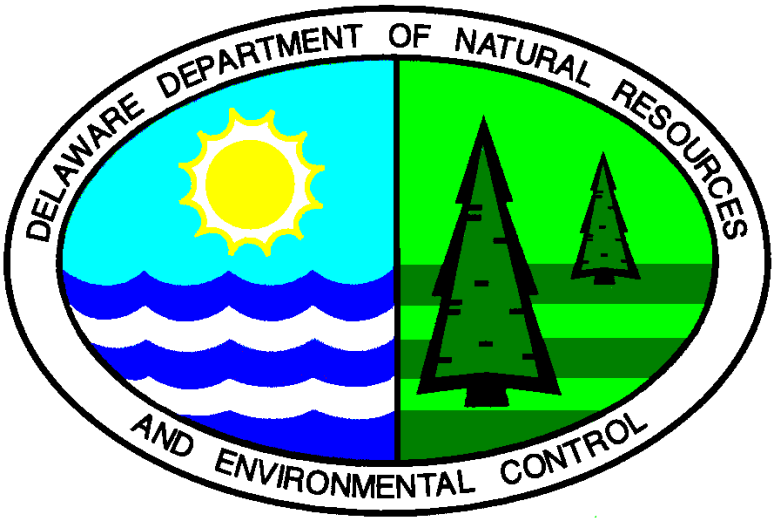
# DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL
# DIVISION OF AIR AND WASTE MANAGEMENT
# SITE INVESTIGATION & RESTORATION BRANCH




Response to Comments on the
June 2005 Draft Arsenic Risk Management Proposal

**February 2007**

# ACKNOWLEDGEMENTS

The Department of Natural Resources and Environmental Control (DNREC) would like to acknowledge the following people for their dedicated and tireless efforts in developing the *June 2005 Arsenic Risk Management Plan Draft Background Document (Arsenic RMP)* and DNREC's *Response to Comments on the Arsenic RMP:*

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# APPROVAL

This **Response to Comments on the June 2005 Draft Arsenic Risk Management Proposal** has been reviewed and approved by the Division of Air and Waste Management, Department of Natural Resources and Environmental Control.

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James D. Werner, Director
Division of Air and Waste Management

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## ATTACHMENTS

# 1.0 INTRODUCTION

## 1.1 Background

On June 22, 2005, the Department of Natural Resources and Environmental Control (DNREC) released the *Arsenic Risk Management Proposal Draft Background Document (Arsenic RMP)* for public notice and comment. The *Arsenic RMP* also included a plan for requesting and incorporating public input before adopting a final default background standard for arsenic at residential properties. As part of the outreach plan, DNREC held public forums on the draft *Arsenic RMP* in Kent, New Castle, and Sussex counties on September 8, 14 and 22, 2005, respectively. DNREC also participated in many public meetings throughout Delaware. The formal public comment period for the draft *Arsenic RMP* was from June 22 through December 31, 2005. This document, DNREC's *Response to Comments on the June 2005 Draft Arsenic RMP (Response to Comments)* provides a response to each comment received during the comment period. A listing of the comments by date is presented in Attachment A.

DNREC issued the *Arsenic RMP* to address Governor Ruth Ann Minner's June 9, 2005 directive to DNREC Secretary John A. Hughes to "review…and propose appropriate standards and policies" for arsenic in soil, focusing on ensuring the health and safety of Delawareans, and solicit public input on the draft arsenic standard prior to final adoption. DNREC's Division of Air and Waste Management prepared the *Arsenic RMP,* in collaboration with DNREC's Division of Water Resources (DWR), the Department of Health and Social Services - Division of Public Health (DHSS-DPH), the Delaware Department of Agriculture (DDA) and the Department of Justice (DOJ). Governor Minner's directive, the proposal and other related documents can be found at the Division's arsenic website,[1] as well as selected DNREC Offices (see Section 1.2 - Purpose).

The *Arsenic RMP* provided a brief review and analysis of scientific issues and supporting information currently available. The *Arsenic RMP* also described the basis for setting cleanup goals and considers several policy options and alternative standards, summarizing the implications for each option. In the *Arsenic RMP,* DNREC recommended the continuation of the risk-based approach for residential cleanup goals. The risk-based approach is required by the HSCA law and the regulations. Using this approach, the cleanup level for arsenic is determined on either a site-specific basis, or set at the naturally-occurring local background level. If a local background level cannot be developed, a default background concentration of 11 parts per million (ppm) is proposed as the cleanup goal. Any reference to "arsenic" throughout this document, unless otherwise specified, is to inorganic arsenic (As, CAS # 7440-38-2).

The default background concentration proposed by the Draft Arsenic RMP (11 ppm) was adopted by DNREC in June 2005, immediately upon release. DNREC subsequently evaluated pending studies and other emerging data to evaluate whether any empirical facts were inconsistent with the information available in June 2005.

[1] The link for the website is: http://www.dnrec.state.de.us/dnrec2000/Divisions/AWM/SIRB/Arsenic/

## 1.2 Purpose

This document, DNREC's *Response to Comments,* presents the public comments that were received during the comment period and the DNREC response to each comment. The Division of Air and Waste Management(DAWM) compiled the comments and responses for DNREC . The DNREC-DWR, the DHSS-DPH and the DDA provided responses on issues that involved their special expertise and responsibility. Public workshops and meetings, and the *Response to Comments* document are all part of a comprehensive community outreach and public involvement program on soil standards for arsenic. The program was designed to provide the public with a convenient opportunity to obtain additional information on arsenic, raise concerns and provide comments to DNREC. DNREC used the comments to develop the *Arsenic Risk Management Plan*.

In addition to this document, the public can review the comments and comment letters, arsenic studies and other related information at the Division's arsenic website: http://www.dnrec.state.de.us/dnrec2000/Divisions/AWM/SIRB/Arsenic. The public can also view the *Response to Comments* document including the comment letters, in hard copy at any of the following three offices:

DNREC
R & R Building - DAWM
89 Kings Highway
Dover, DE 19901
Division of Air and Waste Management
Contact: Tracy Sargent (302.739.9400)

DNREC - New Castle Office
391 Lukens Drive
New Castle, DE 19720
Front Lobby
Contact: Receptionist (302.395.2600)

DNREC – Grantham Lane Office
715 Grantham Lane
New Castle, DE 19720
Front Lobby
Contact: Receptionist (302.323.4542)

These facilities are open from 8:30 a.m. to 4:30 p.m., Monday through Friday, excluding federal and state holidays.

## 1.3 Public Outreach

The *Arsenic RMP* formed the basis for dialogue between DNREC staff and the interested public. The workshops, one in each of Delaware's three counties, were used as public forums to obtain input and comments on the proposal. The comments and questions received at each public

workshop are organized by date and presented in Attachment A. DNREC also received written comments from the following organizations (also included in Attachment A):

- Center for Hazardous Substances in Urban Environments-Technical Outreach Services for Communities (TOSC) on August 15, 2005;
- Milltown-Limestone Civic Alliance on September 14, 2005;
- Council of Civic Organizations of Brandywine Hundred on September 22, 2005;
- DuPont Engineering on October 10, 2005;
- Chemical Industry Council of Delaware on October 17, 2005; and
- Brightfields, Inc. on December 5, 2005.

In addition, DNREC presented the *Arsenic RMP* at meetings held by the Milltown-Limestone Civic Alliance on June 22, 2005; the Cancer Consortium on September 19, 2005; the Southbridge Civic Association on September 20, 2005; the Community Involvement Advisory Council (CIAC) on October 11, 2005; and the Delaware League of Local Governments on November 17, 2005. DNREC closed the public comment period for the draft *Arsenic RMP* on December 31, 2005. In January 2006, DNREC presented the *Arsenic RMP* at a hearing of the Senate Natural Resource Committee.

Many of the comments received raised policy issues, including the process for setting and changing cleanup standards for specific contaminants such as arsenic, implementation of the cleanup goals, and public notice of DNREC's decisions regarding cleanup standards prior to finalization. In addition, several comments raised concerns regarding human health effects of arsenic levels in soils, especially to children who may live and play in areas possibly impacted by arsenic concentrations in soils.

DNREC greatly appreciates the extensive and significant effort made by each participant in working toward setting appropriate soil cleanup goals for arsenic in Delaware. DNREC reviewed and considered all comments and input, and used the comments to draft the *Policy concerning the default background concentration of arsenic and revision to the* ***Remediation Standards Guidance*** *(the Policy).* The *Policy* and *Response to Comments* documents are available on DNREC's arsenic website,[2] and at the three DNREC offices listed above (see Section 1.2 – Purpose). The *Policy* will be published in the *Delaware Register of Regulations*, the *News Journal*, and the *Delaware State News*.

[2] The link for the website is: http://www.dnrec.state.de.us/dnrec2000/Divisions/AWM/SIRB/Arsenic/

# 2.0 COMMENTS

The *Response to Comments* document presents the comments in their entirety by date received (see Attachment A). However, for clarity and ease in reviewing the responses, the document groups the comments into seven subjects:

- Section 2.1 – Comments on Geology, Naturally-Occurring Arsenic and Background Arsenic Studies
- Section 2.2 – Comments on Golf Courses – Human Health Concerns
- Section 2.3 – Comments on Arsenic Exposure – Human Health and Ecological Risk
- Section 2.4 – Comments on Arsenic Cleanup Standards
- Section 2.5 – Comments on Arsenic Exposure Reduction and Remedies
- Section 2.6 – Comments on Policy/Regulations/Guidance Levels
- Section 2.8 – Miscellaneous Comments

In each issue section, the respective comments are identified by a unique comment excerpt number. The excerpt number assigned to each comment is listed by the date and order that it was received. For example, the excerpt number for comment number six received on September 8, 2005 is designated as "**Comment 9/8/05 #6**." Each comment is followed by the Division's response.

Only comments that included questions or requests for more information or data were addressed. Statements of opinion were not addressed, but are included in Attachment A for informational purposes.

## 2.1 Comments on Geology, Naturally-Occurring Arsenic and Background Arsenic Studies

### 2.1.1 Comment 9/8/05 #3:

When you look at the U.S. Geological Survey [USGS] report,[3] which indicates that the average arsenic concentration is 8.5 parts per million (ppm) for residential properties, why would you select a higher default background cleanup standard of 11 ppm instead of 8.5 or 10 ppm?
**Response 9/8/05 #3:** The USGS report was one of several sources of information used by DNREC. Although the USGS report indicated a national average of 7.2 ppm for background arsenic concentrations in U.S. soils, the range included concentrations that were significantly higher, with 97 ppm at the high end of the range. Therefore, DNREC determined that geographically local data from in or near Delaware was more appropriate to use as a basis for setting a default background standard.

DNREC performed a study (referred to as the "PA/SI Study") in the early 1990s that indicated a range of 1-48 ppm for arsenic background concentrations in the state. Although the results of this study were generally consistent with the USGS report, the methodology caused some uncertainty about the interpretation of the results.

[3] Shacklette, Hansford T. and J. Boerngen. 1984. *Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States*, U.S. Geological Survey Professional Paper 1270.

Consequently DNREC performed a new study in 2001, the "Wilmington Parks Study." For this study, DNREC collected eighteen (18) surface soil samples from six park locations within the City of Wilmington in 2001. DNREC chose these locations because they did not have a history of industrial activity and were indicative of background conditions in the Wilmington area.[4] The resulting soil concentrations ranged from 0.6 to 19 ppm. The mean concentration for the Wilmington study was 9.83. The 95 percent Upper Confidence Limit (UCL) of the mean of this data set was 11.[5] DNREC set the default background standard at 11 ppm for arsenic. Approximately 5% of sites that are NOT contaminated are expected have arsenic concentration averages greater than 11 ppm.

All of the results of both studies are found in Attachment B. The DNREC arsenic web page presents a detailed statistical analysis of the data from the two DNREC studies performed by Richard Greene of the DNREC Division of Water Resources.

In conclusion, DNREC performed two formal background studies and evaluated the results of other arsenic studies. The results are broadly consistent with the USGS study. DNREC evaluated the results of the Wilmington Parks Study statistically to determine that 11 ppm is a reasonable estimate of average total arsenic concentrations in uncontaminated soils throughout the state. It was therefore adopted as the default background standard.

Additional studies of arsenic and other naturally occurring inorganic substances are planned and the results will be considered for future policy recommendations.

**2.1.2 Comment 9/14/05 #54:**
All of the background studies should be made available to the public.
**Response 9/14/05 #54:** DNREC is in full agreement with this comment and has provided the background studies on the DNREC arsenic website,[6] as well as in hard copy at the three DNREC offices listed above (Section 1.2 – Purpose). In addition, summary data tables on arsenic from a statistical analysis on the background soil studies have been included in Attachment B.

**2.1.3 Comments 9/14/05 #1, #12, #13; and 9/20/05 #1:**
What is the difference between naturally-occurring arsenic and background arsenic concentrations? (9/14/05, #1) Is background and naturally-occurring arsenic the same in this [background] study? (9/14/05, #12) What is actual naturally-occurring arsenic [in relation to background] with all the historic uses within the state? (9/14/05, #13) What does naturally-occurring arsenic mean? (9/20/05, #1)
**Response 9/14/05 #1, #12, #13; and 9/20/05 # 1:** Naturally-occurring arsenic is arsenic that is present in rocks and soils due to the native mineral content. DNREC uses "background arsenic" to mean the same as "naturally-occurring arsenic." The naturally-occurring or background level is an objective fact, although it is difficult to determine exactly what it is because it varies from place to place. Sometimes DNREC refers to the "default background standard," a regulatory

[4] The Wilmington background study can be found on DNREC's Arsenic website at the following link: http://www.dnrec.state.de.us/dnrec2000/Divisions/AWM/SIRB/Arsenic/pdf/background%20soil.pdf
[5] See Section 4.0 Glossary for a description of "95% UCL."
[6] The state background studies can be found on DNREC's Arsenic website at the following link: http://www.dnrec.state.de.us/dnrec2000/Divisions/AWM/SIRB/Arsenic/

definition that may be used to determine whether a site is contaminated with arsenic through human activities. The term "default background standard" was introduced in the *Remediation Standards Guidance* and is more fully discussed in the Glossary (Section 4.0) of this document. The default background standard is only used in situations where a site-specific background determination is not made.

**2.1.4 Comment 9/8/05 #7:**
What would the residential average for arsenic look like on a national basis if the top ten feet of soil were evaluated? If the first one foot of soil was evaluated?
**Response 9/8/05 #7:** DNREC is not aware of a study with these details. However, residential carcinogenic and non-carcinogenic risk exposure is calculated using data collected from the first two feet of soil.

Also, arsenic does not generally migrate from surface contamination to deeper levels except at extremely high concentrations with acid solvents. Surface contamination may be expected to remain at the surface.

**2.1.5 Comments 9/14/05 #17 and #22:**
Will DNREC, in its review of the arsenic standard, only raise the background level or will it lower the value also? (9/14/05, #17) Do the numbers support the position the DNREC is taking? (9/14/05, #22)
**Response 9/14/05 #17 and # 22:** This and any future change to the default background standard will be consistent with the Hazardous Substance Cleanup Act (HSCA) and the Delaware Regulations Governing Hazardous Substance Cleanup.[7] If review of new data suggests a lower level would be more appropriate for a default background standard in the state, then a lower default background level will be proposed. DNREC will solicit public comment on any new proposed default background standard.

DNREC believes that the proposed default background level of 11 ppm is scientifically defensible and has provided all of the background data and information explaining how it was derived.

**2.1.6 Comment 9/14/05 #23:**
If DNREC has had difficulty setting an arsenic [default background] level, how can the Department deal with other chemicals that are more toxic?
**Response 9/14/05 #23:** DNREC has not, in fact, had any technical difficulty in setting the arsenic default background standards and expects similar methods to prove useful for other naturally occurring substances.

**2.1.7 Comments 9/8/05 #2; 9/14/05 #26; and 9/22/05 #4 and #5:**
Where are the locations for the statewide arsenic soil samples collected in the various studies? (9/8/05, #2) Why is DNREC using the highest level for the entire state and not breaking it into more site-specific areas like the counties? (9/14/05, #26) Is there a difference in levels in different areas of the state? Please show a map of the state and the arsenic levels, or send a map

[7] Delaware Regulations Governing Hazardous Substance Cleanup - *Section 9: Cleanup Levels*

with state levels. (9/22/05, #4) Do you see a significant difference between coastal plain deposits and up north [Piedmont] arsenic concentrations? (9/22/05, #5)
**Response 9/8/05 #2; 9/14/05 #26; and 9/22/05 #4 and #5:** The soil samples were collected at discrete points located throughout New Castle, Kent, and Sussex Counties. Maps showing the locations for the soils samples are included in Attachment C.

The State of Delaware encompasses two physiographic provinces, the Piedmont and Atlantic Coastal Plain, which do not correlate to the tri-county boundaries. The soil sample results for arsenic indicate significant variability across the state and within the Coastal Plain and Piedmont Provinces. The development of site-specific (or localized) background levels is recommended for remedial purposes, due to the natural variability of inorganic compounds or metals within the igneous and metamorphic rocks of the Piedmont and sedimentary formations of the Coastal Plain. However, in the event that a site-specific level cannot be determined, a default background standard is needed.

### 2.1.8 Comments 9/8/05 #1; and 9/14/05 #15 and #48:

What is a borrow pit? (9/8/05, #1) In regards to the borrow pit samples cited in the document, were any surface soils mixed with the deeper soils? (9/14/05, #15) If glauconite or glauconitic sands were found at the Route 202 borrow pit, then this location should not be used in determining the average for the state. This would bias the results high. (9/14/05, #48
**Response 9/8/05 #1; and 9/14/05 #15 and #48:** A borrow pit is defined by the EPA as an excavation site outside the limits of construction that provides soil and gravel material, such as fill material for embankments. Soil samples were collected from a borrow pit located in New Castle County near Concord Pike, as referenced in the *Arsenic RMP*. The samples were collected from approximately 30-50 feet below ground, and were not mixed with surface soils. In addition, the samples from this location were not used in determining the average for the state. The samples were used for comparison purposes showing the range of arsenic concentrations present in undisturbed natural soils at depths of 30-50 feet below surface grade. The arsenic results for the borrow pit samples showed a range of concentrations from 3 to 18 ppm. The arsenic results for the borrow pit were not included in the two DNREC studies mentioned above.

### 2.1.9 Comment 9/22/05 #2:

If a quarry or borrow pit only had [a concentration of] 14 ppm, why would you use 23 ppm as a background concentration?
**Response 9/22/05 #2:** DNREC has never used or suggested a default background concentration of 23 ppm for arsenic. Twenty-three ppm was offered as a risk-based cleanup standard for residential properties, not a default background concentration. The 23 ppm level corresponds to a Hazard Index of 1.0 for noncarcinogenic effects in children when arsenic is the only contaminant. The 23 ppm was based on an interpretation of the HSCA Regulations.[8] It has not been used in practice and would have only applied in the unusual circumstance of arsenic being the only contaminant present at the site. DNREC has since revised its interpretation of the relevant regulation so that the cleanup goal will be the background concentration (default or site-

[8] The ambiguous wording is found in Subsection 9.4 (2) (b): "When the natural background level is less than the 10E-05 cancer risk level or a level corresponding to a hazard index value of one, for direct exposure or inadvertent ingestion, then the 10E-05 cancer risk level or a level corresponding to a hazard index value equal to one becomes the cleanup level."

specific) if either of the two risk-based concentrations are higher than the background concentration.

## 2.2 Comments on Golf Courses – Human Health Concerns

### 2.2.1 Comment 9/8/05 #27:

Any health affects associated with golf courses?

**Response 9/8/05 #27:** The US EPA has developed default exposure parameters for evaluating the human health risks that a site presents in a recreational exposure scenario. The methodology is not specific to golf courses and DNREC has not had the occasion to use it for the evaluation of a golf course. In general, residential use presents greater risk than recreational use because it involves more frequent contact with soil over a longer time period. DNREC cautions that this is general information only and cannot be applied to any specific golf course, because conditions such as pesticide/herbicide use can vary widely from site to site.

### 2.2.2 Comment 9/8/05 #20:

There is an educational component that needs to be done for even playing on golf courses because of possible urological problems. Should this be addressed by the Division of Public Health?

**Response 9/8/05 #20**: The Delaware Division of Public Health (DPH) plays a vital role in protecting human health and the environment, including education. In the case of pesticide safety, the Delaware Department of Agriculture (DDA) also plays a role to ensure products are applied safely and pose no significant risk after application. State agencies, including DNREC, DPH, and DDA collaborate regularly to evaluate hazards and risks, including active collaboration on the *Arsenic RMP*. Certainly, the DPH has conducted educational programs on environmental risks when demonstrated risks and health concerns are present.

For example, DPH conducted educational programs regarding radon gas risks, thanks to a one-time funding from the Governor's Cancer Consortium and the grant clarified long-established identification of radon risks through technical research. DNREC and DPH also collaborated on public education for the recent Delaware Air Toxics Assessment Study (DATAS), thanks to a one-time grant funding from the EPA and the Cancer Consortium. Finally, DPH has provided vital support for public meetings, workshops, and other outreach efforts. Public testimony was given personally by the director of DPH at a recent DNREC public hearing on air pollution control.

With regard to an educational program directed to golfers and possible link to health impacts such as urological problems, we have consulted with DPH and do not have evidence of exposure to arsenic via pathways that would warrant a public health concern. Arsenic has been linked to increased risk of several types of cancer, including bladder and prostate. However, these risks are associated with ingestion (eating dirt) at high concentrations over a long period of time. The potential exposure to arsenic on properties where arsenic-based pesticides have been appropriately applied is not expected to reach levels of concern, even for golfers with some direct soil contact. Based on information available at this time, it is difficult to identify a target population and informational focus for an outreach effort. If future information identifies a particular at-risk population, DPH will be open to reevaluate the situation and conduct appropriate public education and outreach campaigns.

