifteen (15) percent more likely than generalized rural dwellers to have heard of biosolids than those who do not. Their definitions of biosolids are also somewhat more accurate than definitions from individuals who do not live on or near agricultural land. The majority of respondents, however, regardless of the type of community in which they live, have never heard of biosolids.

There is also a correlation between individuals who live or have lived in agricultural communities and their acceptance of a neighbor's application of biosolids to their property:

CORRELATION (Q3 & Q14A)	
48% who have LIVED ON FARMS, RANCHES…	**41%** who have NOT LIVED ON FARMS, RANCHES…
…"think it's great" or "probably ok" to have a neighbor apply biosolids to their property	

Q4. "Do you, or anyone in your household, usually do any farming or gardening?"
Fifty-six (56) percent of respondents state they farm and/or garden.

There is some correlation between those who do farming or gardening and their knowledge of biosolids, but it is weaker than the correlation with respondents who, in Q3, state that they live on agricultural land or in agricultural communities. The weaker correlation may be attributed to dilution of the sample with individuals who work in home gardens.

There is also a limited correlation between individuals who farm or garden and their acceptance of a neighbor's application of biosolids to their property.

CORRELATION (Q4 & Q14A)	
45% of FARMERS & GARDENERS…	**41%** of NON-FARMERS OR GARDENERS…
…"think it's great" or "probably ok" to have a neighbor apply biosolids to their property	

It appears that a person's attachment to agriculture (Q2, Q3) and active involvement in farming or gardening (Q4) somewhat predispose individuals to know more about and accept biosolids recycling. This predisposition is not, however, very pronounced.

Q5. "What type of fertilizer, if any, do you use on your lawn or garden or on your farm?"
A total of six hundred and two (602) respondents answered this question.
36% use chemical fertilizer,
16% use animal manure,
12% use compost, and
1 % use biosolids.

It is important to note that, in asking this question, interviewers did not suggest any answers, so those who mentioned biosolids- or sludge-based products did so without prompting.

Q6A. "Why do you prefer this type of fertilizer?"
The respondents answered that the following traits influenced their preference:
38% "ease of use"
16% "works best"
13% "less impact on the environment"
11% "cheaper"
6% "reputation, ads, habits".
5% "safer for family & pets"
4% "only type available"

It is not surprising to see that nearly half of the respondents state that they base their selection upon convenience and cost. Efficacy ("works best") accounts for a fairly large proportion of the remainder, which may also be interpreted as a statement in favor of convenience. Convenience and cost drive many decisions in an increasingly complex and demanding society.

Family health and environmental impact drive preferences for particular types of fertilizer in less than one household in five, which is consistent with national surveys (Roper, 2001; Gallup, 1999) showing that approximately one in five Americans base their purchasing decisions, to a significant extent, on environmental protection and health.

There is some correlation between those buying organic products and the use of "environmental protection" as a rationale for fertilizer purchases:

CORRELATION (Q6A & Q7)	
78% who PURCHASE ORGANIC…	**45%** who DON'T PURCHASE ORGANIC…
… use environmental protection as rationale for their purchase of fertilizer	

Because the total numbers in this pairing are low, however, this correlation is relatively weak.

Q6B. How likely would you be to use a fertilizer that was made from animal manures that had a barnyard odor and looked like moist soil?

Responses:
43% likely
28% somewhat likely
25% not too likely or not at all likely

The practice of using animal manures is well accepted, even among respondents who live in urban communities. In fact all respondents are more or less equally likely to use fertilizer that was made from animal manures (the following percentages are all within the margin of error):

CORRELATION (Q6B & Q2)		
75% of RURAL respondents…	**68%** of SUBURBAN respondents…	**67%** of URBAN respondents…
… are very likely or likely to use animal manures		

Q6C. How likely would you be to use a fertilizer that was made from human manures and sewage that had a barnyard odor and looked like moist soil?

Twenty (20) percent of the respondents state they would be very likely or somewhat likely to use a fertilizer from human manures and sewage. Seventy-six (76) percent state they were not too likely or not at all likely to use such fertilizer. More significantly, among the respondents who are unlikely to use fertilizer from human manures, fifty-seven (57) percent are "not at all likely" to use them.

Questions Q5 and Q6 speak to a relatively strong negative reaction to using "human manures" as fertilizer. Although question Q5 showed that few people (16%) actually use animal manures, the practice is accepted by seventy-one 71 percent of respondents. When asked if they would extend this practice to the use of human manures, their responses were the opposite, with nearly six in ten stating that they were not at all likely to use them.

People understand and support the use of animal manures. The description of animal and human manures in Q5 and Q6 were the same; i.e. "manures…that had a barnyard odor and looked like moist soil." Yet, they recoil from the notion of using manures from human sources. Both were not described as composted or treated in any way, and there is good reason to be cautious about either, if they are not treated for pathogens. Some practitioners (Toffey, 2000) believe that a visceral resistance impedes acceptance of recycling human wastes, an opinion that finds support in the data generated by these questions.

Q7. "Do you ever seek out and purchase and eat foods that are specifically labeled as being <u>organically grown</u>?" IF YES, ASK: "Would you say you do that occasionally … frequently … or all the time?"

Responses:
60% do not ever seek out and purchase organic foods
24% occasionally
11% frequently
4% all the time.

The purpose of this question was to identify individuals who are sensitive to the ways in which agricultural practices may influence food quality and personal health. This question was also of particular interest because of the controversy surrounding establishment of a national standard for organic foods that excluded biosolids as a possible organic soil amendment.

In this context, the results are somewhat surprising. First, there is a significant (.034), but not especially powerful, correlation between consumers of organic foods and their having heard of biosolids. Second, the attitudes of organic food consumers can be correlated to a neighbor using biosolids on their property (Q14A), with surprising results:

Occasional consumers of organic foods are generally as likely to support (40%) a neighbor's application of biosolids to their property as they are to oppose (42%) the application of biosolids to their property. Moreover, fifty-one (51) percent of respondents who consume organic foods "frequently" or "all the time" believe "it's great" or "probably ok" for a neighbor to apply "biosolids" to their property, which is higher than the percentage of respondents (43%) who do not consume organic foods.

Even when the attitudes of organic food consumers are examined in relation to a neighbor using "sewage sludge" on their property (Q14B), forty (40) percent of occasional consumers of organic foods are supportive of the practice. Among the respondents who consume organic foods "frequently" or "all the time" the percentage supporting the practice drops to twenty-nine (29) percent, which is similar to the percentage (30%) who do not consume organic foods.

The project team had hypothesized measurable opposition to land application of biosolids amongst self-identified consumers of organic foods. But the survey found that the consumption of organic foods is not strongly correlated to perceptions of biosolids.

Q8. "How much would you agree that the term <u>environmentalist</u> applies to you? Would you say that you agree strongly... agree somewhat ... disagree somewhat ... or, strongly disagree?

Responses:
76% agreed strongly or agreed somewhat
16% disagreed strongly or somewhat disagreed.

There is a strong correlation ($p = .103$) between self-described environmentalists and their having heard of biosolids. This is stronger than the correlation between self-described consumers of organic foods and those who say they have heard of biosolids ($p = .034$). The number of self described environmentalists who are able to correctly define "biosolids", however, is not dramatically different from the number from the general population who correctly define biosolids.

As in the previous question, the respondents who might be expected to know or care more about land application of biosolids or sewage sludges—i.e. environmentalists—do not seem to know much more than the general public. Nor do they express opinions that differ in any important way.

3.3.2 Knowledge of Sewage Treatment and Biosolids

Questions Q9 - Q10B test understanding of sewage treatment, while questions Q11-Q12 introduce the term "biosolids" and establish a baseline understanding of how familiar the respondents are with the concept of biosolids recycling. Quoted verbatim responses are as important as the percentages of various responses—they indicate respondents' feelings regarding biosolids recycling.

Q9. "I'm now going to ask you several questions about the sewage from your home. Sewage is the mixture of waste and water that goes down toilets, sinks, and drains. First of all, what happens to the sewage after it leaves your home?

Responses:
52% goes to a public sewage treatment plant
34% goes to a home or group septic system
13% do not know

These percentages are inconsistent with the national averages of homes that discharge to wastewater treatment facilities and homes that rely on onsite (mostly septic) systems. The U. S. Environmental Protection Agency (U. S. EPA) estimates that approximately 75% of households are served by wastewater treatment facilities and 25% by on-site systems. The difference between the surveyed population and the national average is likely created by the under-representation in the surveyed population of urban households, which would all be connected to sewage treatment plants.

The way in which a householder's sewage is treated does not correlate in any important way with any of the other questions in the survey.

Q10A. "Have you, yourself, ever visited a sewage treatment plant?"
Responses:
33% Yes
67% No

Having visited a sewage treatment plant informs people about wastewater treatment and biosolids management and makes them more likely to have heard of biosolids:

CORRELATION (Q10A & Q11)	
58% who HAD VISITED a sewage treatment plant…	**34%** who HAD NOT VISITED a sewage treatment plant…
… said "yes," they have heard of the term "biosolids."	

This correlation between having visited a sewage treatment plant and having heard of biosolids was one of the strongest in this survey.

Those who have visited a sewage treatment plant are also somewhat more accepting of a neighbor applying biosolids or sewage sludge to their property than the general public.

Q10B. "Which of the following statements best describes your overall impression of the sewage treatment plant you saw?
Responses:
93% believe that sewage treatment plants are necessary or a good idea
3% percent stated they are not needed or are detrimental

This question elicited the most unambiguous response of the survey. There is widespread support for sewage treatment that crosses boundaries of age, gender, region, personal habits, agricultural experience or understanding of sewage treatment processes.

Q11. "Have you ever heard of the term BIOSOLIDS?"
Responses:
42% have heard of biosolids
58% don't know the term
This apparently high recognition of the term "biosolids" is, however, somewhat deceiving, as is discussed below.

There are many ways to correlate people's understanding of the term "biosolids" with demographic characteristics, and some correlations are stronger than others. The general state of knowledge about the term, however, remains weak—see the analysis of responses to question Q12, below.

Q12. "How would you define the term BIOSOLIDS?" (RECORD VERBATIM RESPONSE. PROBE FOR SPECIFICS)

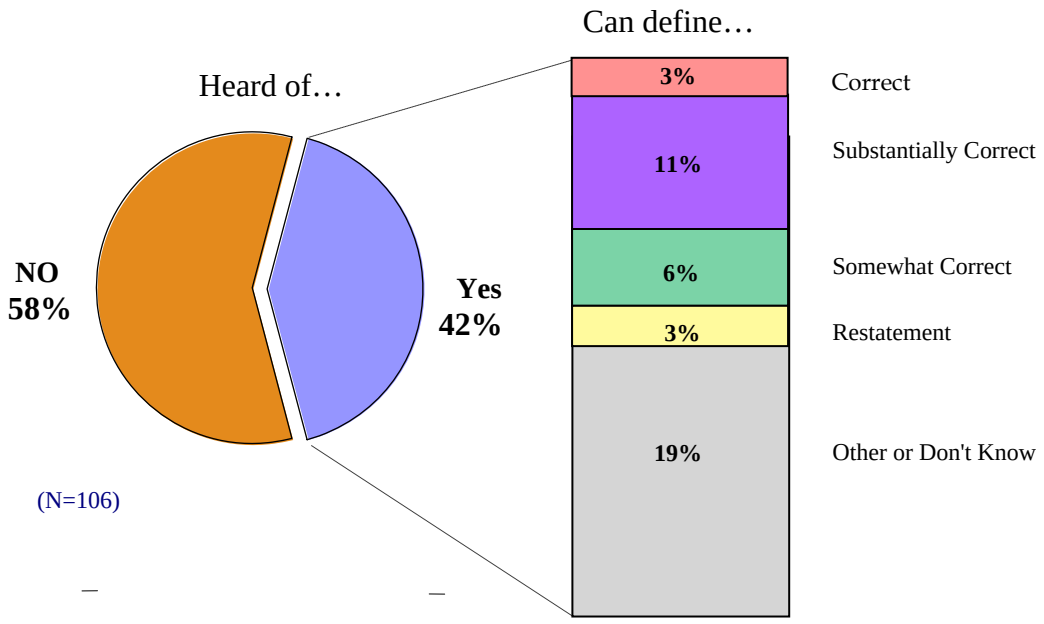
Of the four hundred and forty-nine (449) individuals who, in question Q11, stated they had heard of the term "biosolids," four hundred and forty-seven (447) attempted to define the term in question Q12. Respondents' definitions are widely varied and, for the most part, imprecise.

