B. Tables

Table 1- MSDOH drinking water samples from 9 residences

Chemical	*Number of Detections*	*Number Above Standards*	*Maximum Result* ***(mg/L)***	*Minimum Result* ***(mg/L)***	*U.S. EPA Drinking Water Standard* ***(mg/L)***
Aluminum	8	0	0.0055	0.0002	0.05 – 0.20 *
Antimony	2	0	0.0012	0.0001	0.006 †
Arsenic	8	0	0.0008	0.0001	0.010
Barium	9	0	0.0956	0.0161	2
Beryllium	0	0	Non-Detect	Non-Detect‡	0.0004
Cadmium	9	0	0.0002	0.0001	0.005
Chromium	9	0	0.0023	0.0004	0.1
Copper	9	0	0.0076	0.0008	1.3 §
Lead	7	0	0.0006	0.0001	0.015 §
Manganese	**9**	**6**	**0.1843**	**0.0031**	**0.05**
Mercury	2	0	0.0001	0.0001	0.002
Molybdenum	9	0	0.0004	0.0001	NA **
Nickel	9	0	0.0003	0.0002	NA
Selenium	9	0	0.0008	0.0003	0.05
Silver	9	0	0.0004	0.0001	0.1 *

* SMCL
† MCL
‡ Detection limits not reported by MSDOH
§ Technical Treatment Action Level
** No Drinking Water Standard Available

Chemical	*Number of Detections*	*Number Above Standards*	*Maximum Result* ***(mg/L)***	*Minimum Result* ***(mg/L)***	*U.S. EPA Drinking Water Standard* ***(mg/L)***
Thallium	8	0	0.0002	0.0001	0.002
Vanadium	9	0	0.0004	0.0001	NA
Zinc	9	0	0.2855	0.0008	5.0

Table 2 – DuPont sampling results of 4 plant process wells and 6 community wells, 1997-2002.

Chemical	*Number of Detections*	*Number Above Standards*	*Maximum Result (mg/L)*	*Minimum Result (mg/L)*	*U.S. EPA Drinking Water Standard(mg/L)*
Cadmium	**13**	**10**	**0.22**	**0.003**	**0.005** *
Chromium	7	0	0.05	0.007	0.1
Iron	**45**	**0**	**4.39**	**0.017**	**0.3** †
Lead	5	0	0.014	0.004	0.015
Mercury	11	0	0.0009	0.0001	0.002
Vanadium	5	NA	0.165	0.06	NA ‡

* MCL
† SMCL
‡ No drinking water standard available

Table 3 – Tap Water sample results submitted by a private citizen (25 samples)

Chemical	*Number of Detections*	*Number above Standards*	*Maximum Result (mg/L)*	*Minimum Detection Result (mg/L)*	*U.S. EPA Drinking Water Standard (mg/L)*
Aluminum	**4**	**2**	**0.34**	**0.11**	**0.05 – 0.20** ***
Antimony	**6**	**1**	**0.0065**	**0.002**	**0.006** †††
Arsenic	0	0	Non-Detect	Non-Detect	0.010
Barium	25	0	0.15	0.0039	2
Beryllium	0	0	Non-Detect‡‡‡	Non-Detect	0.0004
Boron	19	NA	0.53	0.11	NA §§§
Cadmium	0	0	Non-Detect	Non-Detect	0.005
Calcium	23	NA	14	1	NA
Chromium	1		0.0024	0.0024	0.1
Cobalt	0	0	Non-Detect	Non-Detect	NA
Copper	**18**	**1**	**3.2**	**0.014**	**1.3** ****
Iron	**21**	**7**	**12**	**0.021**	**0.3**
Lead	**5**	**3**	**0.026**	**0.006**	**0.015**
Magnesium	25	0	3.8	0.1	NA
Manganese	**19**	**13**	**0.22**	**0.018**	**0.05**

*** SMCL
††† MCL
‡‡‡ Detection Limit = 0.002 mg/L
§§§ No Drinking Water Standard Available
**** Technical Treatment Action Level

Chemical	*Number of Detections*	*Number above Standards*	*Maximum Result (mg/L)*	*Minimum Detection Result (mg/L)*	*U.S. EPA Drinking Water Standard (mg/L)*
Mercury	0	0	Non-Detect	Non-Detect	0.002
Molybdenum	16	0	0.0062	0.0021	NA
Nickel	1	0	0.019	0.019	NA
Potassium	23	0	4.1	0.78	NA
Selenium	7	0	0.014	0.006	0.05
Silver	0	0	Non-Detect	Non-Detect	0.1
Sodium	25	0	150	2.3	NA
Thallium	0	0	Non-Detect	Non-Detect	0.002
Tin	2	0	0.014	0.011	NA
Titanium	1	0	0.012	0.012	NA
Vanadium	0	0	Non-Detect	Non-Detect	NA
Zinc	25	0	3	Non-Detect	5

Table 4 – Incomplete groundwater pathways—DuPont DeLisle

Pathway Name	*Source*	*Media*	*Point of Exposure*	*Route of Exposure*	*Exposed Population*	*Time*
Drinking Water Wells	DuPont DeLisle injection wells and RCRA releases	Groundwater	Drinking, Bathing, Showering	Ingestion	None	None

Table 5 – Completed groundwater pathways

Pathway Name	*Source*	*Media*	*Point of Exposure*	*Route of Exposure*	*Exposed Population*	*Time*
Drinking Water Wells	Unknown – possibly plumbing or unidentified source of contamination	Groundwater	Drinking, Bathing, Showering	Ingestion	Approximately 10 persons	Past, Present, Future

Table 6 – Chemicals reported injected at the DuPont DeLisle facility in the 2000 TRI report.

Chemical	*Pounds Injected*	*%Total*
Manganese and compounds	9,500,000	76%
Chromium compounds	1,400,000	11%
Vanadium and compounds	1,100,000	8.8%
Zinc and compounds	220,000	1.6%
Lead and compounds	210,000	1.7%
Nickel and compounds	81,000	0.65%
Cobalt compounds	25,000	0.20%
Copper compounds	21,000	0.17%
Mercury compounds	57	0.00045%
Pentachlorobenzene	12	0.000096%
Hezachlorobenzene	12	0.000096%

Table 7- DuPont DeLisle groundwater data 1997–2001

Chemical	*Number of Samples*	*Number of Detections*	*Maximum Result* ***(mg/L)***	*Minimum Result* ***(mg/L)***
Arsenic	264	73	0.28	Non-Detect
Barium	203	127	6	Non-Detect
Beryllium	193	19	0.42	Non-Detect
Chromium	131	67	1.2	Non-Detect
Cobalt	75	10	0.36	Non-Detect
Copper	101	19	0.47	Non-Detect
Lead	351	182	2.3	Non-Detect
Manganese	12	12	9.4	0.79
Mercury	87	16	0.037	Non-Detect
Nickel	95	12	0.44	Non-Detect
Selenium	28	3	0.025	Non-Detect
Tin	42	2	0.4	Non-Detect
Vanadium	184	27	2.5	Non-Detect
Zinc	101	50	4.9	Non-Detect
Methane	28	24	4.6	0.017
Propane	16	2	0.0046	Non-Detect
1,2 Dichloroethene	21	4	2.3	Non-Detect
Tetrachloroethene	77	23	1.4	Non-Detect
Methylene Chloride	20	5	0.047	Non-Detect

Table 8 – Solid Waste Management Units (SWMU's) covered under the RCRA Corrective Action Plan

West Waste Management Area		
SMWU	***Description***	***Constituents of Concern***
SWMU 8	Barrow pit area	Perchloroehtylene (PCE) and PCE degradation products, total and dissolved barium, beryllium, lead and manganese
SWMU 28	Ponds Waste Management Area	
Southeast Waste Management Area		
SWMU	***Description***	***Constituents of Concern***
SWMU 14	1050 Sump	Arsenic, barium, and lead.
SWMU 22	632 Sump	
SWMU 29	Rain Basin	
Monitored Natural Attenuation Area		
SWMU	***Description***	***Constituents of Concern***
SWMU 23	Former PCE Containment Sump	PCE and degradation products

C. Public Comments and ATSDR Responses

Comment 1-1, Number of copies of consultation

I would suggest that copies of the consultation be made available at the public meeting. At the public meeting, we were told that a copy of the consultation was available at the library. But when I went to the library the next day, the document was missing. It took me about a week before I found someone at ATSDR willing to send me a copy and provide another copy for public review at the library. I believe your agency had at least six people present at the meeting necessitating air travel and hotel expenses. Certainly, making 20 or 30 copies of the 28-page health consultation would have cost little in comparison. The consultation also could have been made available at little charge on disk, or on a Web site. At the very least copies should have been made available to the press.

