Risk-Based Decision-Making Recommendation Report

Final Report

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I. Executive Summary

Cleaning up polluted sites and revitalizing brownfields is a central focus of Connecticut's environmental and economic development efforts. Since 2012, the State has invested approximately $125 million to remediate and help redevelop over 100 contaminated sites. To put this in context, the United States Environmental Protection Agency (EPA) has spent $190 million nationwide on such cleanup work since 1995. Strong public-private partnerships have leveraged the investment of an additional $500 million by non-State partners at polluted sites all around Connecticut. These efforts are the key to sustainable, healthy, and vibrant communities in Connecticut – and to attracting future private investment in those communities.

To build on this progress and facilitate the timely cleanup and redevelopment of contaminated properties, the Connecticut Department of Energy and Environmental Protection (DEEP) constantly seeks to improve the process for cleanup including historically polluted sites. This effort to streamline our cleanup system is referred to as the "Cleanup Transformation". DEEP's primary goals for the Cleanup Transformation include:

- reducing health risks and impacts to natural resources,
- focusing efforts on higher risks, and
- increasing certainty and cost-effectiveness for DEEP, the public and parties conducting cleanups.

The success achieved so far has been shaped by the input of a diverse set of stakeholders and DEEP is committed to continuing this transparent process. Together we are shaping the future of polluted site cleanup in Connecticut.

In 2013, a number of actions were taken to implement portions of the Cleanup Transformation to target higher risks and to increase self-implementation and flexibility to manage risks at all sites. In June of 2013, DEEP adopted amendments to the Connecticut Remediation Standard Regulations (RSRs), 22a-133k-1 through 22a-133k-3. These amendments have already contributed to more sites getting cleaned up faster. Also, the Connecticut General Assembly passed Public Act 13-308 (the "Act"), which contained a number of provisions that implement portions of the Cleanup Transformation agenda. Pursuant to Section 28 of the Act, DEEP, in consultation with the Department of Public Health (DPH), evaluated risk based decision-making related to remediation of contaminated sites.

The Act directed the Commissioner to engage independent experts to assist in assessing Connecticut's risk-based decision-making processes. Through a competitive process, DEEP selected CDM Smith, Inc. (CDM or CDM Smith) to conduct the evaluation and to prepare a report to the Commissioner of DEEP. The scope of work – which was prepared by a team consisting of DEEP, DPH and stakeholders – required CDM Smith to provide: (1) an evaluation of how DEEP and DPH perform risk assessment and risk management, (2) benchmarking with other states and jurisdictions, and (3) suggestions on best practices. CDM issued its report on August 29, 2014 (the "CDM Report"). The CDM Report evaluated risk assessment and risk management practices for site cleanup in Connecticut, and discussed similar practices in other states and one Canadian province. DEEP has reviewed the CDM Report and conducted further

research and analysis as CDM recommended. The following is DEEP's "Risk-Based Decision-Making Recommendation Report" (the "DEEP Report"), which provides a summary of its review of CDM's recommendations and the agency's proposals for improvements to risk assessment and risk management decision-making in Connecticut.

CDM Smith's Themes and Recommendations

The CDM Report provides information that will inform DEEP's ongoing Cleanup Transformation effort. Importantly, CDM confirmed that:

- Connecticut's cleanup standards are generally similar to other surrounding states,
- Connecticut's risk assessment and risk management approaches reflect many "best practices", and
- Connecticut's risk assessment and risk management approaches for human health are similar to other states.

CDM also recommended areas for change, primarily that DEEP should:

- perform human health risk assessments instead of DPH,
- allow more non-standard solutions based on local input in communities burdened by brownfields,
- provide more information on the derivation of numeric cleanup criteria,
- adopt a new process to make it easier to update numeric cleanup criteria to reflect advancements in scientific information,
- evaluate risk goals for pollutants in soil to
  - make the risk goal more protective by incorporating ecological risk to plants and invertebrates into the cleanup criteria, and
  - make the risk goal less protective for human health; specifically, for the one-third of the RSR substances which are carcinogens, change the cancer risk goal, per chemical, from 1 new cancer per 1 million exposed individuals to 10 new cancers per 1 million exposed individuals, and, change the cancer risk goal for multiple chemicals at a site from 1 in 100,000 to 10 in 100,000,
- encourage site-specific risk assessments to help facilitate clean-ups in some situations, and, though currently allowed, should be further encouraged via changes to regulations and/or guidance, and
- streamline ecological risk assessment and management approaches to more quickly identify whether releases need or do not need to be remediated to address ecological (non-human) impacts.

DEEP understands the goals of CDM's recommendations and shares most of them, although some of the recommendations in the CDM Report were presented more as concepts, and thus were not thoroughly researched and analyzed. Following receipt of the CDM Report, DEEP conducted additional research on key issues. This DEEP Report, therefore, outlines CDM's and DEEP's research and provides DEEP's plan to pursue those shared goals to improve the remediation of impacted sites.

One important question that the evaluation sought to answer is: how does Connecticut compare to other states, especially in our region, in terms of risk based decision-making for site cleanup?

The CDM Report confirmed that Connecticut is generally similar to other states, especially in the Northeast, in its cleanup criteria. For instance, CDM's objective comparison of numeric criteria among Connecticut, Massachusetts and New York (CDM Report, p.1-6) showed no systematic conservative bias in Connecticut's criteria. In other words, when compared to the other states CDM evaluated, Connecticut is in line with cleanup levels found in those states. Also, according to CDM's scoring matrix for "best practices", Connecticut ranked in the top half for risk assessment approaches among the states CDM evaluated.

DEEP is always evaluating how to get more sites cleaned up faster, while remaining protective of human health and the environment. From this vantage point, expanding the toolbox of remedy options for cleanup (risk management) is more likely to impact that goal than any changes to specific numeric criteria. Indeed, DEEP's amendments to the remedy options in the RSRs in 2013 appear to be a significant driver of an increase in completed cleanups for historically polluted sites. Because of these commonsense changes to the RSRs, we have gone from an average of approximately 48 completed cleanups per year in the ten years prior to 2013, to over 110 completed cleanups in the first full year after adoption of this first round of amendments to the RSRs.

DEEP's Action Plan

DEEP's detailed analysis of the issues raised in the CDM Report, and their relationship to DEEP's ongoing Cleanup Transformation effort, is provided in Chapter III. Briefly, DEEP recommends a number of actions to improve risk assessment and risk management decision-making:

- On ecological risk, DEEP concurs that a clear, efficient decision-tree process would be useful, and, resources permitting, will develop guidance documents, with opportunity for public input, that parties may follow if they choose. These guidance documents will borrow some of the approaches used in British Columbia and Massachusetts, as well as other states.

- On updating numeric criteria in the RSRs, DEEP concurs that some updating is warranted. While DEEP does not recommend a change to the existing legal adoption process for updating the numeric criteria of the RSRs, DEEP does recommend additional steps early in the process to increase transparency and scientific peer review. In the time period before DEEP updates the numeric criteria, DEEP will post on its website: (1) recommended criteria values for commonly requested substances that do not have RSR criteria; (2) a streamlined procedure for approval of use of these recommended criteria values (unless a party prefers to pursue site-specific criteria); and (3) additional information regarding how the 1996 RSR criteria were calculated.

- With respect to the risk goal for polluted soil, DEEP does not concur with CDM's recommendations to change the goals to incorporate both lower ecological risk (to invertebrates and plants), and increased cancer risk to humans. Instead, DEEP recommends that if risks from polluted soil at a site need to be addressed differently due

to site-specific conditions, then a site-specific approach could be used (as discussed in the next bullet).

- Regarding use of site-specific alternative criteria, DEEP concurs that additional information may be helpful in making this option more valuable. DEEP will endeavor to create guidance and pursue RSR amendments to make site-specific approaches more achievable and efficient.

- A theme found in the CDM Report and throughout DEEP's Cleanup Transformation effort is the desire to ensure that the amount of remediation required is commensurate with the level of risk posed by specific sites. DEEP will continue its efforts to evaluate further refinements to the RSRs to promote risk-based, flexible endpoints, and this risk-based approach will continue to be a major component of the Cleanup Transformation process.

- The Cleanup Transformation effort and the CDM Report support exploring ways to modify the RSRs to increase the availability of self-implementing approaches. As part of the transformation, DEEP will include ways to ensure that these self-implementing provisions are in fact implemented in accordance with applicable requirements (e.g., through audits, certifications, or the like).

- Finally, DEEP believes that the agency structure of risk assessment – with DPH oversight of human health risk assessments and DEEP oversight of ecological risk assessments – is valuable, promotes consistency and avoids duplication of effort, and thus should remain intact.

DEEP notes that beyond the changes to the RSRs and development of guidance information highlighted above, DEEP will be working on a number of matters under the broad umbrella of the Cleanup Transformation – e.g., adding new institutional control tools, developing regulations to improve the reuse and management of polluted soils, and evaluating and potentially updating groundwater classifications. Some recommendations and action items identified in this DEEP Report can be self-implemented by DEEP with continued stakeholder input, but others require regulatory amendment or other formal adoption. A detailed summary of DEEP's Action Plan, and estimated schedules, are presented in Chapter IV. This schedule of tasks is ambitious, and timelines could change due to resource availability.

The Cleanup Transformation effort recognizes, and in fact embraces, the notion that there is always room for improvement. DEEP notes, however, that the RSRs (including the 2013 amendments) were adopted to provide the regulatory certainty sought by those engaging in cleanup. Therefore, while the recommendations in this DEEP Report represent DEEP's commitment to the continual improvement of its programs, the current framework provides many pathways forward to achieve risk-based cleanup endpoints and which are successfully used at hundreds of sites each year.

II. History of the Project and Background

This document provides DEEP's recommendations on risk-based decision-making. DEEP's recommendations build on the Cleanup Transformation, the CDM Report and public comments.

Risk Based Decision Making Report

The CDM Report titled "Evaluation of Risk-Based Decision Making" was prepared in accordance with Section 28 of Public Act 13-308, charging the DEEP, in consultation with DPH, to evaluate the risk-based decision making processes related to the remediation of contaminated sites in Connecticut.

Section 28 of Public Act 13-308 required that:

- The Commissioner of Energy and Environmental Protection, in consultation with the Commissioner of Public Health, evaluate risk-based decision making related to the remediation of contaminated sites. This would be done by engaging "independent experts in the field, with broad national experience, to conduct such evaluation and prepare a report that includes an assessment of the existing process of risk-based decision making including risk assessment and risk management tools utilized to protect public health, general welfare and the environment."
- A second goal of this evaluation is "identification of best practices in ecological and human health risk assessment and risk management."
- "opportunities for public review and input during the evaluation process" be provided, and
- "Upon completion of the evaluation and report, the commissioner shall consider the evaluation and report and make recommendations for statutory and regulatory changes to the risk-based decision making process including, but not limited to, those in section 22a-6u".

The full text of Section 28 is in Appendix A.

Through a competitive request for proposal process, a DEEP/DPH/stakeholder team selected CDM Smith and commissioned them to perform an independent analysis and a comparison of the cleanup practices in Connecticut to those in other States, and Federal and international environmental regulatory authorities. CDM's multi-disciplinary team initiated the evaluation with a public meeting held on March 12, 2014 to solicit feedback from all stakeholders on Connecticut's risk assessment and risk management practices. CDM submitted its Final Report to DEEP on August 29, 2014 and summarized their findings at a presentation to the public on September 10, 2014.

DEEP sought public input on the findings and suggestions contained in the report. Ten organizations or individuals submitted comments to DEEP by September 30, 2014. These included:

- Three professional risk assessment firms and one individual risk assessor

- ❒ Connecticut's environmental professional organization and two individual consulting firms
- ❒ Connecticut's business and industry association
- ❒ Two environmental advocacy groups

A summary of these comments is provided in Appendix E: of this report. The full text of the comments are on the DEEP web page at DEEP: RSR Revision Concepts - Risk-Based Decision Making.

DEEP and DPH offered comments to CDM on draft versions of the report to seek clarity, references to substantiate stated opinions, and other information to demonstrate that the scope of work for the analysis and comparison had been fulfilled. However, DEEP and DPH did not guide CDM to any particular outcome or conclusion. As such, the views and opinions presented in the CDM report are exclusively CDM's.

DEEP has evaluated the CDM report and given consideration to all stakeholder feedback received. During this period, DEEP has continued its effort to transform Connecticut's cleanup programs. DEEP's transformation effort, which includes significant input from stakeholders, covers some of the same ground as that included in the risk evaluation report. Pursuant to Section 28 of Public Act 13-308, the following report represents DEEP's recommendations for a path forward for improving the State's risk-based decision-making.

Risk Assessment and Risk Management

As background to the reader, this section describes what is meant by "risk assessment" and "risk management" in the context of the cleanup of contaminants released in the environment. Both the RSRs and the Connecticut Water Quality Standards are aimed at preventing or remediating risks to people and ecological populations. Some combination of risk assessment and risk management often determines what kind and level of action is needed.

Risk Assessment is, in general, a structured scientific study to determine the potential for health impacts to human or ecological populations. The main considerations in the evaluation of risk are stressors and exposures. Without both the presence of a stressor and exposure of a receptor to that stressor, risk cannot occur. Within the context of remediation, one of the most common stressors is chemical contamination. Potential receptors at contaminated sites can be either human or ecological. Within these broad groups, further delineation of receptors can be made. For example, humans can be grouped as residents, site workers, children, or consumers of locally-caught fish, to name a few. Ecological receptors can also span a very broad range. The results of the risk assessment provide information to assist in decision making for either numeric criteria or for remedial action at a site.

Human health risk assessment in Connecticut is performed by DPH in accordance with Connecticut General Statute 22a-1i. When requested by DEEP, DPH develops toxicity values for given chemicals which are then used in conjunction with exposure calculations to derive media-specific risk-based remediation targets that are protective of public health; DEEP then considers these targets in setting criteria. Ecological risk assessment is performed by DEEP.

Risk Management is, in general, a determination of how best to protect human and ecological health, and builds upon the risk assessment information. Risk management may include setting protection levels (numeric criteria), and identifying acceptable remedial actions/options. The RSRs contain both of these. Factors considered in Risk Management are set forth in CGS 22a-133k:

- Fully protect health, public welfare and the environment,
- Give preference to clean-up methods that are permanent, if feasible,
- Provide standards for polluted commercial/industrial properties less stringent than residential land use, and
- Any factor the Commissioner deems appropriate.

Risk management is performed by DEEP. DEEP has two risk management roles:

- DEEP performs risk management when setting numeric criteria for cleanup at sites across the state. In this regard, DEEP considers the DPH risk assessment plus other risk management factors before finalizing criteria.
- DEEP also exercises its risk management role by adopting remedy options in the RSRs to manage risk in ways other than full removal or full treatment. For example, the RSRs contain provisions for Engineered Controls, other types of capping, Institutional Controls (deed restrictions), and self-implementing variances and exceptions. These risk management approaches in the RSRs allow contamination that may exceed numeric criteria to be left in place. These provisions were carefully crafted to ensure that even though pollutants may exceed the RSR numeric criteria, current and future exposures to the pollutants can be sufficiently limited and managed.

Therefore, the RSRs contain risk management options (remedies) that parties routinely use instead of meeting the numeric risk-based criteria.

III. Department's Analysis of the CDM Report

This chapter provides DEEP's recommended approach to "Risk-based Decision Making," based on a review by DEEP and DPH of the CDM "Evaluation of Risk-based Decision Making" report ("CDM report"), additional research conducted by DEEP on themes raised in CDM's report, and public comments on that report. Ten organizations or individuals submitted comments to DEEP as part of the public comment process. DEEP reviewed and considered all comments in developing the recommendations in this report.

Addressing the Six Main CDM Recommendations

The six main CDM recommendations are restated below, followed by a summary of DEEP's review and recommendations.

CDM's Recommendation 1

CDM: "First, we suggest that Connecticut consider amending relevant law to place these four activities — [Human Health Risk Assessment] HHRA, [Human Health Risk Management] HHRM, [Environmental Risk Assessment] ERA, and [Environmental Risk Management] ERM — all within DEEP."

DEEP/DPH Analysis and Recommendations

DEEP proposes process improvements for risk assessment. DEEP does not recommend changes to the Agencies' risk assessment responsibilities or structure. As for risk management, DEEP agrees that risk management should remain within DEEP.

Collaboration between DPH Risk Assessment and DEEP Risk Management

Generally, DEEP requests that DPH conduct a human health risk assessment for remediation in the following instances:

- One, when DEEP proposes to adopt or amend numeric cleanup criteria in regulations (the RSRs). Note, with a few minor exceptions, the numeric criteria in the RSR's have not been updated since first adopted in 1996.
- Two, when a party submits a request for certain Alternative Criteria (a site-specific alternative to the numeric criteria in the RSRs).
- Three, when a party requests DEEP approval of certain criteria for Additional Polluting Substances (substances that do not have numeric cleanup criteria in the RSRs).