About 14% of the respondents are correct or close in their definition of "biosolids." However, a highly correct definition of biosolids should embrace its essential nature (solid or semi-solid material), origin (municipal wastewater or sewage treatment), and acknowledge the fact that it is treated. By this definition, six (6) percent of those attempting a definition—or 3% of the entire group of respondents—can correctly define the term. One (1) percent specifically define biosolids as "sludge."

Table 3-2: Heard of / Define "Biosolids"

HEARD OF BIOSOLIDS?	**NO**	**YES**	**CAN DEFINE?**	
	58%	**42%**	**% of YES**	**% of all**
Correct: (*treated* human waste /sewage, fertilizer, etc.)			6%	3%
Substantially correct: (human waste, sludge, etc.)			25%	11%
Somewhat correct (biologic waste, organic waste, etc.)			14%	6%
Re-statement (biological solids, solids, etc.)			7%	3%
Other or don't know			48%	19%
(N=1069)				

Figure 3.1: Heard Of / Can Define "Biosolids"



Some examples of responses of the 3% percent of the entire group who provided correct definitions are:

"Biosolids are those treated solids that come back as fertilizer on the land."
"Organic matter that is left after it has been processed by the sewer ponds."

Another eleven (11) percent of respondents are substantially correct in their definition of the term "biosolids." Some examples are:

"Biosolids is human waste."
"A residue from sewer treatment."
"Any waste from a living organism, not necessarily human."
"Byproducts of the waste treatment."
"Sewage that breaks down."

Another group of responses are somewhat close to the definition, and came from six (6) percent of those surveyed. Some examples are:

"Organic waste. Biological waste, actually."
"Organic material."

A fourth group of responses are restatements of the question in another form, building definitions from the name "biosolids." They came from approximately three (3) percent of those surveyed. Some examples are:

"Biodegradable solids."
"Biological wastes."
"Biosolids are solid waste."

None of these four groups are much more likely than other respondents to use recycled biosolids on their own property:

CORRELATION (Q12 & Q16)			
Of the ENTIRE GROUP OF RESPONDENTS…	Of those who CORRECTLY OR CLOSELY DEFINE "BIOSOLIDS"…	Of those who are NOT SO ACCURATE DEFINING "BIOSOLIDS"…	Of those who RESTATE THE QUESTION AS THEIR DEFINITION…
…36%…	**…42%…**	**…35%…**	**40%**
…said they would be "very likely" or "somewhat likely" to use biosolids on their property.			

Among the respondents who provided an incorrect definition of biosolids or said "don't know" (48% of the 42% attempting a definition), a substantial number (40%) later stated (after learning the correct definition) that they are very likely or somewhat likely to apply recycled biosolids to their property.

Examples of the definitions provided by those who said they could define "biosolids" but failed to do so are:

"I don't think I could."
"Don't know – waste or something."
"Cow pies to start fires."
"I wouldn't know, I've just heard of it."

Some subgroups are more likely than others to offer a correct or substantially correct definition of the term "biosolids:"

CORRELATIONS (Q12 & personal traits)	
Respondents AGES 50-69 are…	…14% more likely …
Respondents EDUCATED BEYOND HIGH SCHOOL are…	…15% more likely …
Respondents who have LIVED ON A FARM OR RANCH are…	…15% more likely …
Respondents who have SCIENCE BACKGROUND OR EDUCATION are…	…14% more likely …
Respondents LIVING IN RURAL AREAS are…	…9% more likely …
Respondents who say they are ENVIRONMENTALISTS are…	…7% more likely …
… to have heard of the term "biosolids" in comparison to the entire group of respondents.	

3.3.3 Testing Opinion of Biosolids Recycling

Questions Q13 - Q15 test responses to the concept of biosolids recycling. Half of the survey respondents answered FORM A (Q14A and Q15A), in which the material was referred to as "recycled biosolids." The other half answered FORM B (Q14B and Q15B), in which the material was referred to as "sewage sludge." These questions are followed by Q16-Q17, which pose specific scenarios to uncover feelings about the use of biosolids close to the respondent's home.

In reviewing the responses to these questions, it is important to remember that up to this point in the survey, the respondents had not been given any clear indication of the focus of the survey and had not been asked to provide any significant opinions, and the questions were not challenging. Thus, responses to question Q13 are not affected by any significant bias introduced by the survey itself and should fairly represent opinions regarding biosolids. The subsequent questions begin to challenge respondents to think hard about the possible implications of biosolids recycling; in so doing, the questions themselves begin to introduce a bias that may increase respondents' sense of concern about biosolids recycling.

Q13. "Biosolids are the solid matter removed from sewage that has been treated and tested so they can be recycled as a fertilizer. Based on what you know about

biosolids, what is your overall reaction to the process of recycling biosolids as fertilizer?" (RECORD VERBATIM RESPONSE. PROBE FOR SPECIFICS)

Fifty-three (53) percent of the respondents state that recycling biosolids is a "good idea" or made some other positive comment, and another ten (10) percent offer positive comments with some conditions. The second most frequent group of responses are opposed to recycling biosolids: sixteen (16) percent of the respondents oppose recycling of biosolids, some stating that the practice is "disgusting." Six (6) percent state that they are skeptical or leery of the practice, or that they have some concerns about it. There are many conditional comments, some of which are listed below.

Table 3-3: Reaction to Definition of Biosolids

POSITIVE REACTIONS	63%
General positive reaction (good, positive, etc.)	53%
Positive, with conditions (i.e., not on gardens, lawns)	5%
Positive, if it works	3%
Other positive reaction	2%
NEUTRAL REACTIONS	12%
Indifferent, don't know, don't care	6%
Need more information	4%
Open to the idea	2%
NEGATIVE REACTIONS	25%
General negative reaction (against it, disgusting, etc.)	16%
Skeptical, leery, etc.	5%
Negative reaction - health concerns	2%
Negative reaction - odor	1%
Other negative reaction	1%
(N=)	(1062)

Among the group of responses that were positive are these:

"A good idea."
"A very solid idea – I would question the idea of using it on human foods for consumption, but good for parks."
"As long as it's treated, it's ok."
"I think it's a good idea, if it can be safely reused."

Among the group opposed to recycling biosolids are these comments:

"I don't like the idea."
"I think it's alright for animal waste, but not human."
"Yuck! It turns me right off."
"I'd be worried about spreading disease or viruses."

Ambivalent comments include:

"I would have to have more information on it."
"I'm a little leery."
"The way they do it here is fine, but other places do it differently and I don't like it."
"Not too keen on using it in my yard."

FORM A:

Q14A. "I want you to imagine the following scenario. Suppose your next door neighbor had spread recycled <u>biosolids</u> on their lawn or garden as fertilizer. Which ONE of the following statements BEST describes your attitude towards your neighbor's use of biosolids? Would you say you ... (READ NUMBERS 1 TO 6)

There were 537 respondents who answered this question; these are their responses:
44% "think it's great" or "it's probably OK"
35% would "ask them to stop" or "prefer them not to do it"
19% said it is "none of my business."

There are some correlations that are somewhat significant between the answers to this question and various personal traits:

CORRELATIONS (Q14A & personal traits)	
Those LIVING IN RURAL AREAS are…	…7% more likely …
Those who have LIVED ON A FARM OR IN A FARMING COMMUNITY are…	…4% more likely …
Respondents who have SCIENCE BACKGROUND OR EDUCATION are…	…4% more likely …
MEN are…	…4% more likely …
WOMEN are…	…6% less likely…
SUBURBAN respondents are…	…6% less likely …
URBAN respondents are…	…7% less likely …
… to "think it's great" or "it's probably okay" when asked about their neighbor using "BIOSOLIDS," in comparison to the entire group of respondents.	

There are also regional differences in the responses to this question. The ratio of respondents who are supportive of their neighbor's use of biosolids vs. those not supportive varies by region, as follows:

CORRELATION (Q14A & Region of Residence)	
Region	*Ratio of support to opposition of neighbor's use of biosolids*
Rocky Mountain (AZ, CO, ID, MT, UT, NM, WY)	3.8 : 1
New England (CT, ME, MA, RI, NH, VT)	2.7 : 1
West (AL, NV, OR, WA, CA, HI)	2 : 1
Great Lakes (MN, OH, WI, MI, IN, IL)	1 : 1
Mid-Atlantic (DC, MD, NY, DE, NJ, WV, PA)	1 : 1

FORM B:

Q14B. "I want you to imagine the following scenario: Suppose your next door neighbor had spread <u>sewage sludge</u> on their lawn or garden as fertilizer. Which ONE of the following statements BEST describes your attitude towards your neighbor's use of sewage sludge? Would you say you ... (READ NUMBERS 1 TO 6)

There were 526 respondents who answered this question; these are their responses:
32% "think it's great" or "it's probably OK"
53% would "ask them to stop" or "prefer them not to do it"
18% said it is "none of my business."

It is obvious that the change in terms from "recycled biosolids" to "sewage sludge" alters people's perceptions of the suitability of these materials for application to their neighbor's property. In each response category, the number of respondents who support spreading of "biosolids" declines by ten (10) to twelve (12) percentage points when the material is called "sewage sludge."

The relative patterns of correlations observed in Q14A, above, are roughly repeated in Q14B, but to a lesser extent in some cases:

CORRELATIONS (Q14B & personal traits)	
Those LIVING IN RURAL AREAS are…	…1% more likely …
Those who have LIVED ON A FARM OR IN A FARMING COMMUNITY are…	…4% more likely …
MEN are…	…4% more likely …
WOMEN are…	…2% less likely…
… to "think it's great" or "it's probably okay" when asked about their neighbor using "SEWAGE SLUDGE," in comparison to the entire group of respondents.	

Relative differences between regions remain in place, but the amount of opposition grows across the board when the term "sewage sludge" is employed.

FORM A

Q15A. "If you had questions about your neighbor's use of <u>biosolids</u>, who would you ask FIRST?" "Who would you ask SECOND?"

Five hundred and twenty-seven (527) responded to this question.

Frequency of "first choice" responses appears in the table below.

Frequency of "second choice" responses:
16% local health department
13% state health or environmental officials
12% friends
9% U. S. Environmental Protection Agency

Speaking to friends is the clear choice of people seeking information about a neighbor's use of biosolids. It is important to note that the Internet, which contains a wide variety of information on biosolids and sewage sludge, is not widely chosen by respondents as an initial source of information.

It is possible that questions Q15A and B were leading questions. That is, they may have led some respondents to a particular answer: If you had questions about your neighbor's use of biosolids, who would you ask first?….your neighbor, of course! Despite this possible question-induced bias, there appears to be a sizable proportion of the population that would turn to friends and neighbors for initial information. Local, state, or federal agencies of government that deal with health and environmental issues are the first choice of twenty (20) percent. When asked whom they would ask next, the most frequent (39%) second choices were agencies of government, especially local health departments.

FORM B

Q15B. "If you had questions about your neighbors use of <u>sewage sludge</u>, who would you ask FIRST?" "Who would you ask SECOND?"

Five hundred and twenty-two (522) individuals responded to this question.

Frequency of "first choice" responses appears in the table below.

Frequency of "second choice" responses are similar to those for the previous question:
17% local health department
15% state health or environmental officials
10% U. S. Environmental Protection Agency
9% friends.

Table 3-4: Whom Ask First for Information About "Biosolids" / "Sludge"

	"BIOSOLIDS"	"SLUDGE"
Friend, acquaintance	55%	49%
Local health department	11%	17%
State health officials	6%	6%
University researchers	4%	2%
U.S. EPA	3%	5%
Plant operators	3%	4%
Environmental organization	2%	0%
Other	9%	9%
Don't know	8%	8%
(N=)	(527)	(539)

(X^2= 28.815, p=.002)

There is a significant shift in whom people would turn to for information when the term "sewage sludge" replaced the term "biosolids." Although friends and neighbors still rank most highly, twenty-nine (29) percent select local, state, or federal officials when "sewage sludge" is involved. More importantly, when "sewage sludge" is involved, the second choice of forty-four (44) percent of respondents is government officials. Apparently, the level of concern and negative response to "sewage sludge" revealed in Q14B results in an increased reliance on government officials.