ATSDR response to comment 1-1

In future meetings at DeLisle, ATSDR will bring 20 or 30 copies of any future health consultations discussed. Additional copies of the health consultation have been sent to the Pass Christian Public Library. Press releases, with ATSDR contacts were issued prior to the meeting and no requests by the media or the public were made for a copy of the document prior to the meeting.

Comment 1-2, Lack of public participation

I have a number of concerns about this meeting including the lack of public participation (only about a dozen people showed up). Either little was done to inform affected people of the meeting, or there is a total lack of belief in the local community that this agency will offer anything of value to a population plagued by very high levels of illness. I suspect you have had little public comment on this consultation, which would also indicate that the agency has not connected well with the local population of people experiencing high rates of illness. One reason that is important is that the local people would have information important to the report. For example, they can tell you that you have far under-estimated the number of drinking water wells in the area and over-estimated the average depth of the wells.

ATSDR response to comment 1-2

ATSDR shares your concern regarding the lack of public participation at the meeting. However, the agency made significant attempts to let the public know about the meeting and the findings of the health consultation. The agency did a mass mailing of 269 letters in May, 2003 and then followed up with 226 letters just prior to the meeting. ATSDR also issued press releases prior to the meeting which were picked up by local media outlets. We are attempting to build dialogue with the community by releasing our health consultations for public comment so that we can further discuss and address community concerns.

Comment 1-3 Community Health Concerns, Physician diagnosing manganese poisoning

On page one you have a long list of health concerns people in the area suspect are linked to pollution from Dupont. Then at the end of the page you write, “Some community members also expressed concerns that the chemical releases from the DuPont plant could have contaminated the community’s water and air. They did not, however, have any specific health complaints.” That statement contradicts the list printed above that statement that included different types of cancers, neurological and psychological problems, birth defects and respiratory problems. A physician I know who has treated a number of people who live near the plant says that there is an

epidemic of early Alzheimer's or senile dementia in the area; many middle-aged people are having short-term memory problems. Rashes and neurological problems such as leg tremors are also commonly reported in this area, often by several members of the same family. This physician attributed the problems to manganese poisoning.

ATSDR response to comment 1-3

Multiple individuals talked to ATSDR representatives about their health concerns and the DuPont DeLisle plant. Some had the specific health complaints that they have attributed to the plant. Others had concerns about emissions from the plant (such as what is reported on the TRI report) but did not report any specific health concerns. There is no contradiction in this, just different people with differing concerns.

From information we have been provided by the community members, the diagnosis of "heavy metal poisoning" has been made by a physician in the community on the basis of hair analysis samples and the accompanying neurological symptomotology. As discussed in the text of the health consultation, hair analysis does not provide a reliable means of diagnosing manganese metal poisoning. The manganese levels seen in the drinking water samples are below levels seen in countywide surveys. The scientific literature does not support the hypothesis that the levels of manganese in the drinking water in the DeLisle area is the cause of these neurological problems the commenter has described.

Comment 1-4 Data Quality Evaluation – Water samples submitted by private resident.

On page two under MS Dept. of Health (MSDOH), you indicate that "quality control flags, detection limits and analytic methods" for the testing were not reported with the samples. You accept the MSDOH data anyhow. But you threw out and didn't consider data from private testing because you allege proper testing protocols weren't followed. (Page 3, "ATSDR reviewed the tap water testing results where complete chain of custody was submitted with the results and the analytic method used to analyze the results was reported.") It appears you will accept data that indicates there is no problem, but reject testing that shows higher levels of contaminants in the water. The agency should have the same requirements of MDOH testing as the private testing. And, if the state didn't follow proper protocol with its water testing, has MSDOH been advised of this?

ATSDR response to comment 1-4

A total of 27 water samples were submitted by a private citizen to ATSDR that had a chain of custody and were submitted with analytical information. ATSDR did not discuss two of them because they were samples of St. Louis Bay water and Jordan River water, which are not used for drinking water purposes.

Seven samples submitted that did not have supporting analytic information. These samples were analyzed by an unknown method at a medical laboratory and Omegatech King James Laboratory in Cleveland, OH. One of these samples was again a sample of St. Louis Bay water, so does not represent water that people routinely drink. The data from the six drinking water samples are presented in Table C-1, below.

Table C-1 King James Medical and unknown laboratory drinking water results (7 samples)

Chemical	*Number of Detections*	*Number above Standards*	*Maximum Result (mg/L)*	*Minimum Result (mg/L)*	*US EPA Drinking Water Standard (mg/L)*
Aluminum	3	1	0.25	Non-Detect	0.05-0.2[††††]
Antimony	0	0	Non-Detect	Non-Detect	0.006
Arsenic	0	0	Non-Detect	Non-Detect	0.01
Barium	1	0	0.3	0.3	2
Beryllium	0	0	Non-Detect	Non-Detect	0.004
Bismuth	1	NA	0.0044	0.0044	NA[‡‡‡‡]
Cadmium	0	0	Non-Detect	Non-Detect	0.005
Calcium	6	NA	8	0.42	NA
Chromium	0	NA	Non-Detect	Non-Detect	0.1
Cobalt	0	0	Non-Detect	Non-Detect	NA
Copper	3	1	1.4	Non-Detect	1.3[§§§§]
Iron	4	0	0.04	0.008	0.3
Lead	1	1	0.02	Non-Detect	0.015[‡]
Lithium	3	NA	0.04	0.02	NA
Magnesium	6	NA	3.1	0.25	NA
Manganese	6	1	0.2	0.004	0.05*
Mercury	1	0	0.00044	Non-Detect	0.002
Molybdenum	0	NA	Non-Detect	Non-Detect	NA

[††††] Secondary MCL
[‡‡‡‡] No Drinking Water Standard Available
[§§§§] EPA Technical Treatment Action Level

Chemical	*Number of Detections*	*Number above Standards*	*Maximum Result (mg/L)*	*Minimum Result (mg/L)*	*US EPA Drinking Water Standard (mg/L)*
Nickel	2	NA	0.16	Non-Detect	NA
Phosphorus	1	NA	0.418	Non-Detect	NA
Potassium	6	NA	3.1	0.01	NA
Selenium	1	0	0.01	Non-Detect	0.05
Sodium	6	NA	62.1	2.3	NA
Vanadium	0	NA	Non-Detect	Non-Detect	NA
Zinc	5	0	1.3	Non-Detect	5

Most of the metals have been previously discussed in the health consultation. Two elements not previously discussed are bismuth and phosphorus. Bismuth is a naturally occurs in the earth's crust at an average concentration of 0.2 parts per million [1]. Phosphorus occurs naturally in the earths curst at an average concentration of 0.12% and is present in all fertile soils [1]. Phosphorus is a macronutrient and is essential to support life. A typical adult requires approximately 0.7 grams (or 700 milligrams) of phosphorus per day [2].

Comment 1-5 Why is manganese found in water samples but the pathway is considered incomplete from the plant?

I don't understand the conclusion of this report that there is no drinking water contamination of concern when the MSDOH tables show manganese was detected in all nine water samples, and the maximum result was 0.1843. The EPA drinking water standard is 0.05. And if there is no "exposure pathway" that ATSDR has been able to find, then how come all nine of the wells tested have manganese, which is not a naturally occurring mineral in this area and which is a major constituent of waste products at DuPont Delisle?

ATSDR Response to comment 1-5

Manganese occurs naturally in groundwater [1]. USGS found manganese in a countywide survey of groundwater in 1993 [3]. Groundwater from 25 wells was analyzed for manganese in this survey from the whole county. Manganese was detected in all 25 samples, with a maximal reading of 250 µg/L (0.250 mg/L) in a well completed in the Graham Ferry Formation. The well with the maximal reading was located approximately 24 miles east from the DuPont site. These levels, while higher than the non-health based secondary MCL, are below levels established by EPA (0.3 mg/L) and WHO (0.5 mg/L) as being protective of public health.

Comment 1-6 Why is manganese levels not addressed in the handout at the meeting?

In the ATSDR handout on this issue at the public meeting "Dupont DeLisle Titanium Dioxide Plant, Public Health Consultation Summary," it states "Contaminant levels in water samples from some private wells were higher than EPA drinking water guidelines. Some isolated water samples contained lead and copper at levels that were higher than the MCL." Then you suggest that instead of this being contamination from DuPont "one possible source is leaching from copper pipes and lead solder from plumbing in area residents." But you don't even address the manganese levels found higher than EPA drinking water standards.

ATSDR Response to comment 1-6

As discussed in the text of the public health consultation, manganese has a Secondary MCL of 0.05 mg/L. A secondary MCL is established by EPA only as a guideline. It assists public water systems in managing their drinking water for aesthetic considerations, such as taste, color and odor. ATSDR evaluated the highest manganese levels found in the drinking water samples and determined it was not a threat to public health. In this release of the health consultation, we have provided additional information to help the community understand why manganese in drinking water in DeLisle does not pose a public health hazard.