After DPH performs a risk assessment or reviews one submitted by a party, DEEP evaluates the information provided by DPH and considers risk management factors pursuant to CGS 22a-133k in determining cleanup criteria. The two agencies collaborate during the scoping and performance of the risk assessment, and as needed during DEEP's consideration of risk management.

DEEP/DPH Analysis of CDM's Recommendation

DEEP's and DPH's evaluation did not identify significant benefits that would be gained from shifting the human health Risk Assessment responsibilities from DPH to DEEP. Currently the human health risk assessment expertise resides with the toxicologists at DPH, and these toxicologists perform a number of additional functions at DPH other than risk assessments for DEEP. Having one set of toxicologists assessing human health risk for all agencies and programs ensures consistency in applying the most current toxicological data and risk assessment methods, and assures scientific accuracy, one of the primary "best practices" identified in CDM's report.

By statute (CGS 22a-1i), DPH has responsibility for human health protection in far more areas than those related to hazardous substance releases. DPH programs, including asbestos and lead-

paint abatement, protection of public and private drinking water supplies, fish consumption advisories, consumer product advisories, health evaluation of waste sites under the federal Agency for Toxic Substances and Disease Registry (ATSDR) program, and the healthy schools initiative all require the same expertise and risk assessment methodologies that are used to assess risks for RSR-based environmental cleanup. Hence, even if DEEP were to duplicate this expertise for setting RSR criteria, DPH would need to retain and continue its risk assessment personnel and expertise for use in these other programs.

- ❒ Maintaining risk assessment function in DPH provides a high level of collaboration and consistency for the scientific determinations in all elements of human health protection across many diverse programs. Decentralization could lead to inconsistency in how risk is assessed across programs and agencies. It is also more cost-effective to continue to use DPH expertise, than to add staff positions and costs at an additional agency to perform an over-lapping function.
- ❒ While some states are like Connecticut and have risk assessment and risk management housed separately, other states do have both functions housed within one agency. However, even in those cases, the human health risk assessment function appears to be kept separate from the site remediation work and is typically located within a separate office of science and research.
- ❒ The advantage of separating risk assessment from risk management has been described in several National Academy of Sciences reports on risk assessment (NRC 1983, 1994, 2009), which note that risk assessment provides a uniform methodology for determining whether a health risk exists and if so, then risk management can evaluate how to address these risks.
- ❒ The CDM report suggested that collaboration could be improved if risk assessment and risk management were "under one roof". The CDM report did not identify a lack of collaboration between DEEP and DPH. DEEP's review also found no lack of collaboration between the agencies.

In summary:

- ❒ The existing structure is appropriate, with DPH performing human health risk assessment functions, and DEEP performing ecological risk assessment functions. When DEEP is evaluating updates to RSR criteria, DPH will continue to develop supporting analysis and documentation that provides the toxicological basis for such updates. This documentation will be made available on the DEEP website.

References:

NRC (National Research Council) 1983. Risk Assessment in the Federal Government. Managing the Process. National Academy Press, Washington DC.

NRC (National Research Council) 1994. Science and Judgment in Risk Assessment. National Academy Press Washington DC.

NRC (National Research Council) 2009. Science and Decisions. Advancing Risk Assessment. National Academy Press Washington DC.

CDM's Recommendation 2

CDM: "Second, we suggest that DEEP establish a process whereby property owners, local governmental officials, and other stakeholders are encouraged to develop and present to DEEP, for its approval, non-standard solutions to improve public health in communities burdened with brownfields. Such solutions could also include improvements to already protected habitats and conservation areas elsewhere in the State, in lieu of costly but likely less effective restoration at the developed sites per se. To the extent that DEEP needs to be granted additional authority to approve such nonstandard solutions (as permanent solutions), the legislature should grant the Agency this authority."

DEEP/DPH Analysis and Recommendations

DEEP concurs with the goal of facilitating brownfield reuse and remediation, and will continue to partner with municipalities. DEEP does not, however, embrace the recommendation of allowing different health goals in different communities.

Background: State Efforts on Brownfields

DEEP supports what it understands are the goals of this recommendation – promoting remediation and reuse of brownfields, and partnering with municipalities. Municipalities are key partners, often the leaders, in brownfield remediation and development. Connecticut has many tools in place to encourage and promote brownfield development and remediation, and continues to search for more.

Having flexible and varied options for risk management is an important component of these efforts. Numeric criteria alone may not typically be the primary driver in the cost of brownfield reuse, because the costs of many of the usual brownfield remedial approaches, including site-grading, capping, engineered controls, building footprints, excavation and institutional controls, exist regardless of the specific numeric cleanup criteria. Real estate factors, like location and other costs such as building infrastructure (demolition, stabilization or refurbishment), or the presence of hazardous building materials (lead, PCBs and asbestos) often drive decisions on reuse/redevelopment of previously degraded properties.

The Department embraces the spirit of CDM's recommendation to promote opportunities for meaningful public participation and look for creative solutions to promote brownfield remediation and reuse. Over the past few years, Connecticut has adopted a number of initiatives that have increased flexibility and cleanup options, some of which are specifically targeted to brownfields, and others which are generally available at any site in the state. These include:

- Brownfield grant and loan programs, with funding provided by the legislature and administered by the Connecticut Department of Economic and Community Development (DECD)
  - Connecticut has invested $125M in these grant and loan programs since 2012, with the active support of the Brownfield Working Group in identifying the value and importance of these investments

- Targeted Brownfield Remedy (DEEP Guidance document), that increases the speed and certainty, and lowers the cost, for redeveloping brownfields (see DEEP: State Brownfield Remediation Programs)
- DEEP's RSR amendments in 2013
  - more flexible exits and ways to demonstrate compliance
  - less groundwater sampling to demonstrate compliance
  - faster and less expensive capping options for polluted fill
- Significant liability relief programs for new parties redeveloping brownfields, such as
  - Municipal Liability Relief (2013 legislation)
  - Brownfield Remediation and Revitalization Program, administered by DECD
  - Abandoned Brownfield Cleanup Program, administered by DECD
- Special provisions (such as fee waivers, and liability protections) in various other laws to encourage municipalities and related economic development entities to participate in assembling and marketing brownfield properties, and
- Initiatives underway to make the management of commonly encountered polluted soil more practical and efficient, such as Polluted Fill, Urban Soil, and Background Conditions.

These laws and initiatives provide incentives for remediation and redevelopment, and have provided municipalities with protection and flexibility to investigate, hold and market brownfield properties.

In light of CDM's recommendation, DEEP is evaluating ideas for additional non-standard solutions and incentives for improving public health in communities burdened with brownfields. One such approach is reusing brownfields for municipal or locally supported food production activities, especially in areas underserved by retail food stores or with little land for gardening. For instance, reuse of land as a community garden could provide local public health benefits, and DEEP would consider proposing a presumptive remedy (meaning, a pre-defined set of cleanup actions) to be fully protective of people working on the site or eating the produce. DEEP will encourage additional ideas from municipalities focusing on uses that promote public health.

Separately, DEEP is preparing a second round (Wave 2) of RSR amendments. Many amendments will further facilitate remediation of brownfields and other properties. DEEP will continue to seek public feedback on these proposals during 2015.

DEEP's Analysis of CDM's Recommendation

The CDM Report recommends moving towards a program that allows more non-standard solutions to improve public health for communities that have a higher number of brownfields. Although the CDM Report included this recommendation, the body of the CDM Report does not contain any further information or analysis related to it.

The CDM Report does not indicate what it means by improving public health at a site. There are a wide range of actions that may relate to the concept of improving public health. Also, the Report does not identify what it means by "non-standard solutions", nor does it identify examples being used successfully in other states or Canada.

One significant issue with an approach that focuses on communities burdened with brownfields is environmental justice. The pros and cons of this approach as it relates to environmental justice were not addressed in the CDM Report. DEEP has a long-established Environmental Equity Policy which states that:

> The policy of this Department is that no segment of the population should, because of its racial or economic makeup, bear a disproportionate share of the risks and consequences of environmental pollution or be denied equal access to environmental benefits. The Department is committed to incorporating environmental equity into its program development and implementation, its policy making and its regulatory activities. (DEEP: Environmental Equity Policy)

DEEP is committed to policies and actions that treat Connecticut citizens equitably. DEEP does not support creation of different risk-based standards for different communities. DEEP will ensure that its actions remain consistent with Title VI of the Civil Rights Act of 1964, which ensures no disparate impact to any segment of the population. DEEP does, however, support working with municipalities to identify flexible but protective risk management approaches to address health risks at a given site.

CDM also recommended that DEEP encourage substitution of ecological enhancements in habitat areas that are already protected in lieu of potentially less effective ecological risk reduction on brownfield sites. DEEP does not typically see ecological-driven remediation at many brownfield sites, so the opportunities would probably be few. Also, when there is a need for ecological based remediation, DEEP considers the future, not just the present, in evaluating the goals for the resource area.

In summary, DEEP will do the following:

- ❒ Provide opportunity for a municipality to identify a brownfield that could be used for community health enhancements, such as a community-garden. If sufficient municipal interest, DEEP would consider developing a generic presumptive remedy to be protective for such uses.
- ❒ Finish drafting a second round of amendments to the RSRs for a public comment process in 2015. Many of these amendments will further the reuse of brownfield properties by increasing flexibility for remediation, providing cleanup targets that are typically faster and less costly to achieve, while remaining protective.
- ❒ Examples include:
  - expanded flexibility for meeting groundwater protection standards (drinking water standards) in many locations that have a higher density of cleanup sites (Alternative Groundwater Protection Criteria),
  - more streamlined process for using engineered controls (such as capping),
  - streamlining the process for characterization and capping of polluted fill.

CDM's Recommendation 3

CDM: "Third, we suggest that

(i) DEEP fully and electronically document all of the underlying assumptions, models, exceptions, and other aspects of each default criterion in the RSRs;

(ii) DEEP consider updating these criteria, per British Columbia's criteria, to account for risks to soil invertebrates and to plants as well as for risks to public health; and

(iii) to the extent that legislative involvement is currently required before criteria are updated, this requirement be modified to grant DEEP the requisite authority."

DEEP / DPH Analysis and Recommendations

DEEP concurs with the broad goals of these recommendations, though not the exact approaches. First, DEEP will electronically document the derivation of the 1996 RSR numeric criteria. Second, DEEP does not concur that RSR numeric criteria for soil should be modified to account for ecological risk, though will address it in guidance for site-specific use where warranted. Third, DEEP concurs that RSR numeric criteria need to be updated, and will do so using a transparent, peer-review process, rather than seek a legislative modification of the Connecticut regulation adoption process.

Documenting Environmental Criteria

When the RSRs were first established in 1996, there was a robust public process which included technical work groups to support key areas of program development including the development of risk based numeric criteria. In addition to agency staff, these work groups included scientists and technical staff from the regulated community who had experience and training with each workgroup topic. The criteria workgroup fully vetted the equations, inputs and assumptions which went into the development of the final criteria for the RSRs.

DEEP did not publish the supporting documentation at the time the regulations were adopted in 1996. Some of the documentation regarding the equations and assumptions was integrated directly into the regulations. As DEEP has moved forward with updates to numeric criteria in the RSRs and the Connecticut Water Quality Standards, the agency has ensured that full documentation used to support any proposed update has been provided to the public. For example, new criteria for petroleum hydrocarbon compounds were proposed as part of the 2014 update to the RSRs and DEEP published, for public review and comment, extensive technical support documents, which fully document the inputs and assumptions underlying the proposed criteria, at DEEP: Petroleum Hydrocarbon APS.

CDM has echoed public sentiment and suggested that documentation, which provides full transparency on all aspects of criteria development, be provided. DEEP concurs and proposes the following:

- ❒ Publication of web pages on the DEEP web site to generally document the technical process used to calculate existing numeric criteria in the RSRs.
- ❒ For any future proposals to update criteria, provide to the public complete and transparent technical documentation in support of any such change.

Ecologically-based Criteria

Protection of human health and the environment is the primary focus of state environmental protection programs. Just as environmental contamination within any media, such as soil, water or sediment, has the potential to impact human health, it also has the potential to impact ecological resources. Maintaining conditions to support healthy and diverse ecological populations is important both from an environmental quality and a quality of life point of view. Criteria (in the form of regulations or as guidance benchmarks) for the protection of ecological resources would provide an important tool to support this critical mission.

DEEP concurs with CDM that there is a need to integrate ecologically-based criteria into remediation programs. However, comments from the public highlight that there is a balance between the need for stand-alone ecologically-based criteria and the integration of ecological risk assessment into the remediation program. For the most part, CDM presented their recommendations for ecological risk assessment in its separate Recommendation 4, so DEEP addresses general ecological risk assessment within the context of CDM's Recommendation 4, below.

In Recommendation 3, CDM recommends that DEEP amend soil cleanup criteria to incorporate protection of soil invertebrates and plants, similar to British Columbia's approach. The numeric criteria for soil in the RSRs are based on risks to human health from direct exposure. Ecological risk was not factored into the RSR Direct Exposure Criteria. CDM's recommendation would likely lower the numeric criteria for some substances where the ecological risk to soil invertebrates or plants is more sensitive than the human health risk. For other substances, where the human health risk is the more sensitive factor, CDM's recommendation would not likely change the numeric criteria. However, DEEP is not convinced that incorporating such ecological factors into RSR numeric criteria for soil would be sufficiently beneficial. The RSR Direct Exposure Criteria apply to soil at all sites, including sites that are intensively developed, or which have remedies that may use permanent structures and other capping/engineered controls. Therefore, DEEP does not concur with altering the risk goal of Direct Exposure Criteria by adding risk factors for soil invertebrates and plants. Instead, DEEP believes that a site-specific approach for soil ecological risk is more appropriate, so that such ecological risk can be addressed where necessary.

Surface Water Protection Criteria (SWPC), however, are intended to be calculated based on the lower of the aquatic life and human health based water quality criteria, to be protective of both groups. While aquatic life impacts were considered when setting the SWPC, they were based on the Water Quality Standards and aquatic life criteria available at the time (1996) which only included a subset of the substances in the RSRs. Thus, the majority of the SWPC are currently based on human health considerations alone. This leaves a potentially important gap for some substances regarding protection of ecological resources in Connecticut's surface waters.

Having ecologically-based criteria, as either guidance benchmarks (for soil or sediment) or adopted into regulations (such as the SWPC, discussed above) would be helpful to restore and maintain healthy ecological resources. DEEP will evaluate ecologically-based criteria and benchmarks from published sources to determine their applicability and appropriateness for potential use. At a minimum, any proposals to update SWPC would be part of the criteria proposal development process set forth in "Criteria Adoption Process" below.

Such criteria or benchmarks could be used to define environmental conditions within the various media which would not pose an ecological risk. Alternatively, a party could use a site-specific ecological risk assessment for a more refined evaluation of ecological risks and setting of site-specific ecologically-based remediation goals. This tiered approach to ecologically-based criteria combines both the CDM recommendation for considering ecological receptors when establishing default numeric criteria, and public requests for flexibility in addressing ecological risks.

DEEP proposes to:

- ❒ Evaluate published sources for ecologically-based criteria for potential Surface Water Protection Criteria updates, and for benchmarks for sediment and soil, to determine their applicability and appropriateness for use in Connecticut,
- ❒ Develop guidance for ecological risk assessments for use on a site-specific basis, including ecologically-based numeric benchmarks for environmental media such as soil and sediment, which parties can elect to use in such assessments. This is further discussed under CDM Recommendation 4.

Criteria Adoption Process

In Connecticut, risk-based environmental criteria are adopted as regulations within the RSRs and the Water Quality Standards. The Connecticut regulatory adoption process requires both a robust public process and legislative review and approval. CDM points out that in neighboring states and other regions, updating risk-based criteria does not involve legislative action. As presented within the CDM report, the critical components of a criteria adoption process, in addition to transparency, are outreach to practitioners, scientists and other experts and a public process for communication and collaboration. CDM recommended that DEEP seek the authority to adopt and update risk-based criteria without legislative involvement.

There is merit to the timely updating of risk-based criteria. Development of criteria is heavily dependent upon scientific information and follows a widely recognized approach of combining estimates of exposure with estimates of toxicity to identify risk-based environmental concentrations that are then evaluated to determine risk management factors. Ideally, risk-based criteria would be updated with regular frequency to incorporate both new chemicals and new science. For example, the federal Clean Water Act requires that water quality criteria, which are risk-based environmental criteria for surface waters, be publically reviewed and revised, as necessary, at least once every three years. Other states similarly review and update their risk-based remediation criteria from time to time.

DEEP agrees with the CDM Report recommendation that a criteria adoption process be designed to include collaboration with experts, a robust public review and comment process, more frequent review and revision of criteria as necessary based on updated scientific information.

However, DEEP does not agree with the CDM Report's recommendation to omit the requirement for legislative review of new or modified risk-based remediation criteria. The Connecticut legislature has established the process for how regulations, including the RSRs, should be amended. Changes to that process are political questions for the legislature. As such, DEEP is not recommending any changes to the legally required process for updating the RSR numeric criteria.