Q16. "Now I want to ask you several questions about using recycled biosolids. How likely would you be to use recycled biosolids on your own yard, garden or farm? Would you be very likely … somewhat likely … not very likely … or not at all likely?"

Responses:
10% very likely
26% somewhat likely
25% not too likely
32% not at all likely

The majority of respondents (57%) are *unlikely* to use recycled biosolids in their own yard, a significantly larger percentage than those who would be *likely* to use recycled biosolids.

When this question is correlated against other factors, some of the general trends observed in Q14 are noted again:

CORRELATIONS (Q16 & personal traits)	
Those LIVING IN RURAL AREAS are…	…5% more likely …
Those who have LIVED ON A FARM OR IN A FARMING COMMUNITY are…	…4% more likely …
MEN are…	…7% more likely …
… to use recycled biosolids on their own yard, garden or farm, in comparison to the entire group of respondents.	

Among the regions, residents of the Rocky Mountain and Western states are more likely to use biosolids than residents of other regions.

Q17. "How likely would you be to allow your children to play on a yard treated with recycled biosolids? Would you be very likely … somewhat likely … not very likely … or not at all likely?"

Responses:
9% very likely
22% somewhat likely
19% not very likely
34% not at all likely

This question was designed to test the perception of risk attached to intimate contact with biosolids. Because children are generally regarded as the least able to protect themselves from risk, adults tend to be conservative about allowing children to contact materials they may consider potentially harmful.

Men (36%) are more likely than women (26%) to allow children to play in a yard in which biosolids had been applied, which is a result consistent with other studies of public response to changes in an environment. Women are less likely than men to take risks or allow children to be exposed to possible risks.

The likelihood ("likely" or "somewhat likely") of allowing children to play in a yard in which biosolids had been applied is markedly higher (32%) among adults with education above the high school level than it is among adults whose educational attainment was at the high school level or below (11%). Respondents who work or have been educated in the sciences are seven (7) percent more likely to allow their children to play in a yard in which biosolids had been applied. This result comports with literature that indicates that engineers and scientists express a higher level of "comfort" concerning the control of environmental problems.

Other responses to this question are somewhat unusual. A smaller percentage (31%) of respondents state they were generally likely to allow their children to play in a yard with biosolids than apply them to their own yards (36%, from Q16). The percentage (53%), however, who indicate they would not allow their children to play in a yard with biosolids is lower than the percentage who would not apply (57%) biosolids to their own yard (although the differences are not large). Adults with children in their households do not respond much differently to this question than adults without children.

3.3.4 What Affects People's Level of Concern?

Questions Q18 and Q19A to H test the impacts of factors that the developers of the survey believed may change people's level of concern about biosolids used near their homes.

Q18. "What, specifically, would you need to know in order to be more comfortable about recycled biosolids being used near your home?" RECORD VERBATIM RESPONSE. PROBE FOR SPECIFICS: "Anything else?"

There were one thousand and sixty-five (1065) verbatim responses to this question**.** The responses fall into three basic groups: those who want to know more about health impacts (37%); those who want to know more about the processes that generated biosolids (33%); and those who have generalized questions about research findings and historical impacts (13%). There are no particularly significant correlations between respondents' needs for particular types of information and their personal traits.

Table 3-5: Desired Information about Biosolids

TESTING, SAFETY LITERATURE	23%
More information (in general)	14%
Health issues, hazards, risks	12%

Explanation of the process, how to use it	9%
What it is made of, content	6%
Bacteria, viruses, etc.	6%
How it is treated	4%
General disapproval	4%
Side effects	3%
Already use, already know about it, no problem	3%
Odor	2%
What chemicals are in it	2%
Other	2%
Don't know, don't want to know	10%
(N=)	(1068)

Individuals wanting more information about health impacts offer responses like these:

"I would like to know what it would do to our health in the coming years."
"All the medical information; if it's good/bad or healthy/unhealthy."
"Bacterial issues."
"I'd like to know about the smell, safety factors, and infection factors."

Those who wanted more information about the processes offer these:

"A complete explanation of the process."
"Is it government tested?"
"I'd need to know a lot more about how it is made."

Respondents who stated they want more information about research or historical uses say such things as this:

"I don't know what it would be like. If it's like all the other fertilizers, fine."
"Research done, and testing results."
"Need to know where it is used, and how it worked out."

Q19A. "Would it change your level of concern to know that biosolids applied near your home were from your LOCAL sewage treatment facility? Does this increase or decrease your level of concern about recycling biosolids?"

Responses:
62% it makes no difference
18% greatly or somewhat increases concern
13% greatly or somewhat decreases concern

Knowing that biosolids are locally made apparently makes little difference in the level of concern. The responses to this question suggest that local sewage treatment facilities are not much more trusted or distrusted than those from other communities.

Q19B. "Would it change your level of concern to know that biosolids being applied near your home were from a LARGE CITY like Chicago, New York, or Los Angeles? Does this increase or decrease your level of concern about recycling biosolids?"

Responses:
52% it makes no difference
36% greatly or somewhat increases concern
7% greatly or somewhat decreases concern

By a significant margin, knowing that biosolids are from a large city increases levels of concern. The increase is more pronounced (42%) among residents of rural communities than among suburban or urban residents.

There has been discussion in the wastewater treatment industry regarding perception by suburban or rural residents of biosolids that emanate from urban sites. The survey found clear evidence of distrust of biosolids from urban settings. The survey did not test for the reasons why people distrust urban wastes.

Q19C. "Would it change your level of concern to know that biosolids being applied near your home were produced from sewage that included a LIMITED AMOUNT OF INDUSTRIAL WASTE? Does this increase or decrease your level of concern about recycling biosolids?"

Responses:
20% it makes no difference
63% greatly or somewhat increases concern
12% greatly or somewhat decreases concern

This question elicited one of the most unequivocal responses of the survey. Only one in five respondents stated that the presence of industrial waste in biosolids would not influence their opinion about them being applied near their home. The perception of industrial wastes is well established in the public mind. Industrial contamination has had adverse health and environmental impacts in many cases, local and national, and people have strong negative impressions of "industrial waste."

Q19D. "Would it change your level of concern to know that biosolids being applied near your home DID NOT COST YOUR NEIGHBOR ANYTHING; THEY WERE OBTAINED FOR FREE? Does this increase or decrease your level of concern about recycling biosolids?"

Responses:
65% it makes no difference
22% greatly or somewhat increases concern
8% greatly or somewhat decreases concern

Biosolids managers have speculated that showing value of biosolids products by having them cost something should reduce public concerns. This survey determined that the impact on public

acceptance of charging for biosolids products may be minimal, but does apply to almost 1/4 of the population represented by the survey.

Q19E. "Would it change your level of concern to know that biosolids being applied near your home were REVIEWED AND CERTIFIED EACH YEAR BY AN INDEPENDENT EXPERT AUDITOR? Does this increase or decrease your level of concern about recycling biosolids?"

Responses:
7% greatly increases concern
9% somewhat increases concern
35% somewhat decreases concern
14% greatly decreases concern

Knowing that biosolids applied near their home are independently reviewed and certified each year significantly decreases the levels of concern.

Wastewater treatment programs have tried many different ways of communicating the relative risks associated with recycling biosolids. As is the case with many environmental issues, having third party reviewers provide oversight is generally a good way to engender trust and to reduce levels of public concern. Based on responses to this series of questions, having an independent expert auditor review and certify biosolids appears to be an effective way to decrease concern.

Q19F. "Would it change your level of concern to know that biosolids applied near your home were produced by a process supervised by a LOCAL CITIZENS ADVISORY COMMITTEE? Does this increase or decrease your level of concern about recycling biosolids?"

Responses:
34% it makes no difference
7% greatly increases concern
11% somewhat increases concern
32% somewhat decreases concern
11% greatly decreases concern

Respondents' level of concern significantly decreases if the biosolids production process is supervised by a local citizens advisory committee.

Q19G. "Would it change your level of concern if your neighbor or the biosolids manager contacted you in advance and talked with you about your neighbor's use of biosolids? Does this increase or decrease your level of concern about recycling biosolids?"

Responses:
5% greatly increases concern

8% somewhat increases concern
35% somewhat decreases concern
13% greatly decreases concern

Being contacted by a neighbor or contractor to talk about the use of biosolids significantly reduces concern.

Q19H. "Most scientists say there is negligible risk associated with recycling biosolids. Does this increase or decrease your level of concern about recycling biosolids?"

Responses:
15% greatly increases concern
18% somewhat increases concern
28% somewhat decrease conern
8% greatly decreases concern

If scientists say there is negligible risk associated with biosolids recycling, about one third of the surveyed population find their concerns reduced.

Having scientists testify to the relative risk of an environmental practice is a time-honored practice that has some potential benefit, but not an overwhelming amount. There has been a measured decline in public confidence in the credibility of scientists since the 1950s through 1960s. There is ample evidence that traditional voices of authority no longer sway perceptions in the way they did fifty years ago. The savvy public is more aware that scientific opinion can be purchased or manipulated to suit the objectives of any particular enterprise.

The evidence of ambivalence toward scientific testimony in this instance is reflected in the numbers of respondents who moved in opposite directions. Nearly as many (33%) say they would be more concerned as said they would be less concerned (36%) when presented with scientific evidence. Among the three hundred and thirty-one (331) respondents who are either working in, or have some education in a scientific field, the perceptions are remarkably similar to those of the general public.

Q20. "Who do you think should be responsible for testing and overseeing the use of biosolids?" (READ RESPONSES 1 TO 5)

Responses:
44% state or federal government officials
23% university researchers
11% local government officials
7% landowners
7% sewage plant operators

This result if consistent with the responses to questions Q15A and Q15B, in which local, state, and federal officials were cited as reliable sources of information on recycled biosolids and

sewage sludge. The responsibility for testing and overseeing biosolids is, in the minds of respondents, the clear responsibility of state and federal officials. This position is consistent among subsets of the sample; i.e. males/females, living in farming communities, level of education, age, etc.

Ninety-five (95) respondents volunteered an "other" response to this question, from which some patterns developed. Fifty-four (54) suggested some combination of overseers to the use of biosolids. There was also a fairly frequent (18) expression of interest in the "independence" of those reviewing biosolids. Some of these comments include:

"All of them, together."
"A combination between the government and private sector."
"State people and local people together."
"Independent source without a monetary interest, and local people."
"A board made up of experts – a combination of all."

Although the sample of voluntary comments is relatively small, the theme of combining interested parties into a decision-making entity may be a worthy topic of inquiry for future surveys or focus group research.

3.3.5 Testing Arguments In Favor Or Opposed To Biosolids Recycling

Two series of questions tested particular arguments that have been used in support of biosolids recycling and in opposition to biosolids recycling. In these series of questions, to avoid prejudicing the respondents by placing provided answers in a particular order, the order of possible answers to each question (Q21 – Q26, Q28 – Q33) were rotated with each interview. The final questions (Q27 and Q34) in each of the two series of questions are forced-choice questions covering the same topic as the series of questions just before it. These final questions are intended to corroborate the responses to the previous series of questions.

Q21. "Which of these do you think is the BEST use for biosolids … (READ NUMBERS 1 TO 5. ROTATE RESPONSES)

Possible responses to this question were read to the respondents. Their choices:

31% produce gases than can be burned to generate electricity
25% improving soils damaged by mining, dredging, or construction
16% fertilizer for forests to grow trees
9% fertilizer for food crops
7% fertilizer for lawns and gardens

Correlating this question with other questions or demographic characteristics does not uncover any particularly noteworthy patterns.

Q22. "I'm now going to read you several arguments in favor of recycling biosolids and I want you to tell me how much you agree with each statement. First …" (ROTATE Q22 – Q26)

"Recycling biosolids disposes of a waste product … Do you agree or disagree that this is a strong argument in favor of recycling biosolids?