**2.2.3 Comments 9/8/05 #6, #18, #19 and #22:**
We would like to see a wider testing of agricultural fields in Delaware. (9/8/05, #6) We are extremely concerned about residential levels of arsenic for kids moving into new developments at former golf courses and agricultural property. (9/8/05, #18) We need a high standard [more conservative] for arsenic [at residential properties]. (9/8/05, #19) Should golf courses be used for residential purposes? (9/8/05, #22)
**Response 9/8/05 #6, #18, #19 and #22:** Whether a golf course or former agricultural land is used for residential properties is a local land use decision. The proper application of fertilizers and pesticides/herbicides at agricultural fields, farms and golf courses is strictly regulated by the Department of Agriculture. DNREC does not have regulatory or statutory authority over sites where fertilizers and pesticides have been properly applied. DNREC's cleanup regulations under the Hazardous Substance Cleanup Act (HSCA) **only** apply to agricultural property and golf courses when there has been a release of a hazardous substance. The language of HSCA excludes appropriate application of pesticides and fertilizers from the definition of "release". Unless a documented hazardous substance release, as defined under HSCA (7 Del. C. Chapter 91, Section 2.1), has occurred at a former golf course or agricultural property, DNREC would not have the authority to require an investigation or site cleanup at the property.

DNREC shares the view that the public should be protected from unsafe levels of arsenic in soil above background concentrations, whatever the source. Any change to HSCA to establish authority over contamination resulting from appropriate application of pesticide or fertilizers would require a change to the statutory definition of "release".

**2.2.4 Comments 9/8/05 #23, #24; 9/14/05 #41, #42; and 9/22/05 #12:**
At what level or point in time do golf courses fall under DNREC or the Delaware Department of Agriculture? (9/8/05, #23) Do we need authority to cover golf courses? (9/8/05, #24) Should DNREC have jurisdiction over golf courses and other commercial properties (i.e., orchards) in the state? (9/14/05, #41) In addition, shouldn't DNREC have regulations for all compounds [used at golf courses], not just guidelines? (9/14/05, #42) Should golf courses and farms be regulated? (9/22/05, #12)

**Response 9/8/05 #23, #24; 9/14/05 #41, #42; and 9/22/05 #12:** DNREC is required to operate under our legally mandated authority, the *Delaware Hazardous Substance Cleanup Act* (HSCA) (See 7 Del.C.9101). The release of hazardous substances, **explicitly** excludes "[t]he appropriate application of fertilization and pesticides" (see 9103(17)c.). Most chemical compounds used on agricultural property and golf courses are regulated by the Department of Agriculture, which requires that pesticides, herbicides and fertilizers are properly applied to the land. However, if a release, as defined by HSCA (7 Del. C. Chapter 91, Section 2.1[9]), has occurred at the golf course, then the site is regulated by HSCA. HSCA regulations require risk-based cleanup goals. Golf courses must meet the same cleanup standards as other sites in the program if there is a hazardous substance release. However, if the arsenic levels are the result of appropriately applied pesticides or fertilizer, then the properties are exempt from HSCA.

[9] The HSCA statute can be found at: http://www.delcode.state.de.us/title7/c091/index.htm#P-1_0

**2.2.5 Comments 9/8/05 #25, #26; and 9/14/05 #52:**
Who regulates pesticide certification? (9/8/05, #25) Who regulates pesticide applications at DelDOT properties? (9/8/05, #26) Should protective action be taken to eliminate and penalize use of all pesticide/fertilizers that contain arsenic or other heavy metals in the State of DE in light of its high cancer rate? Not unlike the "No Smoking" ban for the State of DE? (9/14/05, #52)
**Response 9/8/05 #25, #26; and 9/14/05 #52:** The Department of Agriculture regulates pesticide application certification. When pesticides are applied to a site, including by DelDOT employees, they are regulated by the Department of Agriculture. The Department of Agriculture has jurisdiction of the site during the proper application of pesticides/herbicides on the property.

The question of "banning" pesticides and fertilizers that contain arsenic is largely a federal, not state, issue. Petitions to restrict entire classes or uses of chemicals can be submitted to the US EPA pursuant to the Toxic Substance Control Act (TSCA). EPA action my also be pursued under Federal Insecticide, Fungicide and Rodenticide Act. DNREC is not aware of any specific links between cancer rates and arsenic exposure in Delaware. If scientific evidence of such a link can be provided, then DNREC would likely join such a TSCA petition.

**2.2.6 Comments 9/8/05 #21; and 9/14/05 #43 and #45:**
During a planning board meeting in New Castle County, it was noted that there were high levels of arsenic and other contaminants at the former Hercules golf course. What are the standards for golf courses? (9/8/05, #21) Why were there no core or deep samples collected from the Hercules property, only surface samples? (9/14/05, #43) What is the level of arsenic at the Hercules golf course? (9/14/05, #45)
**Response 9/8/05 #21; and 9/14/05 #43 and #45:** There are no separate standards for golf courses. Golf courses must meet the same regulatory requirements and cleanup standards under HSCA as other sites when there has been a hazardous substance release (7 Del. C. Chapter 91, Section 2.1).

As part of an environmental assessment of the former Hercules Country Club property (aka Delaware National Country Club) for Toll Brothers, Brightfields, Inc. completed several investigations. From all the information that is available to DNREC, the hazardous substances at the Site were the result of appropriate applications of pesticides and fertilizers on the golf course. In accordance with State laws and regulations, the application of fertilizers and pesticides fall under the jurisdiction of the Delaware Department of Agriculture (DDA). DNREC submitted the site pesticide and fertilizer logbook records to DDA for review. The DDA has indicated that the logbook records did not indicate any inappropriate application of pesticides or fertilizers, and the contaminants present are consistent with the application of pesticides and fertilizers. Since DNREC, as of this date, has no information that indicates the pesticides and fertilizers were improperly applied, the Department, under HSCA, has no authority over the residual contamination at the Site.

According to the Remedial Investigation/Feasibility Study (RI/FS) completed at the site in October 2004, soil sample results indicated a maximum of 1,100 ppm of arsenic at the 0.0 – 0.5 foot depth. Arsenic concentrations in sediments were identified at a maximum of 8.41 ppm, while arsenic was not detected in the groundwater samples. Surface water sampling results were not reported.

"Core or deep" soil samples were not collected based on the results of the previous environmental investigation in which arsenic concentrations decreased rapidly with increased depth. The follow-up investigations were focused on vertical extent of elevated arsenic concentrations, at depths between 0 to 5.0 feet below grade.

### 2.2.7 Comment 9/14/05 #44:

There is a current drinking water well at Hercules, how does that relate to the 11 ppm [soil] standard?

**Response 9/14/05 #44:** The Hercules Facility (Hercules Incorporated Research Center and Hercules Country Club) has 13 wells that are used to provide drinking water to the combined system. The system is classified as transient and non-transient. All of the wells withdraw water from the fractured rock aquifers of the Wilmington Complex and Wissahickon Formation. The source water assessment completed on June 17, 2004 did not show arsenic exceeding the federal maximum contaminant level (MCL) in any of the 13 wells. Note that the 11 ppm is the proposed default background standard for soil, while the federal drinking water standard for arsenic, as of January 23, 2006, is 10 parts per billion (ppb).

### 2.2.8 Comment 9/14/05 #46:

Is Toll Brothers applying for state/federal funds to develop the former Hercules golf course?

**Response 9/14/05 #46:** No state funding has been requested through DNREC to date and none is expected. DNREC has no information regarding whether or not Toll Brothers has requested federal funding to clean up the former Hercules golf course.

## 2.3 Comments on Arsenic Exposure–Human Health and Ecological Risk

### 2.3.1 Comment 9/8/05 #10:

Which exposure pathways were considered?

**Response 9/8/05 #10:** DNREC qualitatively considered all potential pathways: inhalation, oral ingestion and dermal exposure. Based on the scientific information on arsenic's physical, chemical, physiological and toxicological effects, the inhalation and dermal exposure pathways were excluded as less significant in a non-occupational setting than oral ingestion (i.e., eating soil). Instead, DNREC-SIRB focused on the exposure pathway of ingestion of soil for detailed analysis, as it is the primary pathway for potential exposure at impacted sites.

As stated in the *Arsenic RMP,* page 3, "to ensure a manageable scope…it [the proposal] does not consider other potential exposures to arsenic in food, drinking water or occupational settings such as mining, metal smelting, etc." Note that other exposure pathways are mentioned in the *Arsenic RMP* and the *Response to Comments* document, where needed to quantify and respond as accurately as possible to the nature of the various concerns, questions, comments, and guidance received.

### 2.3.2 Comments 9/8/05 #11, #12, and #29:

Were risk assessment calculations done for the dermal and inhalation exposure pathways? Were they summed (i.e., was cumulative risk considered)? Please provide all the data and

the calculations for all risk assessments performed (oral, dermal, inhalation and cumulative).

**Response 9/8/05 #11, #12, #29**: No, based on a qualitative evaluation of these exposure routes, there was no basis for quantitatively evaluating other exposure routes (inhalation and dermal exposure) because there was no exposure scenario or mechanism for significant exposure, particularly when compared to oral ingestion. However, as requested, the risk assessment calculations were completed for oral, dermal, inhalation, and cumulative exposure pathways, and are included in Attachment D for comparison.

### 2.3.3 Comment 9/8/05 #31:

Are inhalation risks really not significant?

**Response 9/8/05 #31:** Significance, or the likelihood or ability to have influence or effect, is dependant on the exposure scenario. Inhalation of small amounts of arsenic in the air one breathes is considered common depending on where one resides (1-3 nanograms per cubic meter ($ng/m^3$) in remote/rural locations and 20-100 $ng/m^3$ in urban areas).[10] In the context of this evaluation, which is focused on establishing a soil standard, inhalation is clearly not a significant pathway compared to ingestion. Further, there is no evidence that arsenic mobilizes in any consistent manner that would lead to a chronic exposure to airborne respirable arsenic particles.[11] See also the risk calculations in Attachment D to compare the inhalation risk to the ingestion risk.

However, breathing **high concentrations** of inorganic arsenic likely causes one to experience sore throats and/or irritated lungs. The ability of inorganic arsenic to increase the risk of lung cancer is of concern and has been seen primarily in exposure scenarios such as workers exposed to arsenic at smelters, mines and chemical factories, and also in residents living near such smelters, arsenical chemical factories, and waste sites. These types of exposure scenarios have occurred in many of the mining states in the U.S., and in countries such as Bangladesh and India where arsenic is used in colored dyeing operations. Under these types of exposure scenarios, one could also develop a pattern of skin changes (corns or warts on the palms, soles, and torso – the corns could develop into skin cancer). It is uncertain the exact inhalation exposure level that produces these effects, however, it is most likely above 100 micrograms per cubic meter ($\mu g/m^{3)}$ for a brief exposure.

### 2.3.4 Comment 9/14/05 #19:

Why doesn't the report focus on any other pathways except ingestion (i.e., inhalation)?

**Response 9/14/05 #19:** As stated in the response to comments in Sections 2.3.1 and 2.3.3 above, the focus of the *Arsenic RMP* was to provide supporting information for establishing a default background standard for arsenic in soil and cleanup goals. Although environmental sources of arsenic exposure include food, water, soil, and air, the main route of arsenic exposure is via ingestion, primarily of arsenic-containing food. Intake from air, soil, and water is generally much smaller. The average dietary intake of arsenic by adults in the United States is estimated to be 11-14 mg/day. Therefore, the focus of the report was on the ingestion pathway. Ensuring a

[10] ATSDR. 2005. Arsenic Toxicological Profile (Update) http://www.atsdr.cdc.gov/toxprofiles/tp2.html

[11] DNREC evaluated the Washington and Idaho State Studies for the Asarco and Kellogg metal smelters. The presence of widespread Arsenic in soil was identified at concentrations higher than those found in Delaware. Despite those relatively high soil concentrations, the respirable airborne concentrations (i.e., mean particle size of less than 10 microns) were not found in significant concentrations compared to the potential exposure through oral ingestion.

manageable scope for this proposal did not allow for full consideration of other exposure pathways for arsenic.

**2.3.5 Comment 9/14/05 #6:**
Does DNREC believe that the additional cancer rate (moving the number from 4 ppm to 11 ppm) is acceptable to the people of Delaware?
**Response 9/14/05 #6:** DNREC has not substantiated any claims that there is an additional cancer rate to the people of Delaware "by moving the default background standard from 4.0 ppm to 11.0 ppm." The decision to change the default background standard for arsenic associated with the *Remediation Standards Guidance* from 0.4 mg/kg to 11 mg/kg is based upon measured background concentrations of arsenic from soil samples collected statewide.

The purpose of establishing a default background standard is to assist DNREC and others to determine whether a site has been contaminated. DNREC believes that basing the default background standard on a level that is both observed in natural background concentrations, as well as one that is consistent with actions taken by other U.S. Environmental Protection Agency (EPA) Region 3 states in the area, is acceptable when addressing health versus background standards.

The primary reason for establishing the arsenic default background concentration at 11 ppm is because it is dictated by the law and supported by the science. In addition, the use of a default background concentration that is higher than concentration associated with a theoretical risk level of 1/100,000 is because of the several degrees of conservatism built into the risk estimates, largely related to the assumptions about how much dirt is eaten on a daily basis by residents, as well as the chemical form of the arsenic. These exposure/risk assumptions used (derived from standard EPA modeling assumptions) include:

- 100 % of Arsenic is absorbed
- 100 % bioavailability
- 350 days/year for 30 years
- Body Weight
  - Adult – 70 Kg – 141 lbs
  - Child (1-6 years old) -15 Kg – 32 lbs
- Soil Ingestion
  - Adult -100 mg/day
  - Child -200 mg/day
  - Composite ~ 15 Tablespoons/year

It is unlikely any of these assumptions will occur for any individual, much less all of these assumptions simultaneously. Nonetheless, we believe it is prudent to retain these standard assumptions for consistency and to abide by our general policy of observing the precautionary principle. Because of the use of these conservative assumptions (some would and have argued "unrealistic"), we are confident that "moving the number from 4 ppm to 11 ppm" will not result in any increased risk, and have no meaningful impact on the actual cleanup performed in the field.

**2.3.6 Comment 9/14/05 #8:**
Why is DNREC setting the arsenic level above the health-based standard?
**Response 9/14/05 #8:** DNREC drafts guidance and policies on cleanup and background standards to conform with the requirements of the HSCA statute and regulations. DNREC is precluded from establishing quantitative cleanup goals lower than the natural background concentration and enforcing the liability provisions of HSCA where no release of a hazardous substance has occurred.

**2.3.7 Comment 9/14/05 #53:**
Shouldn't Health and Safety issues be addressed?
**Response 9/14/05 #53:** Yes. DNREC interprets this comment to pertain to the health and safety of workers and the public during site remediation. Health and safety issues, in addition to environmental protection, are major components of DNREC remediation decisions. Every field activity at HSCA sites is covered by a Health and Safety Plan (HASP) which must conform to the relevant regulations of the federal Office of Safety and Health Administration. The HASP includes specific information about the known contaminants on the site and means to protect the workers and the public from adverse effects. Health and safety measures typically include air monitoring, dust control, the appropriate use of personal protective equipment, storm water and erosion control, stabilized construction entrances, signage and security.

**2.3.8 Comment 9/14/05 #27; and 9/20/05 #2:**
How does arsenic effect the composition of the human body differently and why wasn't this analyzed in this study? (9/14/05, #27) What is a toxic concentration for arsenic? (9/20/05, #2)
**Response 9/14/05 #27; and 9/20/05 #2:** All trace minerals are toxic at high levels, and some metals (arsenic, nickel, and chromium) have been implicated as causes of cancer. The toxic dose for arsenic would depend on body weight and metabolic factors of the individual. The toxicity of arsenic is based on the form, not solely on the concentration.

Although "toxicity" is technically the slope of the "dose-effect/response" curve, the commenter may have been interested more generally in the Department's consideration of the potential for arsenic exposures to have a toxic effect on citizens. The Risk Management Plan focused directly on this issue as one of its primary issues by addressing the factors influencing whether individuals may receive a toxic dose. As indicated above, the toxic dose depends on many factors including body size, chemical/valence form, route of exposure, etc. The department chose to use very conservative assumption in all cases to ensure that the arsenic cleanups are adequately protective. Sections 1.1 and 2.2 of the June 2005 RMP addressed the issue of toxic dose.

**2.3.9 Comment 9/14/05 #38:**
Why historically has DNREC been increasing the allowable level of arsenic while the [Department of Health and Social Services (DHSS) –] Division of Public Health is lowering their value?
**Response 9/14/05 #38:** The premise of the question (DNREC setting levels different than DHSS/DPH) appears to be based on an inaccurate assumption about the role of DNREC and DPH is the standard setting process. Under the HSCA regulations, DNREC establishes risk-based site specific cleanup goals. Those goals may change from site to site depending on the

nature of the exposure and the number of contaminants. However, it cannot set those goals lower than the naturally occurring background concentration. The *Remediation Standards Guidance*, which includes the Uniform Risk-Based Standards (URS), is an attempt to establish reference values for both risk-based cleanup goals and default background standards.[12] The URSs are not mandatory and were never intended to be a collection of "allowable levels." DNREC is abiding by the HSCA law and regulations ensuring that cleanups are protective of human health and the environment, and determining default background levels to ensure that achievable cleanup goals are established.

Note that DNREC's soil cleanup goals for arsenic differ from state and federal drinking water standards for arsenic. The DHSS lowered the standard for arsenic in drinking water from 50 parts per billion (ppb) to 10 ppb on January 23, 2006.

**2.3.10 Comment 9/22/05 #11, Part A:**
When would a risk-based standard kick in?
**Response 9/22/05 #11, Part A:** Human health risk and ecological risk are always relevant in the evaluation of whether sites are considered contaminated and what cleanup goals should be selected. DNREC's *Remediation Standards Guidance* supports a variety of methods to evaluate the conditions at sites because of all of the variables involved. For example, are there multiple contaminants present? Is contamination spreading? Are other media (sediment, ground water or surface water) also contaminated? In any cleanup, the cumulative risk potential from various contaminants is considered by using risk-based standards.

The importance of default background standards and the URS values is that they provide a reference point for prioritizing sites and helping property owners understand whether DNREC might consider their sites to be contaminated.

**2.3.11 Comment 9/22/05 #11, Part B:**
Please explain arsenic speciation and assumptions in risk calculations.
**Response 9/22/05 #11, Part B:** It is known that arsenic demonstrates species-dependent toxicity. Arsenic speciation and/or form are very important in determining toxicity. The EPA classifies inorganic arsenic as a Group A carcinogen.[13] Generally, there are two types of arsenic, inorganic and organic, with inorganic forms of arsenic being the most toxic.

Further, there are primarily two forms of inorganic arsenic defined by their valence states: arsenites and arsenates. ("Valence state" refers to the combining behavior of the atoms in chemical reactions.) Arsenites in most cases are the more toxic form of inorganic arsenic.[14] The URS unrestricted risk-based concentration of 0.43 ppm is based upon having the most toxic arsenite form in the environment. Arsenites are generally three to ten times more toxic than arsenates. Arsenates are the inorganic form that is predominately found in the environment. Arsenates are less toxic and would have higher cleanup goals. Quantification of elemental

[12] The *Remediation Standards Guidance under the Delaware Hazardous Substance Cleanup Act* document can be found at: http://www.dnrec.state.de.us/dnrec2000/Divisions/AWM/sirb/DOCS/PDFS/Misc/RemStnd.pdf
[13] See EPA data on arsenic at the Technology Transfer website: http://www.epa.gov/ttn/atw/hlthef/arsenic.html
[14] See EPA data on the *Technical Summary of Information Available on the Bioaccumulation of Arsenic in Aquatic Organisms* at: http://www.epa.gov/waterscience/criteria/arsenic/tech-sum-bioacc.pdf

species in a sample, rather than determining total element levels alone, provides information that can be utilized in assessing toxicity, bioavailability and potential effects on the environment.

The assumptions used in risk calculations are very conservative. Risk calculations completed by DNREC for arsenic assume that the total arsenic detected in soil is 100% **inorganic** arsenic. Further assumptions include an individual ingesting 100 milligrams of soil per day and that 100% of the arsenic in the ingested soil is absorbed in the body. The ingestion risk assessment calculation also assumes that human exposure time is 350 days per year, and that 100% of the arsenic will metabolize into the body (i.e., 100% bioavailability).

In addition, the bioavailability factor of 100% absorption has been proven to be inaccurate. Arsenic bioavailability is approximately 10-25%, based on a Florida study that included feeding arsenic to monkeys.[15] Some states require bioavailability assessments for each site. This information would increase the carcinogenic risk concentration four to ten-fold (i.e., the concentration considered protective of human health would increase). Using an estimate of 25% for absorption, the 1 in 100,000 risk corresponds to about 16 to 17 ppm for arsenic.

**2.3.12 Comment 9/22/05 #6:**
Is there a health difference between 6 ppm, 11 ppm, and 23 ppm with respect to health?
**Response 9/22/05 #6:** The methods used in risk assessment are very conservative. The assumption of a human health risk due to arsenic in soil concentration of 6, 11 or 23 ppm is theoretical. Reference soil concentrations (the URS tables, for example) are based on much higher exposures in animal studies, occupational settings or very unusual situations where drinking water was highly contaminated. It is not certain that any health effects occur at the very low doses associated with these soil concentrations. Therefore, it would be impossible to measure the health difference between 6 ppm and 23 ppm. See also Section 2.3.11 above.

**2.3.13 Comment 9/8/05 #15:**
It appears, given risk assessment methodology, if we assume that 1 in 100,000 additional cases of cancer equals an acceptable risk level and assume how much is eaten is equal to 0.4 ppm, then don't we need to have a darn good reason for raising the cleanup standard above this level several times over?
**Response 9/8/05 #15:** In most cases it would not be technically feasible to achieve a cleanup standard of 0.4 ppm arsenic since replacement soil from a borrow source would be expected to have a greater arsenic concentration. That is why the HSCA Regulations prevent DNREC from setting cleanup goals below the naturally occurring background concentration.