DEEP instead proposes an additional initial step in the adoption and updating of risk-based numeric criteria, using an independent Science Advisory Panel to provide review and feedback on development of methodologies by DEEP and DPH. This step can be taken under existing statutory authority, leaving the existing legal regulation adoption process intact.

DEEP, together with DPH and the independent Science Advisory Panel, would review the methodology from which RSR criteria are developed in light of technical and other recommendations from the CDM report, previous public comments, updated scientific and technical information, and any applicable updated guidance published by EPA and others.[1]

After DEEP's, DPH's and Science Advisory Panel's technical work and feedback, DEEP will further evaluate the Science Advisory Panel's comments, continue public discussion and presentations (such as to Remediation Roundtable and other forums), and then formally propose numeric criteria for adoption/amendment – a process that allows for additional public review and comment.

[1] This will also include CDM's recommendation to review the calculation of Direct Exposure Criteria in residential settings for non-carcinogenic substances. DEEP agrees with CDM that the equations to incorporate risks to children should be re-evaluated with updated information and exposure approaches. While such a change could impact the Residential Direct Exposure Criteria calculated for some of the non-carcinogenic substances, DEEP does not expect that it would have a large impact – approximately in the 10% range - even if adopted directly without any other adjustments that may be warranted.

At present, DEEP is considering two approaches to engaging an independent Science Advisory Panel.

- One would take advantage of the current process for using the Connecticut Academy of Science and Engineering (CASE) as the Science Advisory Panel. This approach has merit since there are established protocols for engaging experts. However, there are budget implications to the use of CASE, and we would need to ensure that CASE had access to the scientists with expertise in environmental and regulatory toxicology needed to conduct the review.
- Alternately, DEEP could convene a separate panel of independent scientists and academics with such expertise, modeled after the EPA Science Advisory Board.

In either case, the focus would be on selecting appropriate independent scientific experts. Documents generated during the process will be publicly available.

Additional Risk-Based Criteria Topics:

While DEEP pursues updates to RSR criteria, the agency will also take some more immediate action. The RSRs contain numeric criteria for 88 substances for soil, groundwater and soil vapor. Since 1996, many additional substances, called Additional Polluting Substances (APS), have been found on sites; these substances necessitate development of criteria. Over the years, DEEP has responded to more than 8,800 requests covering more than 200 of these additional substances. The process of developing these criteria can be labor intensive and time consuming for DEEP as well as the regulatory community.

In 2011, DEEP conducted a "Lean" event on the APS application, review and decision process. This was highly successful and resulted in reducing the review timeframe from a few months to just a few weeks. Even with this success, additional opportunities exist to improve the process. DEEP proposes to provide guidance and supporting materials outlining a tiered approach that would further streamline the development and approval of APS.

- Tier 1: **Pre-established APS Criteria**: DEEP will publish a list of recommended criteria for APS that DEEP could quickly approve on a case-by case basis upon request. DEEP would provide full documentation of all formulas and inputs used to derive APS criteria and a form to expedite the request, submittal and approval.

- Tier 2: **APS Criteria for Chemicals without a Default Recommended Value**: DEEP will develop and provide on its website an "APS calculator tool" with associated guidance that could be used by parties to calculate APS criteria for chemicals. This would provide parties an easy way to generate APS criteria for these chemicals using standard RSR equations and inputs. A party could then submit the proposed criteria to DEEP for review, in consultation with DPH, and approval for use at a specific site.

- Tier 3: **APS Criteria Proposal based on a Site-specific Risk Assessment**: DEEP would provide guidance to the regulated community to facilitate the generation of APS criteria using a formal site-specific risk assessment for criteria derivation. This would include DEEP/DPH expectations on the format and elements to be included in

these APS requests. The criteria request and supporting documentation would be submitted to DEEP for review, in consultation with CT DPH, and approval for use at their specific site.

To summarize, DEEP agrees with the recommendation from CDM that criteria need to be updated to reflect advances in science since 1996, and agrees in part with CDM's recommendation to consider an alternative means to adopt risk-based criteria. DEEP also proposes other actions to improve the development and use of site-specific criteria for Additional Polluting Substances until such time as a comprehensive review and revision of the criteria can be accomplished.

With respect to CDM's Recommendation 3 overall, DEEP proposes to:

- ❒ Publish information on the derivation of the RSR numeric criteria adopted in 1996;
- ❒ Establish an independent Scientific Advisory Panel for the purpose of review and feedback to DEEP and DPH in developing methodologies for updates to the risk-based numeric RSR criteria;
- ❒ Work in concert with DPH, with review and feedback from the Science Advisory Panel to
  - ♦ review existing risk assessment methodologies within the RSRs, and
  - ♦ develop methodologies for adopting/updating criteria;
- ❒ Proceed with the public review and comment period and a public hearing so that public comment could be considered and incorporated into the final risk-based criteria adoption proposal;
- ❒ Adopt final numeric criteria pursuant to the statutory process;
- ❒ Provide additional guidance and materials supporting the development of criteria for Additional Polluting Substances, for use on a case by case basis.

CDM's Recommendation 4

CDM: "Fourth, we suggest that DEEP adopt and, as needed, adapt the successful ecological risk assessment and ecological risk management programs already in place in Massachusetts and in British Columbia."

DEEP Analysis and Recommendations

DEEP will adapt components of the British Columbia and Massachusetts ecological risk assessment and risk management programs, including publishing guidance for a tiered approach to ecological risk assessment.

Tiered Approach and Guidance

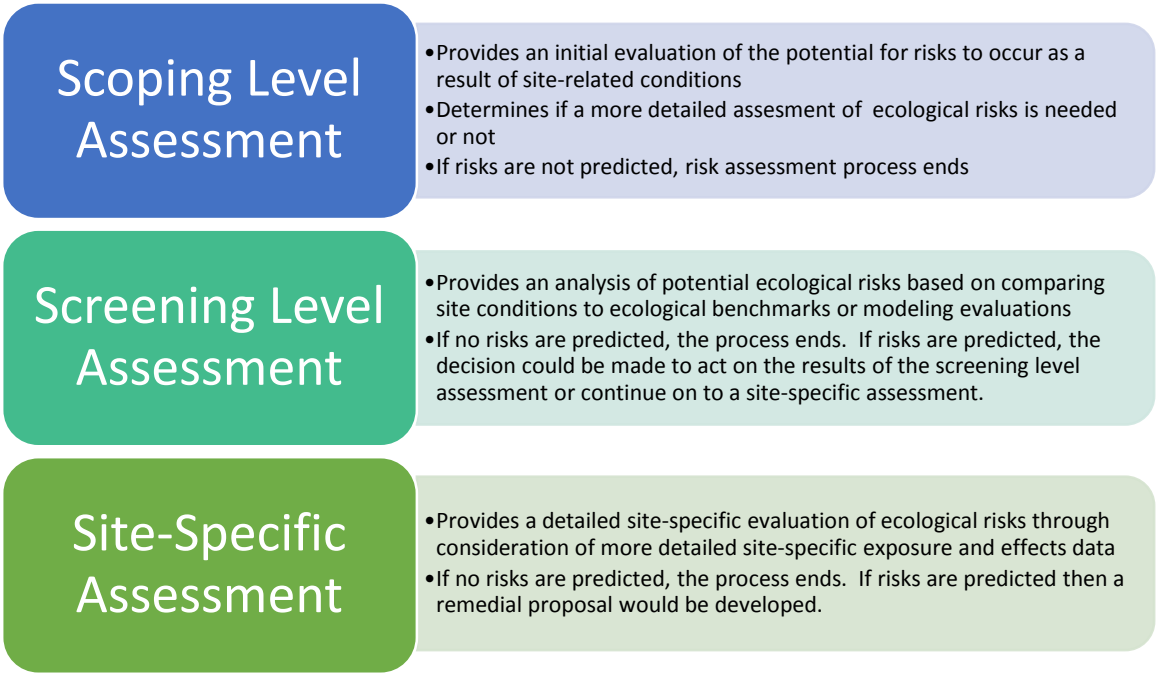
The CDM Report provides an extended review of ecological risk assessment and management. This recommendation, while succinct, summarizes several major concepts which CDM discusses within the report relative to ecological risks. Particularly, while Connecticut's implementation of ecological risk assessment and risk management is similar to the practices found in neighboring states and was ranked around the median of the programs evaluated, CDM also identified important gaps. CDM recommended, among other things, that DEEP:

- ❒ Implement a tiered approach which encompasses both a generic and a site-specific approach to evaluating and addressing ecological risks which is in line with best practices implemented in other states and regions, and
- ❒ Publish a set of guidelines and processes addressing ecological risk.

Public comments on ecological risk assessment supported the recommendations for a tiered approach to risk assessment, including ways to determine when risk assessment is not necessary, similar to regulatory programs in nearby states. Some commenters also suggested including default criteria as a screening tool, and addressing background conditions, while others urged caution and wanted to ensure that any proposed ecological risk assessment guidelines would be effective and protective of ecological communities. Any use by Connecticut of guidance from other jurisdictions needs to reflect the current state of practice for ecological risk assessment.

Implementing a Tiered Approach to Address Ecological Risks

DEEP concurs with CDM, British Columbia, the Commonwealth of Massachusetts and others that a tiered approach is best for addressing ecological risks and that such an approach should accommodate both generic as well as site-specific assessments, based on the level of evaluation appropriate for that site. In general, DEEP recommends a 3-tiered assessment process that includes a Scoping Level Assessment, Screening Level Assessment and a Site-Specific Assessment. Such a structure is similar to that used in British Columbia, Massachusetts and other states, and is consistent with the CDM recommendations and the public comments, as it (1) allows for an early evaluation to determine whether an ecological evaluation is necessary (Scoping Assessment), (2) provides for a screening assessment using generic benchmarks and models (Screening Assessment), and (3) when warranted, maintains the ability to support a full evaluation of risks considering site-specific conditions (Site-Specific Assessment).



A presentation on this approach from several years ago is included on the DEEP website at: http://www.ct.gov/deep/lib/deep/site_clean_up/risk_assessment/eraandremediation.pdf

A more current version of the presentation and additional detail is provided as an attachment to this report in Appendix F.

CDM also recommended that the risk assessment process be integrated into site characterization activities as part of the remediation process. DEEP concurs and believes that integrating the risk assessment process with site characterization will help consolidate data collection and evaluation activities, promoting a comprehensive evaluation of the site in a more efficient manner. This should also reduce uncertainties within the assessment and remediation process and facilitate project completion.

Publishing Ecological Risk Assessment Guidance

CDM stated that guidance for ecological risk assessment is needed and that such guidance should be explicit, well-documented, scientifically-defensible, up-to-date, flexible, easily implemented and in line with best practices implemented in other states/regions.

DEEP concurs with this recommendation and will develop guidance for a tiered approach to ecological risk assessment, including practical implementation information. DEEP will evaluate implementation options ranging from some activities which could be fully self-implementing to others which would require DEEP's review and approval. DEEP's goal is to have the majority of decisions self-implementing by parties, while reserving DEEP review and approval for a few more complex sites or more sensitive ecosystems. As DEEP implements the recommendations of the CDM report, practicality and ensuring protection of ecological resources will be emphasized.

Based on the recommendations in the CDM report and public comments, DEEP proposes to:

- ❒ Develop and implement a tiered approach to evaluate and address ecological risks in Connecticut
- ❒ Develop guidance for conducting ecological risk assessments and implementing ecologically based strategies which will be protective of the environment and promote an efficient approach to site remediation activities
- ❒ Develop a public process for reviewing and disseminating such guidance

British Columbia and Massachusetts approaches

The Department notes that the CDM Report recommended, more extensively than any other ecological risk topic, changes to address ecological risk assessment in ways similar to British Columbia and Massachusetts. For that reason, DEEP conducted additional research to learn more about these two programs, including several phone conversations with the Director of the British Columbia Ministry of Environment, Land Remediation Section. Both agencies incorporate tier-based approaches and guidance documents similar to those described in the section above.

The Ministry of Environment in British Columbia has Screening and Detailed Ecological Risk Assessments, both of which ultimately require approval by the agency in order to reach final closure if they contain any site-specific or risk-based cleanup proposals. In addition to site-specific risk assessments, the ministry also has default sediment criteria, which include numbers for both "typical" sediments and "sensitive" sediments (sediments which are habitat for sensitive components of ecosystems). Massachusetts has Methods 1, 2, and 3, with Method 3 having both a screening and a site-specific risk assessment that includes ecological risk.

For sediment, British Columbia has adopted sediment benchmark screening concentrations for "typical" and "sensitive" sediment areas. British Columbia calculated these numbers using the same data set used by MacDonald's consensus-based Threshold Effects Concentration and Probable Effects Concentration screening criteria (MacDonald et al., 2000). Sensitive sediment criteria were determined to have a 20% probability of some adverse effect, and typical sediment criteria were determined to have a 50% probability of some adverse effect.

DEEP proposes to adapt a list of default screening benchmarks appropriate for use in Connecticut. In doing so, DEEP will consider the British Columbia approach as well as other screening benchmarks currently present in scientific literature and other states (as also discussed in Recommendation 3, above).

In addition, both British Columbia and Massachusetts list specific circumstances in which site-specific ecological risk assessments are not required, such as for small, intensely developed properties that lack important habitat value. In both British Columbia and Massachusetts, these include "de minimis" habitat areas that are determined to be too small or fragmented to support wildlife, do not include sensitive ecosystems and/or do not support sensitive species. British Columbia requires that these excluded areas not include any parks or land adjacent to parks.

The Department agrees with many aspects of the general approach of the ecological risk assessment and management programs in Massachusetts and British Columbia. DEEP proposes some improvements to facilitate the use of the eco-risk programs and, where appropriate, adapting portions of similar programs from other jurisdictions which have been shown to be effective. These components will be incorporated into overall program goals in Connecticut, and will include those aspects that most closely align with the program goals.

DEEP recommends:

- ❒ Adaption of presumptive categories for inclusion and exclusion of ecological risk evaluation similar to those referenced above. These categories and steps for determining applicability will be included in guidance that DEEP will publish.
- ❒ Adoption of a list of default screening benchmarks appropriate for use in Connecticut, after consideration of screening benchmarks used in British Columbia, other jurisdictions and in scientific literature.

Reference:

MacDonald, Donald D., C. G. Ingersoll, and T. A. Berger. "Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems." *Archives of Environmental Contamination and Toxicology* 39.1 (2000): 20-31

CDM's Recommendation 5

CDM: "Fifth, we suggest that DEEP encourage the use of advanced, site-specific risk assessments for sites where application of RSR default criteria may be inappropriate."

DEEP/DPH Analysis and Recommendations

DEEP notes that the ability to employ site specific risk assessments is already in the RSRs. DEEP agrees that site-specific risk assessments may be valuable refinements of risk at certain sites, and will publish guidance and, if necessary, propose regulation amendments to provide clarity on such use.

CDM identifies that best practices include both default criteria ("successful cleanup programs depend on good default criteria" (p.1-3 of CDM's Report)), as well as opportunities for site-specific risk assessment. The CDM Report identifies the Massachusetts "Method 3" approach to site-specific risk assessment as a best practice. DEEP studied the Massachusetts "Method 3" risk assessment approach. Massachusetts by law expressly requires all releases, old and new, to be remediated to state standards within a set timeframe. Massachusetts regulations allow use of the Method 3 site specific risk assessment approach as an option to using the default numeric criteria. As a practical matter, we are informed that parties do not choose to use Method 3 for the majority of sites.

CDM notes that in Connecticut the RSRs currently allow the use of site-specific risk assessment in lieu of using the adopted numeric criteria, to evaluate the need for remediation and to set remedial goals. This is called an Alternative Criteria in the RSRs. This site-specific approach can be used by parties to develop Alternative Criteria, reflective of site-specific conditions, for application at their site. The RSRs allow for site-specific Alternative Criteria to be proposed for soil (Direct Exposure Criteria and Pollutant Mobility Criteria), groundwater (Surface Water Protection Criteria, Volatilization Criteria) and soil vapor (Volatilization Criteria). Depending upon the type of Alternative Criteria proposed, parties have the ability either to conduct a site-specific risk assessment to support a new health-protective criterion or to propose an alternative based on site-specific exposure factors and/or fate and transport modeling.

While this option is currently available under the RSRs, parties have not used it very much. Alternative surface water protection criteria have been developed at some sites based on site-specific dilution modeling. At several sites, there have been site-specific human health and ecological risk assessments conducted to determine both the need for remediation and to set site-specific remediation goals. Typically the sites which choose to conduct such risk assessments are larger sites with more extensive contamination. Examples of such sites include the Exide facility and Mill River in Fairfield (Project Website: DEEP: Mill River Remedial Activities, Fairfield, CT), the Upjohn Pharmacia site in North Haven (project web site: http://www.upjohnnorthhaven.com/index.php) and the former Connecticut Yankee Power Plant in Haddam Neck.