Response:
38% agree strongly
39% agree somewhat
..8% disagree somewhat
6% disagree strongly
5% don't know/no opinion

There is very strong agreement that disposing of a waste product is a good argument in favor of recycling biosolids.

Q23. "Recycling biosolids returns nutrients and organic matter back into the soil … Do you agree or disagree that this is a strong argument in favor of recycling biosolids?

Responses to Q23 are similar to Q22:
39% agree strongly
38% agree somewhat
7% disagree somewhat
6% disagree strongly
8% don't know/no opinion

There is very strong agreement that returning nutrients to the soil is a good argument in favor of recycling biosolids. This is one of the most unequivocal findings of the survey.

Q24. "Recycling biosolids prevents erosion and improves water quality … Do you agree or disagree that this is a strong argument in favor of recycling biosolids?

Responses:
16% agree strongly
25% agree somewhat
17% disagree somewhat
17% disagree strongly
17% don't know/no opinion

There is support for this argument, but not as much as for the previous two statements.

Notable is the percentage of survey participants (17%) who answer "don't know"—more than twice the uncertainty expressed in response to the previous two questions. This may indicate that the relationship of erosion to water quality, or some other aspect of the question, was not well understood by respondents.

Q25. "Recycling biosolids is beneficial and involves minimal risk … Do you agree or disagree that this is a strong argument in favor of recycling biosolids?

Responses:
17% agree strongly

33% agree somewhat
16% disagree somewhat
12% disagree strongly
25% don't know/no opinion

The number of respondents who agree that this is a strong argument is fairly high. The number who responded "don't know", however, is also fairly high when compared to other questions in this series.

Q26. "Recycling biosolids saves money for sewage treatment plants and communities … Do you agree or disagree that this is a strong argument in favor of recycling biosolids?

Responses:
25% agree strongly
37% agree somewhat strongly
11% disagree somewhat strongly
6% disagree strongly
15% don't know/no opinion

More than six in ten respondents agreed that saving money for sewage treatment plants and communities is a strong argument in favor of recycling biosolids. This is a strong response, in isolation from other sample answers.

Q27. "Which of these do you think is the STRONGEST argument FOR recycling biosolids?"
(READ NUMBERS 1 TO 5. ROTATE RESPONSES)

This question is structured as a forced choice, in which respondents select the strongest argument from among those they have rated in Q22-Q26. In this instance, the respondents' answers are consistent with their previous choices:
37% returns nutrients to soils
21% disposes of a waste product
13% saves money
11% beneficial and involves minimal risk
8% prevents erosion

The strongest argument in favor of recycling biosolids in 2002 is that it "returns nutrients to soils." The 1998 survey by Frederick Schneiders Research asked a similar question of a random sample of adults, finding forty-two (42) percent who agreed with this position.

There are no significant regional differences in responses to this question. Nor are factors such as having lived in a farming community, level of education, science education, or gender significantly related to perceptions about the strongest arguments in favor of recycling biosolids.

Q28. "I'm now going to read you some of the arguments that others have made AGAINST recycling biosolids and I want you to tell me how much you agree with each argument." (ROTATE Q28 – Q33)

"There has been inadequate testing of biosolids … Do you agree or disagree that this is a strong argument against recycling biosolids?

Responses:
27% agree strongly
27% agree somewhat
9% disagree somewhat
7% disagree strongly

There are some concerns about the adequacy of testing biosolids, and many concerns about the general lack of information about biosolids, as demonstrated by the responses to Q13 and Q18. Part of the reason why the inadequacy of testing receives such high support in Q28 may be because of this general lack of information.

Q29. "Biosolids have a bad odor … Do you agree or disagree that this is a strong argument against recycling biosolids?

Responses:
28% agree strongly
23% agree somewhat
15% disagree somewhat
8% disagree strongly

Despite the fact that odor is an issue in the field, the response to this question provides the only evidence in this survey that odor is a significant concern to the public—and just barely half of respondents stated that they considered it a strong argument against recycling biosolids. In Q6B and Q6C, there is no indication that the references to "barnyard odor" influences responses. Nor do many respondents identify odor as a serious issue in Q13 or Q18. Biosolids managers and the developers of the survey expected to find a much higher percentage indicating that biosolids having bad odors is a strong argument against recycling them. But, apparently, the savvy public is aware and accepting that odor alone is not a reason for halting a practice. Certainly there is ample evidence that concerned citizens and environmental groups have chosen not to focus on odor issues (Sierra Club, 2002), but, rather, to focus on other issues.

Q30. "There is poor oversight and enforcement by government officials … Do you agree or disagree that this is a strong argument against recycling biosolids?

Responses:
32% agree strongly
27% agree somewhat
11% disagree somewhat
5% disagree strongly
19% don't know

There are no particularly remarkable correlations between this question and other factors to explain the strength of feeling evident in the responses. Considering that only a small percentage of people surveyed have any apparent experience with biosolids recycling, it is appears that the strong response to this question indicates that people generally expect strong oversight and enforcement in any environmental matter.

Q31. "Biosolids are harmful to your health … Do you agree or disagree that this is a strong argument against recycling biosolids?

24% agree strongly
20% agree somewhat
10% disagree strongly
18% disagree somewhat
23% don't know

Based on recent history, health arguments are considered one of the most powerful arguments against any new activity, particularly activities that can affect local environmental conditions. Because of this, one might expect this argument to score more highly than the arguments in Q28, Q29, or Q30—but it did not. There are no correlations with other factors to explain the responses to this question (see discussion of Q34).

Q32. "Biosolids lead to land or water contamination … Do you agree or disagree that this is a strong argument against recycling biosolids?"

Responses:
27% agree strongly
23% agree somewhat
17% disagree somewhat
10% disagree strongly
18% don't know

Environmental contamination is another strong argument against any new activity, but it is not considered as strong as arguments about health impacts, which one might expect to be more persuasive.

Q33. "Not enough is known about biosolids … Do you agree or disagree that this is a strong argument against recycling biosolids?"

Responses:
46% agree strongly
26% agree somewhat
11% disagree somewhat
8% disagree strongly
6% don't know

The responses to this question are the most significant of this series. There is overwhelming agreement (72%) of respondents that a strong argument against recycling biosolids is that "not enough is known about biosolids."

Q34. "Which of these do you think is the strongest argument AGAINST recycling biosolids …
(READ NUMBERS 1 TO 6. ROTATE RESPONSES)

When presented with a forced choice from which to select the strongest argument against recycling biosolids, the results are not entirely consistent with the opinions expressed in the preceding series of questions (Q28-Q33). The following percentages of respondents chose the following arguments as the strongest arguments against recycling biosolids.

44% "not enough is known"
14% "poor oversight and enforcement by government"
13% "adverse health impact"
10% "inadequate testing"
8% "land or water contamination"
6% "bad odors"
6% "don't know"

"Not enough is known" is the clear choice of respondents, in both the series of questions and in the final corroborating question. Based on their agreement with the individual arguments, "adverse health impacts" should have ranked last among the six choices. Instead it ranked third, an insignificant percentage point behind the second choice. Furthermore, this ranking is fairly consistent across demographic factors (gender, rural/urban, live in farming community, children in household, education in science field, ability to define biosolids, or region).

This ranking cannot be clearly explained by the data obtained from Q28-Q33, but it agrees with the expectations developed by the Project Team through the examination of the literature on risk perception. The purpose of asking the final corroborating question is, in part, to allow respondents to review and revise their answers to the individual questions, and many respondents seem to have adjusted their answers in this instance.

3.3.6 Identifying Trusted Sources of Information

Survey questions Q35-Q37 obtain responses on the trustworthiness of information sources, including ranking of these sources. The final question, Q40 asks respondents to identify a single type of person from whom they might obtain trustworthy information.

Q35. "If you were seeking information about biosolids, which of the following sources of information do you think would be the MOST trustworthy? (Possible responses were read to respondents, who chose a first, second, and third "most trustworthy" source of information.)

Responses:

34% U. S. Environmental Protection Agency
21% university researchers

13% state health and environmental officials
10% non-profit environmental organizations
8% independent auditors
6% local health agencies
4% sewage plant operators
1% friends
1% the company delivering the biosolids

Choices of "second most trustworthy source of information:"
23% state health and environmental officials
18% university researchers
17% U. S. Environmental Protection Agency
11% local health departments
10% independent auditors
10% environmental organizations
5% plant operators
2% friends
2% the companies delivering biosolids.

There is a clear preference for agencies of government when respondents are asked to rank sources of trustworthy information. Federal agencies are clearly the first choice. University researchers and state governments are next, followed by local governments, environmental organizations, and independent auditors.

This reflects a traditional view that held sway prior to the mid-1980's. Subsequent studies, however, have shown that government has declined in influence since the mid-1980's. The results of this survey appear to show a dramatic upswing in trust in government agencies.

Q36. "Of the informational sources you just identified as being the MOST trustworthy, what specifically about them made you say that?" RECORD VERBATIM RESPONSE. PROBE FOR SPECIFICS: "Anything else?"

Verbatim responses to this query are consistent with the statistical outcomes. They reveal some of the reasoning, however, that does not show up in the numbers. The respondents trust entities without economic or other vested interests in recycling biosolids. They also trust sources that are most experienced and knowledgeable.

Among their responses are:

"The EPA is looking out for what's best for our environment."
"The EPA has the least economic interest."
"The state wants what's best for the citizens."
"The university is looking out for the better good, and to preserve the future for others."
"It's important that they be neutral and objective, and not side with anyone; not be in it for the money**."**

Q37. "Of the sources you think of as being the LEAST trustworthy, what specifically about them makes you think that?

Verbatim responses in this instance are the mirror image of those to Q36
> 30% economic interest
+/- 15% lack of knowledge or understanding
+/- 15% vested or "political" interest in the outcome

A significant undercurrent of distrust in government, however, is also on display. Approximately 10-15% of the responses specifically cite distrust of government, or corruption of government, as the reason for their answer. Mismanagement and corporate greed are another related theme.

Among the responses are:

"I never trust anyone who has a self interest."
"Big companies are more concerned about themselves, just in it for the money."
"A lot of people are not qualified to give out information."
"They don't know what they're talking about."
"Anything to do with government, because they're always in somebody's pockets."
"Political people aren't trustworthy; they have their own agenda."

Q40. "If you had to choose, which ONE of the following types of people would you trust for accurate information about environmental issues such as recycling biosolids … (READ RESPONSES 1 TO 11)
"Which would you say is your second choice?"

The following percentages of respondents chose the following types of people :
21% a water quality engineer
20% a scientist
17% a non-profit organization
17% a local health agent
9% a farmer
3% a school teacher
3% a neighbor
2% a news broadcaster
2% an elected official
1% a spokesperson for private company
1% a movie star

This final question was designed to find where people were likely to obtain information about environmental issues like biosolids recycling, with an attempt to uncover their preferences for personality types. The responses are consistent with other questions in the survey. Technical experts, government officials, and non-profit organizations are fairly well trusted. Non-vested interests are trusted.

3.3.7 Perception of Risk

Questions 38 and 39 obtained information on the relative perception of risk posed by biosolids in comparison to well-studied common risks. Specifically, these questions help in understanding

how significant a risk respondents believe biosolids to be on a relative scale in comparison to other familiar perceived risks. It is useful to remember that these questions appear late in the survey and may be significantly biased by the concepts and feelings introduced by previous questions.

Q38. "It is likely that a few times a year, you walk on turf or grass, in parks, or near construction sites or farms where biosolids are used. Knowing this, please answer the following questions. Of the following activities, which do you feel poses a greater possible threat to your health?"

"Do you feel that your contact with biosolids poses a smaller or larger possible threat to your health than PESTICIDE RESIDUES IN FOOD?"

Responses:
64% biosolids pose a smaller risk than pesticide residues in food
13% biosolids poses a larger risk
12% same risk
12% don't know

Exposure to pesticides is a known and accepted risk, and some consumers are careful to limit their exposures. The true quantitative risk posed by pesticide residues, however, is uncertain, but generally considered to be relatively small.