Comment 1-7 ATSDR should recommend more manganese testing.

ATSDR should recommend more manganese testing, and especially more testing of poisons such as manganese and arsenic in shallower wells closer to the plant than were tested before.

ATSDR Response to comment 1-7

Given the location of the groundwater contamination on site and the direction of contaminant flow, there is no basis for such a recommendation. Potential groundwater contamination sources associated with the plant are identified and controlled under EPA's oversight. ATSDR's interpretation of the manganese levels are addressed in responses to comments 1-5 and 1-6.

Comment 1-8 I am disturbed at the anti-chelation information ATSDR presents

On page 3, I am disturbed at the anti chelation information presented. It is a sad fact that chelation is one of the ONLY things the medical community has to offer victims of heavy metal poisoning. The point is made on page three that chelating agents have the ability to deplete the organism of essential minerals while drawing out poisons. However, physicians who specialize in this are well aware of the issue, and after a certain number of chelation sessions will replace the essential minerals intravenously. Your warning about depleting the body of essential minerals shows a lack of understanding of proper chelation procedures. Experts also tell me that under proper supervision by a physician, undesired side effects are extremely rare. First you want to deny that people are poisoned, and then discourage people who have been poisoned from getting treatment.

ATSDR Response 1-8

ATSDR recommends that chelation therapy not be undertaken based on hair analysis alone. The reason for this recommendation is that hair analysis does not allow the prediction of a health effect from the concentration of the substance (such as manganese) in hair [2,4]. The ATSDR Hair Analysis Panel report discusses the appropriate uses and limitations of hair analysis [2]. ATSDR has no objection to chelation therapy that is used in a manner that is consistent with good medical practice when medically necessary. The commenter's remarks regarding the need for qualified medical supervision reiterates what was stated in page 3 of the health consultation,

"In cases of suspected or proven environmental intoxications with heavy metals, the primary health care provider should consult a specialist in Environmental-Occupational Medicine, for guidance in the proper evaluation, diagnosis, and treatment of heavy metal poisoning."

Comment 1-9 Exposure pathways are missing.

On page four, the Pathway Analysis is disappointing. There are a number of exposure pathways that are highly likely which you have not considered. Top on the list would be old, abandoned wells, which were not properly plugged and closed. After a period of years the pipes rust away, and provide a pathway for surface water contamination, leachate from the landfills, and even air emissions that fall out in the near facility of the plant to be carried down into the drinking water aquifers.

ATSDR Response comment 1-9

It is possible for an abandoned well to help transmit the groundwater contamination underneath the plant to a drinking water aquifer. For such a phenomena to occur, an abandoned well would have to be located inside the area of contamination and be sufficiently deep enough to allow for penetration into the Miocene aquifer system. There is no indication that an abandoned wells exist at the plant.

Comment 1-10 Wells are missing from Figure 2

This area was settled back in the 1700s, and has been continuously occupied over hundreds of years. Your data (Wells and UST Within Five Miles of the DuPont De Lisle Site) is very much lacking even depicting the number of currently operating private wells—let alone even considering the issue of old, abandoned wells that could serve as pathways for contamination.

ATSDR Response to comment 1-10

Regardless of where other wells are located, contamination underneath the plant is moving away from residential areas near the plant. Figures 2 and 3 illustrates the direction and extent of the groundwater plumes underneath the plant.

The well data used to make the map are from a survey that was conducted by the U.S. Geological Survey in 1993. Possible sources of error include:

- Newer development that has occurred since 1993.
- Latitude and longitude in the USGS datafiles have varying ranges of precision (ranging from 0.1 seconds to 1 minute). Therefore, a well may not appear within up to 5000 feet of its actual location.
- USGS not finding a given well.

We have modified Figure 3 to focus in on the area immediately surrounding the plant. We have also overlain the image with an aerial photograph to attempt to show where residences are in proximity to the DuPont site.

Comment 1-11 Arcadia Avenue and Winding Way are missing wells.

On Arcadia Avenue on your map of wells you show only about one well for every ten homes. Yet each house has its own well. On Winding Way on the east boundary of the plant, there are two dots and about a dozen houses in the area. Again, each house has its own well. Also, wells in this area average about 200 feet in depth, not the 450 feet in depth that you state is the average on page five. Some wells within a mile of the plant boundary are less than 100 feet deep. ATSDR should recommend testing of the more shallow wells.

ATSDR Response to comment 1-11

See response to comment 1-10.

Comment 1-12 Surface water pathway is not addressed.

Another exposure pathway not given attention is pollution to surface waters. I have an aerial photograph of this plant that shows a long white plume of pollution going from the plant far out into the Bay of St. Louis. The landfills at this facility are huge, and are continuing to accept more waste all the time. Your analysis seems to fail to take into account that the continued addition of more waste year after year—with an average rainfall of 55 inches per year that falls onto these landfills—means that each year the more pollution is generated which can end up affected the quality of groundwater, surface water, soils and air. It has been three years since the testing was done by MSDOH. That is another reason more testing would be warranted.

ATSDR Response to comment 1-12

Surface waters were not within the scope of this health consultation. ATSDR visited the landfills in question during a rainstorm and did not observe leakage from them despite heavy rainfall during the visit. Groundwater testing at the site has not revealed any migration of contaminants beyond the plant boundaries, and the plant is compliant with its applicable National Pollution Discharge Elimination System Permits (NPDES).

Comment 1-13 ATSDR does not have enough information to discount the class I underground injection wells.

I don't think ATSDR has enough information to discount any possible contamination from the class I underground wells. During the public meeting June 5, you stated that one deep injection well has failed in the past, and the waste was re-routed around the problem and the well rebuilt. You accept DuPont's claims that there was still no contamination of drinking water supplies. But if other failures of the deep injection wells have occurred, and were either not detected or not reported, contamination of the drinking water aquifers could occur.

ATSDR Response to comment 1-13

EPA and MSDEQ are providing regulatory oversight for the underground injection wells. As discussed in the public meeting, these agencies were informed by the plant of the issues that required the rerouting of the underground injection wells at this site. They continue to monitor and regulate the safe use of these wells. ATSDR does not provide regulatory oversight or review of the injection wells. ATSDR therefore defers to these agencies and their judgments that the problem that resulted in the re-routing of the wells has not affected the area's drinking water supply.

Comment 1-14 How can ATSDR discount the underground injection wells if they do not understand how they work?

If you don't understand properly how the wells work, how can you assure the public that there is no possible contamination from these deep injection wells that handle millions of pounds of toxic waste per year?

ATSDR Response to comment 1-14

As stated in comment 1-13, it is not this agency's role to provide regulatory oversight for the safe functioning of underground injection wells. ATSDR recognizes that the functioning of these wells is a concern of the community, as well as a potential source of contamination for an exposure pathway. Therefore, ATSDR consulted with EPA's Underground Injection Control section to ensure that these wells do not pose an exposure pathway to the community. Sampling data do not indicate that the community's groundwater is contaminated.

Comment 1-15 Has ATSDR reviewed the plant's groundwater sampling plans?

At the end of page five regarding the groundwater pollution plume under the plant, you state, "DuPont determined that the predominant groundwater flow is towards Bay St. Louis, away from residential wells." This is a large site. Elsewhere on the Coast such as at the Seabee base in Gulfport, groundwater flows in several different directions within a relatively small area. More detailed information and analysis is needed before accepting DuPont's word for this. Did ATSDR look at DuPont's groundwater monitoring data? Did you look at how far out testing has been done to detect the limits of the pollution plume? The company could be potentially liable for millions in damages if its groundwater pollution plume goes onto nearby private property. Obviously the company would have a vested interest in saying the plume goes away from any nearby residences. Has ATSDR reviewed the groundwater plume monitoring data to assume proper sampling and testing procedures were used?

ATSDR Response to comment 1-15

Yes, ATSDR reviewed the sources referenced in the health consultation. 56 wells were completed to assess the presence and extent of the contamination at 9 Solid Waste Management Units (SWMUs). Monitoring wells are located on site to ensure that contamination has not spread beyond the boundaries of the site. Furthermore, these reports were developed and submitted under the regulatory oversight of EPA. Falsifying a report submitted under RCRA can result in both criminal and civil penalties to the facility and the individuals who falsified the information [5].

Comment 1-16 ATSDR has not accounted for the manganese releases reported on the TRI.

Page 5 said, "There is no indication that persons are currently being exposed to contaminants from the plant via groundwater." Yet you fail to account for the manganese levels in drinking water that exceed EPA standards. If this manganese isn't from the plant, where does it come from? About 76 percent of the injected wastes reported in the 2000 TRI are manganese and compounds, some 9.5 million pounds worth of them. There is also manganese in air and surface water emissions.