In order to provide additional support to those who may wish to use the alternative criteria provisions within the RSRs, and as recommended by CDM, DEEP will develop guidance to support site-specific risk assessments for human health in consultation with DPH.

Also, DEEP is moving ahead with proposing an RSR amendment to allow self-implementing site-specific alternative criteria, as an alternative to the adopted Pollutant Mobility Criteria (PMC). These criteria prevent continued leaching of pollutants from soil into groundwater. DEEP will include this in the "Wave 2" RSR amendment proposals.

- ❒ The draft amendment will contain self-implementing, site-specific fate and transport adjustments to PMC to derive alternative criteria.
- ❒ Site-specific alternative PMC would, for some sites, eliminate the need for remediation of contaminants which - though exceeding adopted PMC (leaching criteria) - can be shown to be sufficiently immobile, based on site conditions, at concentrations that do not pose a risk to human health or the environment, that protect existing water uses, and do not degrade groundwater quality.

DEEP will consult with DPH on other potential opportunities for site specific risk assessments, including self-implementing options.

Improvements in Timeliness

In a related matter, DEEP and DPH are evaluating timeliness for review and approval of Alternative Criteria requests. This issue was also raised in one of the public comments. DEEP will perform a "Lean" kaizen event to improve internal DEEP, and intra-agency coordination, for the review and decision on requests for Alternative Criteria. A similar Lean event, conducted in 2011, has already resulted in significant improvement to the Additional Polluting Substances review/approval process, reducing review/approval duration from many months to just a few weeks.

To summarize, DEEP will:

- ❒ Work with DPH to develop scientifically sound and well-documented guidance for conducting site-specific human health risk assessments and strategies which will be protective of human health and promote an efficient approach to site remediation activities, including
  - ♦ public participation in the development of guidance;
  - ♦ review and update such guidance from time to time based on new or more current scientific or other appropriate information,
- ❒ consider RSR amendments for a self-implementing site-specific risk assessment;
- ❒ DEEP will prepare a draft RSR amendment for self-implementing, site-specific Pollutant Mobility Criteria (PMC). This will allow fate and transport adjustments to RSR default criteria to derive alternative PMC. Additional information about this approach can be found in the Discussion Document posted at DEEP: RSR Revision Concepts - Wave 2. DEEP will include this in the proposals for "Wave 2" RSR amendments.
- ❒ DEEP will conduct a "Lean" kaizen event to improve internal DEEP, and intra-agency coordination for the review and decision on requests for Alternative Criteria.

CDM's Recommendation 6

CDM: "Finally, sixth, for potentially carcinogenic site contaminants, we suggest that DEEP adopt risk management goals for the reasonably maximally exposed individual (RMEI) of up to 1 in 100,000 per chemical, and up to 1 in 10,000 per site."[2]

DEEP/DPH Analysis and Recommendations

DEEP does not recommend changing the cancer risk goal in Connecticut. The existing cancer risk goal is appropriate and is consistent with the other states in our region. To further the goal of cleaning up sites more quickly, DEEP recommends continuing the successful approach of increased flexibility in remedy options to match site risks to remedy choices.

What Did CDM Recommend?

For the past few decades, Connecticut's cancer risk goal for environmental cleanup, like many other states, has been to achieve a level of 1 new cancer in 1 million people, for a single contaminant, and 1 in 100,000 for multiple contaminants at a site. CDM's recommendation is to change the human health cancer risk goal to something less conservative than presently exists. CDM focused this recommendation on polluted soil, not polluted groundwater, given the references to polluted soil in its discussion (page 6-23 of the CDM Report).

CDM recommends a cancer risk goal of 10 new cancers per 1 million exposed individuals for a single contaminant, and 10 in 100,000 for multiple contaminants at a site. CDM presented some limited analysis to support its recommendation, and referenced British Columbia as a model for this approach. CDM suggested that levels of acceptable risk to public health should be based on the *size of the affected population*, the *nature* of the risk (such as whether it is *theoretical or actuarial*), and the *size and type of uncertainties* surrounding the risk-estimates.

CDM's recommendation applies to cancer risk, thus is relevant to those contaminants that are carcinogens. There are 88 substances in the RSRs that have numeric criteria. Of these, the criteria for 32 substances are based on cancer risk. For 52 substances, RSR criteria are based on non-cancer health risks, such as risks to organs (liver and kidney), and to brain and reproductive function. For four substances, the RSR criteria were set based on background conditions or laboratory detection levels.[3] Therefore, CDM's recommendation applies to the one-third of the

[2] For ease of comparison of risk goals, we will use 1 million people as the baseline for risk from a single chemical. Also, we use 100,000 people as the baseline for the combined risk from multiple chemicals at a site. Thus, Connecticut's cancer risk goal from a single chemical is 1 cancer in 1 million people, and CDM's recommendation is a cancer risk goal of 10 cancers in 1 million. Another way used to express these cancer goals, used later in reference to other states, is 10^{-6} (equal to 1 in 1 million), 10^{-5} (equal to 10 in 1 million), and 10^{-4} (equal to 100 in 1 million).

[3] Background means that a substance is generally present in the over-all environment of Connecticut at levels exceeding what would otherwise be the health standard. For example, arsenic's cancer risk at 1 in 1 million would be well below a concentration of 10 ppm. But arsenic is a natural element in the environment (from rocks) in Connecticut at concentrations above that cancer risk. So, DEEP – applying risk management factors - set the soil criteria at 10 ppm to reflect background conditions, instead of the 1 in 1 million risk assessment for cancer.

substances in the RSRs that have soil direct exposure criteria driven by cancer risk, and would not affect the criteria for the other two-thirds of RSR substances. See Appendix B for the list of substances and cancer v. non-cancer basis.

Basis for the 1 in 1,000,000 (per chemical), and 1 in 100,000 (cumulative chemicals) Cancer Risk Goal (De Minimis Risk Target)

Public health policy is based on the concept that the presence of contaminants in the environment from releases of hazardous substances should pose only a very minor ("de minimis") risk to the public. DPH, like many other states including the states in the northeast, uses 1 in 1 million lifetime cancer risk as the de minimis target (for individual chemicals for single pathways of exposure) in developing public health recommendations for environmental media. There is ample precedent for this de minimis target in standard setting and, although exceptions can be found, it is widely used in the risk assessment/regulatory community (Adler, 2007; Castorina and Woodruff, 2003; Fiori and Meyerhoff, 2002). For example:

- Cleanup targets in the U.S. Environmental Protection Agency's (EPA's) CERCLA program establishes cleanup targets (preliminary cleanup goals) using a point of departure of 1 in a million excess cancer risk for individual carcinogens when considering waste site cleanup. Final cleanup targets recognize a number of other factors, with the final excess cancer risk to an individual based on exposure to all contaminants in all media to be within the range of 100 in 1 million to 1 in 1 million cancer risk. (Environmental Protection Agency, 1990. "40 CFR Part 300—National Oil and Hazardous Substances Pollution Contingency Plan," Final Rule, Fed. Registr. 55, 8666.)
- The U.S. Food and Drug Administration's target for regulating food additives exempt from the Delaney Clause is that the incremental lifetime cancer risk to the 90th percentile food consumer is no greater than 1 in 1 million.
    - The Delaney Clause was an amendment (1958) to the federal Food Drug and Cosmetic Act which stated that known carcinogens shall not be allowed as intentional additives to the food supply. Implementing this clause was challenging because trace levels of a chemical ingredient might not pose much risk, though would still be banned from foods if it had been shown to have carcinogenic effects. This led to Delaney Clause exemptions, allowing carcinogens if present below a level of de minimis risk, which was defined as the incremental lifetime cancer risk to the 90th percentile food consumer of no greater than 1 in a million.
- The Nuclear Regulatory Commission (NRC) uses a preventive target that translates to approximately 1 in a million cancer risk to nearby residents when considering the licensure of nuclear reactors (NRC, 1986; Adler 2007), and
- DEEP's RSR cleanup targets for carcinogens – like many other states' cleanup program criteria - are also based upon this 1 in 1 million cancer risk target.

While DPH and other regulatory agencies target 1 in 1 million risk for each carcinogen in each regulated medium, that goal is often modified by site-specific and risk management factors, so that the site-specific risk target may vary upwards from 1 in 1 million to 100 in 1 million (10^{-6} to 10^{-4} cancer risk).

- The DEEP target of 10^{-6} per chemical and 10^{-5} for all chemicals is within this risk range and may well be at the upper end of the risk range (closer to 10^{-4}) at some sites when considering all chemicals at a site and all pathways that may affect a single individual (e.g., dermal uptake, food ingestion, volatilized chemical; these are not included in RSR calculations).

By maintaining the target chemical risk at the 1 in 1 million level, DPH endeavors to ensure that the particular source does not make a substantial contribution to background cancer risk from the sum of environmental chemicals. This background risk has been calculated to be in the 10^{-4} to 10^{-3} range (e.g., Woodruff et al. 2000). Thus, the de minimis risk target also ensures that, when combined with exposures from other media (soil, drinking water, and vapor into indoor breathing space) which contain that chemical at that site, and added across all carcinogens present on the site, the cumulative risk for that particular chemical will remain within the 10^{-6} to 10^{-4} risk range.

Population Potentially Exposed to Contaminants at a Site

CDM's recommendation to adopt a 10 in 1 million cancer risk goal, per chemical - following the approach taken in British Columbia - appears grounded in part on CDM's statement that only a small number of people might be exposed to hazardous substances at an individual site. Some context for this statement is helpful. First, the risk is the same for each person exposed to the contaminant, regardless of the number of people who could be exposed. Second, if only a few sites existed that were widely scattered over a large area, then perhaps only a small number of individuals could be exposed to site contaminants. As part of DEEP's analysis, DEEP reviewed the states that CDM evaluated by population density and size and included target risk levels for both remediation and Water Quality Standards. Almost exclusively, the states that use the 10 in 1 million target risk level for a single chemical are in the lower half of the evaluated states for population density.

TABLE 1 LISTING OF POPULATION DENSITIES OF PEOPLE PER SQUARE MILE AND TARGET CANCER RISK LEVELS

	Pop Density (people/mi^2)	State Area (mi^2)	Target Cancer Risk single chem (remediation default criteria, or "point of departure" if no default criteria)	Target Risk WQS (single chem)
NJ	1210	8,722	10^{-6}	10^{-6}
RI	1017	1,544	10^{-6}	10^{-6}
MA	858	10,554	10^{-6}	10^{-6}
CT	742	5,543	10^{-6}	10^{-6}
NY	417	54,554	10^{-6}	10^{-6}
CA	246	163,694	10^{-6}	10^{-6}
IL	232	57,913	10^{-6}	10^{-5}
MI	175	96,713	10^{-5}	10^{-5}
NH	147	9,349	n/a	10^{-6}
TX	101	268,596	10^{-5}	10^{-5}
VT	68	9,616	10^{-6}	10^{-6}
ME	43	35,379	10^{-6}	10^{-6}
BC	12	364,764	10^{-5}	n/a
MT	7	147,039	n/a	10^{-5}

= 1 in 100,000 States = 1 in 1,000,000 States

CA uses 10^{-6} as its "point of departure", and has not adopted default criteria.

From this data, Connecticut, the 4th most densely populated state in the U.S., is about 60 times more densely populated than British Columbia. While population density does not affect the cancer risk for exposure to any specific substance, it does increase the likelihood of human exposure(s) to that risk. Connecticut is a small, very densely populated state, with a long and heavy industrial history and thousands of contaminated sites. As a result, contamination left behind by generations of commercial and industrial production and processes is interspersed in many densely populated places throughout our state. Further, since many chemicals remain in soil and groundwater for a long time, potential future uses of a property may create additional exposures.

Population density is one potential indicator of how many people might be in close proximity to one or more contaminated sites, and thus potentially exposed to contaminants currently or in the future. Population density, however, is not in itself dispositive. Also, drinking water and volatilization (vapors rising into indoor air) impacts, for instance, could affect people at some distance from the source site due to the size/length of a groundwater plume.

In States with high population densities and an intensive commercial/industrial history, there may be an increased potential for exposure for a larger number of people than in states with lower population densities. Often there are likely to be multiple remediation sites in an area potentially affecting similar populations of citizens. For all of these reasons, Connecticut, like other states in the northeast, use the 1 in 1 million cancer risk goal for default numeric criteria.

Other States and Agencies

CDM identified other states and agencies with respect to their cancer risk targets for environmental cleanup. DEEP analyzed these and provides some additional information below.

British Columbia (BC)

- CDM is correct that BC uses cancer risk targets of 10^{-5} per chemical and 10^{-4} cumulative. However, CDM stated that in BC the cancer risk goal could be amended by a local health official: "based on the judgment of the local public health official, the cleanup criteria can be less (but not more) stringent than the default criteria" (CDM at 1-3; also referenced in CDM Table 6-2). DEEP evaluated this further as CDM had recommended. DEEP spoke by phone with the Director of the BC Ministry of Environment, Land Remediation Section. What we found in our review is that "local" in this context does not mean city or town, as we typically use the term in Connecticut. In BC, the health official with such authority is a person who works for the Province's Ministry of Health – analogous perhaps to the Connecticut DPH.
  - Also, the type of polluted site that this process is used for seems to be large complex sites, perhaps analogous to state or federal Superfund sites in the United States. The Director was aware of only a handful of such sites where a site specific health determination used an alternative cancer risk target in this manner.

California (CA)

- CA does not have default numeric criteria for carcinogens pegged to 10^{-5} per chemical, or 10^{-4} for a site as a whole.
- CDM indicated that CA uses a less conservative cancer risk target than Connecticut. See CDM Report p. 1-8 (10^{-4} "presumptively acceptable"); p. 6-24 (per chemical at 10^{-5}, and total site risk at 10^{-4}; with reference to CA Proposition 65); and p. 6-25, Table 6-2. DEEP's analysis indicates that actual practice in CA is more complex than that; many site cleanups in CA are pegged to 10^{-6}, and at some sites the result may be more conservative than in Connecticut due to consideration of multiple pathways and multiple contaminants.
- CA uses 10^{-6} per chemical as the starting point. "If the cumulative risk [meaning risk across pathways – soil, water, etc.] is less than one-in-a-million (1×10^{-6}) . . . the PEA [Preliminary Endangerment Assessment] health screening risk evaluation report may be used as support for a 'no further action" decision'." (Preliminary Endangerment Assessment Guidance Manual, State of California, EPA/Department of Toxics Substances Control, Interim Final - Revised October 2013, section 2.5.3).
  - This preliminary risk evaluation uses multiple contaminants and exposure pathways. It is likely to be more conservative than the Connecticut RSRs for individual contaminants, because CA incorporates a holistic consideration of site risk including additive effects of multiple chemicals. CA would only exempt sites from remediation based on a 10^{-6} risk for the site as a whole. In Connecticut, the current default individual RSR numeric criteria do not consider contaminants collectively, but only in isolation.
- After a PEA, CA allows a party the option of making a site-specific demonstration for a risk range for carcinogens of 10^{-4} to 10^{-6}. Based on DEEP's preliminary research and conversations with officials in CA, the 10^{-6} is the presumed goal (point of departure) unless clear justification can be made otherwise, looking at multiple contaminants and multiple pathways, and requiring review and approval by the environmental agency. CA

does not generate chemical specific numeric criteria site-by-site. Instead, the demonstration results in a suite of remedies, which – like CT – could include a mix of institutional controls, capping, inaccessible soil and other measures that allow carcinogen concentrations above a 10^{-6} risk level to remain in place with exposures controlled.

- ❒ CDM referenced CA's "Proposition 65" law as a basis for CA's 10^{-5} cancer risk goal. Proposition 65 is a "right to know" notification requirement based on identified chemicals with threats numerically tabulated at 10^{-5}. It requires owners of property (open to the public) to inform the public (such as signs) of the presence of a potential threat from the chemical. Property owners may choose to take action on the pollution to avoid posting a sign. Thus, CA's Proposition 65 - a notification and short-term measure based law - appears more analogous to the CT Significant Environmental Hazard Notification law, 22a-6u, than to RSR cleanup endpoints.

New York (NY) and New Jersey (NJ)

- ❒ CDM indicated in its Table 6-2 showing Acceptable Risk Estimates from states and agencies, that NY's and NJ's cancer risk targets are "not specified". DEEP's initial research into NY and NJ indicates that that the cancer risk target in both states is predominantly 10^{-6} per chemical. For NY, see 6 NYCRR Part 375 (Subpart 375-3.8). For NJ, see Brownfield and Contaminated Site Remediation Act N.J.S.A. 58-10B-12.

How Might A Change In Cancer Risk Goal Affect Site Cleanup?

DEEP assumes that CDM's recommendation is based on an anticipated benefit of some kind. CDM's Report did not indicate whether such a change to soil direct exposure criteria, if adopted, would have any substantial effect on remediation - timing, costs or remedy options.