There are few correlations between the responses to this question and other responses in the survey. Some, however, are worth noting:

- Among respondents who are correct or close to defining biosolids, seventy-two (72) percent believe that biosolids pose a smaller threat than pesticide residues—familiarity seems to correlate with perception of lower risk.
- Among those who call themselves environmentalists, there is a somewhat higher percentage of individuals (20%) who consider biosolids a larger threat then pesticide residues in food.
- Among individuals who strongly oppose calling themselves environmentalists, there are a higher percentage (72%) who believe biosolids pose less threat than pesticide residues.
- There is, in addition, a slightly higher percentage of respondents from the Rocky Mountain region who state that biosolids pose less threat than exposure to pesticide residues.

Q39. "Do you feel that your contact with biosolids poses a smaller or larger possible threat to your health than DRIVING TO WORK?"

Responses:
64% biosolids pose a smaller risk than driving to work
20% biosolids pose a larger risk
7% same risk
10% don't know

In this question, another familiar risk is compared against exposure to biosolids. The risks of driving are well known, as more than fifty-two thousand (52,000) Americans die each year in traffic accidents, and virtually every driver knows someone who has died or been injured behind the wheel.

The same percentage of people believe that biosolids pose a smaller threat to their health in comparison to both pesticide residues and driving a car to work.

Correlating responses to this question with other questions reveals little worthy of comment. Seventy-four (74) percent of those who accurately define biosolids in Q12 believe biosolids are a smaller threat than driving to work, as do seventy-one (71) percent of those with some education in the sciences.

3.4 CONCLUSIONS

The 2002 Biosolids Public Knowledge and Perception Survey was conducted in February and March, 2002. Respondents were randomly-chosen members of households where the residents owned or rented their houses. This resulted in a population of respondents that, in comparison to the total U.S. population, had…

- above average income levels,
- above average education levels,
- below average representation of urban dwellers,
- below average representation of minorities, and
- were older than the national average.

In addition, it is assumed that the respondent population likely had a higher than average level of knowledge and interest in agricultural practices and sewage management, since they were all homeowners or house renters. And, finally, it is assumed that the surveyed population represents those who are more likely than the average U.S. population to be potential users of biosolids products or neighbors to sites where biosolids are used.

Because of the attributes of the surveyed population, it is reasonable to assume that a random survey of the *total* U. S. population would result in somewhat different findings. For example, it is likely that, compared to the results measured in this survey, a survey of the *total* U. S. population would find that…

- a lower percentage knows about sewage treatment or has visited a wastewater treatment facility, and
- a lower percentage has heard of or knows about biosolids.

The 2002 Biosolids Public Knowledge and Perception Survey was relatively long for a telephone survey, averaging 25 minutes. One benefit of the use of a longer survey is the ability to test for the accuracy and validity of responses. This is done by asking redundant or similar questions. This particular survey included several pairs or groups of similar questions placed in different parts of the survey. The answers to these similar or redundant questions, as well as the overall feeling of responses to other questions, are quite consistent, which suggests that respondents were truthful and consistent during the survey interviews.

The survey data, and their analysis, have revealed potentially useful trends that can help inform the development of biosolids recycling public outreach and participation programs. The major findings of this survey can be summarized in several sections that relate to the levels of knowledge, perception, opinion, and the strength of feelings expressed about biosolids recycling. Following are summary discussions regarding…

1. Personal Knowledge and Opinion
2. Information Needs
3. What Affects Opinions on Biosolids Use
4. Arguments That Influence Public Perception

The order of presentation below does not reflect a judgement regarding relative significance.

3.4.1 Personal Knowledge and Opinion

3.4.1.1 Knowledge of biosolids is limited.

Respondents to the 2002 Biosolids Public Knowledge and Perception Survey were asked several questions (Q9 – Q12) designed to test their overall knowledge of wastewater treatment and biosolids. Although most knew something about how their own sewage is treated, and one third say they have visited a wastewater treatment facility, only 3% of respondents could very accurately define "biosolids," while another 11% were able to define "biosolids" fairly accurately.

Some biosolids stakeholders have speculated that the general population is ignorant about wastewater treatment, as well as about biosolids. But this survey suggests that quite a few people know about wastewater treatment and that the gap in knowledge is mostly with details, including the relatively new term "biosolids."

Those more likely than others to report having heard of biosolids include:

- homeowners and house renters aged fifty (50) to sixty-nine (69);
- people with higher levels of education;
- those with a background in science or who had science education;
- people living in rural areas;
- people who had visited sewage treatment plants;
- people who currently or who at one time lived in a farming or ranching community; and
- self-identified environmentalists.

The question about knowledge of the term "biosolids" was written and placed in the survey in such a way as to provide for direct comparison with a similar question asked in the Frederick Schneiders Research (1998) survey. The finding in this 2002 survey is consistent with the finding of that prior survey in which eighty-five (85) percent of adults could not correctly define biosolids. Thus, between 1988 and 2002 there has been no significant change in the public's knowledge and understanding of the term "biosolids."

The current survey findings are also generally consistent with even earlier findings of Powell Tate (1993), whose *Communications Plan on Biosolids* stated, "Our research survey found that even many of those who should know the term 'biosolids' because of their involvement with agriculture and environmental issues, were unfamiliar with the term."

On the other hand, this survey did reveal a small percentage of the population who can accurately define biosolids, and some who have used biosolids. In real terms, the 3% of survey respondents who know what biosolids are represents approximately 5.5 million people. And those who were close in their definitions represents approximately twenty million people. Given that the term "biosolids" has been in use for only a decade, this represents a substantial level of assimilation into common usage.

The most important finding regarding knowledge of biosolids is that the public mind is a relatively blank slate. Most people know virtually nothing about biosolids, a finding that

suggests that the public's perception of biosolids recycling may be significantly influenced by the first presentation they hear on the topic.

Biosolids managers may, by implication, increase the likelihood of a positive reception to biosolids recycling activities if they—or, better yet, one of the more trusted information sources (government officials, academics—see below)—reach out to the affected public early in the process to provide information about biosolids and answer questions from the public. These survey results clearly support early communications with the public and early public involvement in any biosolids recycling program. (The alternative is to wait for the public to learn about biosolids on their own, and risk the likelihood that they will form opinions around negative experiences, e.g. bad odors, or information that stresses only the negative sides of biosolids recycling.)

3.4.1.2 Support for wastewater treatment is very high.

The responses to most questions in the 2002 Biosolids Public Knowledge and Perception Survey reflected a mixture of opinion or were qualified in some manner. In contrast, an overwhelming ninety-three (93) percent of respondents stated that sewage treatment plants "are a necessary protector of our environment" or "are probably a good idea" (Q10B). It is clear that wastewater treatment agencies, public officials, environmental groups, and others have been successful in ensuring that the public understands the importance of wastewater treatment.

Biosolids management is a critical part of wastewater treatment: for example, wastewater treatment facilities report that residuals management can consume as much as one half of operating expenses. It may be advantageous for wastewater treatment programs to stress the fact that society cannot have wastewater treatment without sewage sludge and, in many cases, biosolids management.

The findings regarding public knowledge, understanding, and support of wastewater treatment indicate that wastewater agencies will benefit from creating additional opportunities for the public to see and hear about agency efforts. Agencies might open their gates more often, invite the public in more frequently, provide more tours and other opportunities to see how wastewater treatment and biosolids production work. Such efforts would build on the strong support wastewater treatment enjoys.

3.4.1.3 People support biosolids recycling in the abstract, but are uneasy about being in close proximity to it.

Many people react positively to a carefully-crafted initial definition of the term "biosolids" (Q13) but there is a notable level of uneasiness when they consider themselves or their families being close to biosolids (Q14 – Q17).

The initial reaction of survey respondents to the definition of biosolids was quite positive. Although the survey showed that there is little public knowledge of the term, almost two thirds of adult homeowners and house renters reacted in a positive fashion to a definition that was read to them under controlled circumstances (in the security of their own homes; a definition from a neutral party; and no competing definitions). At the same time, however, one quarter of the respondents provided clearly skeptical responses, some with considerable passion behind them.

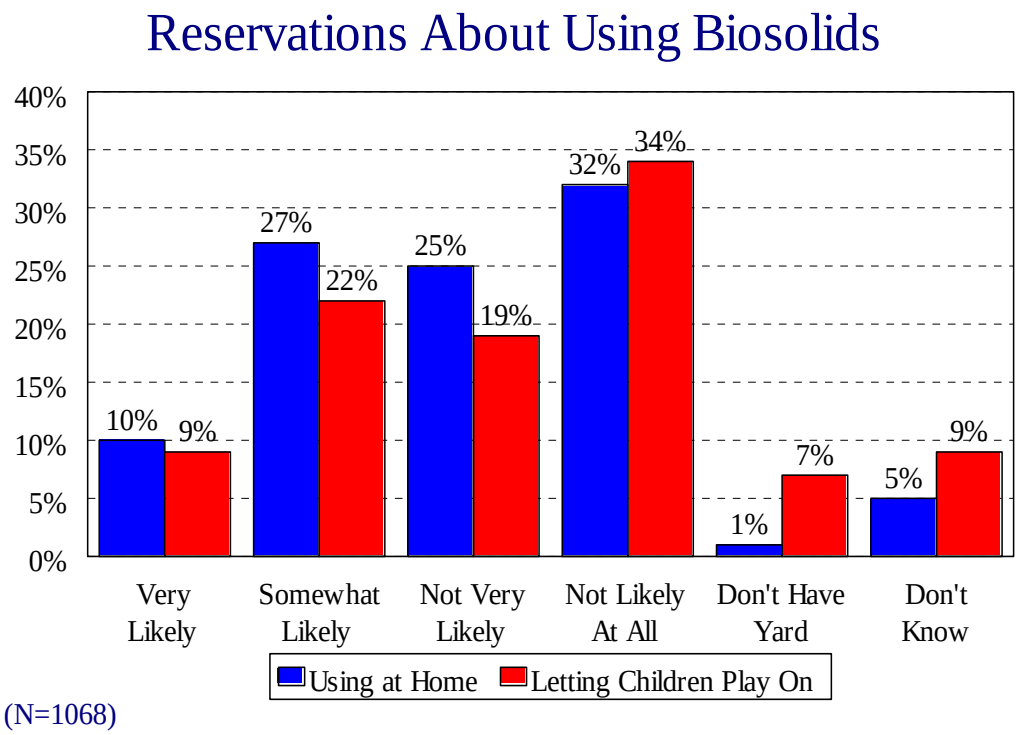
The skepticism expressed by some respondents to this survey is consistent with the skepticism observed in response to any new technology, a widely observed phenomenon.

The subset of respondents who responded in passionately negative terms are the individuals that biosolids managers dread as they introduce new audiences to biosolids recycling; the strength of these negative reactions can naturally trigger anxiety and skepticism in the minds of individuals who had previously not formed strong opinions about biosolids recycling.

When presented with scenarios in which they may come in close personal contact with biosolids, people are more cautious. Twenty-five (25) percent express a clearly negative reaction to the initial concept of biosolids recycling—even when it is explained in the most careful, neutral way. In three scenarios posed by the survey respondents reacted with unease or outright opposition:

- When biosolids are described as “human manures”, three-quarters of the population would rather not use them as fertilizer, even though most would use animal manures as fertilizer.
- After being provided a neutral definition of “biosolids,” respondents were asked how likely they would be to use biosolids at their home. Approximately one-third of U.S. homeowners and house renters say they would be "very likely" or "somewhat likely" to use biosolids.
- Only one in ten say they are very likely to let their child play on a field treated with biosolids, and another two in ten say they are somewhat likely. More than half say that they are not very likely or not at all likely to let their child play on a field treated with biosolids.

Figure 3-2



(N=1068)

This initial natural skepticism or uneasiness with biosolids recycling is a significant finding of this survey, and it is underscored by the quotes of respondents' comments throughout the survey, many of which express uncertainty about this unfamiliar practice.

It is likely that people's uncertainty and uneasiness are an underlying factor in the development of local public outrage: when neighbors to a biosolids recycling program feel uneasy and are forced to quickly decide on whether to "accept" biosolids or not (e.g. due to a pending permit decision), this uneasiness can grow into a strongly negative reaction.