**2.3.14 Comments 9/8/05 #13, #28; and 9/14/05 #35 and #36:**
Were environmental or ecological risks evaluated? (9/8/05, #13) Were ecological receptors looked at in this report when the 11 ppm standard was chosen? (9/14/05, #35) Any organic matter sampled for this study? (9/14/05, #36) What kind of ecological risk assessment was performed? Please provide the data for the ecological risk assessment. (9/8/05, #28)
**Response 9/8/05 #13, #28; and 9/14/05 #35 and #36:** Environmental or ecological risks are evaluated and calculated for each site undergoing cleanup if an ecologically sensitive area is

[15] Roberts, S.M., et al. 2002. Measurement of Arsenic Bioavailability in Soil Using a Primate Model. Toxicological Sciences, 67: 303-310.

within or adjacent to the site. However, it is important to remember that DNREC cannot set cleanup goals that are lower than naturally occurring background concentrations as it would be technically infeasible to meet them.

DNREC uses several different ways to evaluate potential ecological effects of contamination in soil, water and sediment.

Ecological receptors are modeled to determine ecological impacts by calculating a Hazard Index (HI). A HI that is calculated to be greater than one (1.0) could indicate an ecological risk is present. As an example, the snapping turtle was evaluated for exposure to arsenic in soil at a concentration of 11 ppm. The calculations are provided in Attachment E to illustrate the process. In the example, the resulting HI for the snapping turtle is less than one (<1.0). The HI calculation can be used as a screening tool. The species selected for evaluation depends on what is present at the site.

In sediment, No Observed Effect Levels (NOEL) can also be utilized to determine ecological risk. A NOEL is the concentration that an ecological receptor will not exhibit an adverse effect from the chemical exposure. NOELs can also be utilized to calculate an ecological HI. An ecological HI is the chemical exposure concentration divided by the NOEL. The State of Washington has published NOELs for many chemicals of concern.[16] The arsenic NOEL in soil is 57 ppm. The calculated HI would be less than one (<1.0) at an arsenic concentration of 11 ppm utilizing a NOEL of 57 ppm.

In addition, DNREC has published Uniform Risk-Based Standards (URS) for the protection of the environment for surface water, sediment, and surface soil. The concentrations for arsenic are 3 parts per billion (ppb), 8 ppm and 10 ppm, respectively. Generally, the URS is one-tenth of the value required to protect ecological receptors.

For site-specific environmentally sensitive areas of concern, ecological risk assessments should be based on collecting site-specific sediment (organic matter) and tissue samples (from fish and other ecological receptors) for analytical, bio-toxicity and bioavailability testing. Arsenic does not readily bio-accumulate in ecological receptors and is not considered an environmental concern at sediment/soil exposure concentrations of 11 ppm.

In conclusion, there are many ways to evaluate ecological risks. The most appropriate evaluation is to conduct a site-specific ecological risk assessment. For detailed ecological risk assessment procedures, please see the EPA link below for ecological assessment guidance.[17]

**2.3.15 Comment 9/8/05 #30:**
Any fish tissue data? If the threshold for an ecological risk assessment is 56 ppm, and human health is much lower, if we are protective for humans, are we protective for fish as well? Which fish species were used in the studies? Is it the Department's position that no fish were affected below 56 ppm? Please provide the EPA or other data used.

[16] The State of Washington website for the NOELs is at: http://www.ecy.wa.gov/programs/tcp/smu/sed_chem.htm
[17] EPA ecological assessment guidance can be found at: http://www.epa.gov/oswer/riskassessment/risk_superfund.htm

**Response 9/8/05 #30:** Richard Greene of DNREC coauthored a fish tissue study for arsenic in Delaware waters, in which arsenic was assessed with other possible contaminants.[18] The study concluded that arsenic was not an issue in the fish tissue, as the concentration of toxic inorganic arsenic in the fish was extremely low. The fish species used in the study were: summer flounder (*Paralicthys dentatus*), Atlantic croaker (*Micropogonias undulates*), striped bass (*Marone saxatilis*). In addition, the Delaware River Basin Commission (DRBC) and the EPA have completed additional fish studies that may be reviewed on their respective websites.[19] See also Section 2.3.14 regarding ecological risk.

## 2.4 Comments on Arsenic Cleanup Standards

### 2.4.1 Comments 9/8/05 #4, #5, #9; and 9/14/05 #2, #9, and #10:

How was the 11 ppm default background standard derived? (9/8/05 #4) Was the 11 ppm an arbitrary number? (9/8/05 #5) Cleanup standards should be developed using a risk-based approach. Was the 11 ppm default background standard developed using this same way? (9/8/05 #9) What is DNREC's justification for the 11 ppm? (9/14/05, #2) All of the data in the report points to a 10 ppm background level, why was 11 ppm chosen? (9/14/05, #9) Is the 11 ppm number a mean? (9/14/05, #10)

**Response 9/8/05 #4, #5, #9; and 9/14/05 #2, #9, and #10:** DNREC determined that the use of a default background level instead of the URS value of 0.4 was more appropriate because it acknowledged the problem of applying a cleanup standard that was below natural background arsenic levels.

The figure of 11 ppm is not an arbitrary number. DNREC derived the 11 ppm default background by calculating the 95 % of the Upper Confidence Limit (95% UCL) of the mean of 20 soil samples taken from uncontaminated locations.[20] Eleven is not the simple mean of the data. The use of a 95 % UCL takes into account high concentrations in individual samples but limits their influence.[21] DNREC restricted the background study to areas that had no evidence of anthropogenic influence. It is also generally consistent with a variety of background data collected in other studies for this region.

As for the difference between 10 ppm and 11 ppm, the limitations of chemical analysis must be recognized. For example, DNREC recently conducted 20 consecutive analyses (replicates) of the same homogenized soil sample. The arsenic results ranged from 5.7-12.9 ppm (see Table 1 included in Attachment B). These results indicate that when using the appropriate EPA methodology and instrumentation to analyze soil samples, precise results for arsenic cannot be achieved, especially at lower concentrations. Therefore, a significant amount of laboratory error occurs in the analysis at lower concentrations, which is generally plus or minus 5-10 ppm. A

[18] Greene, Richard and E. Crecelius. 2006. Total and Inorganic Arsenic in Mid-Atlantic Marine Fish and Shell Fish and Implication for Fish Advisories. SETAC–Integrated Environmental Assessment and Management. 2:344-354. http://entc.allenpress.com/pdfserv/10.1897%2F1551-3793(2006)2%5B344:TAIAIM%5D2.0.CO%3B2

[19] The DRBC and EPA websites are: www.state.nj.us/drbc and www.epa.gov/ost/fish , respectively.

[20] See Section 4.0 Glossary for discussion of the 95% UCL.

[21] Note that data points are not rejected in order to achieve the lowest possible number. However, data points may be excluded if there is evidence that the arsenic present in the sample is the result of anthropogenic influence. This would include areas that may have received waste fill that contained Arsenic, as well as locations that may have been affected by industrial activities.

given margin of error is already a known factor in conducting ecological and human health risk assessments, and is one of the reasons the calculations are based on the most conservative assumptions. Therefore, when analyzing soil samples for arsenic using the appropriate EPA methodology, laboratory results of 4 ppm, 6 ppm, 11 ppm and even 23 ppm can be considered representative of the same soil sample.

**2.4.2 Comment 9/14/05 #20:**
If a site has a background [concentration for arsenic that is] above 11 ppm, what do you clean it up to?
**Response 9/14/05 #20:** As detailed in the *Remediation Standards Guidance,* there are three options that can be used to develop remedial standards when conducting cleanups in Delaware: 1) Background Standard, 2) Uniform Risk-Based Standard (URS), and 3) Site-Specific Standard. The Background Standard approach consists of either applying a default background standard or developing a site-specific background standard. Environmental consultants using the Background Standard approach when conducting a cleanup for arsenic would have the option of using the proposed default background standard of 11 ppm as the cleanup goal, or developing a site-specific background level for arsenic, which may be higher than the proposed default background level. However, it should be noted that sites using a site-specific background standard may be required to restrict use through deed restrictions or other risk management measures to protect human health and the environment. These measures would be determined on a case-by-case basis. See also Section 2.3.10.

Also note that cleanup goals for each site are subject to public review and comment through the Proposed Plan/Final Plan process required by HSCA.

**2.4.3 Comment 9/14/05 #1 and #3:**
How is it possible that DNREC already has a number that they wanted to use [11 ppm] prior to completing the study? Where is the data that supports the conclusions of the document/report? (9/14/05, #3)
**Response 9/14/05 #1 and #3:** (See Response to Comment 2.1.1 above.) DNREC determined the original arsenic background level by evaluating forty (40) surface background soil samples from Preliminary Assessment and Site Investigation (PA/SI) sites performed under an agreement between DNREC and the United States Environmental Protection Agency (EPA). DNREC collected the surface soil samples for the sole purpose of determining the background level for each PA/SI site.[22] The data evaluation indicated a mean statewide arsenic concentration of 9.8 ppm. As a result of the data evaluation, DNREC set the typical background arsenic soil concentration in Delaware at a range of 1-10 ppm. In 1996, DNREC published the range in DNREC's *Remediation Standards Guidance*.[23]

Additionally, DNREC collected eighteen (18) surface soil samples from six park locations within the City of Wilmington in 2001. The mean concentration for the City of Wilmington study was 9.83. DNREC determined the 11 ppm default background by calculating the 95 percent Upper

[22] This state background study was completed in the 1990s; the results can be found on DNREC's Arsenic website, included in the statistical analysis of background soil samples at the following link: http://www.dnrec.state.de.us/dnrec2000/Divisions/AWM/SIRB/Arsenic/New/Arsenic.xls
[23] See Attachment 3 of DNREC's *Remediation Standards Guidance under the Delaware Hazardous Substance Cleanup Act* at: http://www.dnrec.state.de.us/dnrec2000/Divisions/AWM/sirb/DOCS/PDFS/Misc/RemStnd.pdf

Confidence Limit (UCL) of the data. Please see also Section 2.1.3 and Attachment B for summary tables of the arsenic background study data.

**2.4.4 Comment 9/14/05 #4:**
In a clear and concise process, what steps were used to set up the arsenic standard?
**Response 9/14/05 #4:** DNREC sets cleanup levels for contaminants of concern in accordance with the Hazardous Substance Cleanup Act (HSCA) and the Delaware Regulations Governing Hazardous Substance Cleanup.[24] In addition, the Department developed the *Remediation Standards Guidance* to provide guidance on contaminant levels that may pose a potential human health or environmental concern. The guidance presents three options for remedial standards: 1) Background Standard, 2) Uniform Risk-Based Standard (URS), and 3) Site-Specific Standard. The Background Standard approach consists of either applying a default background standard or developing a site-specific background standard.

Please see also Section 2.1.3, Section 2.1.5, Section 2.1.6, and Attachment B for summary tables of the arsenic background study data.

**2.4.5 Comment 9/14/05 #11:**
What type of arsenic was focused on in this study?
**Response 9/14/05 #11:** All current analytical testing procedures considered the arsenic to be the combination of both organic and inorganic arsenic. When a cleanup goal is based on risk assessment, DNREC assumes that all of the arsenic in soil is the more toxic inorganic form.

**2.4.6 Comment 9/14/05 #14:**
The Wilmington study only had one sample at 19 ppm. If this sample is taken out from the analysis, the average goes from 10.0995 ppm to 9.64, why wasn't this done?
**Response 9/14/05 #14:** The numbers are statistically the same; both values are equivalent to 10 ppm.

**2.4.7 Comment 9/14/05 #28:**
What is the lowest level of arsenic in the surrounding states and in the entire [United] States?
**Response 9/14/05 #28:** As part of a comprehensive arsenic default background evaluation, DNREC compared the State of Delaware's default background to those that are documented in other states (see Table 2). The State of Rhode Island has the lowest published arsenic default background at 7 ppm. However, Rhode Island will accept a concentration as high as 15 ppm during environmental site evaluations.[25] Delaware's proposed default background concentration of 11 ppm is comparable to, or is generally lower than most other states' published arsenic default background concentrations. In addition, most states allow the use of site-specific background concentrations during the risk assessment process. The site-specific designation used in Table 2 indicates that the respective state's arsenic background level is calculated using the risk assessment process to determine a site-specific concentration.

**2.4.8 Comment 9/14/05 #25:**
Why doesn't DNREC move the arsenic level to the national average of 7 ppm?

[24] Delaware Regulations Governing Hazardous Substance Cleanup - Section 9: Cleanup Levels
[25] State of Rhode Island, Remediation Regulations, DEM-DSR-01-93, February 2004.

**Response 9/14/05 #25:** The national average is not used because site-specific background or Delaware default background standards are accepted under HSCA and considered more representative of Delaware's soil conditions.

**2.4.9 Comment 9/14/05 #49:**
Don't you think that arsenic levels for the State of Delaware should be no more than 4 ppm or Senator Sokola's Senate Bill (SB) 68 of 6 ppm?
**Response 9/14/05 #49:** No. All of the arsenic background data reviewed to date indicate that 11 ppm falls within the naturally-occurring levels of arsenic in the state. DNREC does not believe that 4 or 6 ppm would be an appropriate default background standard for the state, as the current data does not support a value less than 11 ppm.

Setting a default background standard of 6 ppm is not scientifically supportable. Also, it is not feasible to implement and could result in fewer site cleanups. Finally, establishing an action level of 6 ppm would inaccurately imply that a concentration above this level is evidence of a "release" and therefore subject to liability under HSCA. In fact, the data show that more than half of the properties in the state have naturally occurring arsenic concentrations above 6 ppm.

**2.4.10 Comment 9/14/05 #50:**
In areas where multiple contaminants are present, shouldn't this in all cases be verified via soil sampling, and shouldn't this figure be reduced to 0.4 ppm for arsenic?
**Response 9/14/05 #50:** In all cases, DNREC bases risk assessments on the results of sampling both soil and ground water. DNREC also samples surface water and sediment if present.

When there are multiple contaminants at a facility, the HSCA Regulations mandate that the cleanup level of each contaminant shall be such that the sum of the risks posed by the contaminants does not exceed the one in one hundred thousand (1/100,000) cancer risk factor or a Hazard Index value of one for noncarcinogenic compounds.[26] The cleanup goal for any single contaminant could vary depending on the number of different contaminants present.

There are about 20 potentially hazardous inorganic substances (including arsenic) that occur naturally in Delaware soils. DNREC has found few soil samples with concentrations of arsenic as low as 0.4 ppm. Most are higher, even when the arsenic is present only because of natural causes.

**2.4.11 Comment 9/14/05 #16:**
Why doesn't DNREC look at new development (residential and industrial) and have the sites cleaned up to 4 ppm? (9/14/05, #16)
**Response 9/14/05 #16:** DNREC only has the authority to investigate a property if there is evidence that a hazardous substance release has occurred, or if there is an imminent threat of a release that would adversely affect human health and the environment. A release is defined under HSCA, 7 Del. C. Chapter 91, Section 3 as follows:

> *"Release" means any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping or disposing into the*

[26] Section 9.4 (1)(c) of the Delaware Regulations Governing Hazardous Substance Cleanup (2002)

> *environment (including the abandonment or discarding of barrels, containers and other closed receptacles containing any hazardous substance or pollutant or contaminant), but excludes:*
>
> > *a. Any release which results in exposure to a person solely within the workplace, with respect to a claim, which such person may assert against an employer provided, however, that this exclusion does not apply to any such release which also results in exposure to the environment;*
> >
> > *b. Emissions from the engine exhaust of a motor vehicle, rolling stock, aircraft, vessel or pipeline pumping station engine;*
> >
> > *c. The appropriate application of fertilizer and pesticide;*
> >
> > d. *Any discharges in compliance with state permits issued in conformance with this title and federally permitted releases under CERCLA.*

Therefore, DNREC does not typically evaluate new developments for potential cleanup, as DNREC does not have the authority under HSCA to investigate a property without evidence of a release, or the potential for a release, of hazardous substances.

**2.4.12 Comments 9/14/05 #5; 9/20/05 #4; and 9/22/05 #7 and #9:**
What was the former cleanup level that caused public concern? (9/20/05, #4) In the recent past, why was the arsenic level raised without public participation and how can the public be sure that this does not happen again? (9/14/05, #5) What was the cleanup level that prompted the Governor to request a review? (9/22/05, #7) Is the cleanup level of 23 ppm still on the table? (9/22/05, #9)
**Response 9/14/05 #5; 9/20/05 #4; and 9/22/05 #7 and #9:** The Department issued the Interim Arsenic Cleanup Standard policy memorandum dated June 7, 2004.[27] An arsenic cleanup goal for residential properties was set at 23 ppm under limited conditions, based on an interpretation of the HSCA Regulations. A poorly phrased provision of the Regulations states that when either the acceptable non-cancer or cancer risk concentration is below the natural background level, then either the non-cancer or cancer risk can be adopted as the cleanup goal even though it might be higher than the background concentration. Previous practice had been to adopt the higher of the natural background concentration (usually 10 ppm) or the cancer risk concentration (4 ppm). The new interpretation was withdrawn by the Department as stated in the *June 2005 Arsenic RMP*.

Based on the public concern regarding the new policy, the Department and the Division of Air and Waste Management are now committed to a public process for all future adjustments in the *Remediation Standards Guidance*. The process will involve a review and comment period and an official response to comments for all future changes, as detailed in the draft *Final Policy*. It will be the responsibility of the program and Division management to ensure this process is followed.

[27] Review the policy on DNREC's Arsenic website at:
http://www.dnrec.state.de.us/dnrec2000/Divisions/AWM/SIRB/Arsenic/pdf/Interim%20Standard.pdf

### 2.4.13 Comments 9/14/05 #24:

What is the federal (EPA) level of arsenic and other compounds of concern found in the state?
**Response 9/14/05 #24:** The EPA uses different cleanup levels for different media and programs within the agency (Superfund, Resource Conservation and Recovery Act [RCRA], Office of Underground Storage Tanks, National Pollutant Discharge Elimination System, etc.). In addition, based on the proposed use, the EPA may use a range for cleanup levels.[28]

### 2.4.14 Comments 9/22/05 #3:

Is it cheaper to cleanup to 23 ppm vs. 11 ppm? (9/22/05, #3) Will a lower cleanup level slow down the building boom in Sussex County? (9/22/05, #10)
**Response 9/22/05 #3:** When considering a remedy for arsenic contamination in soils (i.e., soil removal, capping, or soil stabilization), it would generally be less expensive to remediate to a cleanup level of 23 ppm versus 11 ppm. However, when determining appropriate and cost-effective remedies, many variables must be considered including future use, aerial extent and depth of contamination, as well as the level of contamination.

There are no studies currently available regarding the possible effect of a lower cleanup level on the building boom in Sussex County. However, unless a release of a hazardous substance has occurred, new residential developments typically are not subject to the programs managed by the Site Investigation and Restoration Branch, and therefore, should not be affected by a change in the cleanup level.

## 2.5 Comments on Arsenic Exposure Reduction and Remedies

### 2.5.1 Comment 9/22/05 #13:

What is the remedy(s) for arsenic-contaminated soils?
**Response 9/22/05 #13:** There are many remedies for arsenic-contaminated soils. The following EPA Table 1.1[29] gives an overview of some available options when considering effectively treating arsenic-impacted areas.

[28] Guidance documents regarding the selection of appropriate cleanup levels for various programs including EPA's Superfund program can be found at the following link:
http://www.epa.gov/oswer/riskassessment/policy.htm#6

[29] From USEPA. 2002. *Arsenic Treatment Technologies for Soil, Waste, and Water*, which can be found at:
http://www.epa.gov/tio/download/remed/542r02004/arsenic_report.pdf

**Table 1.1**
**Arsenic Treatment Technology Descriptions**

| Technology | Description |
|---|---|
| **Technologies for Soil and Waste Treatment** | |
| Solidification/ Stabilization | Physically binds or encloses contaminants within a stabilized mass and chemically reduces the hazard potential of a waste by converting the contaminants into less soluble, mobile, or toxic forms. |
| Vitrification | High temperature treatment that reduces the mobility of metals by incorporating them into a chemically durable, leach resistant, vitreous mass. The process also may cause contaminants to volatilize, thereby reducing their concentration in the soil and waste. |
| Soil Washing/ Acid Extraction | An ex situ technology that takes advantage of the behavior of some contaminants to preferentially adsorb onto the fines fraction of soil. The soil is suspended in a wash solution and the fines are separated from the suspension, thereby reducing the contaminant concentration in the remaining soil. |
| Pyrometallurgical Recovery | Uses heat to convert a contaminated waste feed into a product with a high concentration of the contaminant that can be reused or sold. |
| In Situ Soil Flushing | Extracts organic and inorganic contaminants from soil by using water, a solution of chemicals in water, or an organic extractant, without excavating the contaminated material itself. The solution is injected into or sprayed onto the area of contamination, causing the contaminants to become mobilized by dissolution or emulsification. After passing through the contamination zone, the contaminant-bearing flushing solution is collected and pumped to the surface for treatment, discharge, or reinjection. |
| **Technologies for Water Treatment** | |
| Precipitation/ Coprecipitation | Uses chemicals to transform dissolved contaminants into an insoluble solid or form another insoluble solid onto which dissolved contaminants are adsorbed. The solid is then removed from the liquid phase by clarification or filtration. |
| Membrane Filtration | Separates contaminants from water by passing it through a semi-permeable barrier or membrane. The membrane allows some constituents to pass, while blocking others. |
| Adsorption | Concentrates solutes at the surface of a sorbent, thereby reducing their concentration in the bulk liquid phase. The adsorption media is usually packed into a column. As contaminated water is passed through the column, contaminants are adsorbed. |
| Ion Exchange | Exchanges ions held electrostatically on the surface of a solid with ions of similar charge in a solution. The ion exchange media is usually packed into a column. As contaminated water is passed through the column, contaminants are removed. |
| Permeable Reactive Barriers | Walls containing reactive media that are installed across the path of a contaminated groundwater plume to intercept the plume. The barrier allows water to pass through while the media remove the contaminants by precipitation, degradation, adsorption, or ion exchange. |
| **Technologies for Soil, Waste, and Water Treatment** | |
| Electrokinetic Treatment | Based on the theory that a low-density current applied to soil will mobilize contaminants in the form of charged species. A current passed between electrodes inserted into the subsurface is intended to cause water, ions, and particulates to move through the soil. Contaminants arriving at the electrodes can be removed by means of electroplating or electrodeposition, precipitation or coprecipitation, adsorption, complexing with ion exchange resins, or by pumping of water (or other fluid) near the electrode. |
| Phytoremediation | Involves the use of plants to degrade, extract, contain, or immobilize contaminants in soil, sediment, and groundwater. |
| Biological Treatment | Involves the use of microorganisms that act directly on contaminant species or create ambient conditions that cause the contaminant to leach from soil or precipitate/coprecipitate from water. |

## 2.6 Comments on Policy/Regulation/Guidance Levels

### 2.6.1 Comments 9/14/05 #30 and #51:

Why is the review set on an annual schedule and during these reviews, is there a chance that DNREC will lower the level? (9/14/05, #30) There should be no annual review of arsenic action levels unless consideration of a reduction is in order. (9/14/05, #51)

**Response 9/14/05 #30 and #51:** DNREC originally proposed an annual review. However, based on the experience of the last year, DNREC now realizes that one year is not enough time to collect sufficient additional sampling data for technical review and also for regulatory and toxicological thinking to evolve. Instead, DNREC is committing to a comprehensive periodic review within 5 years of default background concentrations and risk-based screening levels for all potential contaminants, not just arsenic. The staff resources required for a 5-year periodic review will be significant. To attempt an annual review would reduce the resources available for site investigation and cleanup. However, more frequent review and changes will be conducted if new information warrants it.