While DEEP did not find information that indicates such a change would substantially improve the pace of site cleanup, there are a number of factors that indicate any such change may only have a negligible impact. First, as identified above, only about 1/3 of the RSR criteria are based on cancer risk. The criteria for the other 2/3 of contaminants would stay the same under CDM's recommendation. Second, contaminant concentrations in releases of hazardous substances from leaks, spills, dumping, etc., prior to cleanup, are typically highly concentrated. Third, the remedy selected would often be the same, regardless of the cleanup criteria. Excavation or capping, for instance, would equally remediate soil pollution from a release regardless of whether the criteria for carcinogens is set at a cancer risk goal of 10 in 1 million or 1 in 1 million.

Also, there is no clear indication that releases, except for some instances of groundwater plumes, would be cleaned up faster. Some groundwater plumes could meet less protective groundwater criteria sooner (for instance, shorter duration for natural attenuation monitoring or other long-term groundwater remedy operation). However, CDM's recommendation is for polluted soil, not polluted groundwater.

- ❒ There are three sets of RSR criteria for polluted groundwater: drinking (Ground Water Protection Criteria (GWPC)), surface water protection (Surface Water Protection Criteria (SWPC)), and breathing vapors rising from groundwater into indoor air (Volatilization Criteria). Criteria for drinking and volatilization are directly tied to human health

protection. SWPC are a mix – some criteria are tied to aquatic health and some to human health protection.

- CDM did not say that it recommends the 10 in 1 million cancer risk goal (per chemical) to apply to drinking water. RSR criteria for drinking water (GWPC) match the Maximum Contaminant Levels (MCLs) set by EPA, with a few exceptions (a few GWPC are higher, and a few lower than the MCLs). MCLs are set by EPA using a 1 in 1 million cancer risk goal, per chemical, and are further refined for some chemicals based on cost and feasibility. As such, the RSR's GWPC already reflect the same cancer risk, cost and feasibility factors as the MCLs. Furthermore, DEEP does not believe that there would be public acceptance of a less protective cancer risk goal for contaminants in drinking water, either for people using private wells or for public water systems (which must meet MCLs) that rely on groundwater sources.

The more significant factor affecting speed and practicality of cleanup will likely continue to be the toolbox of remedy options and approaches to risk management. For groundwater, DEEP streamlined the process in the 2013 RSRs – eliminating up to three years of groundwater monitoring to achieve RSR endpoints. DEEP has also developed, with a workgroup of private professionals, an improved approach and process for DEEP Technical Impracticability determinations, including recently published guidance and Fact Sheets. Changes to regulations will be proposed to further enhance the usefulness of this variance. Also, as discussed below, DEEP is developing a variety of approaches for alternative criteria and remedy options for groundwater to provide more remedy options to match the level of risk.

Clean Air Act

CDM's analysis included a few brief references to some Clean Air Act emission limits. The context for those references is unclear since they refer to a 1989 NESHAP based on a risk assessment methodology, whereas with the adoption of the 1990 Clean Act Amendments EPA's policy on regulating air emissions changed to a far more successful control technology approach. As such, the cancer risks from stationary sources' air emissions, that CDM cited, presently would likely reflect outcomes of using specific available air emission control technology, rather than a health-based goal.

Clean Air Act permitting is essentially a technology-forcing program. Permitting and emission limits are targeted to what type of emission control technology is in use around the country and in some cases around the globe. It targets the use of maximum available control technology to reduce emissions of hazardous air pollutants from production facilities. The health risks associated with exposure to emissions is essentially the result, not the target, of the contemporary 1990 Clean Air Act Amendments permitting approach.

DEEP Recommendations:

After review, DEEP concludes that the existing health goal of 1 in 1 million cancer risk per single chemical, and 10 in 1 million for all chemicals at a site cumulatively, in combination with a variety of flexible remedial options to achieve a cleanup endpoint (including many that leave the pollution in place with proper controls), continues to be the appropriate goal for applying the de minimis risk target for cancer. To further the goal of cleaning up sites more quickly, DEEP recommends continuing the successful approach of increased flexibility in remedy options to match site risks to remedy choices. These include DEEP's RSR proposals for Alternative Groundwater Protection Criteria and for self-implementing Engineered Controls to address historic fill/urban soil, as well as reclassification of groundwater in appropriate locations. Information about these and other risk management proposals is available on DEEP's website.

References:

Adler, MD (2007). Why De Minimis? *University of Pennsylvania, Institute for Law & Economics, Research Paper No. 07-12*, 2007.

Castorina, R and Woodruff, TJ (2003). Assessment of Potential Risk Levels Associated with U.S. Environmental Protection Agency Reference Values. *Environ Health Perspect* 111: 1318–1325.

Fiori, JM and Meyerhoff, RD (2002). Extending the Threshold of Regulation Concept: De Minimis Limits for Carcinogens and Mutagens. *Regulatory Toxicology and Pharmacology* 35: 209–216.

Woodruff TJ, Caldwell, J, Cogliano, VJ and Axelrad DA (2000). Estimating Cancer Risk from Outdoor Concentrations of Hazardous Air Pollutants in 1990. Environ Res 82: 194–206.

Significant Environmental Hazard Notification

Section 28 of Public Act 13-308 requires that DEEP, in the context of CDM's report, consider recommendations to revise the Significant Environmental Hazard Notification statute, CGS 22a-6u. For the reasons outlined below, DEEP is not recommending any changes to section 22a-6u at this time.

Significant Environmental Hazard Notification Statute

CDM's report did not specifically address the Significant Environmental Hazard Notification statute, CGS 22a-6u ("SEHN"). CDM stated that its report focuses on risk assessment and risk management for final cleanup standards, and not on short-term measures to stop exposures to short-term risks (such as CGS 22a-6u).

The SEHN statute requires notification when certain conditions - defined in the law - are detected. These are either when contamination at levels many times higher (an order of magnitude or more) than cleanup standards are detected near people, or immediate unwanted exposure would occur (such as drinking polluted water). This notification triggers an evaluation of whether people are being exposed, and, if so, a process to take action to stop the exposure. The intent is that once a known heightened hazard is apparent, timely action is needed to eliminate any exposure to it.

The SEHN statute was amended in 2013 by Public Act 13-308 as one part of the Cleanup Transformation implementation. The purpose of the amendments to the SEHN statute was to refine which heightened conditions should require timely action to eliminate any exposures, and to promote self-implementing actions for a more rapid response time. The primary changes in 2013 to the SEHN statute were to amend some conditions for notification to include:

- a fuel oil release (non-aqueous phase liquid) is in a drinking water well or is threatening surface water,
- groundwater pollution above drinking water standards found within a 200 foot radius of a drinking water well,
- heavy metals or PCBs 15 times higher than the cleanup standard in surface soil within 300 feet of a school, residence, daycare or playground, unless the metals or PCB hot spot is under pavement or access is secured with fencing,
- surface soil at a school, residence, daycare or playground polluted with a contaminant 15 times higher than the cleanup standard, except for both lead paint being adequately addressed at a residential property and petroleum hydrocarbons,
- groundwater within 15 feet of an occupied building is polluted with volatile organic compounds (VOCs) more than 10 times higher than the Connecticut cleanup standard for volatilization from groundwater
    - This protects against breathing vapors that can make their way into indoor air,
    - Exceptions are made for unoccupied buildings, and for buildings in which the VOC is used in a production process, and

- A variety of procedural amendments to make the statute more self-implementing and efficient.

DEEP evaluated whether aspects of the CDM Report relate to, inform and/or provide reason to further amend the SEHN statute. DEEP found nothing in CDM's evaluation that warrants additional amendments at this time to the statute. CDM's objective comparison of the default RSR criteria to two neighboring states – Massachusetts and New York - showed no systematic conservative bias in Connecticut (CDM Report at page 1-6). This indicates that the RSR numeric criteria, which are the foundation of the SEHN conditions, are generally consistent with our neighboring states. Also, CDM ranked Connecticut's risk assessment approaches in the top half of "best practices" of the states it evaluated.

DEEP does not think that CDM's recommendations to change the goals for soil criteria to incorporate ecological risk for invertebrates and plants (which would make some criteria more conservative), or to increase the human health cancer risk goal (which would make some criteria less conservative), warrant amendment of the SEHN statute. Connecticut's existing cancer risk goal is consistent with the northeast states, which use the same cancer risk goal for default numeric criteria. Also, RSR criteria for metals are not set on cancer risk; they are set for other health effects (and for arsenic, set based on natural background). RSR criteria for PCBs are based on cancer risk, though since EPA regulates PCBs nationwide (via the Toxics Substances Control Act), PCB criteria is generally consistent among all states. Therefore, the SEHN conditions for surface soil do not warrant amendment based on CDM's report.

The SEHN conditions also include groundwater contamination – for the exposure routes of drinking water and for volatilization (breathing vapors that can rise up from groundwater into overlying buildings). CDM's analysis and recommendations focused largely on soil, and not on these groundwater exposures and risks. Therefore, there is little if anything in the CDM Report to warrant amendment to the SEHN conditions related to groundwater. The drinking water criteria in the RSRs are largely based on EPA's Maximum Contaminant Levels for public water systems.

Also, for volatilization, new information does relate to the need for short-term action to address potential health risks associated with volatilization from groundwater near buildings. Consistent with the approach taken by EPA and Massachusetts in 2014, DPH and DEEP recently published guidance on non-cancer risks of cardiac defects and impaired immunity from *in utero* exposure, which can result from TCE in indoor air. The guidance recommends that exposures at the residential volatilization criteria, or at 1.6 times the industrial/commercial volatilization criteria, should trigger evaluation of the need for short-term measures to protect pregnant women from the potential for *in utero* exposure. [4] At present, DEEP does not recommend amendment to the

[4] An important new development is that animal and human studies have shown TCE to be a developmental toxicant, having the ability to cause cardiac defects and impaired immunity (both are non-cancer risks) from *in utero* exposure. The time frame over which exceedance of the inhalation reference concentration (RfC) may create a significant health risk (cardiac defects and impaired immunity) is likely much shorter than the cancer-based target. Both animal and human epidemiology studies provide evidence of TCE's toxicity to fetal development (USEPA, 2011; Forand et al. 2012, Chiu et al. 2013). This has led USEPA to derive an inhalation reference concentration (RfC) of 2 $\mu g/m^3$ to protect against these developmental effects (USEPA, IRIS 2011). In the RSRs, the TCE Target Indoor Air Concentration (TAC) used to calculate RSR volatilization criteria is 5 $\mu g/m^3$ for both the residential and

SEHN statute for this exposure pathway, and instead recommends first seeing how the guidance influences actions where warranted.

Manageable Program

For informational purposes, DEEP reviewed past data to evaluate the potential effect of the 2013 SEHN amendments on the number of future notifications. Using data over the past three years (2012 through 2014), there were 24 total SEHNs submitted for surface soil, and 3 submitted for groundwater volatilization. See Table 2 below. Only 4 of the 24 surface soil notifications were for heavy metals or PCBs at commercial/industrial property that potentially were within 300 feet of a residence, school, daycare or playground. Our preliminary analysis did not discern whether any of the 4 may have had exposure controlled by existing pavement or fencing (meaning notification would not be required under the amended law). While this data is not a strong indicator of future notifications, it provides some context to anticipate a manageable number of additional notifications due to the carefully crafted, more specific thresholds, and more self-implementation, in the 2013 amendments.

TABLE 2 2012-2014 SIGNIFICANT HAZARD NOTIFICATIONS

Year	Total SEHN – all categories	Surface Soil Risk category	Volatilization Risk category
2014	33	7	0
2013	31	4	2
2012	36	7 (plus 6 residential for lead paint)	1
Total for 3 years	100	18[1]	3

[1] Not including the 6 residential lead notifications, which will be exempted under the amended statute

Benchmarking

Other states may have a similar approach to identifying short-term risks that warrant short-term measures to control exposure where older releases are discovered. DEEP reviewed the Massachusetts cleanup program (Statute Chapter 21E, and regulations 310 CMR 40.0000) for comparison. Massachusetts uses the term “imminent hazard” or “potential imminent hazard” and has a variety of triggers for different media and substances. A few examples for surficial soil are presented in the Table below, to compare Massachusetts and Connecticut triggers for notification and evaluation of the need for short-term measures. The Connecticut SEHN thresholds used in the Table are from the statute as amended in 2013, effective July 2015.

industrial/commercial scenarios. This target was set in the 1996 RSR criteria based upon cancer risk with adjustment for the TCE concentrations that can occur in non-impacted (or “background”) indoor air locations. [See CT DEEP: Trichloroethylene (TCE) Developmental Risks and MA guidanceTrichloroethylene (TCE) | MassDEP and EPA recommendations].

TABLE 3. EXAMPLES OF MA AND CT SOIL THRESHOLDS FOR SHORT-TERM ACTION

Substance **All units are parts per million (ppm)**	**MA within 500 ft of residential**	**CT Residential**	**CT industrial, commercial within 300 ft of residential, if** **- metals or PCBs in release, and** **- not paved or fenced**
Arsenic total	40	150	150
Cadmium total	60	510	15,000
Chromium VI (or total)	200	1,500	1,500
Mercury total	300	300	9,150
PCB total	10	15	150
Hazardous substances other than metals and PCBs	Risk evaluation based on $10^{-5,}$ roughly equates to a 10 x cleanup criteria	15 x cleanup criteria	30 x cleanup criteria (no change from prior to amendments)

Even with the thresholds in the 2013 amendments to the SEHN statute, Connecticut is often many times less stringent, and less protective of potential exposures at residences, schools and playgrounds than Massachusetts.

Summary

In summary, the CDM Report does not warrant any changes to the Notification of Significant Environmental Hazard Statute (CGS 22a-6u), including the 2013 amendments (effective date July 1, 2015).

IV. Conclusion and Plan Forward

DEEP will move forward to implement the recommendations outlined in this report on a timeframe consistent with DEEP's resources. Certain recommendations fit well into the Cleanup Transformation process. Other recommendations are complimentary to that process and will be pursued simultaneously.

A summary of the actions DEEP intends to accomplish, along with estimated schedules, are set forth below.

Ecological Risk

- ❒ DEEP will develop guidance on how to perform each tier of the ecological risk assessments (Scoping, Screening, and Site-Specific), including adapting into guidance some of the ecological risk assessment and management approaches used in British Columbia and Massachusetts, as well as other states.
    - **Estimated schedule: drafts for public comment in 2016**

Update Numeric Criteria

- ❒ DEEP will initiate, with DPH, a new approach to updating numeric criteria for cleanup:
    - As an initial step, DEEP, working with DPH, will convene a Science Advisory Panel to provide review and feedback on developing methodologies for updating numeric criteria to use best available science; these will include:
        - inputs integral to criteria calculation, such as exposure assumptions and sources of toxicity information,
        - updates to existing numeric criteria,
        - adding Additional Polluting Substances into RSR numeric criteria to make them self-implementing, and
        - including additional exposure categories for risk-based criteria, to more accurately reflect uses at some sites (e.g., passive recreation) and thus lessen the cleanup requirements at those sites,
    - **Estimated schedule: initiate Panel selection process Fall 2015; start Work with Panel in 2016**

- ❒ Based on recommendations from the Science Advisory Panel and other new information, DEEP will draft criteria proposals for public review and comment,
    - **Estimated schedule: subject to duration of work with Science Advisory Panel**

- ❒ In the time period before DEEP updates numeric criteria, DEEP will post on its website recommended criteria values for commonly requested Additional Polluting Substances, and a streamlined procedure for approval, which a party can opt to use unless it prefers to pursue site-specific criteria,
    - **Estimated schedule: June 2015**

- DEEP posted on its website information on how the RSR criteria were calculated in 1996 DEEP: 1996 RSR Criteria Derivation,
  - **April 2015**

Risk-based, Flexible Risk Management Approaches, including use of Alternative Criteria

- DEEP will continue its efforts to further refine the Remediation Standard Regulations (RSRs) to increase risk-based flexible endpoints, and increase the availability of self-implementing approaches; a few examples are:
  - creating RSR provisions for self-implementation of site-specific risk assessments, for instance:
    - self-implementing, site-specific alternative criteria development for pollutants leaching from soil to groundwater (Pollutant Mobility Criteria), which will result in less need for soil remediation at some sites while still being protective,
  - developing Alternative Ground Water Protection Criteria for locations designated as potential drinking water sources, where groundwater will not be used for drinking for the foreseeable future and where the pollution will steadily dissipate; this would result in endpoints that are faster to achieve, while not increasing risk.
  - **Estimated schedule: publish public hearing draft by early 2016**

- On other significant transformation actions, DEEP will:
  - Initiate the regulation adoption process to add a Deed Notice option, which is an easier, more cost effective Institutional Control tool (used to control future exposures when contamination is left in place),
  - **Estimated schedule: publish public hearing draft by early 2016**

  - Continue to develop draft regulations to improve the reuse and management of polluted soil.
  - **Estimated schedule: publish public hearing draft by early 2016**

  - Conduct a statewide evaluation of ground water classifications to determine additional areas that may be appropriate for reclassification from GA designation (drinking water) to GB (non-drinking water), which greatly reduces the cleanup effort for sites in GB areas,
  - **Estimated schedule: evaluation already underway, commence formal re-designation process by end of 2015, complete process in 2016.**

- DEEP will "Lean" the process for reviewing and approving site-specific Alternative Criteria,
  - **Estimated schedule: Fall 2015**

- DEEP will provide guidance on site-specific human health risk assessments to encourage greater use where parties deem it beneficial,
  - **Estimated schedule: 2016**

- DEEP will provide calculation tools for Alternative Criteria, and for Additional Polluting Substance criteria, beyond those already contained in the RSRs,
  - **Estimated schedule: Fall 2015**

- DEEP will further evaluate opportunities for local government participation in solutions for motivating reuse of Brownfield sites to generate over-all public health benefits, and will seek feedback from municipalities on community garden and food production concept.
  - **Estimated schedule: by end of 2015**

The timing and process for public feedback will differ based on the type of recommendation. For instance, for some proposals to amend the RSRs, DEEP has already published "Public Discussion Drafts," while for others, the process (including public outreach) has not begun. For guidance documents, DEEP will seek public input on draft guidance before finalizing the guidance.