ATSDR Response to comment 1-16

ATSDR did discuss manganese. The manganese levels would not be associated with the health effects that the community is concerned about as discussed in the document. The manganese levels are within background range for the county. The health consultation does not address air emissions or surface water releases form the plant. Testing data do not indicate that these pathways are having an impact on the community's drinking water.

Comment 1-17 The presence of arsenic proves that there is a completed exposure pathway.

You stated at the end of page five and top of page six: "A completed exposure pathway from either the underground injection wells or the plant does not exist. Nevertheless, some of the groundwater testing results submitted to ATSDR were higher than the EPA drinking water guidelines." By your own admission there must be an exposure pathway—if not from the injection wells, from surface contamination going down abandoned wells into drinking water aquifers or from landfills in the area. You should recommend more testing to ascertain the exposure pathway or pathways. There are also other contaminants such as arsenic that are showing up in the drinking water that should not be naturally occurring. Even if these toxins are not yet to levels exceeding drinking water standards, they are an indication that contamination is occurring and needs to be addressed.

ATSDR Response to comment 1-17

ATSDR has recommended more testing for those samples where lead and copper were elevated above the MCL. Arsenic is a naturally occurring element found in ground water throughout the United States. A U.S. Geological Survey study found arsenic to be occurring at a level higher than 1 µg/L (0.001 mg/L) 25% of the time Harrison County water [6]. Arsenic levels that have been detected in samples from DeLisle are below EPA's MCL.

Comment 1-18 Manganese exceeds EPA drinking water standard.

On page eight you say manganese was detected in 28 of 34 samples, and then claim that this isn't at levels exceeding the RDA for manganese. Why did this paragraph not contain information from the chart included that these are higher levels than the drinking water standards for EPA? And could you explain why you use this rather dubious route to discount the hazards from this toxin that is released in great quantities from the plant? You seem to discount that people may already be getting more than the RDA from their diet. Then when you add it from the drinking water, the levels may be toxic—as have been reported by area doctors. Also, you don't consider that this is a predominantly low-income area, and one where a lot of people have home gardens. Some of their produce is sold at roadside stands in the area. DuPont has operated this facility many years. How much as manganese has built up in soils over those years? How much is being ingested in locally produced vegetables and fruits? How much contamination do people get from mowing their grass or doing other yard work? How much is also taken up into the food chain (along with dioxin, arsenic, mercury and other pollutants also emitted from this facility) by fish, and then consumed by this population also receiving the heavy metals in their air and drinking water?

ATSDR Response to comment 1-18

The secondary MCL for manganese has been discussed in responses 1-6 and 1-16. Further discussion to explain using the RDA as a method to discuss the toxicity of manganese in the diet is provided below.

The Recommended Dietary Allowance for manganese is 5 milligrams per day. This RDA is based on the body's need for manganese, and not the latter's toxicity. Dietary manganese in drinking water is not a "toxin;" it is an elemental nutrient required for normal human growth and maintenance of health. Manganese is a cofactor for a number of enzymatic reactions, particularly those involved in phosphorylation, chloesterol and fatty acid synthesis. It serves as an activator of several enzymes including hydrolases, kinases, decarboxylases and transferases, and is required for the activity of three metalloenzymes: arginase, pyruvate carboxylase and mitochondrial superoxide dismutase.

At the maximum concentration of manganese detected (0.22 mg/L) in drinking water at this site, one would have to drink almost 23 liters of water every day to (at least 10 times normal) just to equal the RDA. We assume an adult drinks about 2 liters of water/day. At a normal consumption rate of 2 L/day, maximally "contaminated" drinking water would add only 0.44 mg of manganese to a high normal dietary intake of 10 mg or more. Thus, combining a maximal manganese exposure from drinking water with a high exposure from food would still result in a total oral intake that has been established safe in humans.

The use of a RDA for manganese is consistent with the approach that EPA uses. EPA's oral Reference Dose (RfD) for manganese (10 mg/70 kg BW/day or 0.14 mg/kg/day), unlike EPA's RfDs for most other substances, is not even based on adverse health effects [7]. It is based, instead, on an average daily intake of manganese in the diet, derived from a composite of data from several studies.

Manganese is not expected to bioaccumulate up the food chain significantly to higher trophic levels [8]. Oral overdoses are made unlikely by the existence in the liver and gut of efficient homeostatic controls which keep blood levels relatively constant (at 2-8 ug/dL) in the face of rather wide variations in diet. As dietary intake increases, the normally low absorption of manganese (about 5%) falls even lower. Thus, in humans, incidents of oral manganese toxicity are rare [8]. Even if a potentially toxic dose were somehow ingested, the tendency for extremely large doses of manganese to irritate the G.I. tract and induce vomiting would prevent systemic toxicity from resulting ingestion [9].

Note: Heavy occupational exposure to manganese in air (e.g., in manganese miners) is, in fact, rapidly toxic, resulting in a Parkinsonism-like neurological syndrome called Manganism. However, in spite of a partial overlapping symptomology, Manganism and Parkinson's Disease are distinctly different medical conditions.

Comment 1-19 ATSDR did not consider synergistic effects.

I have read EPA statements that the synergistic impact of several different toxins together can have an impact 1,000 times more damaging than the single toxin. What evaluation has there been of the synergistic impact of all these chemicals together? For those reasons I don't find the entire discussion of individual contaminants on pages 6, 7, 8 and 9 to be very reassuring. You are looking at drinking water only, without taking into considering what is being absorbed in the air, food crops, and fish.

ATSDR Response to comment 1-19:

At the time of the original health consultation ATSDR did not have environmental data concerning air, food crops and fish. Therefore, we could not address these pathways much less any potential synergistic impacts.

In general, the scientific literature on interactions is limited in its direct applicability to mixtures associated with hazardous waste sites [10]. Mixtures of chemicals could have greater than additive effects (synergism, potentiation), additive effects, and less-than-additive-effects (antagonism, inhibition, masking) [10]. As part of the agency's internal review process, the health consultation was submitted to the Division of Toxicology (DT) for review. As part of DT's review of the chemicals found in the drinking water in the DeLisle area, they reviewed the question of the effects of the mixture of chemicals present in the drinking water. DT did not find specific mixture concerns that warrant further investigation.

In regards to chemicals potentially having a 1,000 fold greater than additive effect, the respondent is apparently referring to the article by Arnold et al. (1996) [11] That article claimed that "combinations of two weak environmental estrogens, such as dieldrin, endosulfan, or toxaphene, were 1,000 times as potent in hER-mediated transactivation as any chemical alone." This study was remarkable because, if confirmed, it would have been an example where chemical exposures that did not produce appreciable toxic results were combined to produce a toxic effect. It was published in Science on June 7, 1996 and great weight was put on this report as the basis of discussion, thought and even public policy. However, this article was voluntarily withdrawn by the authors a year later after other laboratories (Texas A & M, Duke University, National Institute of Environmental Health Sciences, and the Chemical Industry Institute of Toxicology) and even the original laboratory that performed the research could not reproduce the results [12],[13].

Comment 1-20 ATSDR's conclusions are not supported and are premature.

Your conclusions on page nine that area wells are not impacted by this facility is not supported by the information presented. Your finding of No Public Health Hazard is at the very least premature until you consider results of sampling of shallower wells than those indicated in the study. It also seems premature to submit this finding before assessing the air pollution and dioxin issues.

Comment ATSDR Response to comment 1-20

ATSDR will address the questions regarding air emissions from the plant and dioxin-like compounds in two future health consultations. Available toxicological and medical literature indicate that the levels of manganese found in the drinking water in the DeLisle community is not a public health hazard.

Comment 1-21 I am concerned about the dioxin reported on the facility's TRI.

Regarding the dioxin, at the public meeting June 5 I said I was very concerned about the fact that nearly half of all total dioxin and dioxin related compounds released reported in the 2000 TRI came from this facility. According to information from the EPA presented on the Web site http://www.scorecard.org/about/txt/new.html: For the first time, TRI now provides data on dioxin compounds. Chemicals And Allied Products is the industrial sector responsible for over 80% of total releases. Mississippi tops all 50 states in terms of total environmental releases; with Harrison County receiving almost half of total reported U.S. releases, all due to land disposal operations at a single facility: the Du Pont Delisle Plant in Pass Christian." This should be of grave concern, especially since these compounds are listed as some of the most hazardous to public health known. (http://www.scorecard.org/env-releases/facility.tcl?tri_id=39571DPNTD7685K#)

(pollution rank health impact). For decades DuPont didn't even report it was releasing the dioxin like compound, supposedly just "discovering" it in recent years. It is certainly to the company's

benefit now to discount any health impact from the dioxin and other pollution—even while people who live in nearby homes see family member after family member felled by cancer and other diseases. ATSDR must look at the cumulative impacts of this toxic releases over the 23 years DuPont has been in operation at Delisle.

ATSDR Response to comment 1-21

This agency is preparing a health consultation regarding your concerns about the dioxin-like compounds related to this facility.