Note that if the data supports lowering the default background level, the Department will propose a change.

### 2.6.2 Comments 9/8/05 #8, #16; and 9/14/05 #21:

[The standards should be] legally binding regulations, as regulations provide the public with opportunities for notice, establishing standards and reasoning, and comment. What process was used to adopt the cleanup standard, and protection of public input and notice? If not using the process for regulations, why not? (9/8/05, #8) Shouldn't the regulations have "teeth in them?" (9/8/05, #16) Why isn't this guideline set as a regulation? (9/14/05, #21)

**Response 9/8/05 #8, #16; and 9/14/05 #21:** DNREC is mandated to follow the requirements of the Hazardous Substance Cleanup Act (HSCA). Under HSCA and with full public comment opportunity, regulations were promulgated to establish procedures for identifying cleanup levels or standards based on site-specific risks (7 Del. C. Section 9104(b)(2)g.). The standards in the *Remediation Standards Guidance* are known as the Uniform Risk-based Standards (URS). In developing the URS, as well as updating and revising them, DNREC based the levels used in the guidance on the Risk-Based Concentrations (RBCs) levels set by the U.S. Environmental Protection Agency (EPA). The EPA reviews the RBCs quarterly and revises their tables based on new information received and reviewed.

Typically, several values in the RBC tables are changed each quarter. In addition, there are over 1,000 chemicals listed in the DNREC guidance document. To change these levels by regulation is a very expensive and time-consuming process. To develop or amend a guidance document takes approximately 6 months, depending on the number of public comments and concerns. To develop a regulation and adopt it takes a minimum of 18 months and usually takes over 24 months. In addition, it costs at least $10,000 more to draft and adopt a regulation than it costs to draft and adopt a guidance document. So if each chemical listed in the URS had to be amended at different times, the potential cost to the state is $10,000,000 just to adopt each chemical one time. Even over a number of years and assuming chemicals are grouped together, the potential costs per year to adopt the levels quarterly would be $40,000 per year above the cost to establish a guidance document.

Further, SIRB has used the *Remediation Standards Guidance* document to ensure that the actual cleanup goals for chemicals of concern, which are not adopted as a drinking water standard for groundwater, and all chemicals of concern in soil, make use of the most current data and information and the appropriate level of conservatism in the risk calculation. DNREC's current risk calculation method utilizes the most conservative values for all variables. This results in a very conservative level being set for the guidance values and unless the variables are changed based on site-specific information, very conservative values for the cleanup goals.
In addition, as part of a comprehensive arsenic regulation/rule statue and guidance policy evaluation, DNREC did a comparison to other state standards (see Tables 2 and 3 in Attachment B). As result of the comparison, thirty-four states have soil cleanup goals/standards/levels as guidance, seven have cleanup goals/standards/levels as a regulation or rule, five have cleanup goals/standards/levels as regulation or rule and guidance, two are part of statute and two were unavailable. However, the twelve states that have cleanup goals/standards/levels as part of their regulations have step approaches or site-specific values that are not listed in the regulations. In addition, the regulations contain a very limited number of chemicals. Chemicals not listed would then fall under site-specific evaluation, instead of the regulations or rules. For example, the State of Washington specifically listed certain petroleum products and other chemicals not listed in the regulations as guidance. Furthermore, as part of evaluation, only the State of Washington has limited chemical list of cleanup goals for sediment. The remaining states have sediment cleanup goals as guidance.

Establishing procedures for public participation in the decision for a remedy at a facility or site is mandated under the 7 Del. C. Section (9104(b)(2)j.). The public has an opportunity to comment on the proposed cleanup goals and remedies for each site in the state individually under the Site Investigation and Restoration Branch's public participation process. This is done by providing public notice in the state's two largest newspapers, 'The News Journal' and 'Delaware State News,' regarding the availability of a proposed plan of remedial action for comment or public hearing, if requested, for a given site. Notice is also provided to all elected members of the General Assembly in whose district the facility or site is located. If located in a municipality, notice is also given to the governing body of the municipality. In addition, notice is provided to any civic, neighborhood or similar association in which the site is located, provided that such association makes itself known to the Department for this purpose and provides a legal mailing address.

**2.6.3 Comment 9/8/05 #17:**
At industrial sites that are cleaned up, why is the public around them not informed about the cleanup and issues?
**Response 9/8/05 #17:** The public is informed about site cleanups through DNREC's HSCA-mandated public participation process (see also Section 2.7.2 above). The proposed plan of remedial action is noticed, as detailed above, for every site undergoing a remedy. The public is provided with a twenty-day comment period on the proposed plan. In addition, the public can request a hearing or public meeting to discuss the cleanup process for the site. The public may also object to the DNREC-approved cleanup process. After requesting a DNREC hearing on a site, the public can continue to exercise their right to object to the cleanup process by appealing the cleanup decision to the Environmental Appeals Board or by going through the court system.

In addition, when a release occurs, or there is an imminent threat of a release of a hazardous substance that will require a remedy, public notification is required within 20 days of such determination. Likewise, public notice is also required within 20 days after entering into negotiations for a voluntary cleanup settlement agreement or a brownfields development agreement (BDA) with any person that agrees to perform a remedy.

**2.6.4 Comment 9/14/05 #7:**
Why doesn't DNREC have a policy that is health-based?
**Response 9/14/05 #7:** The human health risk assessments performed for each site are health-based. However, HSCA (7 Del. C. Chapter 91) and the Regulations Governing Hazardous Substance Cleanup provide for the consideration of natural background levels of a contaminant if that level is greater than the health-based risk number.

**2.6.5 Comment 9/14/05 #37:**
Is DNREC making policy decisions for the government of Delaware or for the people of Delaware?
**Response 9/14/05 #37:** DNREC is implementing policy decisions to protect human health and the environment for the State of Delaware per the HSCA statute by applying the Department's technical expertise.

## 2.7 Miscellaneous Comments

**2.7.1 Comments 9/14/05 #31, #32, and #33:**
Does DNREC have a conflict of interest because the Department contributes funds for certain clean ups? (9/14/05, #31) In the document, it states that budgets would be affected by choosing a lower level. What budget is that? (9/14/05, #32) Is the state currently cleaning up sites [with the HSCA Fund] where development is not occurring? (9/14/05, #33)
**Response 9/14/05 #31, #32, and #33:** In accordance with HSCA requirements, an annual expenditure plan is prepared and submitted to the Governor and representatives of the General Assembly. This budget would be affected by a lower or more conservative arsenic standard because the state-funded sites (i.e., HSCA sites) would cost more to clean up, and in turn, a decreased amount of funds would be available to other sites that have additional contaminants present. This could result in fewer HSCA sites being cleaned up each year.

DNREC-SIRB uses the same HSCA-mandated standards for all sites regardless of funding source and receives no financial benefit from the sites. In addition, there are numerous sites that are currently funded by HSCA that do not have development occurring (i.e., Millsboro groundwater plume), due to the potential to impact human health and the environment.

**2.7.2 Comment 9/14/05 #34:**
Is DNREC providing funding for site(s) at the Riverfront with HSCA funds?
**Response 9/14/05 #34:** The Department is providing HSCA funding for several Riverfront redevelopment sites that are undergoing cleanup, in accordance with the HSCA statute and regulations.

**2.7.3 Comment 9/20/05 #3:**
Many of the basements in the Southbridge area have dirt basements. Will there be soil testing of the basements for arsenic?
**Response 9/20/05 #3:** The main source of any potential arsenic in the Southbridge area of Wilmington would come from the former Lobdell metal-working material or tannery wastes. DNREC has reviewed historical insurance and geologic survey maps to determine if there was any evidence of an arsenic release occurring in this area, such as the presence of a former tannery site, or areas with historic Lobdell metal-working fill.

Based on DNREC's review, the homes in the Southbridge area do not appear to be affected by Lobdell activities. Further, based on a review of historical information regarding former tannery locations in the area, there are currently no homes in the vicinity of former tanneries. Therefore, there is no reason to sample the basements at this time, as no Lobdell fill, former tannery sites, or evidence of the potential for other contaminants of concern is present in the Southbridge area.

**2.7.4 Comments 9/8/05 #14; and 9/14/05 #18:**
Which advisory committees will be looking at the proposal for comment and input? (9/8/05, #14)
Who is on the advisory panel? (9/14/05, #18)
**Response 9/8/05 #14; and 9/14/05 #18:** Any State of Delaware advisory committee that expressed an interest was encouraged to look at the *Arsenic RMP* and provide comments and input. Some of the advisory committees requested presentations including the Community Involvement Advisory Council[30] and the Delaware Cancer Consortium.[31] DNREC will continue to use existing public advisory committees, as available, to review the *Final Arsenic Risk Management Policy* to help resolve concerns raised by the public. DNREC does not plan, at this time, to establish a new advisory panel for this purpose.

**2.7.5 Comments 9/14/05 #47:**
What is the purpose of this workshop? What were your expected outcomes? (9/14/05, #47)
**Response 9/14/05 #47:** The workshops are a foundation for a comprehensive community outreach and public involvement program for the proposal. The workshops provided the public in each county with an opportunity to obtain additional information on the proposal and make comments to DNREC. The comments were collected for DNREC response and the public's review, and presented in this *Response to Comments* document. In addition, the comments were used to develop the *Final Arsenic Risk Management Policy.*

**2.7.6 Comment 9/22/05 #8:**
What is the timeline for this decision?
**Response 9/22/05 #8:** DNREC has reviewed and considered all comments and input received from June through December 2005. The comments were used to draft the *Final Arsenic Risk Management Policy.* Following a 20-day comment period and incorporation of appropriate comments, the *Final Policy* will be noticed in the Delaware Register of Regulations, the News Journal, and the Delaware State News.

[30] For more information on the CIAC, please visit the website at: http://www.dnrec.state.de.us/ciac/
[31] For more information on the DCC, please visit the website at: http://www.dhss.delaware.gov/dhss/dph/dpc/consortium.html

### 2.7.7 Comment 8/11/2005 (by letter from TOSC—The full letter is included in Attachment A.):

We are concerned that the process for utilizing the established background level is not discussed in adequate detail in the document . . . A second, related area of concern is the silence of the document on the topic of action levels as opposed to cleanup levels. Without defining risk based action levels, all areas of the state with backgrounds above the established statewide level become problematic. Pristine areas could become targets of local alarm even if they do not pose unacceptable risk . . . We recommend a clear exposition of how the established background is to be used . . .

**Response 8/11/205:** DNREC recognizes the importance of this comment and recommendation. The process for establishing cleanup levels and using default background levels is the subject of the *Remediation Standards Guidance* which is referenced in the *Arsenic RMP, Section 4.0*.

To summarize the *Guidance,* established background concentrations are used for two distinct purposes:

- The level of background contamination is used to decide <u>whether</u> to clean up a site, that is, whether or not a release of hazardous substances has occurred resulting in potential liability under HSCA. In evaluating a potential cleanup site, the concentrations at the site are compared to background concentrations using the appropriate rules and statistical tests as described in the *Remediation Standards Guidance.*[32]

- According to the HSCA Regulations, cleanup levels are determined using a "risk based approach on a site specific basis."[33] However, the soil cleanup level will not be less than the background concentration.[34] Therefore, the background concentration is relevant in deciding <u>how much</u> to clean up a site. For arsenic, the default cleanup level is 11 ppm since the background concentration is greater than the acceptable risk based concentration for most exposure scenarios.

Note that the Delaware HSCA definition of "background" excludes contributions from human activity. This differs from some other jurisdictions where the term "background" may include ambient concentrations of chemicals that are not site related but may be the result of area-wide contamination, such as aerial deposition. In general, the natural background concentration is lower than the ambient background concentration. At the same time, DNREC must be very careful to avoid creating HSCA liability at a property solely because the concentrations of arsenic there are at the higher end of the background range.

*PLEASE NOTE THAT THE VIEWS AND INTERPRETATIONS OF THE COMMENTERS EXPRESSED IN THE ABOVE COMMENTS DO NOT NECESSARILY REFLECT THOSE OF THE DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL. OR THE STATE OF DELAWARE.*

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[32] *Remediation Standards Guidance under the Delaware Hazardous Substance Cleanup Act – Section 3:* Background Standard*, Section 6:* Demonstration of Attainment.

[33] Delaware Regulations Governing Hazardous Substance Cleanup - Subsection 9.1(1): Cleanup Levels

[34] Delaware Regulations Governing Hazardous Substance Cleanup - Subsection 9.4(2): Soil Cleanup Levels

## 3.0 REFERENCES

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Rhode Island Department of Environmental Management. 2004. *Rules and Regulations for the Investigation and Remediation of Hazardous Material Releases (Remediation Regulations),* Office of Waste Management, DEM-DSR-01-93, amended February 2004. http://www.dem.ri.gov/pubs/regs/regs/waste/remreg04.pdf

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USEPA. 2002. *Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites,* EPA 540-R-01-003, OSWER 9285.7-41, September 2002. http://www.epa.gov/swerrims/riskassessment/pdf/background.pdf

USEPA. 2003. *Technical Summary of Information Available on the Bioaccumulation of Arsenic in Aquatic Organisms,* EPA-822-R-03-032, Office of Science and Technology, Office of Water, December 2003. http://www.epa.gov/waterscience/criteria/arsenic/tech-sum-bioacc.pdf

## WEBSITE REFERENCES

ATSDR – ToxFAQs for Arsenic (http://www.atsdr.cdc.gov/tfacts2.html)

CleanupLevels.Com (State and Federal Cleanup Levels for Hazardous Waste Sites) (http://www.cleanuplevels.com/#State%20Cleanup%20Levels)

Delaware Cancer Consortium (http://www.dhss.delaware.gov/dhss/dph/dpc/consortium.html)

Delaware Department of Health and Social Services, Division of Public Health (http://www.dhss.delaware.gov/dhss/dph/index.html)

Delaware Department of Natural Resources and Environmental Control (DNREC), Division of Air and Waste Management, Site Investigation and Restoration Branch

- Arsenic Home Page (June 2005). (http://www.dnrec.state.de.us/dnrec2000/Divisions/AWM/SIRB/Arsenic/)
- Delaware Regulations Governing Hazardous Substance Cleanup, amended February 2002. (http://www.dnrec.state.de.us/dnrec2000/Divisions/AWM/sirb/DOCS/PDFS/Misc/fdb99085.pdf)
- Hazardous Substance Cleanup Act (HSCA), amended 2002. (http://www.delcode.state.de.us/title7/c091/index.htm#P-1_0)
- Remediation Standards Guidance under the Delaware Hazardous Substance Cleanup Act, revised December 1999. (http://www.dnrec.state.de.us/dnrec2000/Divisions/AWM/sirb/DOCS/PDFS/Misc/RemStnd.pdf)
- State Background Study - Inorganic Background Concentrations in Delaware. (Included in Richard Greene's statistical analysis of background soil samples.) (http://www.dnrec.state.de.us/dnrec2000/Divisions/AWM/SIRB/Arsenic/New/Arsenic.xls)
- State Background Arsenic Study (March 19, 2002). (http://www.dnrec.state.de.us/dnrec2000/Divisions/AWM/SIRB/Arsenic/New/791462.pdf)
- State Background Metals Study (December 10, 2002). (http://www.dnrec.state.de.us/dnrec2000/Divisions/AWM/SIRB/Arsenic/pdf/background%20soil.pdf)
- State Background Arsenic Study (June 7, 2004). (http://www.dnrec.state.de.us/dnrec2000/Divisions/AWM/SIRB/Arsenic/pdf/Interim%20Standard.pdf)

Delaware Department of Natural Resources and Environmental Control (DNREC), Office of the Secretary, Community Involvement Advisory Committee (CIAC) (http://www.dnrec.state.de.us/ciac/)

Delaware River Basin Commission (www.state.nj.us/drbc)

Six Sigma Home Page (http://www.isixsigma.com/library/content/six-sigma-newbie.asp)

US Environmental Protection Agency

- Key Policy Guidance Documents (Cleanup Level-Related Publications for various EPA Programs including Superfund, RCRA, and UST), USEPA (http://www.epa.gov/oswer/riskassessment/policy.htm#6)

- Waste and Cleanup Risk Assessment Website (Ecological Assessment Guidance) (http://www.epa.gov/oswer/riskassessment/risk_superfund.htm)

- Fish Advisories, USEPA (www.epa.gov/ost/fish)

- Technology Transfer Network – Air Toxics Website (http://www.epa.gov/ttn/atw/hlthef/arsenic.html)

United States Golf Association (http://www.usga.org/home/index.html)

Washington State Department of Ecology, Sediment Quality Chemical Criteria Website for No Observed Effect Levels- NOELs (http://www.ecy.wa.gov/programs/tcp/smu/sed_chem.htm)

# 4.0 GLOSSARY

**95% Upper Confidence Level (UCL)** A confidence interval for a mean specifies a range of values within which the unknown population average may lie. The confidence level is the probability value associated with a confidence interval. When we say that the 95% UCL of the average of a sample data set is 11, it means that we are 95% certain that the true average of all the data, the population, (all of the uncontaminated soil in Delaware, for example) is less than 11.

**Acute**
Occurring only once or more than once within a short period of time.

**Acute Exposure**
One dose or multiple doses of short duration spanning less than or equal to 24 hours.

**Adverse Health Effect**
A biochemical change, functional impairment, or pathologic lesion that affects the performance of the whole organism, or reduces an organism's ability to respond to an additional environmental challenge.

**Aquifer**
An underground geologic or rock formation, group of formations, or a part of a formation capable of yielding groundwater. Aquifers are usually composed of sand, soil, gravel, or porous rock that stores and supplies groundwater to wells and springs.

**Background Level**
The level of contaminant(s) present in an area from naturally occurring substances, excluding contaminants and other contributions resulting from human activity. The concentration of a particular substance in the medium of concern (air, soil, sediment or groundwater for environmental purposes) provides a defensible reference point with which to evaluate whether or not a release from the site has occurred. Two types of background levels may exist for chemical substances: (a) Naturally occurring levels: ambient concentrations of substances present in the environment, without human influence; (b) anthropogenic levels: concentrations of substances present in the environment due to human-made, non-site sources (e.g., automobiles, industries).

**Background Sample**
An air, soil, sediment or groundwater sample used in establishing background levels.

**Background Standard**
See Default Background Standard.

**Borrow**
An excavation site outside the limits of construction that provides gravel and/or soil material, such as clean fill for embankments or other landscaping structures. Clean

borrow material may also be specified as cover material for remedial activities (see also Maintained Engineered Cover).

**Brownfield(s)**

Any vacant, abandoned or underutilized real property the development or redevelopment of which may be hindered by the reasonably held belief that the real property may be environmentally contaminated.

**Carcinogen**

A substance or agent that may cause, induce or increase the risk of cancer in humans. The EPA's Integrated Risk Information System (IRIS) may be used as the basis for determining that a particular hazardous substance is a carcinogen. The term also includes suspected carcinogens. The IRIS database may be reviewed at: http://www.epa.gov/iris/. The Hazardous Substance Cleanup Act (HSCA) specifies achieving a cleanup level in most cases of 1.0E-05 or a potential risk for one additional cancer death caused by exposure to a carcinogen in a human population of 100,000 in a lifetime.

**CERCLA**

The Comprehensive Environmental Response, Compensation and Liability Act of 1980, 42 U.S.C. § 9601 et seq., as amended. Please click on the EPA link, Comprehensive Environmental Response, Compensation, and Liability Act, to review more information on CERCLA.

**CERCLA Hazardous Substance**

Hazardous substance as defined by CERCLA, Section 101(14); the list of CERCLA hazardous substances having reportable quantities is found in 40 CFR 302 in Table 302.4.

**CERCLA Pollutant or Contaminant**

Section 101(33) of CERCLA states that: "pollutant or contaminant shall include, but not be limited to, any element, substance, compound, or mixture, including disease - causing agents, which after release into the environment and upon exposure, ingestion, inhalation, or assimilation into any organism, either directly from the environment or indirectly by ingestion through food chains, will or may reasonably be anticipated to cause death, disease, behavioral abnormalities, cancer, genetic mutation, physiological malfunctions (including malfunctions in reproduction) or physical deformations, in such organisms or their offspring; except that the term "pollutant or contaminant" shall not include petroleum, including crude oil or any fraction thereof which is not otherwise specifically listed or designated as a hazardous substance under subparagraphs (A) through (F) of paragraph (14) and shall not include natural gas, liquefied natural gas, or synthetic gas of pipeline quality (or mixtures of natural gas and such synthetic gas)."