Appendices

A. Public Act 13-308
B. List of Substances with RSR Numeric Criteria for Direct Exposure, and Cancer/Non-Cancer Derivation
C. Supplemental Research
D. Groundwater Reclassification Process
E. Public Comments Summarized
F. Ecological Risk Assessment – Tiered Approach

V. Appendix A
Public Act 13-308, Section 28

Sec. 28. (NEW) (*Effective from passage*) The Commissioner of Energy and Environmental Protection, in consultation with the Commissioner of Public Health, shall evaluate risk-based decision making related to the remediation of contaminated sites. The commissioner shall, within existing resources, engage independent experts in the field, with broad national experience, to conduct such evaluation and prepare a report that includes an assessment of the existing process of risk-based decision making including risk assessment and risk management tools utilized to protect public health, general welfare and the environment. Such evaluation and report shall also include identification of best practices in ecological and human health risk assessment and risk management used by the United States Environmental Protection Agency and other regulatory agencies, and those published by the National Academy of Sciences. The commissioner shall provide opportunities for public review and input during the evaluation process. Upon completion of the evaluation and report, the commissioner shall consider the evaluation and report and make recommendations for statutory and regulatory changes to the risk based decision making process including, but not limited to, those in section 22a-6u of the general statutes, as amended by this act, not later than October 1, 2014. For purposes of this section, "commissioner" means the Commissioner of Energy and Environmental Protection.

VI. Appendix B
Determinants of RSR Direct Exposure Criteria (soil)

{Cancer (C) vs Non-Cancer (NC) vs Background/Lab Reporting Limit (B/LR) vs Ceiling (CLG)}

VOCs

Carcinogens

Acrylonitrile - C
Benzene - C
Carbon tetrachloride – C
Dibromochloromethane – C
1,4-Dichlorobenzene - C
1,2-Dichloroethane - C
1,2-Dichloropropane - C
1,3-Dichloropropene - C
Ethylene dibromide (EDB) - C
Methylene chloride - C
1,1,1,2-Tetrachloroethane - C
1,1,2,2-Tetrachloroethane - C
Tetrachloroethylene - C
1,1,2-Trichloroethane - C
Trichloroethylene - C
Vinyl chloride - C

Non-Carcinogens

Acetone - NC, CLG
Bromoform - NC
2-Butanone(MEK) – NC, CLG
Chlorobenzene - NC, CLG
Chloroform - NC
1,2-Dichlorobenzene - NC, CLG
1,3-Dichlorobenzene - NC, CLG
1,1-Dichloroethane - NC, CLG
1,1-Dichloroethylene – NC
trans-1,2-Dichloroethylene - NC, CLG
cis-1,2-Dichloroethylene - NC, CLG
Ethylbenzene - NC, CLG
Methyl-tert-butyl-ether - NC, CLG
Methyl isobutyl ketone - NC, CLG
Styrene - NC, CLG
Toluene - NC, CLG
1,1,1-Trichloroethane - NC, CLG
Xylenes - NC, CLG

Semi-Volatiles

Carcinogens

Benzo(a)anthracene – C, B/LR
Benzo(b)fluoranthene – C, B/LR
Benzo(k)fluoranthene - C
Benzo(a)pyrene – C, B/LR
Bis(2-chloroethyl)ether - C
Bis(2-chloroisopropyl) ether - C
Bis(2-ethyl hexyl) phthalate - C
Hexachloroethane – C
Hexachlorobenzene – C
Pentachlorophenol - C

Non-Carcinogens

Acenaphthylene - NC, CLG
Anthracene - NC, CLG
Butyl benzl phthalate - NC, CLG
2-chlorophenol - NC
Di-n-butyl phthalate - NC, CLG
Di-n-octyl phthalate - NC, CLG
2,4-Dichlorophenol - NC
Fluoranthene - NC, CLG
Fluorene - NC, CLG
Naphthalene - NC, CLG
Phenanthrene - NC, CLG
Phenol - NC, CLG
Pyrene - NC, CLG

Inorganic Substances

Carcinogens
Arsenic – C, B

Non-Carcinogens
Antimony - NC
Barium – NC
Beryllium – NC
Cadmium - NC
Chromium, trivalent – NC
Chromium, hexavalent - NC
Copper – NC
Cyanide - NC
Lead - NC
Mercury - NC
Nickel – NC
Selenium - NC
Silver - NC
Thallium - NC
Vanadium - NC
Zinc – NC

Pesticides, PCB's and Total Petroleum Hydrocarbons (TPH)

Carcinogens
Alachlor - C
Chlordane - C
Dieldrin - C
Heptachlor epoxide - C
Heptachlor - C
Lindane - C
Toxaphene – C
PCB's - C

Non-Carcinogens
Aldicarb - NC
Atrazine - NC
Endrin - NC
2-4 D - NC
Methoxychlor - NC
TPH - NC

12/2014 DPH

VII. Appendix C
Supplemental Research: CTDEEP Evaluation and Comparison of Risk-Based Decision-Making Between State Programs

Objective

As a part of the DEEP review of the CDM Report, additional details were needed for a more in depth and direct comparison of the risk programs in other States with Connecticut. The objective of this exercise was to compare the risk based practices and criteria of Connecticut with the same selection of States from the CDM Risk Report (August 29, 2014).

An evaluation of remediation criteria, water quality standards values, and programmatic details was conducted for the states that CDM evaluated: Massachusetts, Rhode Island, Vermont, New Hampshire, Maine, New York, New Jersey, California, Texas, Montana, Michigan, Illinois, and the Canadian province of British Columbia. This list was primarily selected on geographic proximity to Connecticut, and additional States were agreed to by DEEP and CDM. The States that were further away from Connecticut were selected for various reasons. California was selected due to utilizing several unique and State specific values and practices. Michigan was selected due to utilizing a lifetime cancer risk estimate of 1×10^{-5} (1 in 100,000) for each chemical as opposed to 1×10^{-6} (1 in 1,000,000) that many states use. Montana was selected for evaluation due to familiarity with CDM staff and for having a unique mission of remediation to restore conditions as close to pristine as possible. Illinois was included due to its modified risk-based corrective action program that considers issues important to the state, including groundwater exclusion zones and the use of impermeable barriers for mitigation during redevelopment. Finally, Texas was included for several reasons including the use of State derived inhalation toxicity values and the use of individual cancer risk estimates for risk management of 1×10^{-5}(CDM 2014).

The completion of this DEEP exercise helped provide an evaluation of relevant programs and criteria for any end user of this document to review and utilize.

Methods

DEEP completed an additional review of State Risk Programs to compare Connecticut practices to the same States that CDM evaluated. The focus of the DEEP review was to provide more detail on how the various states compared on specific aspects of risk assessment and risk management programs as well as on risk based criteria values. To complete this evaluation DEEP used accessible web documents and criteria listings to obtain as much information on comparative State programs as was possible in the time allotted. The list of documents consulted in the CDM Risk Report was a starting point for information collection, but DEEP staff went beyond that list to find additional documents and details. A spreadsheet of questions and sub-questions was developed by DEEP staff to assist with obtaining pertinent information for the comparison of programs. The overall goal was to allow for a deeper understanding of how various States implement their risk assessment and management programs. A total of 27 questions were developed for the spreadsheet survey. Multiple staff from the Remediation, Emergency Response/Spill Prevention and the Planning and Standards Divisions worked on components of the evaluation.

A training and familiarizing session of the spreadsheet survey was conducted with involved staff. Information could not be obtained for all questions in all states, given the time DEEP allotted. Also, some information was considered too vague or ambiguous to be used.

The second component of data research was a direct comparison of criteria from the included States. A representative selection of constituents were chosen for comparison. The list featured an even mixture of carcinogenic and non-carcinogenic chemicals. Again, primarily web based inquiries were used to obtain values from State produced documents and criteria lists. This compilation of criteria from other states is based on available internet sources from each state, so is preliminary and not vetted through each such state's regulatory agency for accuracy to ensure precise "apples-to-apples" comparison. Thus, the information presented in graphs at the end of this Appendix are to provide general context. Also, not all States had criteria for all constituents.

TABLE C. 1. LIST OF CONSTITUENTS EVALUATED IN DEEP REVIEW OF CRITERIA

Carcinogenic Constituents	Non Carcinogenic Constituents
benzene, 1,2-dichloroethane, benzo(a)pyrene, tetrachloroethylene, trichloroethylene, vinyl chloride, chlordane, dieldrin, Total PCBs	toluene, anthracene, phenanthrene, naphthalene, 1,1-dichloroethylene, 1,1,1-trichloroethane, cadmium, chromium, copper, mercury, Total PAHs

Standing alone, a difference in numeric criteria between states would not necessarily mean there would be a difference in whether a remedial action may be needed, or the type of remedial action selected. Other factors would more often determine those questions, such as the number and types of pollutants in a specific release, the concentrations of pollutants in the release area prior to cleanup, the physical site conditions and proximity of receptors, and issues related to the party performing cleanup.

Additional focus was placed on British Columbia (BC) due to the strong recommendations to mimic their programs from CDM Smith in their report. At least one phone call took place between DEEP staff and BC cleanup program personnel (Director of the British Columbia Ministry of Environment, Land Remediation Section) to discuss the details of the BC cleanup program. Additional conversations took place with regulatory agency staff in California, to clarify how they function in regards to criteria comparison and risk assessment of remedial activities.

DEEP staff also gathered information on State Water Quality Standards (WQS) values for the group of States in the CDM Report. A list of State target risk level values was obtained from EPA to aid in the evaluation of WQS numbers. Some comparison of actual numeric values was also conducted by DEEP to further the understanding of how target risk levels impact the development of environmental criteria. A series of graphs comparing a subset of constituents amongst the State WQS is included at the end of this Appendix.

Results

The CDM Report gave accumulated scores for the risk program in each State on a scale of 0.1 through 1.0. 1.0 is the highest possible score in comparison to the Best Practices selected by CDM. There are separate scores for ecological risk assessments and human health risk assessments. DEEP compiled the scores from the CDM Report and displayed them in the following graph. The Connecticut program scores are included as yellow bars in each graph.

Of note, Connecticut always scored at or above the median values for each evaluated program. The Connecticut programs are also always significantly above the smallest bar that represents the absolute lowest score in the list of evaluated programs.

- The ecological risk assessment score values for Connecticut were 0.32, 0.32, 0.33 and the lowest scores were 0.16 for Vermont's "State provided value" and a 0.18 for Michigan's "Site Specific Risk Assessment". The highest scores were a 0.55 for Massachusetts "Method 3"and Rhode Island "Method 3".
- For the human health risk assessment scores, Connecticut scored a 0.39, 0.41 and 0.48. The overall lowest scores were a 0.14 for California "RI/FS Predictive ERA "and a 0.15 for New Jersey "HHRA" and the highest scores were a 0.56 for Canada and their "2 Detailed Quantitative Risk Assessment HHRA and a 0.55 for California's "Preliminary Endangerment Assessment".
    - CDM Smith scored CT in roughly the top third or higher for human health risk assessment. CDM Smith ranked Connecticut's methods as 8, 11 and 12 out of 32 methods for human health risk assessment best practices. Note, CDM's report stated the CT HHRA methods ranked 13, 14 and 18, though a count of scores on p. 6-10 of the CDM Smith Report indicates a ranking of 8, 11 and 12.

These combined pieces of analysis depicted in these graphs, show that Connecticut currently operates in the middle or higher in the list of evaluated group programs when compared to CDM's list of Best Practices. DEEP acknowledges that there are many ways to benchmark practices among states, and none are exact, given the high number of variables, relationship among variables, and context. CDM's approach is further explained by CDM in its Report.

FIGURE C. 1. BAR GRAPH OF SCORES FOR HUMAN HEALTH RISK PROGRAMS.

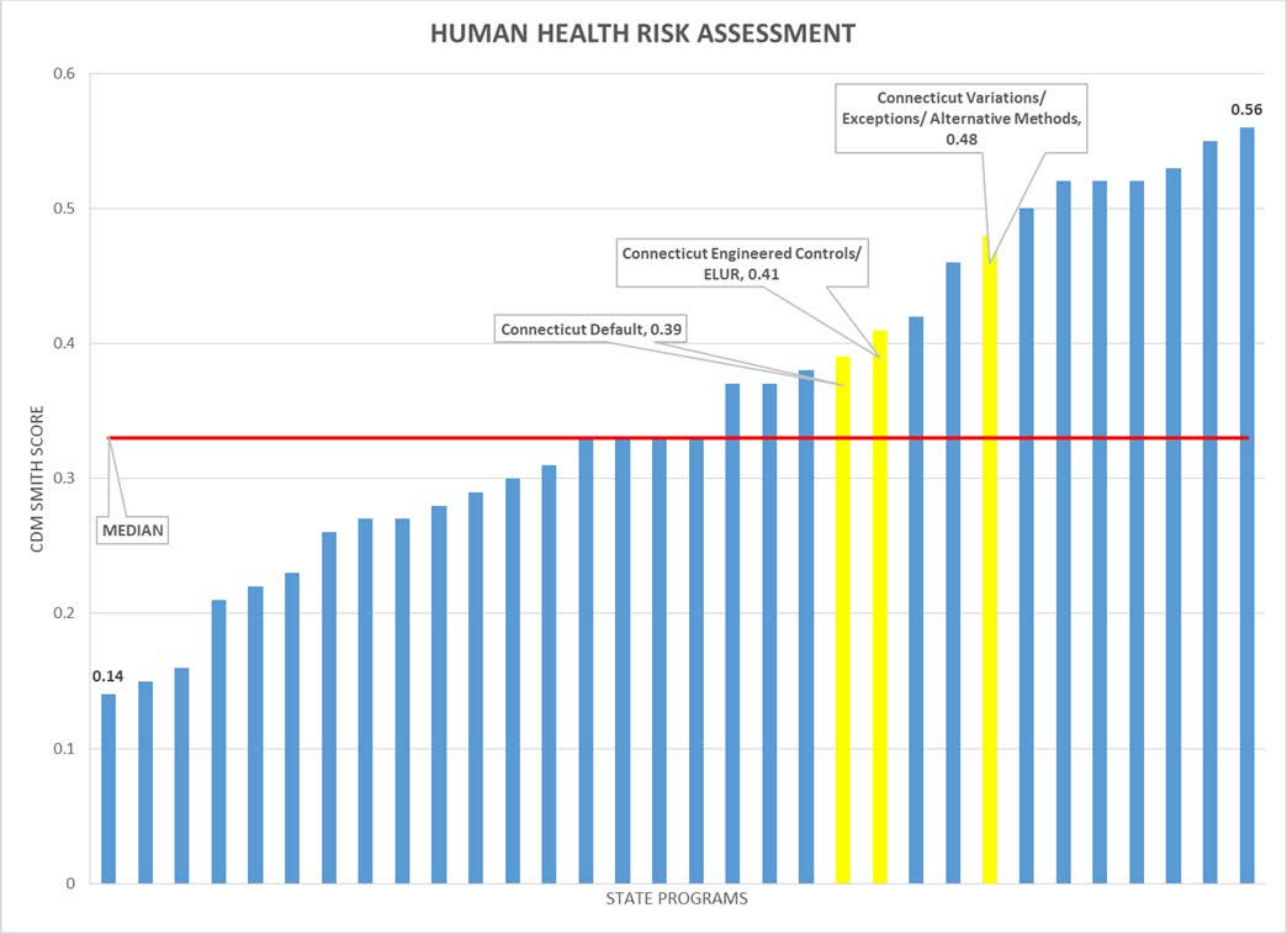
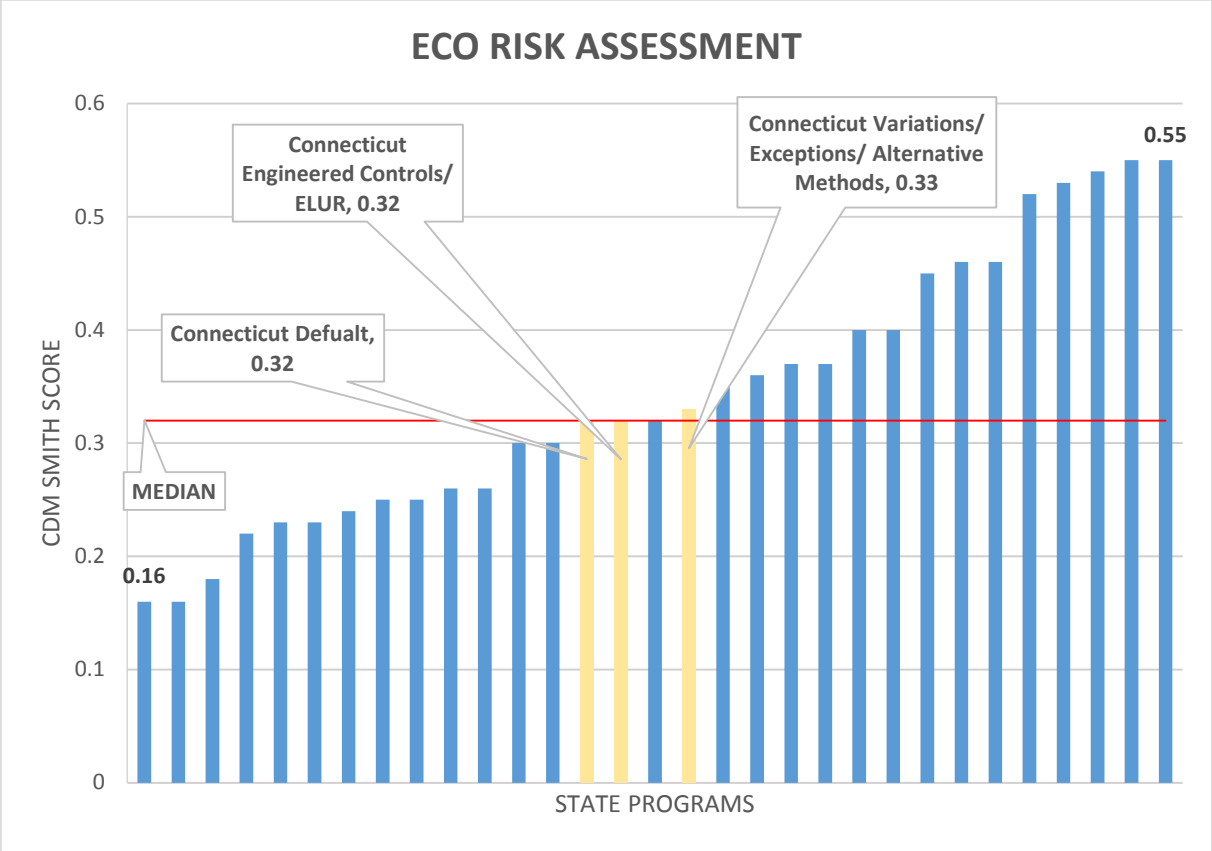