Biosolids managers can address this uneasiness by providing adequate information and plenty of time for people to process the concept, gather more information, ask questions, and gain better understanding. Doing so will not convince everyone, but it will reduce the chances of inciting the outrage that comes from ignoring people's uneasiness and pressuring them to make decisions before their questions have been answered to their satisfaction.

3.4.1.4 The choice of words makes a significant difference.

As has been argued by people on both sides of debates about biosolids / treated sewage sludge recycling, the terms themselves color people's impressions. This survey split the respondents into two groups. Half the sample answered two questions (Q14A & Q15A) about "recycled biosolids;" the other half answered two identical questions (Q14B & Q15B) about "sewage sludge." The acceptance of a neighbor's use of biosolids dropped from forty-four (44) percent to thirty-two (32) percent when the term "sewage sludge" was used in the question in place of the term "biosolids." Twice as many think "biosolids" use "is great," as think "sewage sludge" use "is great".

It is important to note that the use of the term "biosolids" is no insurance that the concept will be accepted: in either case, less than half accept their neighbor's use of biosolids or sewage sludge and there is a significant proportion of negative responses (uneasiness) in either case.

Nonetheless, it is clear that—at least initially—U. S. homeowners and house renters are significantly more likely to respond favorably to the use of "biosolids" by a neighbor than they are to the use of "sewage sludge," a result that appears to confirm the obvious recommendation of Powell -Tate (1993) that "…use of the term 'sewage sludge' instead of 'biosolids' may neutralize efforts to gain widespread acceptance of the term 'biosolids.'" The use of terms is particularly important when introducing the concept to the public, as their initial impressions may predispose them to either accept or reject information that is offered, which, in turn, creates the context within which they will form an opinion.

However, the benefit of using the term "biosolids" is likely short-lived. While the language clearly makes a difference in the early stages of a person's development of knowledge and opinion, its importance may diminish as a person focuses more on the actual concepts and more detailed information.

This survey did not directly test this hypothesis. But, assuming it to be true, it is recommended that, contrary to what Powell-Tate said, biosolids managers *should not* shy away from clear, factual, up-front discussion of the process by which biosolids are generated, treated, and used. Such information should be provided soon after the overall concept of biosolids recycling is introduced. Every person who considers biosolids recycling in more than a cursory way is going to wrestle with the concept of taking one of the most unappealing wastes we know, treating it, and using it as fertilizer. It is likely that a person's acceptance or support will be gained only after he or she has worked through this personal opinion-formation process—a process that requires information that the person perceives as complete, neutral, and objective.

3.4.2 Information Needs

3.4.2.1 People seek more information.

Respondents identified many different kinds of information that they would seek, if they were interested in learning more about biosolids (Q18). The categories of information they would most frequently seek were:

- biosolids testing and safety;
- general information about health issues;
- hazards and risks; and
- the process of creating and using biosolids.

When asked to be more specific about health issues, respondents to this survey focused on general health hazards, risks, bacteria, viruses, and side effects. The type of questions they asked about how biosolids are processed focused on the original materials that go into biosolids, how they are treated, what chemicals are added, and what has historically been done with them. A third cluster of responses were focused on the availability of research findings on chemical composition, health research, research into alternative management techniques, and general questions about the overall amount of research that has been done on biosolids.

Responses to this and similar questions clearly show that *the public knows what questions are potentially important when evaluating environmental issues such as biosolids recycling. This is an important finding*. Some observers of debates about biosolids have suggested that the public is not well-informed about true environmental concerns. This does not appear to be accurate with regard to public reaction to the concept of biosolids recycling. Even though a minority of people know about sewage treatment, and even fewer know about biosolids, a large percentage can identify environmental and health issues that they think must be important with regard to biosolids. The questions they have about these issues—and the answers they receive—help them form opinions about biosolids recycling. Biosolids managers should anticipate these concerns and respond with appropriate information. As a rule, the public first needs to know how biosolids are generated and treated and then the health/safety impacts that may accompany any management process that is used.

It is interesting to note that this survey's finding—that respondents' have some uncertainty about biosolids and they can quickly identify potential issues—is similar to what was measured in a focus group study conducted for the Greater Vancouver Regional District (Greater Vancouver, 2000). This prevalent uncertainty or hesitancy keeps people from fully and unconditionally

embracing what they intellectually find to be a good idea. More study could be done to better understand the impacts of this common response on the formation of people's opinions and their subsequent behavior regarding biosolids recycling.

In general, responses to this survey's questions about information needs confirmed the hypothesis that there is a huge gap between what the wastewater treatment industry knows and what the public knows about biosolids recycling. The gap is wide and it crosses demographic and geographic boundaries. Although some groups (those aged 50-69, individuals who live in agricultural communities, those with more education, and those with education in the sciences) are statistically more likely to know *something* about biosolids, the depth of their knowledge is thin and their numbers are not likely to constitute a majority of residents in any community.

3.4.2.2 Initially, people turn to familiar faces for information about biosolids being used locally.

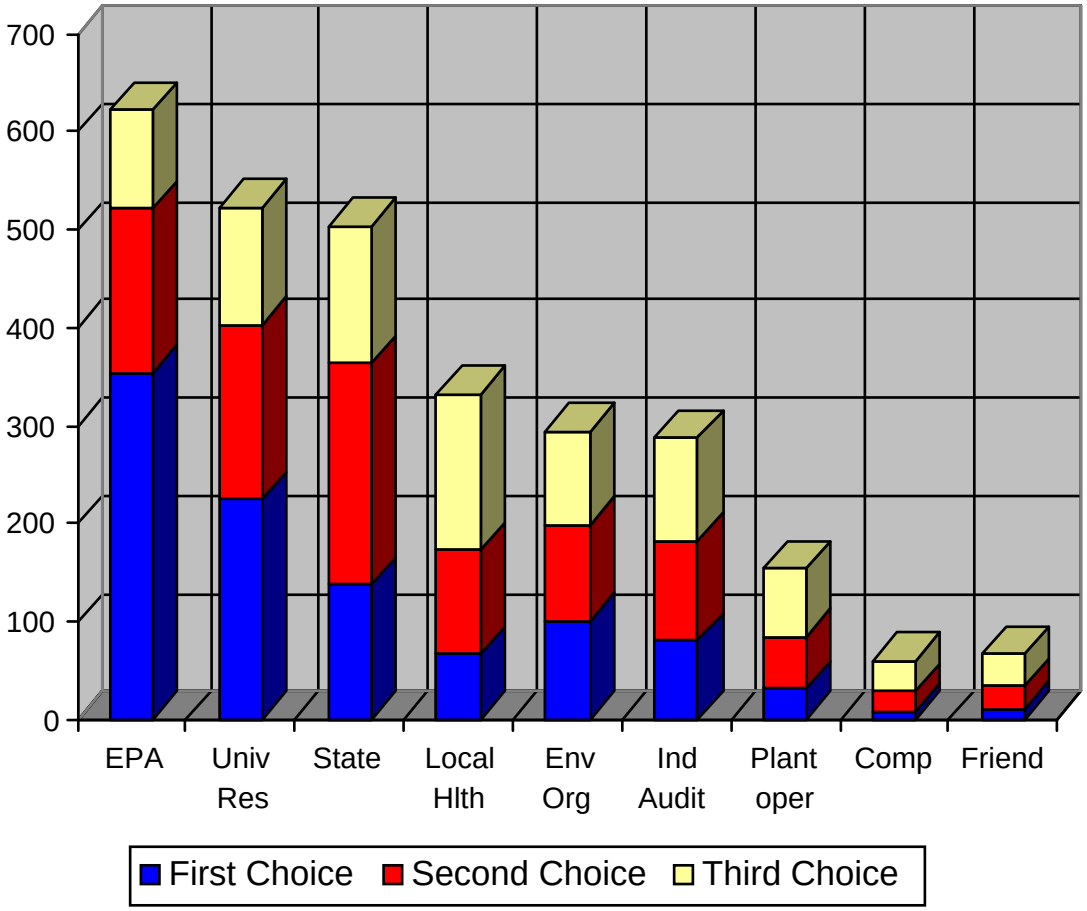
According to this survey (Q15A & Q15B), friends and acquaintances are the first source of information that most people would turn to when seeking information about "biosolids" or "sewage sludge" being used in their neighborhood. Other initial sources of information would be local health departments and state health officials.

The survey measured small, but significant, differences regarding whom people would first approach for information on "biosolids" versus whom they would initially approach for information on "sewage sludge:" U.S. homeowners and house renters are somewhat more likely to ask a friend or acquaintance about a hypothesized neighbor's use of "biosolids" than they are about a hypothesized neighbor's use of "sewage sludge." In contrast, respondents to this survey are significantly more likely to ask their local health department about the use of "sewage sludge" than they are about the use of "biosolids."

3.4.2.3 People trust government agencies and academic researchers.

Survey respondents saw the federal government as the most trustworthy source of information on biosolids (Q20 & Q35). University researchers and the state governments were seen as next most trustworthy. Local governments, environmental organizations, and independent auditors are groups also considered trustworthy. Wastewater plant operators, companies delivering biosolids, and friends are less trustworthy sources (even though friends are likely the first source of information!)

Figure 3-3: **ɹstworthy Sources**



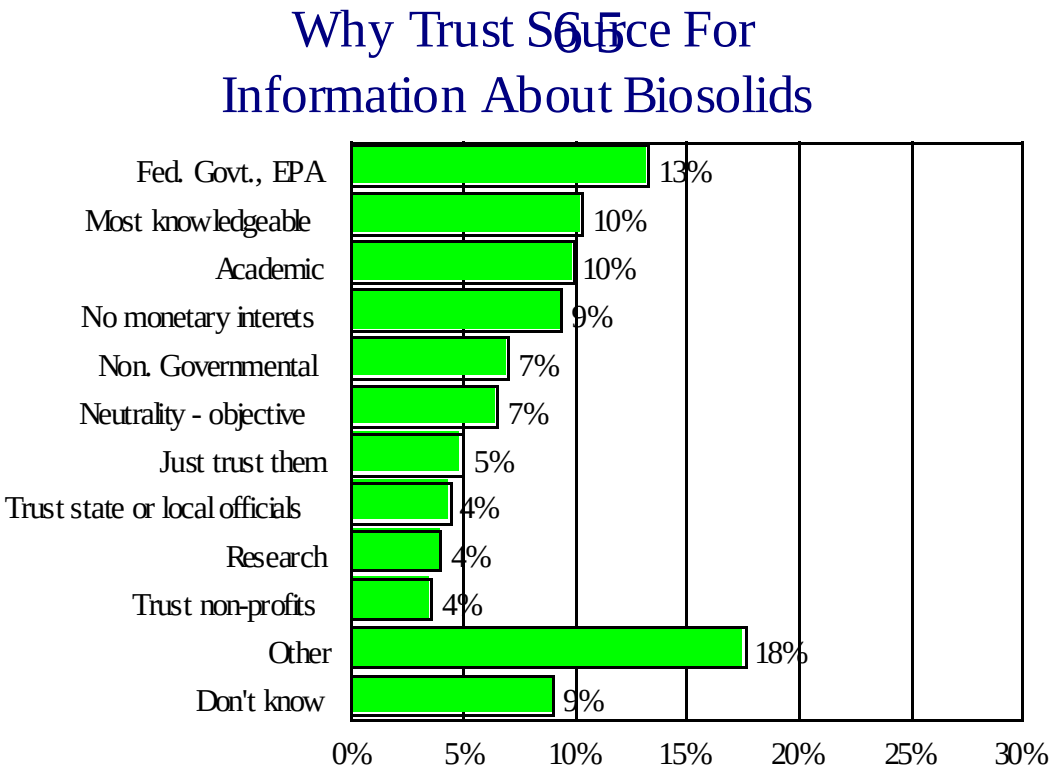
When identifying individuals and organizations to speak on biosolids issues, the first choice of someone the public would find trustworthy would be an expert from the U. S. EPA or another federal agency. They are seen as most trustworthy, initially and cumulatively. A second tier of potential purveyors of information would be university researchers or state officials, and a third tier would be a local official, environmental organization, or independent auditor. It is clear that organizations with a perceived commercial interest in biosolids are not seen as trustworthy providers of information.