**Chronic Exposure**

Continuous or repeated exposure to a hazardous substance over a long period of time.

**Cleanup**

The process of removing, treating, or disposing of contaminants at a site and restoring the site to a condition that is not dangerous to people or the environment.

**CLP**

The EPA's Contract Laboratory Program or CLP is provides a range of state-of-the-art chemical analytical services of known and documented quality on a high volume, cost-effective basis to support ongoing Superfund enforcement, emergency response and remedial actions, site investigations, and state-lead assessments.

**Community**

An interacting population of various types of individuals (or species) in a common location; a neighborhood or specific area where people live.

**Community Involvement**

A process in which the concerns of local citizens are addressed during the Superfund process.

**Concentration**

The amount of one material dispersed or distributed in a larger amount of another material.

**Contaminant**

Harmful or hazardous substance, and as used by DNREC-SIRB, introduced into the environment.

**Contaminant Level**

The concentration of a contaminant. For inorganic chemicals in soil, it is usually expressed in units of parts per million (ppm) or milligrams per kilogram (mg/kg).

**Contamination**

The extent/area impacted by the introduction of harmful or hazardous substances into the environment.

**Default Background Standard**

A regulatory term introduced in DNREC's *Remediation Standards Guidance*.[35] DNREC developed three remediation standard options to provide flexibility in the DNREC's Site Investigation and Restoration Branch cleanup programs. The three cleanup options were Background Standards, Uniform Risk-based Standards and Site-Specific Standards, as outlined in The default background standard is one of two background standard approaches; the other approach is the site-specific background standard.

[35] See Attachment 3 of DNREC's *Remediation Standards Guidance under the Delaware Hazardous Substance Cleanup Act* at: http://www.dnrec.state.de.us/dnrec2000/Divisions/AWM/sirb/DOCS/PDFS/Misc/RemStnd.pdf .

The default background standards are intended to be generic values that are considered to be reasonably attributable to natural or regional anthropogenic sources found statewide. For organic substances, the default background standard uses the laboratory method practical quantitation limits as the default standard. For inorganic substances (i.e., metals), derived values are used as the default standard. The default background values for inorganics in soils represent average concentrations of inorganics detected in background samples collected as part of HSCA investigations throughout Delaware in rural and urban locations in the 1990s.

DNREC published the ranges in the *Remediation Standards Guidance* in 1996. However, if the upper value of the concentration range exceeded the unrestricted soil Uniform Risk-Based Standard (URS) or the environment URS, then the value presented in the Delaware Default Background Remediation Standards is the most stringent soil URS value (see Attachment 3 of the *Remediation Standards Guidance*).

**Department**

The Department of Natural Resources and Environmental Control (DNREC).

**Detection Limit (DL)**

The lowest quantity of a hazardous substance that can be distinguished from the normal random "noise" of an analytical instrument or method. For DNREC-SIRB purposes, the detection limit is the method detection limit (MDL) or, for real-time field instruments, the instrument detection limit (IDL) as used in the field.

**Ecology**

Study of the relationships of living organisms to each other and to their environment.

**Ecosystem**

A specialized community, including all the component organisms, that forms an interacting system; for example, a marsh, a shoreline, a forest.

**Ecosystem Bioaccumulation Potential**

Ecosystem bioaccumulation potential evaluates the tendency for a substance to accumulate in the tissue all aquatic organisms, not just human food chain organisms (as in bioaccumulation potential), and forms one component of the ecosystem toxicity/persistence/bioaccumulation and ecosystem toxicity/mobility/persistence/bioaccumulation factors within the environmental threat - waste characteristics factor category.

**Emergency Response**

As used in programs overseen by DNREC-SIRB, an environmental response action to situations where a release or potential for imminent release of a hazardous substance may cause immediate and serious harm to people or the environment.

**Environment**
The navigable waters, the waters of the contiguous zone, ocean waters, and any other surface water, groundwater, drinking water supply, land surface or subsurface strata or ambient air on the Earth.

**Environmental Risk**
Likelihood, or probability, of injury, disease, or death resulting from exposure to a potential environmental hazard.

**EPA (United States)**
U.S. Environmental Protection Agency.

**Epidemiology**
Study of causes of disease or toxic effects in human populations.

**Evidence of Hazardous Substance Migration**
Chemical analyses and/or visual evidence that demonstrate hazardous substances attributable to a source have migrated away from that source into the surrounding soil, groundwater, surface water, or air (e.g., leachate containing hazardous substances coming out of the source; stained or contaminated soil that can be attributed to migration from the source; evidence of the overflow from a surface impoundment containing hazardous substances).

**Exposure**
Coming into contact with a substance through inhalation, ingestion, or direct contact with the skin; may be acute or chronic.

**Facility**
For programs overseen by DNREC-SIRB, any building, structure, installation, equipment, pipe or pipeline (including any pipe into a sewer or publicly owned treatment works), well, pit, pond, lagoon, impoundment, ditch, landfill, storage container, motor vehicle, rolling stock, vessel, aircraft, or any site or area where a hazardous substance has been generated, manufactured, refined, transported, stored, treated, handled, recycled, released, disposed of, placed or otherwise come to be located.

**Fertilizers**
Nitrogen and phosphate-rich chemical compounds that are used to increase the productivity of croplands; fertilizer production usually includes the use and disposal of petrochemicals.

**Fund**
For DNREC-SIRB programs, the reference is to the Hazardous Substance Cleanup Fund created pursuant to § 9113 of the Delaware Code Title 7.

**Groundwater**
Water found beneath the land surface that fills pores between land materials such as sand, soil, or gravel (i.e., within the zone of saturation).

**Hazard Index (HI)**

The numerical value obtained by dividing a person's expected daily intake of a non-carcinogen by a level which is not expected to produce toxic effects. Under HSCA, cleanup levels are usually designed to achieve a hazard index value of one with a cancer risk of 1.0E-5.

**Hazard Ranking System (HRS)**

The method EPA uses to assess and score the hazards posed by a site that takes into account the nature and extent of contamination and the potential for the hazardous substances to migrate from the site through air, soil, surface water, or groundwater; HRS scores are used to determine whether a site should be placed on the National Priorities List (NPL). Please click on the EPA link, Hazard Ranking System, to review more information on the HRS.

**Hazardous Substance**

A broad term that includes all substances that can be harmful to people or the environment; toxic substances, hazardous materials and other similar terms which are subsets of hazardous substances. See also CERLA Hazardous Substance, which consists of hazardous substances, pollutants, and contaminants as defined in CERCLA sections 101(14) and 101(33), except as otherwise specifically noted in the HRS. For DNREC-SIRB programs, a hazardous substance is defined as:

a. Any hazardous waste as defined in Chapter 63 of Delaware Code Title 7 or any hazardous waste designated by regulation promulgated pursuant to Chapter 63 of Title 7;
b. Any hazardous substance as defined in CERCLA; or
c. Any substance determined by the Secretary of DNREC through regulation to present a risk to public health or welfare or the environment if released into the environment.

**Hazardous Waste**

By-products or waste materials of manufacturing and other processes that have some dangerous property; generally categorized as corrosive, ignitable, toxic, or reactive, or in some way harmful to people or the environment.

**Health Risk Assessment**

Scientific evaluation of the probability of harm resulting from exposure to hazardous materials.

**Heavy Metals**

Inorganic compounds (i.e., metals) such as lead, chromium, copper, and cobalt that can be toxic at relatively low concentrations.

**Imminent Threat of Release**

Potential for a release which requires action to prevent or mitigate damage to the environment or endangerment to public health or welfare, which may result from such a release.

**Information Repository**

A set of current information, technical reports, and reference documents regarding a regulated site or regulatory issue. The repository should be located in a public building that is convenient for local residents, such as a public school, city hall, or public library.

**Innovative Treatment Technologies**

Remedies that have been tested, selected, or used for treating hazardous waste or contaminated materials, which may not yet have much information on cost and performance.

**Inorganic Compounds**

Chemical compounds that do not contain carbon, usually associated with life processes; for example, metals are inorganic.

**Liability**

Under Superfund and other regulatory environmental programs, a party responsible for the presence of hazardous substance/waste at a site is also legally responsible for acting and paying to reduce or eliminate the risks posed by the site.

**Long-Term Remedial Action**

A response action that eliminates or reduces a release or threatened release of hazardous substances that is serious, but not an immediate danger to people or the environment and may take years to complete (also known as a long-term action).

**MCL**

Maximum Contaminant Level or MCL means the allowed level of a specific chemical in drinking water, as promulgated by the EPA pursuant to the Safe Drinking Water Act, 42 US Code Section 300 (f) et seq., as amended.

**Maintained Engineered Cover**

Vegetated cover, usually made of compacted clean soil. It is generally placed over a source as a cap at the site's closure and is designed and constructed to minimize the migration of liquids through the closed source, function with minimum maintenance, and accommodate settling and subsidence. Maintenance of the integrity and effectiveness of the final cover may include repairing the cap as necessary to correct the effects of settling, subsidence, erosion, and other events.

**Method Detection Limit**

The lowest concentration of a hazardous substance that a method can detect reliably in either a sample or laboratory method blank.

**Migration**

As used in programs overseen by DNREC-SIRB, the movement of a contaminant; actual or potential migration is one measure of the dangers created by a contaminant.

**Migration Pathways**

The route(s) or medium(s) through which contaminant(s) or hazardous substance(s) may be transported from the source of the release into the environment (e.g., soil, groundwater, surface water, air).

**Mutagenic**

Causing alteration in the DNA (genes or chromosomes) of an organism.

**National Priorities List (NPL)**

EPA's list of the most serious uncontrolled or abandoned hazardous substance/waste sites, identified as candidates for long-term action using money from the federal Superfund Trust Fund or General Funds. Please click on the EPA's link, National Priorities List, to review more information on the NPL.

**Natural Resources**

Land, fish, wildlife, biota, air, water, groundwater, drinking water supplies, and other such resources belonging to, managed by, held in trust by, appertaining to, or otherwise controlled by Delaware, the United States, any foreign government, any local government, or any Indian tribe.

**Non-Carcinogen**

A hazardous substance which may cause toxic or poisonous effects, but will not cause cancer.

**NPL**

National Priorities List (see above).

**Operable Unit**

Any subdivision of a facility in terms of area or environmental media or any other manner approved by the Secretary of the Department.

**Operation and Maintenance**

The activities necessary to provide for continued effectiveness and integrity of a response activity after implementation of the remedial action is completed.

**Organic Compounds**

Chemical compounds that contain carbon, an element usually associated with life processes.

**PCB**

Polychlorinated biphenyls.

**Pesticides**

Chemical compounds used to control insects and other organisms that may reduce agricultural productivity; most are toxic.

**Physiological Response**

Measure of physical change or damage in a species as a result of exposure to a contaminant.

**Plan of Remedial Action**

A detailed plan describing cleanup actions and related information for the containment or permanent removal and disposal of hazardous substances from a facility.

**Plume**

An area of groundwater contamination.

**Potentially Responsible Parties (PRPs)**

As used in programs overseen by DNREC-SIRB, any individual or company potentially responsible for, or contributing to, contamination at a Superfund site, and/or any person identified pursuant to Delaware Code Title 7 § 9105(a)(1) through (6) of this title as a person liable with respect to a facility.

**Preliminary Assessment/Site Investigation (PA/SI)**

Preliminary Assessment (PA) is the process of collecting and reviewing available information about a known or suspected hazardous waste site or release that is used to determine if the site requires further study.

Site Inspection (SI) is the technical phase of the federal superfund process, following the Preliminary Assessment (PA), during which EPA gathers information (including sampling data) from a site needed to score the site using the Hazard Ranking System (HRS) to determine whether the site should be placed on the National Priorities List (NPL).

Site Assessment is the process by which EPA determines whether a potential Superfund site should be placed on the National Priorities List (NPL); it can consist of a Preliminary Assessment (PA) or a combination of a PA and a Site Inspection (SI). The Site Investigation and Restoration Branch uses the term to define the assessment of a facility and/or property to determine whether hazardous substances have entered the environment. (67 Del. Laws, c. 326, § 1; 70 Del. Laws, c. 186, § 1; 70 Del. Laws, c. 218, §§ 2-10; 73 Del. Laws, c. 183, § 2; 74 Del. Laws, c. 185, §§ 2, 3; 74 Del. Laws, c. 409, §§ 6, 7.)

**Proposed Plan of Remedial Action (Proposed Plan)**

A plan for remedial action or cleaning up a Superfund or HSCA site submitted by DNREC-SIRB and subject to public comment.

**Quality Assurance/Quality Control (QA/QC)**

Quality Assurance/Quality Control or QA/QC are specific procedures put into place when collecting and analyzing samples (i.e., soil, sediment, groundwater, and air samples) to ensure that the laboratory analytical results have not been adversely impacted by unrelated factors (e.g., cross-contamination in the field or the laboratory).

**Remedial Investigation/Feasibility Study (RI/FS)**

A Remedial Investigation (RI) is the environmental study or evaluation of a release of a hazardous substance at a facility or site to determine the nature, extent, and impact of the release and the collection of data necessary to conduct a feasibility study. The RI is done to define the risks to public health, welfare and the environment, and the extent of contamination that requires remediation. This is usually the first step following the confirmed release of a hazardous substance. A Feasibility Study (FS) is conducted after the RI to develop, screen and evaluate options for remedial action or remedial alternatives.

**Release**

When a hazardous substance goes from a controlled condition (for example, inside a truck, barrel, storage tank, or landfill) to an uncontrolled condition in the air, water, or land. Any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping or disposing into the environment (including the abandonment or discarding of barrels, containers and other closed receptacles containing any hazardous substance or pollutant or contaminant), but excludes:

a. Any release which results in exposure to a person solely within the workplace, with respect to a claim which such person may assert against an employer provided, however, that this exclusion does not apply to any such release which also results in exposure to the environment;

b. Emissions from the engine exhaust of a motor vehicle, rolling stock, aircraft, vessel or pipeline pumping station engine;

c. The appropriate application of fertilizer and pesticide;

d. Any discharges in compliance with state permits issued in conformance with this title and federally permitted releases under CERCLA.

**Remedial Action**

The containment of a contaminant mass or toxicity reduction, isolation, treatment, removal, cleanup or monitoring of hazardous substances released into the environment, or the taking of such other actions as may be necessary to prevent, minimize or mitigate harm or risk of harm to the public health or welfare or the environment, which may result from a release or an imminent threat of a release of hazardous substances. The Department issues a proposed plan of remedial action outlining the proposed remedy, for public comment. After review and consideration of the comments received during the comment period, the Department issues a final plan of remedial action.

**Remedy**

Any action, response or expenditure consistent with the purposes of this chapter to identify, minimize or eliminate any imminent threat posed by any hazardous substances to public health or welfare or the environment including preparation of any plans,

conducting of any studies and any investigative, oversight of remedy or monitoring activities with respect to any release or imminent threat of release of a hazardous substance and any health assessments, risk assessments or health effect studies or natural resource damage assessments conducted in order to determine the risk or potential risk to public health or welfare or the environment. The implementation of a remedy may consist of distinct phases such as design, construction, operation, and maintenance and compliance monitoring.

**Residual Contamination**

Contaminants left at a site after the risks posed by the site have been reduced and the site no longer threatens people or the environment, or that currently is not possible to remove.

**Resource Conservation and Recovery Act (RCRA)**

A Federal law that authorizes EPA to set standards for companies producing, handling, transporting, storing, and disposing of hazardous waste.

**Response Action**

An action taken by DNREC, EPA or other federal, state, or local agency to address the risks posed by the release or threatened release of hazardous substances. The Department may require or conduct an interim response action at any time before the selection of the final remedial action to prevent, minimize or mitigate harm to public health, welfare, or the environment.

**Responsible Party**

A person or business that is responsible for a hazardous site. Whenever possible, EPA and DNREC require Responsible Parties, through administrative and legal actions, to clean up the sites they have contaminated.

**Risk Assessment**

The process of defining the possible health effects of exposure of human populations to hazardous substances. Risk assessment may also include defining the risk to the environment.

**Risk-Based Concentration Values (RBC)**

The levels or concentrations of contaminant(s) determined to be protective of human health and the environment. The EPA in Region 3 has developed and posted a Risk-Based Concentration (RBC) Table at: http://www.epa.gov/reg3hwmd/risk/human/index.htm. The RBC Table contains Reference Doses (RfDs) and Cancer Slope Factors (CSFs) for about 400 chemicals. Toxicologists use RBCs to screen sites and calculate Hazard Quotients and lifetime cancer risks of contaminants in water, air, fish tissue, and soil.

**Sample Quantitation Limit (SQL)**

The quantity of a substance that can be reasonably quantified given the limits of detection for the methods of analysis and sample characteristics that may affect quantitation (e.g., dilution, concentration).

**Sampling**
The collection of representative specimens analyzed to characterize site conditions.

**Secretary**
Secretary of the Department (DNREC), or the Secretary's designee.

**Site Cleanup**
See Cleanup.

**Site-Specific Standard**
DNREC developed three remediation standard options to provide flexibility in DNREC's Site Investigation and Restoration Branch cleanup up programs. These are Background Standards, Uniform Risk-based Standards and Site-Specific Standards, as outlined in DNREC's *Remediation Standards Guidance*.[36] Site-Specific Standards are used for sites that do not meet the assumptions used to derive, or conditions applicable to the URS, or sites that contain substances in different media not specified in DNREC's *Remediation Standards Guidance*. It is also applicable to sites with multiple contaminated media beyond soil or groundwater (i.e., sediment, surface water, air, biota, etc.).

**Source**
An area where a hazardous substance may have been deposited, stored, disposed, or placed. Also, soil that may have become contaminated as a result of hazardous substance migration. In general, however, the volumes of air, ground water, surface water, and surface water sediments that may have become contaminated through migration are not considered sources.

**Source Reduction**
The design, manufacture, or use of products that in some way reduces the amount of waste that must be disposed of; examples include reuse of by-products, reducing consumption, extending the useful life of a product, and minimizing materials going into production.

**Superfund**
See CERCLA.

**Superfund Amendments and Reauthorization Act (SARA)**
A Federal law that amended CERCLA on October 17, 1986. SARA made several important changes and additions to the Superfund program, including highlighting the importance of permanent remedies and innovative treatment technologies in cleaning up hazardous waste sites; requiring the Superfund process to consider the standards and requirements found in other state and federal laws and regulations; provided new enforcement authorities and settlement tools; increasing state involvement in the superfund program; increasing the focus on human health problems posed by hazardous substance/waste sites; stressing greater citizen participation in making decisions on how

[36] See Attachment 3 of DNREC's *Remediation Standards Guidance under the Delaware Hazardous Substance Cleanup Act* at: http://www.dnrec.state.de.us/dnrec2000/Divisions/AWM/sirb/DOCS/PDFS/Misc/RemStnd.pdf

sites should be cleaned up; and increasing the size of the Superfund Trust Fund to $8.5 billion.

**Superfund Trust Fund**

A public trust fund created with passage of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) in 1980 to be used exclusively to help pay for the cleanup of abandoned hazardous substance/waste sites.

**Surface Water**

Bodies of water that form and remain above ground, such as lakes, ponds, rivers, streams, bays, and oceans.

**Toxic**

Poisonous substances or chemicals.

**Toxic Substances Control Act (TSCA)**

A Federal law that empowers EPA to require the chemical industry to test chemicals and provide safety information before they are sold.

**Toxicology**

Study of the effects of poisons in living organisms.

**Treatment Technologies**

Processes applied to hazardous waste or contaminated materials, to permanently alter their condition through chemical, biological, or physical means, and reduce or eliminate their danger to people and the environment.

**Underground Storage Tank**

An underground tank storing hazardous substances or petroleum products.

**Uniform Risk-Based Standards**

DNREC developed three remediation standard options to provide flexibility in the Delaware Hazardous Substance Cleanup Act program. These are Background Standards, Uniform Risk-based Standards and Site-Specific Standards. DNREC published the Uniform Risk-Based Standards (URS) as potential screening levels for the protection of human health and the environment in the *Remediation Standards Guidance*.[37] Generally, the URS are one order of magnitude more restrictive than is required by HSCA to protect human and ecological receptors. The URS are more protective than the level required under HSCA to compensate for the possible effects of multiple contaminants, or a cumulative risk to human health and the environment. The URS are used primarily for guidance purposes as a site assessment screening tool.

[37] DNREC's *Remediation Standards Guidance under the Delaware Hazardous Substance Cleanup Act* is available at the following link: http://www.dnrec.state.de.us/dnrec2000/Divisions/AWM/sirb/DOCS/PDFS/Misc/RemStnd.pdf.

**Volatile Organic Compounds (VOCs)**

Hazardous substances that are organic (carbon-based) compounds that evaporate at room temperature.

**Water Table**

The upper limit of a geologic layer saturated with water.

**Well**

A hole drilled or sunk into the ground to characterize the vertical soil and groundwater profile, or to reach a supply of groundwater.

**Well Log**

A record of geologic materials with depth based on data obtained beneath a point on the land surface and representative of types, depths, and thicknesses of materials beneath that point. The data may represent visual observations, physical/chemical characterizations, and/or geophysical properties. The record also contains information on wells (drinking and monitoring), where appropriate.

**Worker**

A person working on a property with an area of observed contamination and whose workplace area is on or within 200 feet of an area of observed contamination. Both full and part-time workers are considered when evaluating environmental risks.