FIGURE C.2. BAR GRAPH OF SCORES FOR ECOLOGICAL RISK PROGRAMS.



DEEP compiled data was reviewed and final evaluations and graphics were developed for questions that specifically addressed any recommendations in the CDM Smith Risk Report. In some instances the question or recommendation did not lend itself to a strong visual representation. Other questions did not garner enough responses and were not compiled due to lack of information.

CDM Recommendation #1- Amend relevant laws so that all types of risk assessment and management occur within one agency (DEEP).

The review conducted by DEEP staff addressed this recommendation by investigating which agencies are responsible for various components of Risk Assessment and Management. The review targeted these categories: manages remediation of waste sites, develop new toxicity potency values for new chemicals and update old values, develop exposure scenarios, equations and assumption for exposure assessment at waste sites, review site specific alternative exposures and risk assessment, and make risk management decisions such as acceptable level of cancer risk. The review of information showed that most states evaluated have multiple agencies involved in these components of the risk decision making process. Only Massachusetts and New Jersey, as cited by CDM Smith, complete all of the researched components under one agency.

CDM Recommendation #2 – Establish a process where local property owners and government officials are encouraged to develop and present for approval, nonstandard solutions to improve public health in communities burdened by brownfields.

One of the critical recommendations from CDM is delegating some risk assessment responsibilities to the local authorities. DEEP staff evaluated if other States give municipal control to risk

assessment or management. Most States do not give control to local officials for components of risk decision making. There was only one jurisdiction where the response was yes to some extent: Maine. The details show that Maine does this for minor spills and fire situations. The British Columbia situation was further investigated via a phone call to the Director of the British Columbia Ministry of Environment, Land Remediation Section. It was learned that the position of local public health official in British Columbia is not stationed in a local entity, but is in fact a staff person of the Provincial public health agency. So, although the CDM report reads as if the local government has authority, it is actually an extension of the Provincial government. Connecticut does not currently delegate risk assessment authority for environmental cleanup to municipalities. In Connecticut, there is precedent of working closely with municipal staff, particularly on larger remediation sites, and allowing for participation in the process of remedy selection and implementation.

Environmental justice is another important issue relevant to this recommendation, though DEEP did not attempt to research this issue among other states due to its complexity, and the fact that no other state appeared to use this approach for selection of risk goals and risk assessment.

CDM Recommendation #3- (i) DEEP fully and electronically document all aspects of the default RSRs, (ii)consider updating criteria to account for risks to soil invertebrates and plants, as well as additional human exposure scenarios, and (iii) update numeric criteria more frequently including a process that does not require legislative involvement.

With respect to CDM recommendation 3(ii), an additional data comparison among states is included below in a table that compares types of soil criteria that are available. This compilation shows that the compared States are very similar in the criteria offered except for inclusion of passive recreation and agricultural criteria. Note some states (such as Massachusetts) may include agricultural/gardening pathway as a factor in the derivation of criteria, but not as a separate criteria on its own. Information was not available for all states evaluated.

TABLE C. 2. A COMPARISON OF THE TYPES OF SOIL CRITERIA THAT ARE AVAILABLE IN THE EVALUATED STATES (ANY BLANK CELLS REPRESENT UNCLEAR RESULTS).

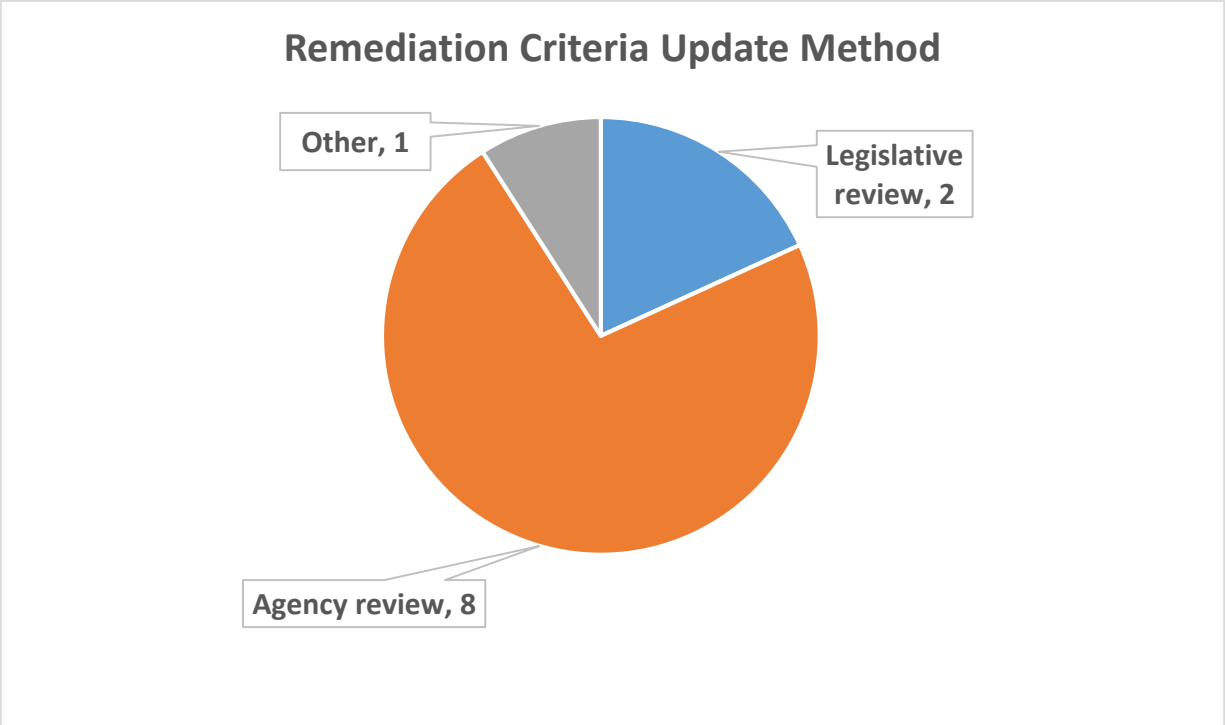
Soil Criteria Category	CT	Mass	VT	NH [1]	RI	ME[2]	MT	Ill [2]	MI [4]	Ca [3]	TX	NY	NJ[4]	BC
Residential	yes	yes	yes		yes	yes	yes	yes	yes		yes	yes	yes	yes
Industrial	yes	yes	yes		yes	no	yes	yes			yes	yes	yes	yes
Commercial	yes	yes	yes		yes	yes					yes	yes	yes	yes
Passive Recreational	no	yes	no		no	yes						no		yes
Agricultural	no	no	no		no	no		yes				no		yes

1 NH has S-1, S-2, S-3 categories it is possible that S-1 is similar to Residential considerations in other states
2 ME & Ill also have a construction worker scenario
3 CA uses site specific analysis and comparison for all risk assessments and comparisons
4 MI and NJ group industrial and commercial together into Nonresidential

With respect to CDM recommendation 3(iii), the evaluation conducted by DEEP staff included a question about how are remediation numeric criteria are updated. The potential responses were: legislative approval, agency review and public comment, and other. Most of the States involved in the evaluation follow an agency review and public comment format. The response that is recorded

as other was for Maine. Maine remediation efforts are based on guidance documents. However, those guidance documents are revised via a proposed draft and public comment process operated by the environmental regulatory agency, similar to most other States.

FIGURE C. 3. PIE GRAPH SHOWING METHOD OF UPDATING ENVIRONMENTAL CRITERIA



CDM Recommendation #4- Suggest DEEP adopt and adapt the successful ecological risk assessment and ecological risk management programs already in place in Massachusetts and in British Columbia.

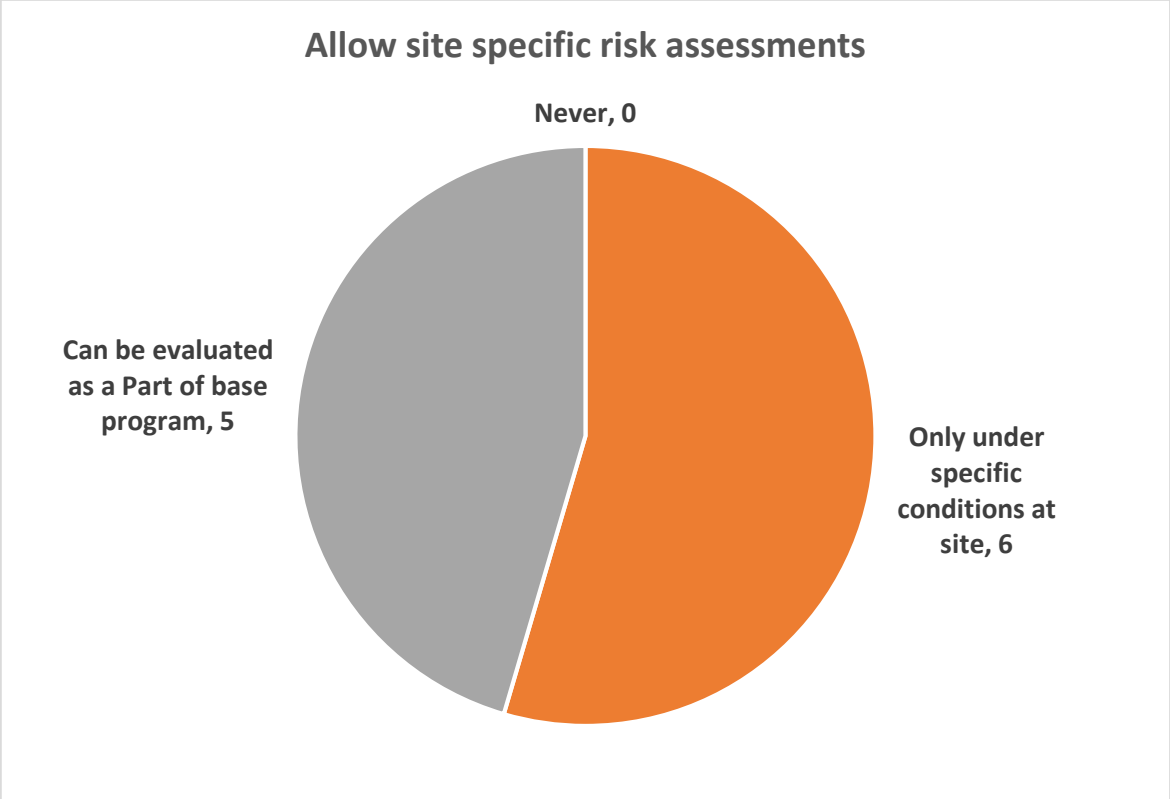
DEEP staff catalogued information on what tiers are used in ecological risk assessments. Choices were Scoping, Screening, Site Specific and Other. The information found for each State ranged from hierarchical review, to a full tiered process, to referral to EPA (which recommends tiers). No State programs recommended a different approach. Also, because the CDM report specifically recommended that DEEP evaluate approaches used in British Columbia and Massachusetts, the DEEP evaluation focused on those two jurisdictions in addition to the multi-state survey; see DEEP Report, above, at Recommendation 4.

CDM Recommendation #5- Suggest that DEEP encourage the use of site-specific risk assessment for sites where default criteria may be inappropriate.

DEEP staff reviewed State risk programs by evaluating conditions that would allow for a site specific risk assessment to be conducted for a site. The categories evaluated were: default exposure scenarios don't apply, complex sites with many chemicals and pathways, default criteria are difficult to meet and cumulative risk across chemicals evaluated against less stringent risk target, and default criteria are difficult to meet and more refined risk assessment used to evaluate remedial options. Other and Never were also categories to choose from in the spreadsheet. All of the States reviewed for this report provide an opportunity for site specific assessment. DEEP staff entered text to provide details on situations and conditions that States utilize to help clarify conditions for site specific assessments. Some of these text details indicated that site specific assessments can be

considered as part of the core risk programs for a State. It was also apparent that even if site specific assessments are allowed, there is still oversight by the regulatory agency and that various levels of approval occur for site specific proposals.

FIGURE C.4. GRAPHICAL REPRESENTATION OF STATES THAT CAN ALLOW SITE SPECIFIC RISK ASSESSMENTS FOR REVIEW BY REGULATORY STAFF



CDM Recommendation #6- For potentially carcinogenic site contaminants, suggest that DEEP adopt risk management goals for the reasonably maximally exposed individual (RMEI) of up to 1 in 100,000 per chemical, and up to 1 in 10,000 per site.