Comment 1-22 ATSDR is ignoring doctors who say that there is a public health problem in the area.

In conclusion, I was originally very pleased that ATSDR had been brought in to do a health assessment. I felt the situation was beyond the ability of the MSDOH and DEQ to evaluate. I thought that ATSDR's involvement would actually mean surveying the health of the local population and determining if there was an unusual incidence of illness. ATSDR seems to ignore the figures that would indicate all these millions of pounds of toxics are having an impact on the health of nearby residents, and instead base your conclusion on limited data that leaves DuPont smelling like a rose. Instead of talking to local physicians about what kind of illnesses they are seeing in local residents, and looking to see if they are consistent with manganese, arsenic and mercury poisoning—which they are—you instead just look at a very limited set of data—tests from nine deep water wells—and conclude there is no problem.

ATSDR Response to comment 1-22

ATSDR is investigating if there is a link between environmental pollution from the DuPont DeLisle plant and the health concerns that the community and our petitioner has raised to us.

ATSDR physicians and scientists did speak to one physician who believed that manganese was causing a higher rate of neurological effects in the community. After the initial public meeting in July 2002, ATSDR contacted primary care physicians and internists practicing at the Hancock medical center and the Biloxi regional hospital to ask if there were health concerns relating to the plant. None of the physicians contacted said that they had patients that were concerned about the environmental pollution from the plant or had been diagnosed with heavy metal poisoning.

The health consultation discusses the lack of a completed exposure pathway from a source of groundwater contamination at the plant in detail. Part of the information we used was testing conducted by three different parties of over 40 drinking water wells (not 9, as the commenter suggests).

The purpose of the health consultation was to examine if metals in drinking water would explain the health concerns in the community, not to confirm or disaffirm the presence of a given illness in the community. This approach is well reasoned, given the limited number of diseases uniquely associated with environmental pollution.

Comment 1-23 The government discounts the community's concerns and is ignoring local physicians who say people have heavy metal poisoning.

I have over the years received a number of calls from distressed people in this area. Sometimes they call from their hospital beds. They call Sierra Club because they have lost faith that the government has any concern for their health and well-being. They have been diagnosed with

heavy metal poisoning by their physicians, the same types of metals released in great quantities by this industrial neighbor, but the government discounts their concerns and continues to allow this facility to emit huge quantities of toxins. As far as I have been able to determine, there is no permit limit for the dioxin being released at the plant, and no requirement to reduce those emissions.

ATSDR Response to comment 1-23

From information we have been provided by the community members, the diagnosis of "heavy metal poisoning" has been made by a community physician on the basis of hair analysis samples. As discussed, there is no valid scientific justification for using hair analysis in the differential diagnosis of manganese poisoning. Other community physicians that ATSDR has spoken with do not share this concern. Dioxin-like congeners and air emissions from the plant will be addressed in a future health consultation.

Comment 1-24 ATSDR could do a better job than this.

The taxpayers—not DuPont—paid for ATSDR to do this study. And the taxpayers deserve better than this.

ATSDR Response to comment 1-24

This health consultation was prepared by researching underground injection wells, the hydrogeology of the area, and the toxicology of the metals in the groundwater samples. We also consulted with technical experts within ATSDR and EPA. This document was reviewed through the agency's review process. We stand by our conclusions and recommendations because they are based on the scientific information about the pathways and exposures in this community.

Comment 2-1 Paragraph numbering would be helpful.

Commenting would be facilitated if the paragraphs in the document were numbered. I will use page number and paragraph sequence number on that page. Ex: (p2-3) means page 2 paragraph 3.

ATSDR Response to comment 2-1

ATSDR does not generally number paragraphs in its documents.

Comment 2-2 A listing of acronyms would be helpful as well.

ATSDR Response to comment 2-2

ATSDR has added a glossary (Appendix D) explaining the terms and acronyms used in the text.

Comment 2-3 The pathway table needs additional information.

(p 4-1)The Pathway Analysis tables look like a great way to evaluate exposure potential. They may be even more useful if an additional column were added to list the specific contaminants being considered. It might also be useful to combine tables 4 and 5 by adding a probability of completion column. I suggest that you include a detailed discussion to explain how you arrived at the entries in Tables 4 and 5. Since (a) EPA Toxic Release Inventory (TRI, www.epa.gov) documented onsite release of 14,799,029 pounds of toxics into deep wells of questionable reliability, landfills which leach into the groundwater, and directly into the Bay of St. Louis, (b) Table 7 shows contamination of under-plant groundwater with many of the same toxics, and (c) Table 1 shows some of these same toxics in nearby residential well water samples(manganese 4

times EPA standard), then it seems likely that the incomplete pathway listed in Table 4 may actually be complete and should appear in Table 5 with source being DuPont onsite releases.

ATSDR Response to comment 2-3

Available data from EPA and MSDEQ indicate that the underground injection wells have not impacted residential drinking water in the community. As discussed in the text, data submitted by the plant to EPA indicate that groundwater flow is away from residential wells in the area and that groundwater contamination below the plant has not migrated off site. We have revised the manganese discussion in this final health consultation to explain more precisely, why we believe the manganese levels seen in these samples are at background levels and why these levels detected are not a public health hazard.

Comment 2-4 Additional exposure pathways should be added to Tables 4 and 5

(p 4–1) I suggest that you also analyze some additional possible pathways to be considered in this and later consultations and added to Table 4 or 5.

a. DuPont landfills toxics including about 40% of the entire nations release of dioxin and dioxin-like compounds. Heavy rains wash toxics into bay. Toxics accumulate and concentrate in estuarine food chain. Boy catches fish in bay containing elevated levels of heavy metals and dioxin like compounds. Boy eats fish. Boy gets sick.

b. Wind blows toxics from landfill. Toxics fall on bushes. Rabbit eats bushes. Boy catches and eats rabbit. Boy gets sick.

c. DuPont releases 2 million pounds of toxics into the air. Boy breathes air. Boy gets sick.

d. DuPont releases 2 million pounds of toxics into the air. Toxics fall on pasture. Cow eats grass. Boy eats cow. Boy gets sick.

ATSDR Response to comment 2-4

ATSDR is preparing health consultations regarding the dioxin like compounds at the facility and air emissions.

Comment 2-5 Air exposure pathways need to be addressed.

(p 4-2) Please add air emissions as a source of groundwater contamination to the extent that at least some of the 2 million plus pounds of toxics (ref: EPA TRI) falls on the land and surface water and moves into the groundwater.

ATSDR Response to comment 2-5

The majority of the 2 million pounds of air releases from the plant are of the form of gases (carbonyl sulfide) and acid mists (hydrochloric acid). These would not be expected to impact the groundwater significantly.

Comment 2-6 Wells are missing from Figure 2

(p 5-3) I believe that there are a good many more houses and wells in the area than there are wells indicated on the map. On my street, Arcadia Road, I think only about 10% of the wells are shown. My well is about 200 feet deep. I suspect that the deeper wells are probably bigger and more likely to have gotten into the MARIS database but that shallower wells are very common.

This would skew the average well depth to be much greater than it should be. Furthermore, the older wells use iron casings, which may very well have rusted through in places and would be contaminated with shallow groundwater.

ATSDR Response to comment 2-6

Data used in the MARIS database is from a well survey done by the U.S. Geological Survey in 1993. It is possible that newer development to have occurred since the time of this survey, or as the commenter suggests, that some wells have been missed. The commenter is correct with the observation that older casings may deteriorate with time, allowing shallow groundwater to infiltrate the well. However, groundwater contamination underneath the plant is not moving in the direction of residential wells. Therefore, there is not a risk of chemical contamination from the plant impacting a given residential well.

Comment 2-7 Food chain exposure route is not addressed.

(p 5-4) Please add seafood as a route and point of exposure to the extent that toxics are taken up into the food chain of our extremely productive estuaries, which have long served our many residents who frequently eat fish and shrimp from St. Louis Bay. Please include an analysis of the behavior of these toxics in an estuarine environment.

ATSDR Response to comment 2-7

At the time of the original health consultation ATSDR did not have environmental data concerning the estuaries' fish and shellfish. This health consultation addressed groundwater only.

Comment 2-8 Agricultural products are not addressed.

(p5-4) Please add locally produced agricultural products as a route and point of exposure to the extent that air emitted toxics fall on cropland and pasture and are taken up into produce, meat, and milk which are locally produced and consumed. Please include an analysis of the behavior of these toxics in agriculture.

ATSDR Response to comment 2-8

ATSDR will address this concern as part of its health consultation concerning the air emissions of the plant.

Comment 2-9 Please evaluate whether manganese could serve as a tracer for the plume of contaminated groundwater under the DuPont property.