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# ATTACHMENT A: Comments and Questions

## **Workshops:**

### DNREC Workshop September 8, 2005

1. What is a borrow pit?
2. Where are the locations for the statewide arsenic soil samples collected in the various studies?
3. When you look at the USGS report, which indicates that the average arsenic concentration is 8.5 parts per million (ppm) for residential properties, why would you select a higher default background cleanup standard of 11 ppm for residential properties? Why did DNREC choose 11 ppm instead of 8.5 or 10 ppm?
4. How was the 11 ppm default background standard derived?
5. Was the 11 ppm an arbitrary number?
6. We would like to see a wider testing of agricultural fields in Delaware.
7. What would the residential average for arsenic look like on a national basis if the first top ten feet of soil was evaluated? If the first one foot of soil was evaluated?
8. Commenter expressed appreciation for the proposal, but indicated that Delaware deserves something better. [The standards should be] legally binding regulations, as regulations provide the public with opportunities for notice, establishing standards and reasoning, and comment. What process was used to adopt the cleanup standard, and protection of public input and notice? If not using the process for regulations, why not?
9. Cleanup standards should be developed using a risk-based approach. Was the 11 ppm default background standard developed this same way?
10. Which exposure pathways were considered?
11. Were risk assessment calculations done for the dermal and inhalation exposure pathways? Were they summed (i.e., cumulative risk) considered?
12. Please provide the data calculations for the risk assessment (oral, dermal, inhalation, & cumulative).
13. Were environmental or ecological risks evaluated?
14. Which advisory committees will be looking at the proposal for comment and input?
15. It appears, given risk assessment methodology, if we assume that 1 in 100,000 additional cases of cancer equals an acceptable risk level, and assume how much is eaten is equal to 0.4 ppm, then don't we need to have a darn good reason for raising the cleanup standard above this level several times over?
16. Shouldn't the regulations have "teeth in them?"
17. At industrial sites that are cleaned up, why is the public around them not informed about the cleanup and issues?
18. We are extremely concerned about residential levels of arsenic for kids moving into new developments at former golf courses and agricultural property.
19. We need a high standard (more conservative) for arsenic [at residential properties]?
20. There is an educational component that needs to be done for even playing on golf courses because of possible urological problems. Should this be addressed by the Division of Public Health?
21. During a planning board meeting in New Castle County, it was noted that there were high levels of arsenic and other contaminants at the former Hercules golf course. What are the standards for golf courses?

22. Should golf courses be used for residential purposes?
23. At what level or point in time do golf courses fall under DNREC or the DE Dept. of Agriculture?
24. Do we need authority to cover golf courses?
25. Who regulates billboard pesticide certification?
26. Who regulates DelDOT properties?
27. Any health affects associated with golf courses?
28. What kind of ecological risk assessment was performed? Please provide the data for the ecological risk assessment.
29. Please provide all the data and the calculations for all risk assessments performed.
30. Any fish tissue data? If the threshold for an ecological risk assessment is 56 ppm, and human health is much lower, if we are protective for humans, are we protective for fish as well? Which fish species were used in the studies? Is it the Department's position that no fish species were affected below 56 ppm? Please provide the EPA or other data used.
31. Are inhalation risks really not significant?

## DNREC Workshop September 14, 2005

1. How is it possible that DNREC already has a number that they wanted to use (11 ppm) prior to completing the study?
2. What is DNREC justification for the 11 ppm?
3. Where is the data that supports the conclusions of the document/report?
4. In a clear and concise process, what steps were used to set up the arsenic standard?
5. In the recent past, why was the arsenic level raised without public participation and how can the public be sure that this does not happen again?
6. Does DNREC believe that the additional cancer rate (moving the number from 4 ppm to 11 ppm) is acceptable to the people of Delaware?
7. Why doesn't DNREC have a policy that is health based?
8. Why is DNREC setting the arsenic level above the health-based standard?
9. All of the data is the report points to a 10 ppm background level, why was 11 ppm chosen?
10. Is the 11 ppm number a mean?
11. What type of arsenic was focused on in this study?
12. Is background and natural-occurring arsenic the same in this study?
13. What is actually naturally occurring arsenic (in relation to background) with all the historical uses within the state?
14. The Wilmington study only had one sample at 19 ppm. If this sample is taken out from the analysis, the average goes from 10.095 ppm to 9.64, why wasn't this done?
15. In regards to the borrow pit samples cited in the document, were any surface soils mixed with the deeper soils?
16. Why doesn't DNREC look at new development (residential and industrial) and have the sites cleaned up to 4 ppm?
17. Will DNREC, in its review of the arsenic standard, only raise the background level or will it lower the value also?
18. Who is on the arsenic advisory panel?
19. Why doesn't the report focus on any other pathways except ingestion (i.e., inhalation)?
20. If a site has a background above 11 ppm, what do you clean it up to?

21. Why isn't this guideline set as a regulation?
22. Do the numbers support the position the DNREC is taking?
23. If DNREC has had a difficulty setting an arsenic level, how can the Department deal with other chemicals that are more toxic?
24. What is the federal (EPA) level of arsenic and other compounds of concern found in the state?
25. Why doesn't DNREC move the arsenic level to the national average of 7 ppm?
26. Why is DNREC using the highest level for the entire state and not breaking it into more site-specific areas like the counties?
27. How does arsenic effect the composition of the human body differently and why wasn't this analyzed in this study?
28. What is the lowest level of arsenic in the surrounding states and the entire states?
29. Why isn't DNREC using 4 ppm as it standard or at minimum 6 ppm?
30. Why is the review set on an annual schedule and during these reviews, is there a chance that DNREC will lower the level?
31. Does DNREC have a conflict of interest because the Department contributes funds for certain clean ups?
32. In the document, it states that budgets would be affected by choosing a lower level. What budget is that?
33. Is the state currently cleaning up sites (w/ HSCA funds) where development is not occurring?
34. Is DNREC providing funding for site(s) at the Riverfront with HSCA funds?
35. Were ecological receptors looked at in this report when the 11 ppm standard was chosen?
36. Any organic matter sampled for this study?
37. Is DNREC making policy decisions for the government of Delaware or for the people of Delaware?
38. Why historically has DNREC been increasing the allowable level of arsenic while the [Department of Health and Human Services (DHHS) –] Division of Public Health is lowering their value?
39. Statement: DNREC data quality does not support Six Sigma methodology.
40. Statement: The public has a problem with how the data was collected.
41. Should DNREC have jurisdiction over golf courses and other commercial properties (i.e., orchards) in the state?
42. In addition, shouldn't DNREC have regulations for all compounds [used at golf courses], not just guidelines?
43. Why were there no core or deep samples collected from the Hercules property, only surface?
44. There is a current drinking water well at Hercules, how does that relate to the 11 ppm standard?
45. What is the level of arsenic at the Hercules golf course?
46. Is Toll Brothers applying for state/federal funds to develop the former Hercules golf course?

47. *Additional questions submitted by citizens in writing at the end of the meeting:*
48. What is the purpose of this workshop? What were your expected outcomes?

49. If glauconite or glauconitic sands were found at the Route 202 burrow pit, then this location should not be used in determining the average for the State. This would bias the results high.
50. Arsenic levels for the State of DE should be no more than 4 ppm or Senator Sokola's SB 68 of 6 ppm.
51. In areas where multiple contamination is present, this should in all cases be verified via soil sampling, this figure be reduced to 0.4 ppm.
52. There should be no annual review of arsenic action levels unless consideration of a reduction is in order.
53. Should protective action be taken to eliminate and penalize use of all pesticide/fertilizers use that contains arsenic or other heavy metals in the State of DE in light of its high cancer rate? (Not unlike the "No Smoking ban for the State of DE.)
54. Shouldn't Health and Safety issues be addressed?
55. All of the background studies should be made available to the public.

*Additional submittals received at end of meeting:*

*A. The President of the Millstone-Limestone Civic Alliance provided a letter at the end of the meeting with a list of five (5) written comments.*

*B. The Chairman of the Council of Civic Organizations of Brandywine Hundred provided related information from the New Jersey Department of Environmental Protection entitled "Historic Pesticide Contamination" and "Environmental Assessment and Risk Analysis Element Research Project Summary on Ambient Levels of Metals in New Jersey Soils" (May 2003).*

DNREC Workshop September 22, 2005

1. What is the difference between naturally-occurring arsenic and background arsenic concentrations?
2. If a quarry or borrow pit only had 14 ppm, why would you use 23 ppm as a background concentration?
3. Is it cheaper to cleanup to 23 ppm vs. 11 ppm?
4. Is there a difference in levels in different areas of the state? Please show map of state and levels, or send a map with state levels.
5. Do you see a significant difference between coastal plain deposits and up north [Piedmont] arsenic concentrations?
6. Is there a health difference between 6 ppm, 11 ppm, and 23 ppm with respect to health?
7. What was the cleanup level that prompted the Governor to request a review?
8. What is the timeline for this decision?
9. Is the cleanup level of 23 ppm still on the table?
10. Will a lower cleanup level slow down the building boom in Sussex County?
11. When would a risk-based standard kick in? Please explain arsenic speciation and assumptions in risk calculations.
12. Should golf courses and farms be regulated?
13. What is the remedy(s) for arsenic contaminated soils?

## Meetings:

Southbridge Civic Alliance Meeting - Comments and Questions (9/20/05)

1. What does naturally-occurring arsenic mean?
2. What is a toxic concentration for arsenic?
3. Many of the basements in the Southbridge area have dirt basements. Will there be soil testing of the basements for arsenic?
4. What was the former cleanup level that caused public concern?

## Letters:

Technical Outreach Services for Communities (TOSC) – Comments (8/15/05)

Milltown-Limestone Civic Association – Comments (9/14/05)

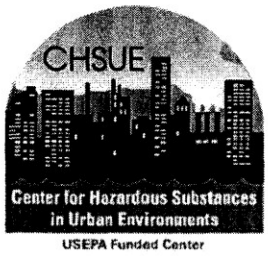
Council of Civic Organizations of Brandywine Hundred – Comments (9/22/05)

DuPont Engineering – Comments (10/10/05)

Chemical Industry Council of Delaware – Comments (10/ 17/05)

Brightfields, Inc. – Clarification Letter (12/5/05)

8/11/2005




**TOSC Comments on DNREC's Arsenic Risk Management Proposal**
**Draft Background Document**

TOSC believes that the process used to arrive at a uniform background level for Arsenic is defensible and will prove very useful in future cleanup decision-making.

We are concerned that the process for utilizing the established background level is not discussed in adequate detail in the document. At potentially contaminated sites that are located in areas of higher than the established background, the decision process needs to be defined for dealing with such issues as arsenic concentrations at the local (higher) background, hot spots above the local background on the site, and the unimpacted areas surrounding the site which naturally have higher concentrations than the established background level.

A second, related area of concern is the silence of the document on the topic of action levels as opposed to cleanup levels. Without defining risked based action levels, all areas of the state with backgrounds above the established statewide level become problematic. Pristine areas could become targets of local alarm even if they do not pose unacceptable risk.

We recommend that a clear exposition of how the established background is to be used be made a part of the public document and that it be discussed in detail at the public presentations.

Please contact us if you have any questions, comments, or would like our assistance with any other community hazardous waste issues.

Thank you,
Robyn Gilden, RN, MS
Program Manager

2/[illegible]/05

I'm William H. Dunn, President of the Milltown-Limestone Civic Alliance. A number of members of our group, as well as a retired Chemical Engineer, have reviewed the June 22, 2005 arsenic report by DNREC. I'll review a number of observations that we have noted and finish with our recommendation.

1) DNREC's very first sentence in their Arsenic Draft Background Document states, "This document reflects a proposal for public comment by [the] Department of Natural Resources and Environmental Control staff, working with other state agency staff, to establish a cleanup goal for arsenic in soil at residential settings to background levels – using 11 parts per million(ppm) as a default background concentration, and to undertake a significant public participation process to solicit and use public input before finalizing this cleanup goal." This implies, before beginning whatever process they went through to write this document, they decided what their number would be. After twenty-one years in the chemical research field and a myriad of different projects, never have the people I work with, decided what our variable value would be before we began a project.

2) Rather than challenging the poorly developed assumptions of their own agency in the past, DNREC decided to challenge the nationally recognized standards and how they were develop. This approach fails to recognize that the EPA and [illegible] and their oversight organizations are not being scrutinized by the Governor of Delaware, they are.

3) DNREC has defined the difference between 1/100,000 and, as I calculate it, 1/39,090 cancer cases as a "slightly elevated lifetime cancer risk". Now, if your NOT one of the one and half additional cancer cases, you might agree that it is a slight increase. But, if you are one of those cases, you might have a different position.

4) Mr. Robert Schulte, DNREC's Senior Chemist, last Thursday argued that to analyze a single sample more than once would be a "waste of the taxpayers' money". Based on my career experiences, three to five repeat analyses for research purposes is acceptable, but for a statically significant value, you need ten analyses. The corporate world today talks about statically significant data in terms of Six Sigma methodology, the data DNREC is presenting in this report wouldn't even qualify as two sigma.

5) Given that some might reject our interpretation of the report, their own evaluation would find that the report's data supports a overall background value of 10ppm and for existing residential properties, 8.5ppm.

This is only a small amount of the problems I and other people who work in, or are retired from, the chemical industry have with this report. One of things a community group in Delaware doesn't have is the ability find knowledgeable chemists and engineers.

It is the recommendation of the Milltown-Limestone Civic Alliance that DNREC immediately lower the permissible arsenic level for new residential homes to the national average of 7.2 mg/Kg for soil or 7.2ppm. We were prepared to recommend and support four levels of tolerable arsenic differentiated by northern New Castle County or the

portion of the county on the Piedmont Plateau and the rest of the state, and residential use versus commercial or industrial.

Instead, we will begin lobbying the State Legislature to move forward with S.B. 68. Presently, the Bill is being sponsored by Senators Sokola and Blevins as well as Representatives Hudson, Roy and Gilligan. We will be asking them to help lobby their House and Senate counterparts to pass S.B. 68 with nothing more than minor modifications. This important legislation will not only establish a legal standard for new residential homes, it will mandate proper remediation by the developer before construction begins.

Thank You

William H. Dunn
President – Milltown-Limestone Civic Alliance

216 Fenwick Ave.
Wilm., DE 19804
(H) 994-9334
(C) 598-6313

COUNCIL OF CIVIC ORGANIZATIONS OF BRANDYWINE HUNDRED

ARSENIC CLEANUP RESOLUTION

Whereas our primary concern is the health of our citizens especially our children, the adverse impact from long term ingestion of contaminated soils must be prevented.

Whereas present law 7DelC-9103, specifies- If soil concentrations are consistent with naturally occurring levels of the contaminant in the area, then DNREC does not require remediation as the enabling law only allows DNREC to address contamination that is the result of a RELEASE.

Whereas the law indicates if DNREC determines the contamination is the result of appropriate application of fertilizer and pesticides, which often contain arsenic, then DNREC cannot require remediation as that is specifically exempt from remediation under the Hazardous Substances Cleanup Act under the definition of release.

Whereas NEW DEVELOPMENTS on agricultural land, chicken farms, orchards, vegetable fields, golf courses, turf farms etc. are occurring and are of concern because of historical use of fertilizers and pesticides and potentially high levels of contaminants like arsenic and other health and cancer risk contaminants.

Whereas now a guideline/policy system is used to define limits for contaminants.

Whereas the natural background geology of Delaware which includes the mineral Glauconite-green sand - which contains arsenic, is and must be considered in the evaluation.

Be it Resolved by the CCOBH Executive Committee, that:

Authority be given DNREC to review potential NEW DEVELOPMENTS for residential and other uses and DNREC require remediation if contaminants like arsenic are above health and cancer risk levels.

A public process, including hearings be established that results in a regulation, with a mechanism for change as health data and other scientific information advances.

Additional funding, if needed, be authorized to permit accurate, representative, through and precise sampling and analytical results on natural background and contaminated soil samples. (Note: Currently available data appears to be inadequate to differentiate between natural levels and the lower levels of contaminate that might be set as limit. Nearby states have wide range of limits and should be studied.)

All state, county, city and towns activities like new parks, schools, roads etc. should also be under specified cleanup requirements.

Therefore CCOBH endorses the intent of Senate bill 68 requiring remediation for New Developments where arsenic is present above a default limit specified by DNREC regulations or the legislature.

This resolution was passed on September 22, 2005 by the Executive Committee of CCOBH, The Council Of Civic Organizations of Brandywine Hundred, an Umbrella group of 140 civic organizations, representing 83,000 people in Brandywine Hundred.

Daniel E. Bockover
President

Wallace L. Kremer
Environment Committee Chairman

DuPont Engineering
Barley Mill Plaza - Bldg. 19
4417 Lancaster Pike
Wilmington, DE 19805

October 10, 2005

WORKING COPY

Robert Schultes
Analytical Chemist
DNREC
391 Lukens Drive
New Castle, DE 19720

DNREC Proposal to Establish a Generic Background Level of Arsenic in Soils at 11 ppm

Dear Mr. Schultes:

This letter provides DuPont's support of certain elements of the Department of Natural Resources and Environmental Control's (DNREC's) recent proposal to use site-specific background levels of arsenic as a cleanup level in residential settings and to establish 11 ppm as a default background level of arsenic in soil.

DuPont is a Delaware-based company that has operated here for over 200 years. During parts of our history, we have created certain situations that now require remediation. As such, the subject proposal by DNREC has the potential to impact remediation activities at a number of our facilities. DuPont has a keen interest in seeing that a practical and scientifically sound approach is used to establish the background level for arsenic.

We support many of the positions articulated in the "Arsenic Risk Management Proposal Draft Background Document" dated June 22, 2005 that DNREC uses as the basis for its proposal. For example, we agree with the Department's position that a cleanup standard for arsenic that uses default exposure and toxicity assumptions could result in an unworkably stringent standard. Associatively, the use of site-specific background as a basis for establishing the arsenic cleanup level is appropriate, when such a value is available.

After reviewing the background document, DuPont believes that Option "D" (i.e. 23 ppm default background) would represent an equally defensible position to the 11 ppm standard proposed by the Department. This is based on the following observations:

- The toxicity criterion that underpins risk management decisions on arsenic is sufficiently conservative as to allow minor deviations from strict risk management standards. The Taiwanese studies that form the basis for the current arsenic potency factor are recognized to likely overstate potential carcinogenic risk among U.S. citizens owing to differences in diet, lifestyle and nutritional status.

- The bioavailability of arsenic in soil is typically far less than 100%. If actual measures of site soil bioavailability are considered, the cleanup level may well approach or exceed the 23 ppm option articulated by the Department.

Following the same reasoning that led us to believe that the 23 ppm default level is highly defensible, we also believe that the default criteria should be set no lower than the 11 ppm option articulated in the background document.

An area for clarification in the risk management proposal has to do with how DNREC intends to apply background data to remediation decisions. DuPont recommends that *average* post-cleanup residual concentrations be compared to the site cleanup level, as opposed to requiring that *all* post-cleanup results be below the background standard. Use of an average residual arsenic concentration as a risk management standard will afford an adequate degree of public health protection in a cost-effective manner.

We appreciate this opportunity to provide comment on the arsenic risk management standard proposal, and we commend the Department for developing such a technically thorough, yet very transparent document to aid in the dialogue on this important topic.

If you have any questions about DuPont's position on this issue, or if we can provide clarification to any of the points in this letter, please do not hesitate to call me at (302) 992-6771.

Best regards,

Bob Genau

Bob Genau
Principal Project Leader
DuPont Corporate Remediation Group

Cc: Tim Bingman, DuPont
Pam Meitner, DuPont
File

**CIC CHEMICAL INDUSTRY COUNCIL OF DELAWARE**
1201 Orange Street, Suite 1010
Wilmington, DE 19801
302/655-2673 Fax:302/655-4374



WORKING COPY

October 17, 2005

The Honorable John A. Hughes
Secretary
Delaware Department of Natural Resources and Environmental Control
89 Kings Highway
Dover, DE 19901

Establishing Background Levels of Arsenic in Soils for Residential Remediation

Dear Secretary Hughes:

This letter is in response to the Department of Natural Resources and Environmental Control's (DNREC's) recent proposal to use site-specific background levels of arsenic as a cleanup level in residential settings and to establish 11 ppm as a default background level of arsenic in soil.

The Delaware Chemical Industry Council (DCIC) represents the major chemical industrial enterprises in the State of Delaware. Many of our members have historic operations here dating back many decades, and we believe that this decision has the potential to impact remediation activities for a number of our members, as well as to establish an important precedent for other remediation programs.

DCIC appreciates the fact that the current proposal acknowledges the practical reality that a generic criterion based purely on risk could be more stringent than levels of arsenic that naturally occur in background soils. We would offer the following reactions to the positions articulated in the "Arsenic Risk Management Proposal Draft Background Document" dated June 22, 2005 that DNREC uses as the basis for its proposal:

- We support the use of background levels of inorganic materials as a basis for identifying contaminants of potential concern. Moreover, we believe that it is critical to afford responsible parties the option to use background in lieu of a purely risk-based cleanup standard in those situations where generic risk-based cleanup levels are below background.

- We believe that for all constituents, including arsenic, the responsible party should be afforded the option of developing site-specific cleanup levels. The development of such site-specific cleanup standards should include a consideration of the uncertainty surrounding the toxicity criterion for the constituent, and the site-specific exposure assumptions for a given site, including a consideration of bioavailability.

- We do not believe that the 11 ppm default value for arsenic in background adequately reflects the diversity of soil types encountered in the state. If the State believes that it needs to develop a generic background level for those situations where the development of site-specific background data is not feasible, we feel that the State would be technically justified in using the upper end of the observed range of background values (i.e. 23 ppm).

We appreciate this opportunity to provide comment on the arsenic risk management standard proposal. Given the potential impact of this proposal on our membership, we hope that you will consider our comments in the constructive spirit in which they were intended.

If you have any questions about DCIC's positions on this issue, please call me at 302-655-4707.

Best regards,

William T. Wood, Jr.

William T. Wood, Jr.
Executive Director

**BrightFields, Inc.**
Environmental Services

December 5, 2005

DEC - 6 2005

Mr. Tim Ratsep
DNREC-SIRB
391 Lukens Drive
New Castle, DE 19720

**RE: Response to DNREC-SIRB Question on 11/14/2005**
**Hercules Road Property**
**Wilmington, Delaware**
**BrightFields File #1938.01.21**

Dear Mr. Ratsep:

Please find below BrightFields' response to your question from November 14, 2005 regarding the Hercules Road property.

**Question:**

**Why were no deep samples collected past 5 feet deep on the Hercules Road Property? Only surface samples were collected?**

**Response:**

The scope of work for this project consisted of two separate investigations (HSCA Investigation and Non-HSCA Investigation) both of which collected surface soil and deep soil samples.