These findings may be important in terms of implementing the generic recommendation of Powell-Tate (1993) regarding the selection of "gatekeepers." (Gatekeepers are people, often leaders, who help shape opinions in their particular field of expertise; others rely on gatekeepers regarding what to think about a particular subject. Powell-Tate recommended that biosolids managers seek out and provide information on biosolids to gatekeepers.) Clearly, it will benefit biosolids program managers to engage respected experts who are leaders in their fields, especially those who are from one of the trusted information sources—a federal agency, university, or state agency.

It is interesting to note the relatively low trust rating respondents gave independent auditors (see Q35). This result may be due to a lack of understanding of the term "independent auditor" as it appeared in this question—the concept of an independent audit is complex and can mean many different things to different people. This finding (Q35) must be contrasted with the finding of a question posed earlier in the survey (Q19E), which found that having an annual certification by "an independent expert auditor" dramatically reduces respondents' level of concern. Also supportive of the value of independent auditing is the response to the question asking why respondents trust whom they trust—many identified independence as a critical factor (see next section). The contrasting finding of question 35 is the most incompatible result identified in the survey data. It also stands in contrast to both the literature and case studies, which showed that independent auditors can play an important role in answering questions from the public and gaining their trust in biosolids recycling.

3.4.2.4 People trust government and those who are knowledgeable and objective.
The reasons that respondents trust certain organizations cluster in three areas (Q36 & Q37): that the organization is a governmental organization, that the organization is the most knowledgeable about the topic, and that the organization is neutral and objective. It should come as no surprise that the neutrality and objectiveness of an individual or organization engenders feelings of trust within the general public. What is surprising, however, is the strong perception that agencies of government are trustworthy.

Figure 3-4:



This finding is a turnaround. Government had been falling into disfavor for more than a decade. Whether or not this finding is corroborated by future studies will determine if it is a complete reversal, or merely a transitory change in public perception, perhaps due to the tragic events of September 11, 2001,the response to which has been led by government agencies.

The finding that people trust those who are most knowledgeable on a subject provides a clue as to why professional organizations such as the National Biosolids Partnership, the Water Environment Federation, the Association of Metropolitan Sewerage Agencies, and regional biosolids and byproducts associations have been successful in working with the public. These are organizations that bring considerable expertise to the topic of biosolids recycling and, therefore, garner the trust and respect of a significant proportion of the general population. In addition, regional associations have the ability to know details of local situations—an added level of expertise that national organizations cannot reasonably provide.

Those who have garnered the most trust amongst critics of land application are government officials (e.g. Dr. David Lewis of U. S. EPA) and academic institutions (e.g. Cornell Waste Management Institute).

At the same time, trustworthiness of organizations hinges on their ability to remain objective. According to this survey, the most frequently cited reason for distrusting an organization is if the organization has some interest in biosolids recycling that would taint its presentation of information. This includes a financial, political of other form of self interest. Other reasons cited *less frequently* by respondents are that the person or organization

- lacks knowledge about the topic,
- is from the government,
- is not truthful, or
- is corrupt.

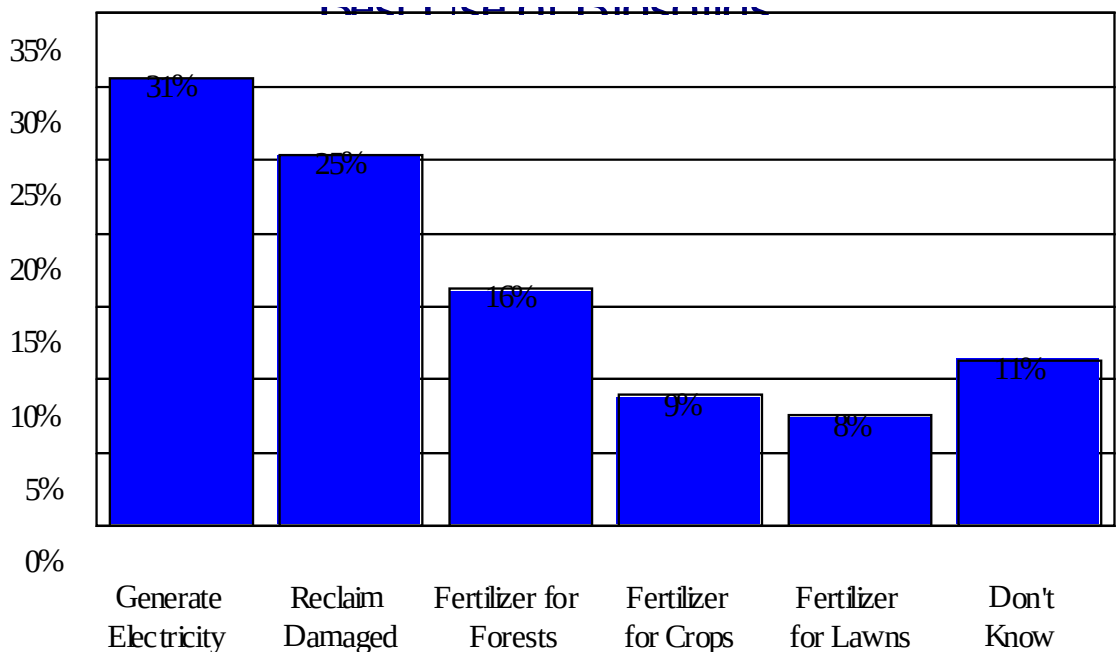
Some critics of biosolids recycling have criticized U. S. EPA, WEF, AMSA, and regional associations as being untrustworthy because they appear to have interests in promoting biosolids recycling that taint their objectivity. Results of this survey suggest that organizations will generate trust amongst the greatest percentage of the public if they strictly focus on learning more about biosolids recycling and developing objective information to share with all parties equally.

3.4.3What Affects Opinions on Biosolids Use

3.4.3.1 People favor constructive uses of biosolids.

Lack of knowledge about biosolids doesn't appear to have limited respondents' imagination when it comes to expressing opinions on preferred uses for the material (Q21). Generating electricity through the combustion of gases is the favored use of biosolids among the choices that were presented. Americans have frequently embraced new ideas after a period of initial skepticism, and using wastewater treatment byproducts to turn on the lights has a certain innovative appeal, especially given well-publicized concerns about sources of energy.

Figure 3-5: Best Use of Biosolids

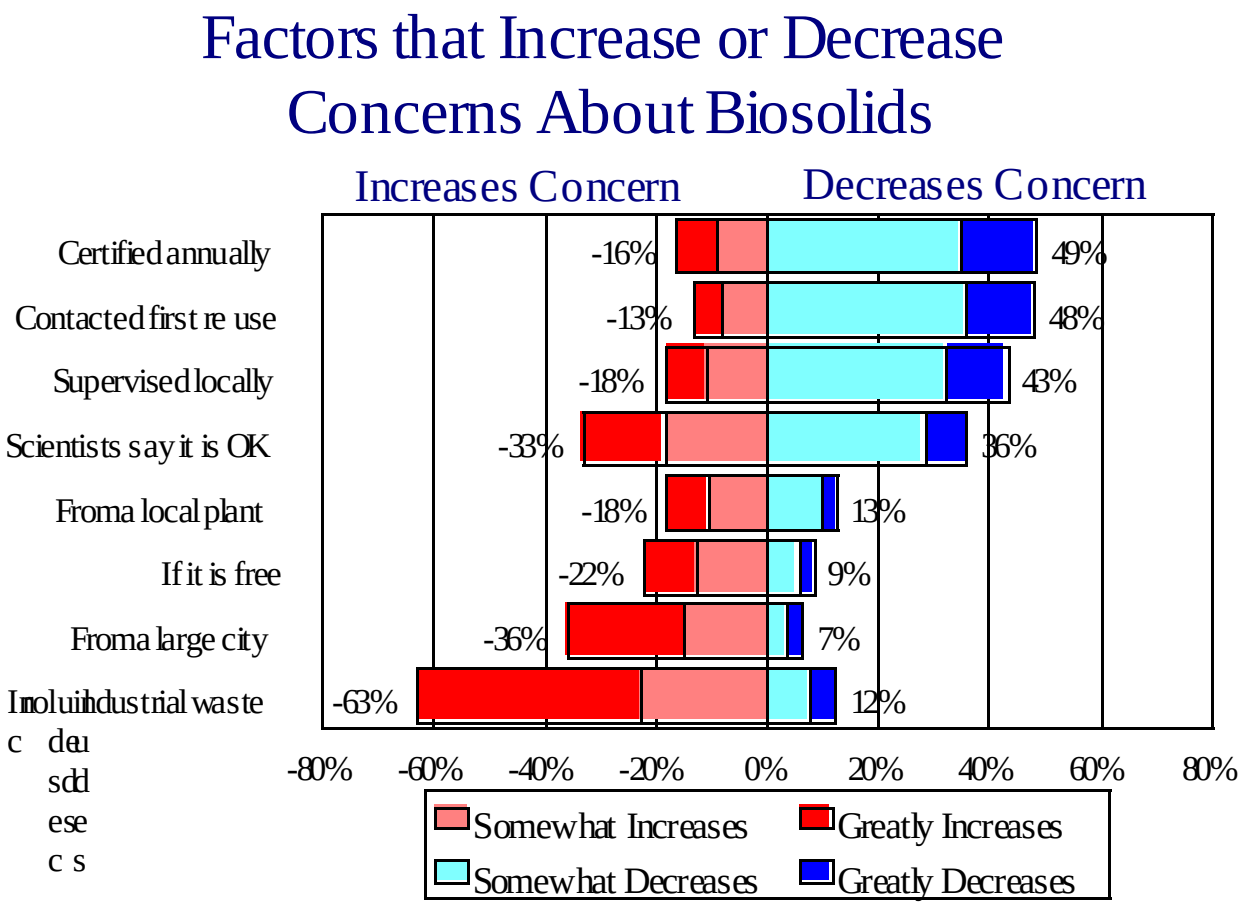


The survey found that there is somewhat less support for crop applications of biosolids. This finding has to raise some concern amongst biosolids managers, as agricultural land application is currently a favored use for biosolids. Managers of agricultural biosolids recycling programs may derive greater environmental benefits and enhance public support by utilizing—and touting their use of—digested biosolids from which energy has been extracted.

The cumulative total of responses to the question on best uses of biosolids (Q21) suggests a decided preference for the use of biosolids in a manner that keeps them away from human contact. This may be coincidental, and additional survey or focus group work would be necessary to test this validity of this apparent choice.

3.4.3.1 Some factors increase their concern, others decrease their concern.
Homeowners and house renters were asked to indicate whether several factors increase, decrease, or have no effect on their level of concern about using biosolids (Q19A – Q19H). Factors that serve to decrease citizen concerns about the use of biosolids include knowing that it is certified annually, if they are contacted prior to it being used, and if its use is supervised locally. Factors that have mixed or no impacts on concerns about using biosolids are having scientists say it is OK to use, knowing that it comes from a local plant, or having it be provided free of charge.

Figure 3-6:



Knowing that biosolids may have been produced from materials that contain some industrial waste dramatically increases concern among the respondents, and knowing that it comes from a large city also increases concern. These factors are clear deterrents to generating public acceptance for biosolids.

3.4.4 Arguments That Influence Public Perception

3.4.4.1 Returning nutrients to the soil and waste disposal are the strongest arguments for using biosolids.

Of those tested in this survey (Q22 – Q27), the most persuasive arguments for using biosolids are:

- recycling biosolids returns nutrients and organic matter back into the soil; and
- recycling biosolids disposes of a waste product.

These are powerful arguments in the minds of eight out of ten respondents.

The argument that recycling biosolids saves money for sewage treatment plants and communities is seen as a moderately strong argument for the use of biosolids. Less persuasive arguments for the use of biosolids are that recycling biosolids is beneficial and involves minimal risk and recycling biosolids prevents erosion and improves water quality.