(p 5-4). I am not satisfied that exposure to toxics via groundwater has been ruled out. Table 1 shows a manganese level nearly 4 times higher than the EPA SMCL. While this level is not considered toxic, where did the manganese come from? Does manganese naturally occur in groundwater in this area in this concentration or does it indicate or perhaps even prove a route of exposure? Please evaluate whether any of these metals could serve as a tracer for the plume of contaminated groundwater under the DuPont property.

ATSDR Response to comment 2-9

Manganese does not serve as a marker for the plume of contaminated groundwater under the DuPont property. The manganese levels the commenter is referring to, while 4 times the secondary MCL, is within background range for the county. We have revised the manganese section of the health consultation to address where manganese is coming from in these water samples.

Comment 2-10 Table 1 needs revision.

(p19-Table 1) For the manganese entry the Number above Standards should clearly not be 0 since the max value of 0.11843 exceeds the 0.05 EPA SMCL.

ATSDR Response to comment 2-10

We have revised the table to indicate that the secondary MCL (while not appropriate for health screening purposes) was exceeded.

Comment 2-11 ATSDR has lost credibility with the community.

I must admit that your agency had a lot more credibility with me at the start of the meeting than at the end. From the toxicologist who claimed that dioxin and heavy metals are good for us to the lead investigator who explained how the deep injection wells worked and how safe they were but when asked about the purpose of the annular fluid shown on the large diagram answered that it was the "injectate," the material being disposed of. This showed that he fundamentally failed to understand how the wells were supposed to work. Then there were the people in the back who honestly came across to me as bouncers and crowd control specialists, interrupting any citizen showing any emotion or disagreeing with your absence of findings.

Sorry folks, I came into this hoping to find out that I was not being poisoned, but the meeting and my review of the document have led me to believe that I <u>am</u> being poisoned when I breath, drink, swim, eat from my own garden, or eat fresh fish, and that you people don't bother to get your facts straight and for some reason are determined ignore evidence and try to mislead me. The very worst part of it is that I, as a taxpayer paid you to do it and all your expenses.

ATSDR Response to comment 2-11

We are sorry that you do not believe our findings and appreciate your candor about your concerns. The agency toxicologist mentioned did not claim that dioxin and heavy metals was good for us, but was commenting generally that there is a certain *dose* of chemical required to elicit toxic effects.

As to the underground injection wells, the speaker who was addressing the issue worked with experts within the agency as well as with experts within EPA to address the community's legitimate questions concerning this admittedly complicated technology. He was confused as to if pressure monitoring was performed on the injectate or in the annular fluid of the well. This issue was discussed and clarified during the meeting. Nevertheless, the technical knowledge of the presenter during the public meeting does not detract from the fact that the agencies with regulatory oversight of these wells (EPA and MSDEQ) do not believe that these wells have affected the community's drinking water.

Regarding "crowd control specialists" and "bouncers," ATSDR did not have team members in the back of the room as referenced. A community involvement specialist chaired the meeting to ensure all who had comments or questions could be heard. Other members of the team were present mainly to provide technical information as needed.

In reference to the comments about other pathways, ATSDR did not have information regarding these pathways of exposure. We are working to get information about them and to develop health consultations regarding these issues for the community. This health consultation addressed groundwater contamination. If you are in doubt of the credibility of our findings concerning

drinking water, we suggest that you have your water tested by a certified laboratory, following their instructions on sample collection and shipment carefully.

Comment 3-1 Language concerning DuPont's testing done as a requirement of its UIC permit needs revision.

We suggest that the language in the Data Quality Evaluation regarding the DuPont water samples being biased high due to "mis-calibration" be changed to note that the groundwater monitoring is performed as part of DuPont's Underground Injection Control Permit. Comparing the results with MCL's should be done with caution. This is because the Practical Limits of Quantification is higher for the type of analysis required by DuPont's Underground Injection Control permit than type of analysis performed for monitoring for compliance with the MCLs.

ATSDR Response to comment 3-1

The issues raised by this commenter are noted. We have revised the data quality section and the discussion of the cadmium sections accordingly.

Appendix C References

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D. ATSDR Glossary of Environmental Health Terms

The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal public health agency with headquarters in Atlanta, Georgia, and 10 regional offices in the United States. ATSDR's mission is to serve the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and diseases related to toxic substances. ATSDR is not a regulatory agency, unlike the U.S. Environmental Protection Agency (EPA), which is the federal agency that develops and enforces environmental laws to protect the environment and human health.

This glossary defines words used by ATSDR in communications with the public. It is not a complete dictionary of environmental health terms. If you have questions or comments, call ATSDR's toll-free telephone number, 1-888-42-ATSDR (1-888-422-8737).

Absorption
The process of taking in. For a person or animal, absorption is the process of a substance getting into the body through the eyes, skin, stomach, intestines, or lungs.

Acute
Occurring over a short time [compare with **chronic**].

Acute exposure
Contact with a substance that occurs once or for only a short time (up to 14 days) [compare with **intermediate duration exposure** and **chronic exposure]**.

Additive effect
A biologic response to exposure to multiple substances that equals the sum of responses of all the individual substances added together [compare with **antagonistic effect** and **synergistic effect]**.

Adverse health effect
A change in body function or cell structure that might lead to disease or health problems.

Aerobic
Requiring oxygen [compare with **anaerobic**].

Ambient
Surrounding (for example, *ambient* air).

Anaerobic
Requiring the absence of oxygen [compare with **aerobic**].

Analyte
A substance measured in the laboratory. A chemical for which a sample (such as water, air, or blood) is tested in a laboratory. For example, if the analyte is mercury, the laboratory test will determine the amount of mercury in the sample.

Analytic epidemiologic study
A study that evaluates the association between exposure to hazardous substances and disease by testing scientific hypotheses.

Antagonistic effect
A biologic response to exposure to multiple substances that is **less** than would be expected if the known effects of the individual substances were added together [compare with **additive effect** and **synergistic effect**].

Background level
An average or expected amount of a substance or radioactive material in a specific environment, or typical amounts of substances that occur naturally in an environment.

Biodegradation
Decomposition or breakdown of a substance through the action of microorganisms (such as bacteria or fungi) or other natural physical processes (such as sunlight).

Biologic indicators of exposure study
A study that uses (a) **biomedical testing** or (b) the measurement of a substance [an **analyte**], its **metabolite**, or another marker of exposure in human body fluids or tissues to confirm human exposure to a hazardous substance [also see **exposure investigation**].

Biologic monitoring
Measuring hazardous substances in biologic materials (such as blood, hair, urine, or breath) to determine whether exposure has occurred. A blood test for lead is an example of biologic monitoring.

Biologic uptake
The transfer of substances from the environment to plants, animals, and humans.

Biomedical testing
Testing of persons to find out whether a change in a body function might have occurred because of exposure to a hazardous substance.

Biota
Plants and animals in an environment. Some of these plants and animals might be sources of food, clothing, or medicines for people.

Body burden
The total amount of a substance in the body. Some substances build up in the body because they are stored in fat or bone or because they leave the body very slowly.

CAP
See **Community Assistance Panel**.

Cancer
Any one of a group of diseases that occurs when cells in the body become abnormal and grow or multiply out of control.

Cancer risk
A theoretical risk for getting cancer if exposed to a substance every day for 70 years (a lifetime exposure). The true risk might be lower.

Carcinogen
A substance that causes cancer.

Case study
A medical or epidemiologic evaluation of one person or a small group of people to gather information about specific health conditions and past exposures.

Case-control study
A study that compares exposures of people who have a disease or condition (cases) with people who do not have the disease or condition (controls). Exposures that are more common among the cases may be considered as possible risk factors for the disease.

CAS registry number
A unique number assigned to a substance or mixture by the American Chemical Society Abstracts Service.

Central nervous system
The part of the nervous system that consists of the brain and the spinal cord.

CERCLA [see **Comprehensive Environmental Response, Compensation, and Liability Act of 1980**]

Chronic
Occurring over a long time (more than 1 year) [compare with **acute**].

Chronic exposure
Contact with a substance that occurs over a long time (more than 1 year) [compare with **acute exposure** and **intermediate duration exposure**].

Cluster investigation
A review of an unusual number, real or perceived, of health events (for example, reports of cancer) grouped together in time and location. Cluster investigations are designed to confirm case reports; determine whether they represent an unusual disease occurrence; and, if possible, explore possible causes and contributing environmental factors.

Community Assistance Panel (CAP)
A group of people, from a community and from health and environmental agencies, who work with ATSDR to resolve issues and problems related to hazardous substances in the community. CAP members work with ATSDR to gather and review community health concerns, provide information on how people might have been or might now be exposed to hazardous substances, and inform ATSDR on ways to involve the community in its activities.

Comparison value (CV)
Calculated concentration of a substance in air, water, food, or soil that is unlikely to cause harmful (adverse) health effects in exposed people. The CV is used as a screening level during the public health assessment process. Substances found in amounts greater than their CVs might be selected for further evaluation in the public health assessment process.