As part of the November 2003 Hercules Road property HSCA Remedial Investigation, in addition to the 10 surface (maximum depth of 2 feet bgs) soil samples that were collected, ten deep (greater than 2 feet bgs) soil samples (8 samples from 10 to 12 feet bgs, 1 sample from 4 to 5 feet bgs, and 1 sample from 3.5 to 4.75 feet bgs) were collected and analyzed for full target analyte list (TAL) and target compound list (TCL) parameters at Lancaster Laboratory. These samples were collected to characterize the site as a whole.

The purpose of the focused Non-HSCA Remedial Investigation was to characterize the vertical and lateral extent of elevated concentrations of metals (notably arsenic and lead) in soil beneath two greens (green 2 and green 4) as proxies for all of the greens. This investigation utilized a portable x-ray fluorescence instrument (XRF), which gave quantified analytical result of metals during sample collection. These initial field screening results were used to assess whether or not a deeper

sample needed to be collected. The results of the field screening analysis showed that metal concentrations decrease rapidly with increased depth.

In addition to the field screening analysis, all samples were also analyzed at the DNREC-SIRB laboratory and at Lancaster Laboratory. Both the field screening XRF results and the laboratory sample results indicate that concentrations decrease rapidly with increased depth. The results of this investigation showed that the vertical extent of metal concentrations above the DNREC Uniform Risk-Based Standard (URS) are present at depths that vary from 0 to 3.5 feet bgs in greens 2 and 4 and that metal concentrations decrease to below the URS beginning at a depth of 3.5 feet bgs. Based on the results of this investigation, there was no need to go any deeper than five feet deep, because the vertical extent of metal concentrations above the URS extended to a maximum depth of 3.5 feet bgs.

We trust that this response addresses your question. If you need any further clarification please contact Heather Wrigley or me at (302) 656-9600.

Sincerely,
**BrightFields, Inc.**

Mark Lannan
Principal

cc: Andrew Semon, Toll Brothers, Inc.
Kathy Stiller-Banning, DNREC-SIRB

# ATTACHMENT B: Arsenic Background Soil Concentration Data Tables

# Arsenic Summary Tables *

**Background Concentrations of Total Arsenic in Delaware Surface Soils**

The DNREC Site Investigation and Remediation Branch (SIRB) has compiled data on background concentrations of metals in Delaware surface soils. These concentrations were drawn from 2 data sources:

1. Wilmington Parks Background Metals Study
2. Various waste site investigations performed throughout the State where samples believed to represent background were collected along with site samples.

The data from these 2 sources are summarized below.

**Wilmington Parks Background Metals Study Results**

| Sample ID | Data Source | County | Arsenic (ug/g) |
|---|---|---|---|
| Kentmere ss-01 | Wilm Parks Study | New Castle | 7.7 |
| Kentmere ss-02 | Wilm Parks Study | New Castle | 8.6 |
| Kentmere ss-03 | Wilm Parks Study | New Castle | 8.9 |
| Rockford ss-01 | Wilm Parks Study | New Castle | 8.3 |
| Rockford ss-02 | Wilm Parks Study | New Castle | 9.8 |
| Rockford ss-03 | Wilm Parks Study | New Castle | 10.3 |
| Rockford ss-04 (dup) | Wilm Parks Study | New Castle | 8.7 |
| Alapocas ss-01 | Wilm Parks Study | New Castle | 9.3 |
| Alapocas ss-02 | Wilm Parks Study | New Castle | 11.6 |
| Alapocas ss-03 | Wilm Parks Study | New Castle | 9.3 |
| Baynard ss-01 | Wilm Parks Study | New Castle | 11.1 |
| Baynard ss-02 | Wilm Parks Study | New Castle | 6.5 |
| Baynard ss-03 | Wilm Parks Study | New Castle | 14.7 |
| Baynard ss-04 (dup) | Wilm Parks Study | New Castle | 8.9 |
| Brandywine ss-01 | Wilm Parks Study | New Castle | 13.2 |
| Brandywine ss-02 | Wilm Parks Study | New Castle | 5.6 |
| Brandywine ss-03 | Wilm Parks Study | New Castle | 19.4 |
| Sellers ss-01 | Wilm Parks Study | New Castle | 5.7 |
| Sellers ss-01 | Wilm Parks Study | New Castle | 13 |
| Sellers ss-01 | Wilm Parks Study | New Castle | 11.3 |

* - This data is derived from Rick Greene's statistical analysis of background soil samples. See link at http://www.dnrec.state.de.us/dnrec2000/Divisions/AWM/SIRB/Arsenic/New/Arsenic.xls

# Arsenic Summary Tables (Continued)

## Transposed Arsenic Data - Background Metals Data Collected During Waste Site Investigations

| Site No. | Site Name | Data Source | County | Arsenic (ug/g) |
|---|---|---|---|---|
| DE-281 | Diamond State | Salvage "SI" | New Castle | 8 |
| DE-176 | Ametek | "SI" | New Castle | 4.5 |
| DE-192 | Castle Ford | "SI" | New Castle | 4 |
| DE-169 | DE Contracting | "SI" | New Castle | 26 |
| DE-18 | FMC Co. | "SI" | New Castle | 5.1 |
| DE-165 | Forbes Steel | "SI" | New Castle | 13.3 |
| DE-67 | Halby Chem. A | "SI" | New Castle | 4.4 |
| | Halby Chem. B | "SI" | New Castle | 14.7 |
| DE-126 | Juliano | "SI" | New Castle | 5.5 |
| DE-39 | Newark L/F | "SI" | New Castle | 31 |
| DE-199 | NVF Newark | "SI" | New Castle | 5.1 |
| DE-81 | NVF Stateline | "SI" | New Castle | 23 |
| DE-266 | Amtrack WRF | "SI" | New Castle | 7.5 |
| DE-146 | Wilson Contracting | "SI" | New Castle | 4.3 |
| DE-193 | Salem Church Dump | "SI" | New Castle | 3.4 |
| DE-196 | Middletown L/F | "SI" | Kent | 3.9 |
| DE-211 | All Rite New | "SI" | Kent | 1.1 |
| DE-66 | Eastern Disposal | "SI" | Kent | 5.1 |
| DE-154 | Frazier's Pit | "SI" | Kent | 9.2 |
| DE-48 | Globe Union | "SI" | Kent | 3.3 |
| DE-110 | Litton Ind. | "SI" | Kent | 13 |
| DE-123 | Middletown Sewer | "SI" | Kent | 1.77 |
| DE-128 | Mill St. Dump | "SI" | Kent | 29 |
| DE-104 | Pearson's Corner | "SI" | Kent | 7.8 |
| DE-153 | Scull Prop | "SI" | Kent | 9.1 |
| DE-127 | Ennis Dump | "SI" | Kent | 2.6 |
| DE-190 | Lewes C/G | "RI" | Sussex | 3.6 |
| DE-188 | Georgetown C/G | "SI" | Sussex | 1.9 |
| DE-149 | Jackson Pit | "SI" | Sussex | 1.4 |
| DE-132 | Lebanon Rd L/F | "SI" | Sussex | 22 |
| DE-150 | Metcalf Pit | "SI" | Sussex | 6.7 |
| DE-202 | Moore Dump | "SI" | Sussex | 1.6 |
| DE-109 | Seaford Drum | "SI" | Sussex | 0.63 |

## Arsenic Summary Tables (Continued)

**Transposed Arsenic Data - Background Metals Data Collected During Waste Site Investigations**

| Site No. | Site Name | Data Source | County | Arsenic (ug/g) |
|---|---|---|---|---|
| DE-13 | Sussex Co. L/F #5 | "RI | Sussex | 0.67 |
| | Sussex Co. L/F #5 | "RI | Sussex | 0.58 |
| DE-118 | Sussex Lumber | "SI" | Sussex | 48 |
| | | This value is clearly inconsistent with the other data. Anthropogenic influence strongly suspected. Therefore, censor. | | |

* - This data is derived from Rick Greene's statistical analysis of background soil samples. See link at http://www.dnrec.state.de.us/dnrec2000/Divisions/AWM/SIRB/Arsenic/New/Arsenic.xls

**TABLE 1**
**REPLICATE ARSENIC SOIL ANALYSIS**

| December 05, 2005 | Arsenic Concentration (mg/kg) |
|---|---|
| 1 | 6.9 |
| 2 | 8.8 |
| 3 | 9.4 |
| 4 | 9.1 |
| 5 | 9.1 |
| 6 | 12.9 |
| 7 | 8.0 |
| 8 | 8.1 |
| 9 | 10.7 |
| 10 | 5.7 |
| 11 | 10.6 |
| 12 | 12.0 |
| 13 | 10.6 |
| 14 | 11.6 |
| 15 | 11.2 |
| 16 | 8.7 |
| 17 | 11.5 |
| 18 | 9.9 |
| 19 | 9.5 |
| 20 | 12.0 |

X-ray Fluorescent (XRF) analysis performed 12/5/05 on 20 soil replicates.

**TABLE 2**
**STATE-SPECIFIC DEFAULT ARSENIC BACKGROUND LEVEL/RANGE**

| State | Background Level or Range |
|---|---|
| Alabama | Site-specific[1] |
| Alaska | 1-10 mg/kg [2] |
| Arizona | Site-specific[3] |
| Arkansas | 1.1-16.7[2] |
| California | Site-specific[4] |
| Colorado | 4-40 mg/kg[2] |
| Connecticut | Up to 10 mg/kg[5] |
| Delaware | 11 mg/kg |
| District of Columbia | 15-17[2] |
| Florida | .01-61.1 mg/kg[2] |
| Georgia | Site-specific[6] |
| Hawaii | 5-15 mg/kg[7] |
| Idaho | Not Available |
| Illinois | 0.35-24 mg/kg[2] |
| Indiana | Site-specific[8] |
| Iowa | 5-10 mg/kg[2] |
| Kansas | Non-detect- 99 mg/kg[2] |
| Kentucky | 0.1-10 mg/kg[2] |
| Louisiana | 0-20.6[2] |
| Maine | 1-28 mg/kg[2] |
| Maryland | 3.6-11mg/kg[9] |
| Massachusetts | Not Available |
| Michigan | 0.1-11 mg/kg[2] |
| Minnesota | Not Available |
| Mississippi | 0-26 mg/kg (4-10 Avg.)[2] |
| Missouri | Site-specific[2] |
| Montana | 0.94-187[10] |
| Nebraska | Site-specific[11] |
| Nevada | Not Available |
| New Hampshire | 0-12 mg/kg[2] |
| New Jersey | 0.02-350 mg/kg[2] |
| New Mexico | 0.15-17 mg/kg[2] |
| New York | 3-12 mg/kg[2] |
| North Carolina | Not Available |
| North Dakota | <0.1-34 mg/kg[2] |
| Ohio | Non-detect – 30 mg/kg[2] |
| Oklahoma | 0-32 mg/kg[2] |
| Oregon | 1-10 mg/kg[2] |

**TABLE 2 (Continued)**
**STATE-SPECIFIC DEFAULT ARSENIC BACKGROUND LEVEL/RANGE**

| State | Background Level or Range |
|---|---|
| Pennsylvania | Site-specific[12] |
| Rhode Island | 7 mg/kg (20)[13] |
| South Carolina | 2-11 mg/kg[2] |
| South Dakota | Not Available |
| Tennessee | 0.1-120 mg/kg[2] |
| Texas | 1-18 mg/kg[2] |
| Utah | Site-specific[14] |
| Vermont | Site-specific[15] |
| Virginia | 2.6-17 mg/kg[16] |
| Washington | 5-9 mg/kg[2] |
| West Virginia | 5.9-13 mg/kg[2] |
| Wisconsin | Site-specific[17] |
| Wyoming | Site-specific[18] |

**Key:**
mg/kg = milligrams per kilogram or parts per million (ppm)
Non-detect = compound or metal not detected above the laboratory method
detection limit
Not Available = information not available
Site-specific = background concentration is determined on a site-specific basis

**REFERENCES**:
1 www.adem.state.al.us
2 http://cleanuplevels.com
3 www.azdhs.gov
4 www.calepa.ca.gov
5 www.dep.state.ct.us
6 www.gaepd.org
7 www.hawaii.gov/doh/eh
8 www.in.gov
9 www.mde.state.md.us
10 www.dep.mt.gov
11 www.deq.state.ne.us
12 www.pader.state.pa.us
13 Arsenic concentrations are allowed as high as 15 ppm
14 www.dequtah.gov
15 www.anr.state.vt.us
16 www.eq.state.va.us
17 www.dnr.state.wi.us
18 www.deq.state.wy.us

**TABLE 3**
**UNITED STATES SOIL CLEANUP STANDARD POLICY BY STATE**

| State | Statue | Regulation/Rule | Guidance/Policy |
|---|---|---|---|
| Alabama | No | No | Yes |
| Alaska | No | No | Yes |
| Arizona | No | No | Yes |
| Arkansas | No | No | Yes |
| California | No | No | Yes |
| Colorado | No | No | Yes |
| Connecticut | No | Yes | No |
| Delaware | No | No | Yes |
| District of Columbia | NA | NA | NA |
| Florida | No | Yes | No |
| Georgia | No | No | Yes |
| Hawaii | No | No | Yes |
| Idaho | No | No | Yes |
| Illinois | No | No | Yes |
| Indiana | No | No | Yes |
| Iowa | No | Yes/No | Yes/No* |
| Kansas | Yes | No | No |
| Kentucky | No | No | Yes |
| Louisiana | No | Yes | No |
| Maine | No | Yes/No | Yes/No |
| Maryland | No | No | Yes |
| Massachusetts | No | No | Yes |
| Michigan | No | Yes | No |
| Minnesota | No | No | Yes |
| Mississippi | No | No | Yes |
| Missouri | No | No | Yes |
| Montana | No | No | Yes |
| Nebraska | No | No | Yes |
| Nevada | No | Yes/No | Yes/No |
| New Hampshire | No | No | Yes |
| New Jersey | No | No | Yes |
| New Mexico | No | No | Yes |
| New York | No | No | Yes |
| North Carolina | No | No | Yes |
| North Dakota | No | No | Yes |
| Ohio | No | Yes | No |
| Oklahoma | No | No | Yes |
| Oregon | Yes | No | No |

**TABLE 3 – (Continued)**
**UNITED STATES SOIL CLEANUP STANDARD POLICY BY STATE**

| State | Statue | Regulation/Rule | Guidance/Policy |
|---|---|---|---|
| Pennsylvania | No | No | Yes |
| Rhode Island | No | Yes** | No |
| South Carolina | No | No | Yes |
| South Dakota | No | No | Yes |
| Tennessee | No | No | Yes |
| Texas | No | Yes | Yes |
| Utah | No | No | Yes |
| Vermont | No | No | Yes |
| Virginia | No | No | Yes |
| Washington | No | Yes | Yes |
| West Virginia | No | Yes/No | Yes/No |
| Wisconsin | No | Yes | No |
| Wyoming | No | No | Yes |

*Yes/No-both site specific/ default standards can be utilized
**Specific requirements for Arsenic are documented in RI's regulations

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**UTAH**
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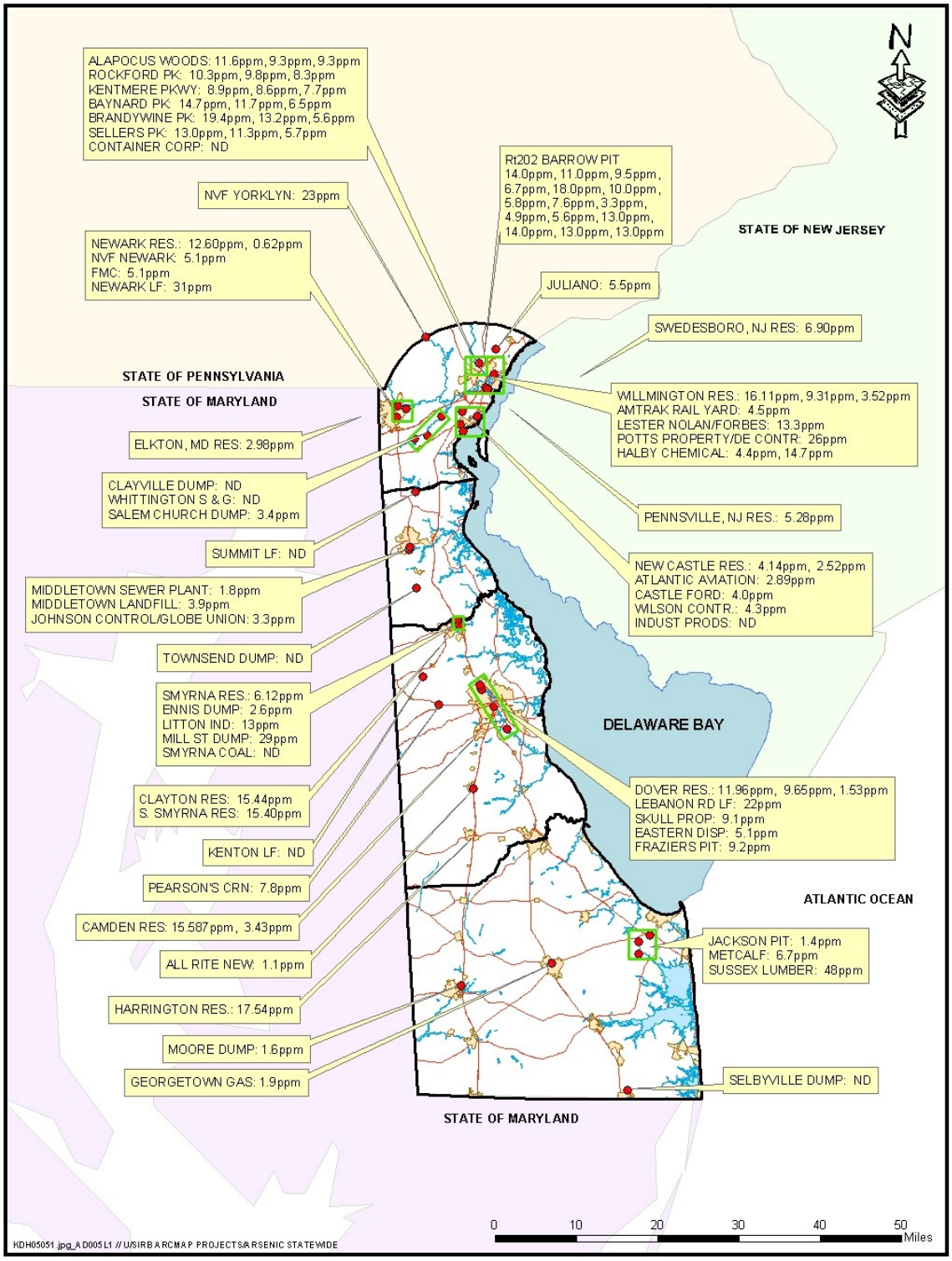
# ATTACHMENT C: Maps - Geographical Representation of Statewide Arsenic Levels




REFRENCES:
RESIDENTIAL VALUES WERE ANALYSED BY DNREC-SIRB RESIDENT CHEMIST ROBERT M. SCHULTE.

RT202 BARROW PIT SAMPLES WERE COLLECTED FOR THE RIVERFRONT HEADQUARTERS SITE DE1309

REMAINING VALUES ARE BACKGROUND SAMPLES FROM STATED SITES.