After they had rated each individual argument, respondents were asked to rank the *strongest* argument for recycling biosolids against the others. Returning nutrients to the soil and disposing of a waste product were again cited as the strongest arguments for recycling biosolids; saving money for sewage treatment plants and communities gets moderate support. Stating that recycling biosolids is beneficial with few risks, or that it prevents erosion and improves water quality, are not considered as strong as other arguments for recycling biosolids (for a more thorough analysis, consult the Results to Q22-27, above).

These results are similar to those reported by the 1998 survey of Frederick Schneiders Research, in which respondents rated the strength of biosolids recycling messages. In that survey, the notion of returning nutrients to the soils as biosolids fertilizer was judged to be a strong message by forty-two (42) percent of respondents. Decreasing runoff and soil erosion was considered a strong argument by thirty-six (36) percent, and describing scientific studies that call biosolids "safe and beneficial" is a strong argument for thirty-five (35) percent. It appears that the public is most consistently likely to respond to arguments that emphasize the recycling of nutrients to the soil.

However, the argument that biosolids recycling disposes of a waste product was not recommended as a good one by Powell-Tate; rather, they recommended avoiding focusing on the waste origin of biosolids. Based on the support found for this statement in the current survey, it may be prudent to rethink this approach. The public is savvy and distrusts any attempts to cover up the origin of biosolids. Open acknowledgement and discussion of how biosolids are produced, treated, and used will likely benefit from positive public response to the fact that biosolids recycling disposes of a necessary waste product. Most people can understand and recognize that 1) wastewater treatment is a necessary and good thing; 2) biosolids are generated from it and must be managed, and 3) a benefit of a well-run biosolids recycling program is that it disposes of this byproduct.

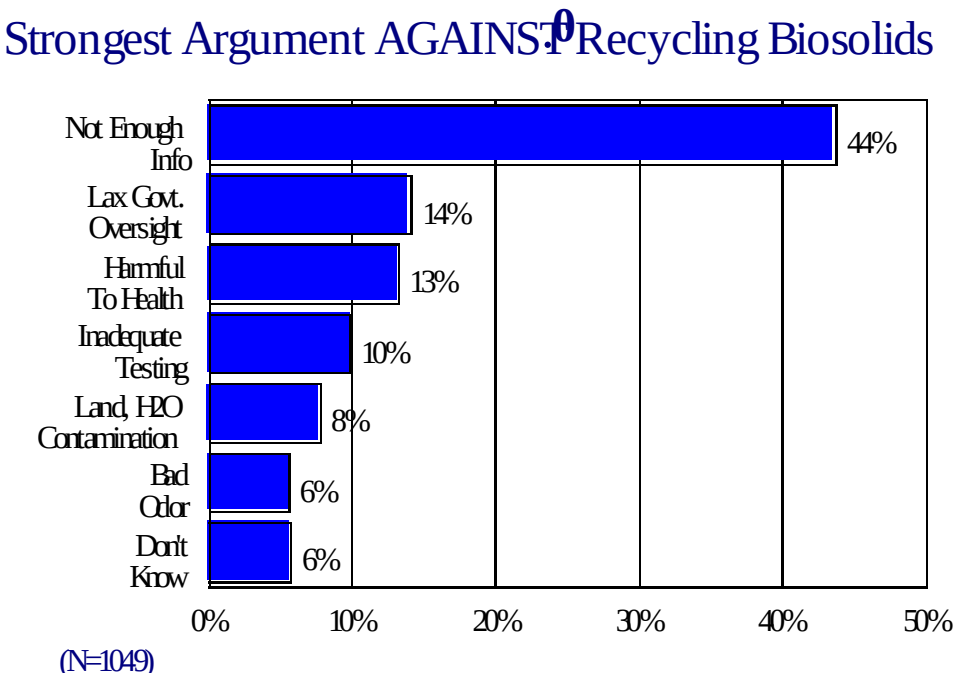
A marketing focus group analysis done for Greater Vancouver in 2000 (Greater Vancouver, 2000) included a major recommendation that, when marketing Greater Vancouver's Nutrifor biosolids product, "The objective of any awareness campaign should be to define biosolids as an environmentally sound way to use sewage sludge…" The current survey corroborated this: people support biosolids recycling because it disposes of a necessary by-product.

3.4.4.2 Lack of information is the strongest argument against recycling biosolids.
Respondents were read several individual arguments that have been made against the use of biosolids and asked whether they agreed or disagreed that each is a strong argument against recycling biosolids (Q28 – Q34).

"Not enough is known about biosolids" was clearly chosen as the strongest argument against using biosolids in the eyes of U.S. homeowners and house renters. Seven respondents out of ten (70%) considered this a strong argument against recycling biosolids.

Why such a strong positive response to this particular argument? Probably because the large majority of respondents didn't know much about biosolids and they tend to assume their lack of

Figure 3-7:



knowledge is at least somewhat representative of a general lack of knowledge.

But the strong response to these questions may be driven by something else as well. Earlier in the survey, respondents generally supported the concept of biosolids recycling (Q13), but they subsequently came up with questions and expressed uncertainty (e.g. Q18). The variety of questions and the depth of their uncertainty may have been reflected in the strength of their choice that "not enough is known about biosolids recycling."

There is another indication that this interpretation is valid. Seventy-eight (78) percent of respondents who say they have not heard the term "biosolids" (in Q11) agree that "not enough is known" is a strong argument against biosolids recycling. This compares with only sixty-five (65) percent of those who have heard of biosolids. Those who felt they knew more did not as readily buy into the "not enough is known" argument. This finding parallels the finding of research that has shown that unknown risks tend to be seen as greater risks (Slovic, 1993).

However, it is worth noting a finding somewhat contrary to the previous statement. The responses to questions (Q38 & Q39) about the relative risk presented by biosolids versus other commonly conceived risks (pesticide residues on foods and driving) strongly identified biosolids as *low* risk—less than that of driving and, somewhat surprisingly, less than pesticide residues in foods. Thus, even though their level of knowledge was low, respondents to this survey did not end up seeing biosolids as particularly risky—even after they had heard two series of positive and negative statements about biosolids recycling.

While the results regarding perception of risk are somewhat contradictory, what remains very clear from this survey is that the success or failure of the wastewater treatment and biosolids management industry in gaining public acceptance of any biosolids management practice will depend to a large extent on increasing public knowledge of this subject.

Finally, there was some expectation on the part of some project participants that the argument about health concerns would have a stronger response than the survey found (just 13% chose this as the strongest argument against biosolids recycling). What lies behind such responses is difficult to guess; additional research would be needed to better understand such responses.

3.5 Placing This Survey in Context and Topics Needing Additional Investigation

The 2002 Biosolids Public Knowledge and Perception Survey is by far the largest (>1000 surveyed) and most rigorous national survey of its type to date. In utilizing several questions and testing several hypotheses included in previous surveys (Powell-Tate, 1993; Frederick Schneiders Research, 1998), it built on past assessments of public knowledge and perception of biosolids management. At the same time, the current survey establishes some new baseline information that can be re-tested in future surveys of the same segment of the public (house owners and renters), most notably:

- the level of knowledge of the term "biosolids,"
- the level of initial uneasiness with the concept of biosolids recycling,
- the sources of uneasiness / concerns,
- how risky biosolids recycling appears to people,
- the most persuasive arguments for and against biosolids recycling,
- whom people turn to for information, and
- what sources of information people trust regarding this topic.

By following the methods, format, and some of the basic questioning of this survey, future surveys should be able to determine whether or not biosolids managers' future public outreach and participation efforts have the intended effect of improving public knowledge, understanding, participation, and perceptions of biosolids management. However, a general survey of this sort is not recommended for at least five years. Why? Because this survey's strongest finding was that people know very little about biosolids recycling; time is needed to develop more widespread knowledge. A survey would make the most sense after a concerted effort is made to increase public knowledge.

In the near term, it could be useful—perhaps in focus groups—to probe how people's uncertainty about biosolids recycling evolves as they learn more about biosolids. It appears that, if pressured to form opinions, people's uncertainty creates a level of discomfort that most often leads to formation of negative opinions about biosolids recycling. However, if enough time is provided for people to absorb information, ask questions, and integrate the concept with their world view, it is more likely, although not guaranteed, that a positive or accepting opinion of biosolids recycling may develop.

Other questions that come from the results of this survey and await further testing include:

- Does the fact that most people support wastewater treatment have much influence on how they perceive and form opinions about biosolids management?
- How strong are the arguments in support of or against biosolids recycling? Do the arguments supportive of biosolids recycling actually have much effect in overcoming people's initial uneasiness about biosolids? Do the arguments have more or less influence than other aspects of the communication and information exchange process, such as who the communicator is, how information is presented, etc.?
- It might be useful to explore deeper the rather tentative, "hypothetical" support for recycling biosolids in general that can so easily disappear in the face of negative press coverage and/or increased local opposition.
- Why is it that respondents did not identify bad odor as a more significant argument against biosolids recycling? Experience in real world situations has certainly demonstrated that odors are the single most common factor triggering concern.
- What are the key attributes of the communication process and who would be the best spokespeople and sources of information for biosolids recycling?
- What were respondents' underlying assumptions as they answered the questions about arguments in favor of biosolids recycling and those opposed? Did they assume the statements were statements of fact? They were asked to evaluate how strong they felt the arguments were. To what extent were their answers just reflecting their opinion of biosolids?

Finally, future surveys might be tempted to test other political, economic, or social norms to see if there is any correlation between them and respondents' knowledge and perceptions of biosolids recycling. This survey tested a few such norms—self-identification as an "environmentalist," those who choose organic products, different age groups, different regions, etc. But this survey found weak or no correlations of this sort. Why? Because the overarching finding of this survey was that very few people know anything about biosolids. Therefore, it is unlikely that any correlations will become highly significant until a much larger proportion of the population knows a lot more about biosolids recycling. Therefore, testing for correlations of this sort is not likely to be useful in the near future.

3.6 A Brief Final Summary of Survey Findings

Based on the 2002 Biosolids Public Knowledge and Perception Survey of a representative sample of U.S. homeowners and house renters (people more likely to know something about sewage treatment and agriculture/gardening), the following is well established:

- Knowledge of the term “biosolids” is limited (only 3% can accurately define "biosolids" and another 11% had at least a fairly good idea what “biosolids” are).
- Support for wastewater treatment is very high (93%!).
- Regional differences are minimal regarding the level of public knowledge and perceptions of biosolids recycling.
- People are uneasy and have questions about biosolids recycling.
- The choice of words does make a significant difference: using "sewage sludge" instead of "biosolids" creates a marked drop in positive response to a neighbor's hypothetical use of the material.
- If they need to learn more about biosolids, people want more information about many different aspects of biosolids recycling.
- Faced with a hypothetical situation in which biosolids are used by a neighbor, people say they would turn to and trust friends and neighbors, government agencies, and academic researchers for initial information.
- Faced with a hypothetical situation in which biosolids are used by a neighbor, people say they would trust government and others who appear knowledgeable and objective (they strongly distrust those with a profit motive).
- People favor constructive uses of biosolids (creating energy, recycling nutrients).
- Some factors increase people’s concern about biosolids (if it includes an industrial waste source or is from a large city), others decrease their concern (if it is certified annually, if they are contacted prior to its use, if it is supervised locally).
- Strong arguments in favor of biosolids recycling are: *Biosolids recycling returns nutrients to the soil*, and *Recycling biosolids disposes of a necessary waste*.
- Most people think that biosolids recycling is a relatively small risk to them.
- Although they clearly expressed support of the concept of recycling biosolids, respondents indicated that the strongest argument against biosolids recycling is “not enough is known,” indicating that they are uncomfortable with their own personal lack of information and/or what they perceive to be an overall lack of information on this topic.

The 2002 Biosolids Public Knowledge and Perception Survey provides biosolids managers and other stakeholders with information about many factors and actions that will impact their chances of building trust, improving communications, and building public support. There is no silver bullet—no one thing that will make the difference in terms of improving public perceptions, participation, and support for a particular biosolids management program. Rather, there are many small actions and factors that a biosolids manager can pay attention to—and the total sum of those actions will increase the likelihood of gaining greater public trust, greater public participation, and improved public perceptions of the particular biosolids management program.