Completed exposure pathway [see **exposure pathway**].

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)
CERCLA, also known as **Superfund**, is the federal law that concerns the removal or cleanup of hazardous substances in the environment and at hazardous waste sites. ATSDR, which was created by CERCLA, is responsible for assessing health issues and supporting public health activities related to hazardous waste sites or other environmental releases of hazardous substances.

Concentration
The amount of a substance present in a certain amount of soil, water, air, food, blood, hair, urine, breath, or any other media.

Contaminant
A substance that is either present in an environment where it does not belong or is present at levels that might cause harmful (adverse) health effects.

Delayed health effect
A disease or injury that happens as a result of exposures that might have occurred in the past.

Dermal
Referring to the skin. For example, dermal absorption means passing through the skin.

Dermal contact
Contact with (touching) the skin [see **route of exposure**].

Descriptive epidemiology
The study of the amount and distribution of a disease in a specified population by person, place, and time.

Detection limit
The lowest concentration of a chemical that can reliably be distinguished from a zero concentration.

Disease prevention
Measures used to prevent a disease or reduce its severity.

Disease registry
A system of ongoing registration of all cases of a particular disease or health condition in a defined population.

DOD
United States Department of Defense.

DOE
United States Department of Energy.

Dose (for chemicals that are not radioactive)
The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure. Dose is often expressed as milligram (amount) per kilogram (a measure of body weight) per day (a measure of time) when people eat or drink contaminated water, food, or soil. In general, the greater the dose, the greater the likelihood of an effect. An "exposure dose" is how much of a substance is encountered in the environment. An "absorbed dose" is the amount of a substance that actually got into the body through the eyes, skin, stomach, intestines, or lungs.

Dose (for radioactive chemicals)
The radiation dose is the amount of energy from radiation that is actually absorbed by the body. This is not the same as measurements of the amount of radiation in the environment.

Dose-response relationship
The relationship between the amount of exposure [**dose**] to a substance and the resulting changes in body function or health (response).

Environmental media
Soil, water, air, **biota** (plants and animals), or any other parts of the environment that can contain contaminants.

Environmental media and transport mechanism
Environmental media include water, air, soil, and **biota** (plants and animals). Transport mechanisms move contaminants from the source to points where human exposure can occur. The **environmental media and transport mechanism** is the second part of an **exposure pathway**.

EPA
United States Environmental Protection Agency.

Epidemiologic surveillance
The ongoing, systematic collection, analysis, and interpretation of health data. This activity also involves timely dissemination of the data and use for public health programs.

Epidemiology
The study of the distribution and determinants of disease or health status in a population; the study of the occurrence and causes of health effects in humans.

Exposure
Contact with a substance by swallowing, breathing, or touching the skin or eyes. Exposure may be short-term [**acute exposure**], of intermediate duration, or long-term [**chronic exposure**].

Exposure assessment
The process of finding out how people come into contact with a hazardous substance, how often and for how long they are in contact with the substance, and how much of the substance they are in contact with.

Exposure-dose reconstruction
A method of estimating the amount of people's past exposure to hazardous substances. Computer and approximation methods are used when past information is limited, not available, or missing.

Exposure investigation
The collection and analysis of site-specific information and biologic tests (when appropriate) to determine whether people have been exposed to hazardous substances.

Exposure pathway
The route a substance takes from its source (where it began) to its end point (where it ends), and how people can come into contact with (or get exposed to) it. An exposure pathway has five parts: a **source of contamination** (such as an abandoned business); an **environmental media and transport mechanism** (such as movement through groundwater); a **point of exposure** (such as a private well); a **route of exposure** (eating, drinking, breathing, or touching); and a **receptor population** (people potentially or actually exposed). When all five parts are present, the exposure pathway is termed a **completed exposure pathway**.

Exposure registry
A system of ongoing followup of people who have had documented environmental exposures.

Feasibility study
A study by EPA to determine the best way to clean up environmental contamination. A number of factors are considered, including health risk, costs, and what methods will work well.

Geographic information system (GIS)
A mapping system that uses computers to collect, store, manipulate, analyze, and display data. For example, GIS can show the concentration of a contaminant within a community in relation to points of reference such as streets and homes.

Grand rounds
Training sessions for physicians and other health care providers about health topics.

Groundwater
Water beneath the earth's surface in the spaces between soil particles and between rock surfaces [compare with **surface water**].

Half-life ($t_{½}$)
The time it takes for half the original amount of a substance to disappear. In the environment, the half-life is the time it takes for half the original amount of a substance to disappear when it is changed to another chemical by bacteria, fungi, sunlight, or other chemical processes. In the human body, the half-life is the time it takes for half the original amount of the substance to disappear, either by being changed to another substance or by leaving the body. In the case of radioactive material, the half life is the amount of time necessary for one half the initial number of radioactive atoms to change or transform into another atom (that is normally not radioactive). After two half lives, 25% of the original number of radioactive atoms remain.

Hazard
A source of potential harm from past, current, or future exposures.

Hazardous Substance Release and Health Effects Database (HazDat)
The scientific and administrative database system developed by ATSDR to manage data collection, retrieval, and analysis of site-specific information on hazardous substances, community health concerns, and public health activities.

Hazardous waste
Potentially harmful substances that have been released or discarded into the environment.

Health consultation
A review of available information or collection of new data to respond to a specific health question or request for information about a potential environmental hazard. Health consultations are focused on a specific exposure issue. Health consultations are therefore more limited than a public health assessment, which reviews the exposure potential of each pathway and chemical [compare with **public health assessment**].

Health education
Programs designed with a community to help it know about health risks and how to reduce these risks.

Health investigation
The collection and evaluation of information about the health of community residents. This information is used to describe or count the occurrence of a disease, symptom, or clinical measure and to estimate the possible association between the occurrence and exposure to hazardous substances.

Health promotion
The process of enabling people to increase control over, and to improve, their health.

Health statistics review
The analysis of existing health information (i.e., from death certificates, birth defects registries, and cancer registries) to determine if there is excess disease in a specific population, geographic area, and time period. A health statistics review is a descriptive epidemiologic study.

Indeterminate public health hazard
The category used in ATSDR's public health assessment documents when a professional judgment about the level of health hazard cannot be made because information critical to such a decision is lacking.

Incidence
The number of new cases of disease in a defined population over a specific time period [contrast with **prevalence**].

Ingestion
The act of swallowing something through eating, drinking, or mouthing objects. A hazardous substance can enter the body this way [see **route of exposure**].

Inhalation
The act of breathing. A hazardous substance can enter the body this way [see **route of exposure**].

Intermediate duration exposure
Contact with a substance that occurs for more than 14 days and less than a year [compare with **acute exposure** and **chronic exposure**].

In vitro
In an artificial environment outside a living organism or body. For example, some toxicity testing is done on cell cultures or slices of tissue grown in the laboratory, rather than on a living animal [compare with **in vivo**].

In vivo
Within a living organism or body. For example, some toxicity testing is done on whole animals, such as rats or mice [compare with **in vitro**].

Lowest-observed-adverse-effect level (LOAEL)
The lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals.

Medical monitoring
A set of medical tests and physical exams specifically designed to evaluate whether an individual's exposure could negatively affect that person's health.

Metabolism
The conversion or breakdown of a substance from one form to another by a living organism.

Metabolite
Any product of **metabolism**.

mg/kg
Milligram per kilogram.

mg/cm^2
Milligram per square centimeter (of a surface).

mg/m^3
Milligram per cubic meter; a measure of the concentration of a chemical in a known volume (a cubic meter) of air, soil, or water.

Migration
Moving from one location to another.

Minimal risk level (MRL)
An ATSDR estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), noncancerous effects. MRLs are calculated for a route of exposure (inhalation or oral) over a specified time period (acute, intermediate, or chronic). MRLs should not be used as predictors of harmful (adverse) health effects [see **reference dose**].

Morbidity
State of being ill or diseased. Morbidity is the occurrence of a disease or condition that alters health and quality of life.

Mortality
Death. Usually the cause (a specific disease, condition, or injury) is stated.

Mutagen
A substance that causes **mutations** (genetic damage).

Mutation
A change (damage) to the DNA, genes, or chromosomes of living organisms.

National Priorities List for Uncontrolled Hazardous Waste Sites
(National Priorities List or **NPL)**
EPA's list of the most serious uncontrolled or abandoned hazardous waste sites in the United States. The NPL is updated on a regular basis.

No apparent public health hazard
A category used in ATSDR's public health assessments for sites where human exposure to contaminated media might be occurring, might have occurred in the past, or might occur in the future, but where the exposure is not expected to cause any harmful health effects.

No-observed-adverse-effect level (NOAEL)
The highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or animals.

No public health hazard
A category used in ATSDR's public health assessment documents for sites where people have never and will never come into contact with harmful amounts of site-related substances.