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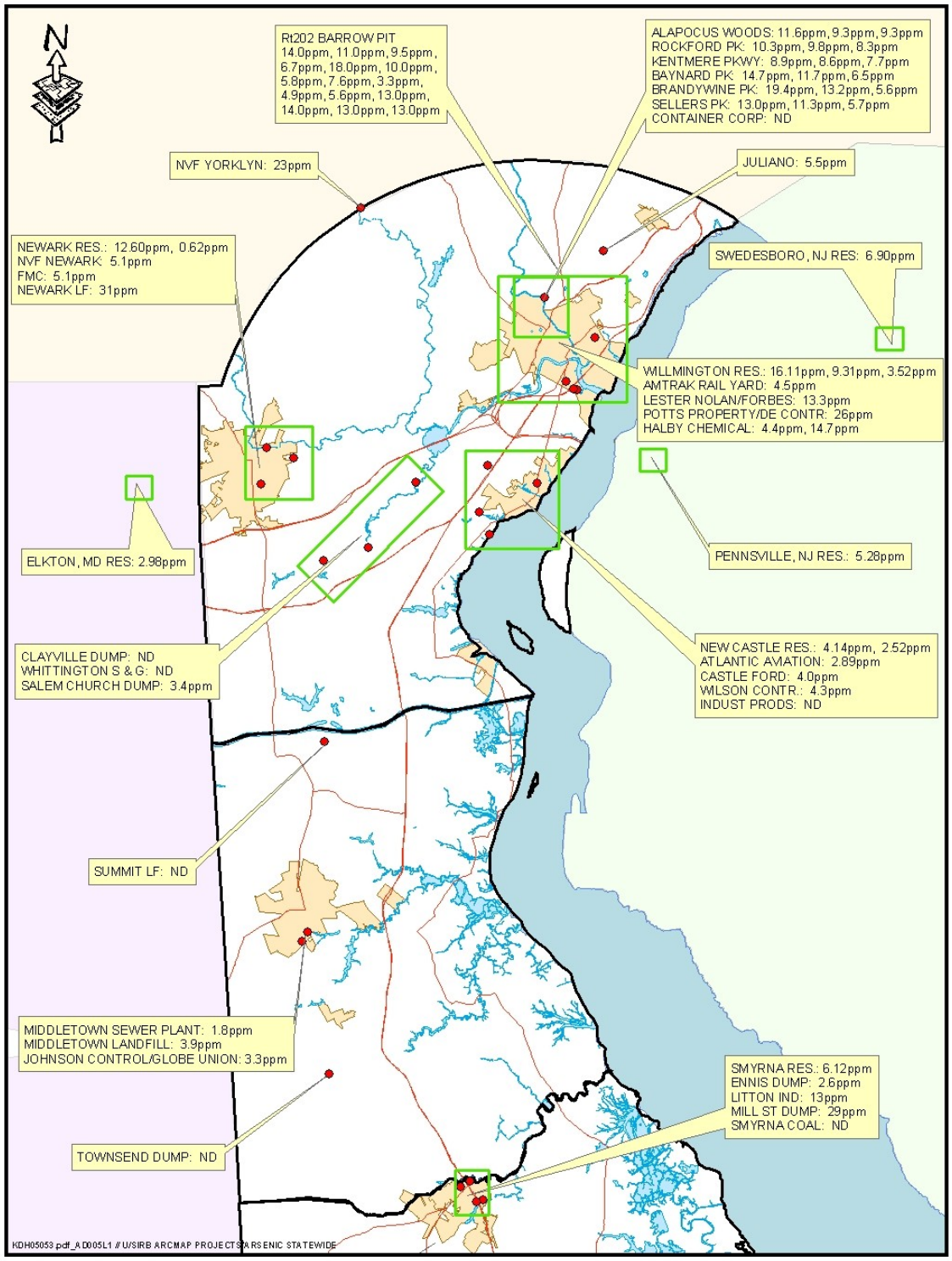
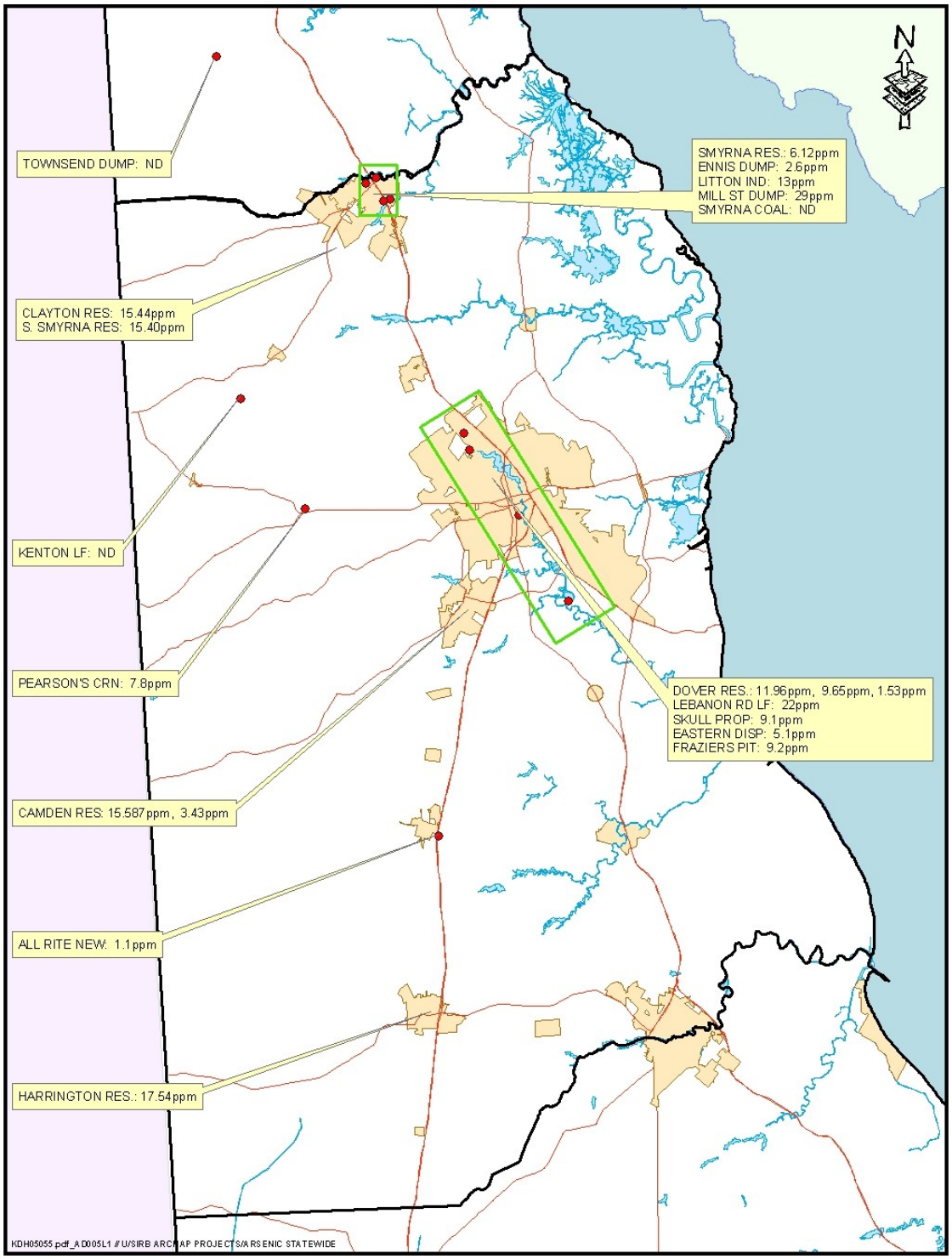
SITE INVESTIGATION & RESTORATION BRANCH
391 LUKENS DR
NEW CASTLE, DE 19720-2774
302.395.2600

**STATEWIDE ARSENIC VALUES**


N
Rt202 BARROW PIT
14.0ppm, 11.0ppm, 9.5ppm,
6.7ppm, 18.0ppm, 10.0ppm,
5.8ppm, 7.6ppm, 3.3ppm,
4.9ppm, 5.6ppm, 13.0ppm,
14.0ppm, 13.0ppm, 13.0ppm
ALAPOCUS WOODS: 11.6ppm, 9.3ppm, 9.3ppm
ROCKFORD PK: 10.3ppm, 9.8ppm, 8.3ppm
KENTMERE PKWY: 8.9ppm, 8.6ppm, 7.7ppm
BAYNARD PK: 14.7ppm, 11.7ppm, 6.5ppm
BRANDYWINE PK: 19.4ppm, 13.2ppm, 5.6ppm
SELLERS PK: 13.0ppm, 11.3ppm, 5.7ppm
CONTAINER CORP: ND
NVF YORKLYN: 23ppm
JULIANO: 5.5ppm
NEWARK RES.: 12.60ppm, 0.62ppm
NVF NEWARK: 5.1ppm
FMC: 5.1ppm
NEWARK LF: 31ppm
SWEDESBORO, NJ RES: 6.90ppm
WILLMINGTON RES.: 16.11ppm, 9.31ppm, 3.52ppm
AMTRAK RAIL YARD: 4.5ppm
LESTER NOLAN/FORBES: 13.3ppm
POTTS PROPERTY/DE CONTR: 26ppm
HALBY CHEMICAL: 4.4ppm, 14.7ppm
ELKTON, MD RES: 2.98ppm
PENNSVILLE, NJ RES.: 5.28ppm
CLAYVILLE DUMP: ND
WHITTINGTON S & G: ND
SALEM CHURCH DUMP: 3.4ppm
NEW CASTLE RES.: 4.14ppm, 2.52ppm
ATLANTIC AVIATION: 2.89ppm
CASTLE FORD: 4.0ppm
WILSON CONTR.: 4.3ppm
INDUST PRODS: ND
SUMMIT LF: ND
MIDDLETOWN SEWER PLANT: 1.8ppm
MIDDLETOWN LANDFILL: 3.9ppm
JOHNSON CONTROL/GLOBE UNION: 3.3ppm
SMYRNA RES.: 6.12ppm
ENNIS DUMP: 2.6ppm
LITTON IND: 13ppm
MILL ST DUMP: 29ppm
SMYRNA COAL: ND
TOWNSEND DUMP: ND
KDH05053.pdf_AD005L1 // U/SIRB ARCMAP PROJECTS/ARSENIC STATEWIDE
REFRENCES:
RESIDENTIAL VALUES WERE ANALYSED BY DNREC-SIRB RESIDENT CHEMIST ROBERT M. SCHULTE.
RT202 BARROW PIT SAMPLES WERE COLLECTED FOR THE RIVERFRONT HEADQUARTERS SITE DE1309
REMAINING VALUES ARE BACKGROUND SAMPLES FROM STATED SITES.
DELAWARE DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL
DNREC-SIRB
SITE INVESTIGATION & RESTORATION BRANCH
391 LUKENS DR
NEW CASTLE, DE 19720-2774
302.395.2600
ARSENIC VALUES IN NEW CASTLE COUNTY
This map is provided by the DNREC-SIRB solely for display and reference purposes and is subject to change without notice. DNREC-SIRB will not be held responsible for the assumed accuracy contained in the map or for use other than its intended purposes.




REFRENCES:
RESIDENTIAL VALUES WERE ANALYSED BY DNREC-SIRB RESIDENT CHEMIST ROBERT M. SCHULTE.

RT202 BARROW PIT SAMPLES WERE COLLECTED FOR THE RIVERFRONT HEADQUARTERS SITE DE1309

REMAINING VALUES ARE BACKGROUND SAMPLES FROM STATED SITES.

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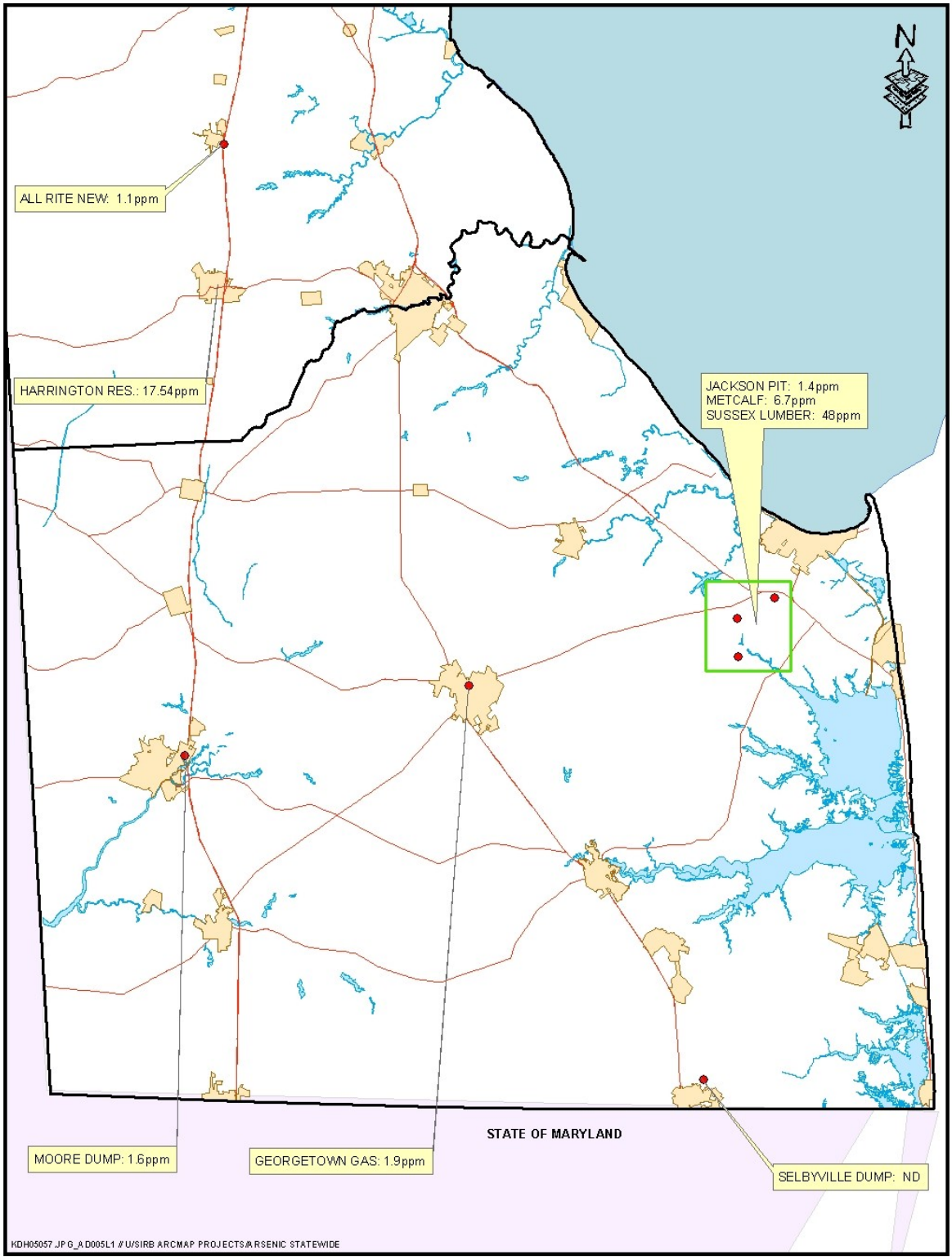
302.395.2600

ARSENIC VALUES IN KENT COUNTY

This map is provided by the DNREC-SIRB solely for display and reference purposes and is subject to change without notice. DNREC-SIRB will not be held responsible for the assumed accuracy contained in the map or for use other than its intended purposes.




REFRENCES:
RESIDENTIAL VALUES WERE ANALYSED BY DNREC-SIRB RESIDENT CHEMIST ROBERT M. SCHULTE.

RT202 BARROW PIT SAMPLES WERE COLLECTED FOR THE RIVERFRONT HEADQUARTERS SITE DE1309

REMAINING VALUES ARE BACKGROUND SAMPLES FROM STATED SITES.

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302.395.2600

**ARSENIC VALUES IN SUSSEX COUNTY**

# ATTACHMENT D: Human Health Risk Assessment Results

Exposure Parameters used in Arsenic Carcinogenic Risk Calculations for Age-Adjusted Resident

| **Exposure Parameter Abbreviation and Units** | **Parameters** | **Exposure Parameter Abbreviation Key** |
|---|---|---|
| THQ | --- | Target Hazard Quotient |
| TR | 1.00E-05 | Target Risk |
| EF (days/year) | 350 | Exposure Frequency |
| ED child (years) | 6 | Exposure Duration |
| ED adult (years) | 24 | Exposure Duration |
| Atcarc (days) | 25550.00 | Averaging Time |
| BWadult (kg) | 70 | Body Weight |
| BWchild (kg) | 15 | Body Weight |
| IRadult (mg/d) | 100 | Ingestion Rate |
| IRchild (mg/d) | 200 | Ingestion Rate |
| CF (kg/mg) | 1.00E-06 | Conversion Factor |
| SAadult ($cm^2$) | 5700 | Surface Area Exposed (Skin) |
| SAchild ($cm^2$) | 2800 | Surface Area Exposed (Skin) |
| AFadult (mg/ $cm^2$) | 7.00E-02 | Adherence Factor |
| AFchild (mg/ $cm^2$) | 2.00E-01 | Adherence Factor |
| ABS (unitless) | 3.00E-02 | Absorption Factor for Arsenic |
| InhR adult $m^3$/day) | 2.00E+01 | Inhalation Rate |
| InhR child ($m^3$/day) | 1.00E+01 | Inhalation Rate |
| PEF ($m^3$/kg) | 3.34E+09 | Particulate Emission Factor |
| IFS adj (mg-year/kg-day) | 114.00 | Age-Adjusted Ingestion Rate |
| SFS adj (mg-year/kg-day | 361.00 | Age-Adjusted Dermal Exposure Factor |
| inhFadj (m3yr)(kg-day) | 10.90 | Age-Adjusted Inhalation Factor |
| B (unitless) | 1 | Bioavailability Factor |

## Arsenic Cancer Risk Assessment for Age-Adjusted Resident

| | | | | | | | | Age-Adjusted Resident – Cancer Risks | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Chemical | Oral Slope Factor $(mg/kg\text{-}d)^{-1}$ | Inhalation Slope Factor $(mg/kg\text{-}d)^{-1}$ | $GI_{abs}$ | Dermal Slope Factor $(mg/kg\text{-}d)^{-1}$ | Dermal Absorption Factor | Particulate Emission Factor $(m^3/kg)$ | Soil Concentration (mg/kg) | Incidental Soil Ingestion Cancer | Dermal Contact Cancer | Inhalation of Particulate Cancer | Total Risk All Pathways |
| Arsenic | 1.50E+00 | 1.51E+01 | 1 | 1.50E+00 | 3.00E-02 | 3.34E+09 | 11 | 2.58E-05 | 2.45E-06 | 7.40E-09 | 2.83E-05 |

| Exposure Parameter Abbreviation and Units | Parameters | Exposure Parameter Abbreviation Key | Reference |
|---|---|---|---|
| THQ | --- | Target Hazard Quotient | |
| TR | 1.00E-05 | Target Risk | DNREC Target Risk Factor |
| EF (days/year) | 350 | Exposure frequency | USEPA Exposure Factors Handbook ,1989 |
| ED child (years) | 6 | Exposure Duration | USEPA Exposure Factors Handbook ,1989 |
| ED adult (years) | 24 | Exposure Duration | USEPA Exposure Factors Handbook ,1989 |
| Atcarc(days) | 25550.00 | Averaging Time | USEPA Exposure Factors Handbook ,1989 |
| BWadult (kg) | 70 | Body Weight | USEPA Exposure Factors Handbook ,1989 |
| BWchild (kg) | 15 | Body Weight | USEPA Exposure Factors Handbook ,1989 |
| IRadult (mg/d) | 100 | Ingestion Rate | USEPA Exposure Factors Handbook ,1989 |
| IRchild (mg/d) | 200 | Ingestion Rate | USEPA Exposure Factors Handbook ,1989 |
| CF (kg/mg) | 1.00E-06 | Conversion Factor | |
| SAadult ($cm^2$) | 5700 | Surface Area Exposed (skin) | USEPA Region 3, 2003 Technical Guidance Manual: Updated Dermal Exposure Assessment Guidance |
| SAchild ($cm^2$) | 2800 | Surface Area Exposed (skin) | USEPA Region 3, 2003 Technical Guidance Manual: Updated Dermal Exposure Assessment Guidance |
| AFadult ($mg/cm^2$) | 7.00E-02 | Adherence Factor | USEPA Region 3, 2003 Technical Guidance Manual: Updated Dermal Exposure Assessment Guidance |
| AFchild ($mg/cm^2$) | 2.00E-01 | Adherence Factor | USEPA Region 3, 2003 Technical Guidance Manual: Updated Dermal Exposure Assessment Guidance |
| ABS (unitless) | 3.00E-02 | Absorption Factor for Arsenic | USEPA Region 3, 1995 -Assessing Dermal Exposure from Soil |
| InhR adult ($m^3$/day) | 2.00E+01 | Inhalation Rate | EPA Exposure Factors Handbook ,1989 |
| InhR child ($m^3$/day) | 1.00E+01 | Inhalation Rate | EPA Exposure Factors Handbook ,1989 |
| PEF ($m^3$/kg) | 3.34E+09 | Particulate Emission Factor | USEPA Soil Screening Guidance Calculator, 2006, PEF for Philadelphia, Climactic Zone VIII |
| IFS adj (mg-year/kg-day) | 114.00 | Age-adjusted ingestion rate | |
| SFS adj (mg-year/kg-day) | 361.00 | Age-adjusted dermal exposure factor | |
| inhFadj (m3yr)(kg-day) | 10.90 | Age-Adjusted Inhalation factor | |

All exposure parameters are consistent with:
USEPA. 2002. "Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites"

**Inhalation Exposure Calculation**

Carcinogenic Intake = CS x IR x ET x EF x ED/BW x AT x PEF

**Dermal Contact with Soil/Solid Media Calculation**

Carcinogenic Intake = CS x CF x SA x AF x ABS x EF x ED/BW x AT

Carcinogenic Intake X Slope Factor=Carcinogenic Risk

# ATTACHMENT E: Ecological Risk Assessment Result

Ecological Hazardous Quotient Biota Calculation for the Snapping Turtle
11 PPM Point Concentration

Ecological Hazard Quotient (HQ) = EC/TV

| | | | |
|---|---|---|---|
| CS | = | 11 mg/kg | Arsenic Concentration |
| UF | = | 6.9E-01 | Uptake Factor |
| ET | = | CS x UF=ET | Estimated Biota Tissue Concentration - Benthic Micro-invertebrate (7.59 mg/kg) |
| IR | = | .015 kg/day | Ingestion Rate for Biota |
| G | = | 3.16 | Gastrointestinal Composition Absorption (kg) |
| EC | = | ET x IR/G | Exposure to Arsenic from Biota (3.6E-02 mg/kg/day) |
| TV | | 0.4 | Toxicity Value (mg/kg /day) |
| HQ | | 0.09 | <1 |

Ecological Hazardous Quotient Plant = Calculation for the Snapping Turtle

| | | | |
|---|---|---|---|
| Arsenic | = | 11 ppm | Concentration |
| UF | = | 1 | Uptake Factor |
| ET | = | CS x UF | Estimated Plant Tissue Concentration (11mg/kg) |
| IR | = | .035 kg/day | Ingestion Rate |
| G | = | 3.16 kg | Gastrointestinal Composition Absorption |
| EC | = | ET x IR/G | Exposure to Arsenic from Plants (1.21E-01mg/kg/day) |
| TV | = | 0.4 | Toxicity Value |
| HI | = | 0.3 | Hazard Quotient |

Ecological Hazardous Quotient Sediment Calculation for the Snapping Turtle
11 PPM Point Concentration

Ecological Hazard Quotient (HQ) = EC/TV

| | | | |
|---|---|---|---|
| CS | = | 11 mg/kg | Arsenic Concentration |
| UF | = | 1 | Uptake Factor |
| ET | = | CS x UF=ET | Estimated Sediment Tissue Concentration -Benthic Micro-invertebrate (11 mg/kg) |
| IR | = | 0.0023 kg/day | Ingestion Rate for Biota |
| G | = | 3.16 | Gastrointestinal Composition Absorption (kg) |
| EC | = | ET x IR/G | Exposure to Arsenic from Biota (8.0E-03 mg/kg/day) |
| TV | | 0.4 | Toxicity Value (mg/kg/day) |
| HQ | | 0.02 | <1 |

Ecological Hazardous Index is Sum of the Hazard Quotient Snapping Turtle

HI = +0.09 + 0.02 + 0.3 = 0.41 (<1)