NPL [see **National Priorities List for Uncontrolled Hazardous Waste Sites]**

Physiologically based pharmacokinetic model (PBPK model)
A computer model that describes what happens to a chemical in the body. This model describes how the chemical gets into the body, where it goes in the body, how it is changed by the body, and how it leaves the body.

Pica
A craving to eat nonfood items, such as dirt, paint chips, and clay. Some children exhibit pica-related behavior.

Plume
A volume of a substance that moves from its source to places farther away from the source. Plumes can be described by the volume of air or water they occupy and the direction they move. For example, a plume can be a column of smoke from a chimney or a substance moving with groundwater.

Point of exposure
The place where someone can come into contact with a substance present in the environment [see **exposure pathway**].

Population
A group or number of people living within a specified area or sharing similar characteristics (such as occupation or age).

Potentially responsible party (PRP)
A company, government, or person legally responsible for cleaning up the pollution at a hazardous waste site under Superfund. There may be more than one PRP for a particular site.

ppb
Parts per billion.

ppm
Parts per million.

Prevalence
The number of existing disease cases in a defined population during a specific time period [contrast with **incidence**].

Prevalence survey
The measure of the current level of disease(s) or symptoms and exposures through a questionnaire that collects self-reported information from a defined population.

Prevention
Actions that reduce exposure or other risks, keep people from getting sick, or keep disease from getting worse.

Public comment period
An opportunity for the public to comment on agency findings or proposed activities contained in draft reports or documents. The public comment period is a limited time period during which comments will be accepted.

Public availability session
An informal, drop-by meeting at which community members can meet one-on-one with ATSDR staff members to discuss health and site-related concerns.

Public health action
A list of steps to protect public health.

Public health advisory
A statement made by ATSDR to EPA or a state regulatory agency that a release of hazardous substances poses an immediate threat to human health. The advisory includes recommended measures to reduce exposure and reduce the threat to human health.

Public health assessment (PHA)
An ATSDR document that examines hazardous substances, health outcomes, and community concerns at a hazardous waste site to determine whether people could be harmed from coming into contact with those substances. The PHA also lists actions that need to be taken to protect public health [compare with **health consultation**].

Public health hazard
A category used in ATSDR's public health assessments for sites that pose a public health hazard because of long-term exposures (greater than 1 year) to sufficiently high levels of hazardous substances or **radionuclides** that could result in harmful health effects.

Public health hazard categories
Public health hazard categories are statements about whether people could be harmed by conditions present at the site in the past, present, or future. One or more hazard categories might be appropriate for each site. The five public health hazard categories are **no public health hazard**, **no apparent public health hazard**, **indeterminate public health hazard**, **public health hazard**, and **urgent public health hazard**.

Public health statement
The first chapter of an ATSDR **toxicological profile**. The public health statement is a summary written in words that are easy to understand. The public health statement explains how people might be exposed to a specific substance and describes the known health effects of that substance.

Public meeting
A public forum with community members for communication about a site.

Radioisotope
An unstable or radioactive isotope (form) of an element that can change into another element by giving off radiation.

Radionuclide
Any radioactive isotope (form) of any element.

RCRA [see **Resource Conservation and Recovery Act (1976, 1984)**]

Receptor population
People who could come into contact with hazardous substances [see **exposure pathway**].

Reference dose (RfD)
An EPA estimate, with uncertainty or safety factors built in, of the daily lifetime dose of a substance that is unlikely to cause harm in humans.

Registry
A systematic collection of information on persons exposed to a specific substance or having specific diseases [see **exposure registry** and **disease registry**].

Remedial investigation
The CERCLA process of determining the type and extent of hazardous material contamination at a site.

Resource Conservation and Recovery Act (1976, 1984) (RCRA)
This Act regulates management and disposal of hazardous wastes currently generated, treated, stored, disposed of, or distributed.

RFA
RCRA Facility Assessment. An assessment required by RCRA to identify potential and actual releases of hazardous chemicals.

RfD
See **reference dose**.

Risk
The probability that something will cause injury or harm.

Risk reduction
Actions that can decrease the likelihood that individuals, groups, or communities will experience disease or other health conditions.

Risk communication
The exchange of information to increase understanding of health risks.

Route of exposure
The way people come into contact with a hazardous substance. Three routes of exposure are breathing [**inhalation**], eating or drinking [**ingestion**], or contact with the skin [**dermal contact**].

Safety factor [see **uncertainty factor]**

SARA [see **Superfund Amendments and Reauthorization Act**]

Sample
A portion or piece of a whole. A selected subset of a population or subset of whatever is being studied. For example, in a study of people the sample is a number of people chosen from a larger population [see **population**]. An environmental sample (for example, a small amount of soil or water) might be collected to measure contamination in the environment at a specific location.

Sample size
The number of units chosen from a population or environment.

Solvent
A liquid capable of dissolving or dispersing another substance (for example, acetone or mineral spirits).

Source of contamination
The place where a hazardous substance comes from, such as a landfill, waste pond, incinerator, storage tank, or drum. A source of contamination is the first part of an **exposure pathway**.

Special populations
People who might be more sensitive or susceptible to exposure to hazardous substances because of factors such as age, occupation, sex, or behaviors (for example, cigarette smoking). Children, pregnant women, and older people are often considered special populations.

Stakeholder
A person, group, or community who has an interest in activities at a hazardous waste site.

Statistics
A branch of mathematics that deals with collecting, reviewing, summarizing, and interpreting data or information. Statistics are used to determine whether differences between study groups are meaningful.

Substance
A chemical.

Substance-specific applied research
A program of research designed to fill important data needs for specific hazardous substances identified in ATSDR's **toxicological profiles**. Filling these data needs would allow more accurate assessment of human risks from specific substances contaminating the environment. This research might include human studies or laboratory experiments to determine health effects resulting from exposure to a given hazardous substance.

Superfund Amendments and Reauthorization Act (SARA)
In 1986, SARA amended CERCLA and expanded the health-related responsibilities of ATSDR. CERCLA and SARA direct ATSDR to look into the health effects from substance exposures at hazardous waste sites and to perform activities including health education, health studies, surveillance, health consultations, and toxicological profiles.

Surface water
Water on the surface of the earth, such as in lakes, rivers, streams, ponds, and springs [compare with **groundwater**].

Surveillance [see **epidemiologic surveillance**]

Survey
A systematic collection of information or data. A survey can be conducted to collect information from a group of people or from the environment. Surveys of a group of people can be conducted by telephone, by mail, or in person. Some surveys are done by interviewing a group of people [see **prevalence survey**].

Synergistic effect
A biologic response to multiple substances where one substance worsens the effect of another substance. The combined effect of the substances acting together is greater than the sum of the effects of the substances acting by themselves [see **additive effect** and **antagonistic effect**].

Teratogen
A substance that causes defects in development between conception and birth. A teratogen is a substance that causes a structural or functional birth defect.

Toxic agent
Chemical or physical (for example, radiation, heat, cold, microwaves) agents that, under certain circumstances of exposure, can cause harmful effects to living organisms.

Toxicological profile
An ATSDR document that examines, summarizes, and interprets information about a hazardous substance to determine harmful levels of exposure and associated health effects. A toxicological profile also identifies significant gaps in knowledge on the substance and describes areas where further research is needed.

Toxicology
The study of the harmful effects of substances on humans or animals.

Tumor
An abnormal mass of tissue that results from excessive cell division that is uncontrolled and progressive. Tumors perform no useful body function. Tumors can be either benign (not cancer) or malignant (cancer).

Uncertainty factor
Mathematical adjustments for reasons of safety when knowledge is incomplete. For example, factors used in the calculation of doses that are not harmful (adverse) to people. These factors are applied to the lowest-observed-adverse-effect-level (LOAEL) or the no-observed-adverse-effect-level (NOAEL) to derive a minimal risk level (MRL). Uncertainty factors are used to account for variations in people's sensitivity, for differences between animals and humans, and for differences between a LOAEL and a NOAEL. Scientists use uncertainty factors when they have some, but not all, the information from animal or human studies to decide whether an exposure will cause harm to people [also sometimes called a **safety factor**].

Urgent public health hazard
A category used in ATSDR's public health assessments for sites where short-term exposures (less than 1 year) to hazardous substances or conditions could result in harmful health effects that require rapid intervention.

Volatile organic compounds (VOCs)
Organic compounds that evaporate readily into the air. VOCs include substances such as benzene, toluene, methylene chloride, and methyl chloroform.

Other Glossaries and Dictionaries

Environmental Protection Agency http://www.epa.gov/OCEPAterms/

National Center for Environmental Health (CDC)
http://www.cdc.gov/nceh/dls/report/glossary.htm

National Library of Medicine (NIH) http://www.nlm.nih.gov/medlineplus/dictionaries.html