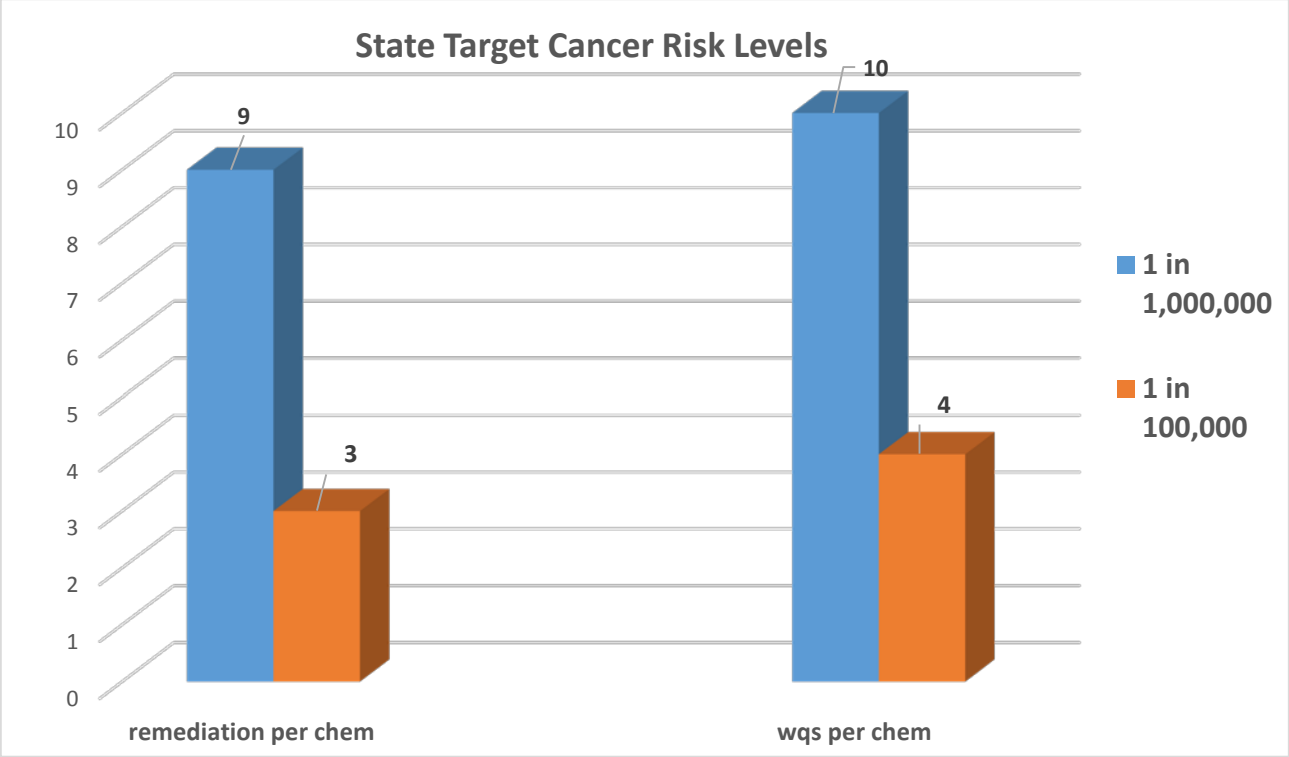
DEEP staff evaluated which substances are covered by CDM's recommendation. Numeric cleanup criteria for oil and hazardous substances are set either based on cancer risk or non-cancer health risk. Of the 88 substances for which the RSRs contain numeric criteria, DPH identified about one-third have criteria based on cancer risk. The list of substances that have numeric criteria in the RSRs, and the identification of whether criteria is set based on cancer v. non-cancer risk, is in Appendix B.

Also, DEEP staff collected information on default target risk levels for as many of the targeted States as possible during DEEP's review. A bar graph showing remediation single chemical risk levels for carcinogens is included in this report. WQS results for target risk level is also included in the graph.

The target risk level is one factor that is considered in the formulas and calculations of criteria for a State. These target risk levels are only utilized in the formulas for dealing with carcinogenic constituents. Other States will utilize additional variables and factors to develop their criteria, such

as bioconcentration factors, exposure durations, and ingestion rates in their calculations. These additional variables and factors will alter the final calculated criteria values. Also, each States' program, and how it uses cancer risk goals in setting numeric criteria, is unique. The information collected in this DEEP review is preliminary to give general context, and is not vetted through each state for precise and nuanced ways it is used in each such state. Some states have target cancer risk levels as a default, or a point of departure, though may allow a request for state approval of alternatives on a site-specific basis.

FIGURE C.5. BAR GRAPH OF TARGET CANCER RISK LEVELS.



An additional review was done to show human population densities in each evaluated State and compare with Target Cancer Risk Levels. The columns in the table are sorted left to right with the largest population densities on the left column with New Jersey ranking first. Also included is the square mile area of each State to further enhance the comparisons of people and probability of target cancer risk levels. The population densities are based on 2013 estimates from the US Census Bureau. DEEP conducted this evaluation to better understand CDM Smith's comment about risk levels and size of the affected population of people in regards to site exposures.

When thinking about what one in a million (1×10^{-6}) actually means, it isn't as straightforward as one person in every million will be impacted by a stressor. Nor does it mean that if there are less than 1,000,000 people, no person will be impacted by a stressor. What it means is every person who is or will in the future be at the site has an equally increased risk of being impacted by a stressor. In States that use one in one hundred thousand (1×10^{-5}) as the cancer risk goal, there will be a slightly larger equal increased risk to people being affected by a stressor. When looking at the table below, the States that utilize 1 in 100,000 risk levels tend to have lower population densities.

TABLE C.3. LISTING OF POPULATION DENSITIES OF PEOPLE PER SQUARE MILE AND TARGET CANCER RISK LEVELS

	Pop Density (people/mi^2)	State Area (mi^2)	Target Cancer Risk single chem (remediation)	Target Risk WQS (single chem)
NJ	1210	8,722	10^{-6}	10^{-6}
RI	1017	1,544	10^{-6}	10^{-6}
MA	858	10,554	10^{-6}	10^{-6}
CT	742	5,543	10^{-6}	10^{-6}
NY	417	54,554	10^{-6}	10^{-6}
CA	246	163,694	10^{-6}	10^{-6}
IL	232	57,913	10^{-6}	10^{-5}
MI	175	96,713	10^{-5}	10^{-5}
NH	147	9,349	n/a	10^{-6}
TX	101	268,596	10^{-5}	10^{-5}
VT	68	9,616	10^{-6}	10^{-6}
ME	43	35,379	10^{-6}	10^{-6}
BC	12	364,764	10^{-5}	n/a
MT	7	147,039	n/a	10^{-5}

= 1 in 100,000 States = 1 in 1,000,000 States

For example, from this data, Connecticut, the fourth most densely populated state in the U.S., is over 60 times more densely populated than British Columbia. Population density is one potential indicator of how small or large the number of people that currently and in the future could be in close proximity to a site, and thus potentially exposed to site contaminants (drinking water and volatilization, for instance, could be impacted at some distance from the source site due to size/length of a groundwater plume). Population density is not in itself dispositive, and is only one factor in evaluating the population potentially exposed.

Other Data Reviewed

Some additional information was collected during the DEEP Staff research efforts. These further pieces of detail can help with a deeper understanding of how the various State risk programs operate and can highlight additional differences or similarities. The spreadsheet utilized by DEEP staff had a total of 27 questions. Due to the limited time available to conduct the research (essentially one month, October 2014), not every question resulted in enough information for complete comparison, and some have very few if any results at all. Several of the additional questions are included in this following section with accompanying details, depictions of results, and explanations.

Risk Assessment Comparisons

Another question dealt with the basic starting point for remediation of certain media. This is whether or not the State has a set of regulations for the remediation of soil, sediment, and groundwater. Six States, including Connecticut did not have regulations for sediment and some States did not have requirements in regulations but were guidance only or had more generic laws with orders to protect the environment.

TABLE C.4. STATE REGULATIONS EXIST FOR REMEDIATION OF VARIOUS ENVIRONMENTAL MEDIA, ANY BLANK CELLS ARE DUE TO UNCLEAR RESULTS.

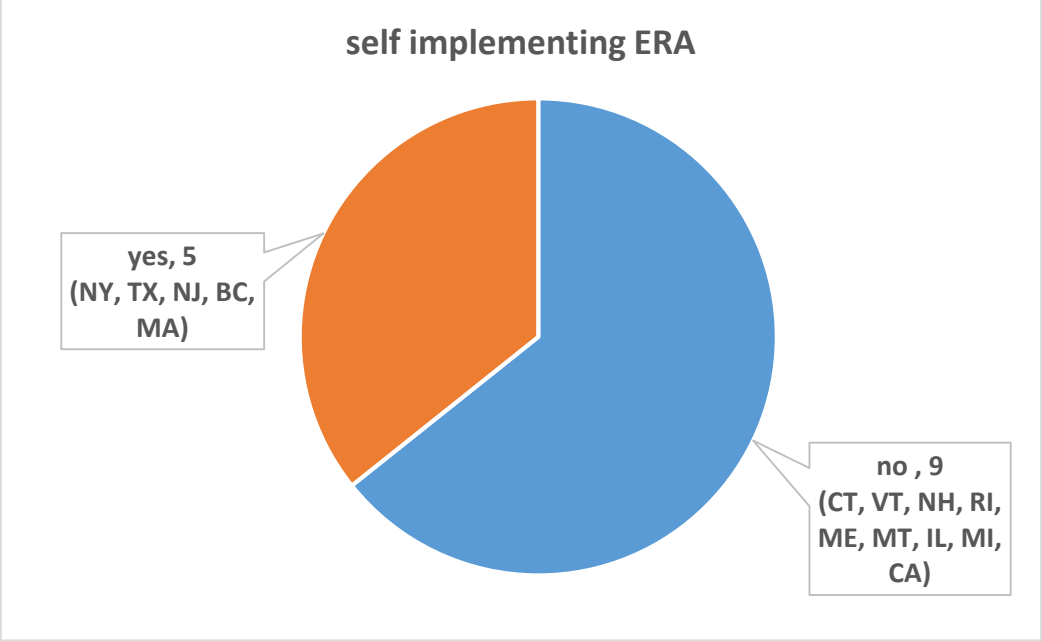
Media	CT	MA	VT	NH	RI	ME[1]	MT	IL	MI	CA[2]	TX	NY	NJ	BC
soil	YES	YES			YES	NO	NO	YES	YES	NO	YES	YES	YES	yes
sediment	NO	YES			NO	NO	NO		YES	NO	YES	NO		yes
GroundH2O	YES	YES	YES		YES	NO	YES	YES	YES	NO	YES	YES	YES	yes

1 Maine uses guidance documents only
2 California has generic legal requirements to protect the environment

Other data obtained by completing the review has been displayed in graph form. Several examples of this data are included in the following pages. The objective was to obtain base risk program information and directly compare with other State programs, and then give clear visuals to explain the results of the research.

Data were collected on self-implementation of risk assessment permissions for each State. Both eco-risk and human health risk programs were evaluated by DEEP. A count of States that allow for self-implementing Eco Risk Assessment is shown in the following pie graph. Based on the information obtained by DEEP, nine of the States evaluated do not appear to allow for self-implementing ecological risk assessment. The five states that appear to allow it are: Texas, New York, New Jersey, Massachusetts and British Columbia. In British Columbia, it appears that risk assessors must be certified to conduct an eco-risk assessment before they will be accepted by the Ministry of the Environment. Not all private risk practitioners meet this level of certification.

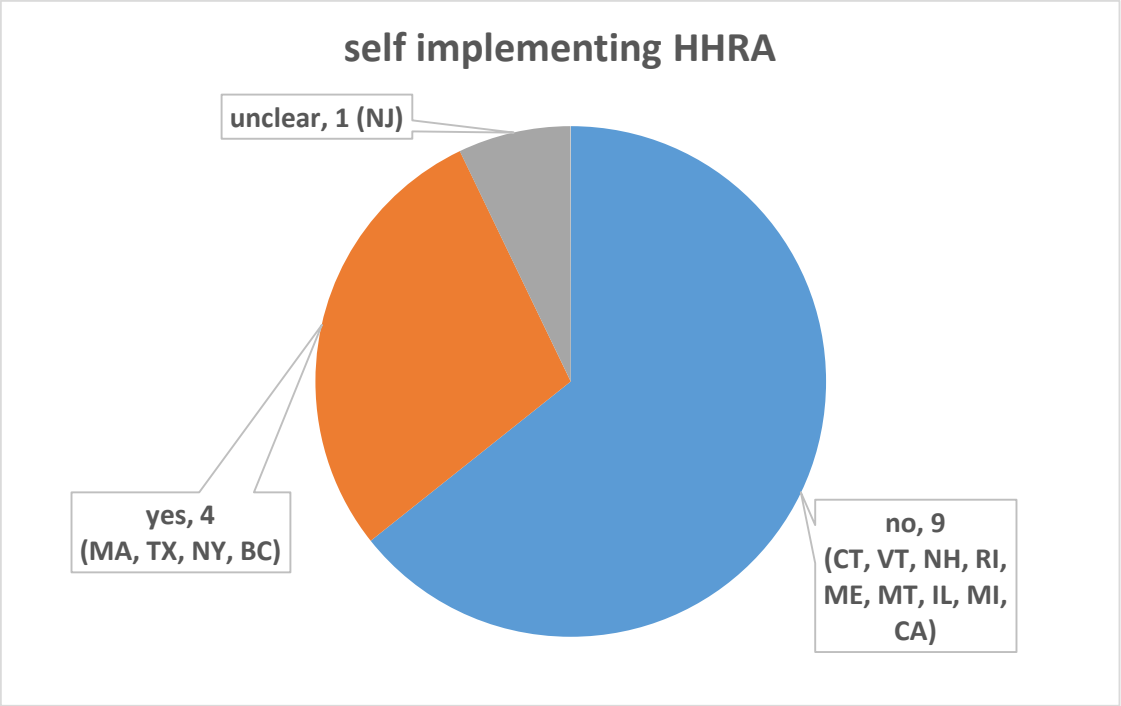
FIGURE C.6. GRAPHICAL REPRESENTATION OF STATES THAT ALLOW FOR SELF-IMPLEMENTING ECOLOGICAL RISK ASSESSMENT.



A second evaluation looked at the human health risk assessments to create a similar graph depicting self-implementation. This graph shows a similar proportion of States with the majority appear to

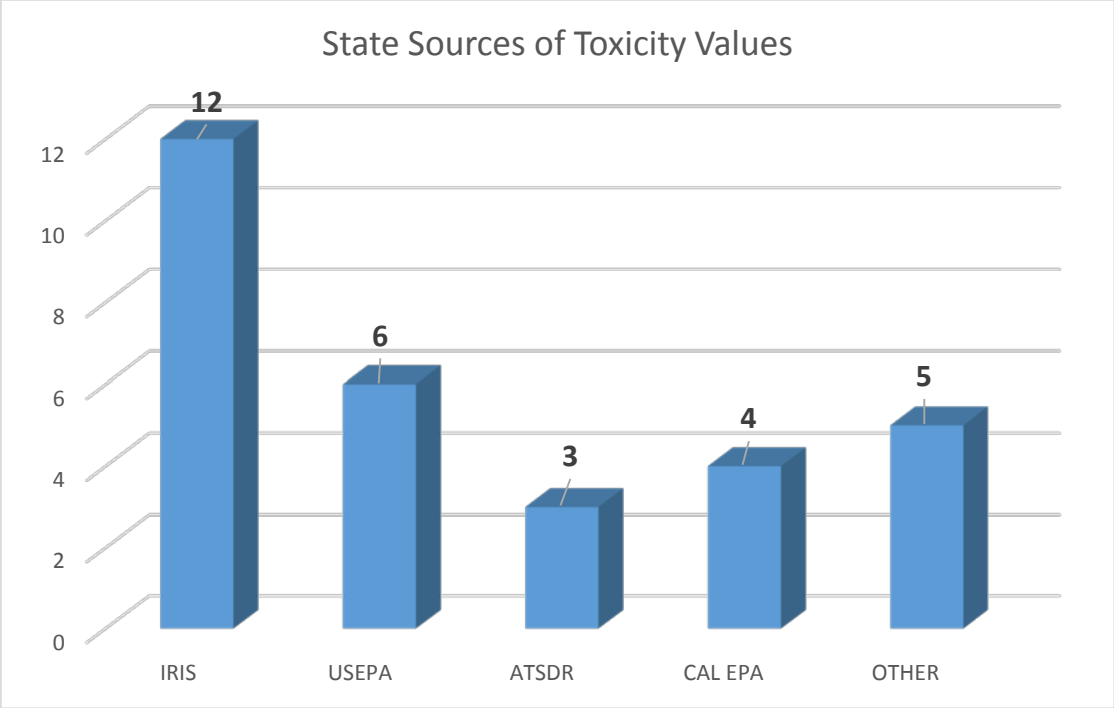
not allow for self-implementation of human health risk assessments. The only programs that appear to allow for self-implementation are Texas, New York, Massachusetts and British Columbia. For both of these evaluations, Connecticut is included with the majority of State programs, showing similar implementation and function of risk based programs.

FIGURE C. 7. GRAPH GIVING EACH STATE'S PERMISSIONS FOR SELF-IMPLEMENTING HUMAN HEALTH RISK ASSESSMENTS



For human health risk assessments, DEEP staff collected information on the sources of toxicity data used in the risk programs for each State. Almost every program utilizes IRIS as a source with many mentions of primary or first source for data. The only programs that did not mention IRIS were British Columbia and New York. Other sources used for toxicity data included USEPA, ATSDR, and Cal EPA. Connecticut uses all of these depending on the chemical and updates to the science. Some other States showed a use of multiple sources, similar to Connecticut, but a hierarchy starting with IRIS was the priority source. The result of this research showed that most States use similar sources of information for their toxicity data and there were not any programs operating in a largely different manner. CDM did not evaluate States on details of toxicity sources (or on exposure inputs), instead generally stating that best practice is reflected by making policy choices among variables, not the specific values finally adopted. CDM Report at page 5-4, footnote 12.

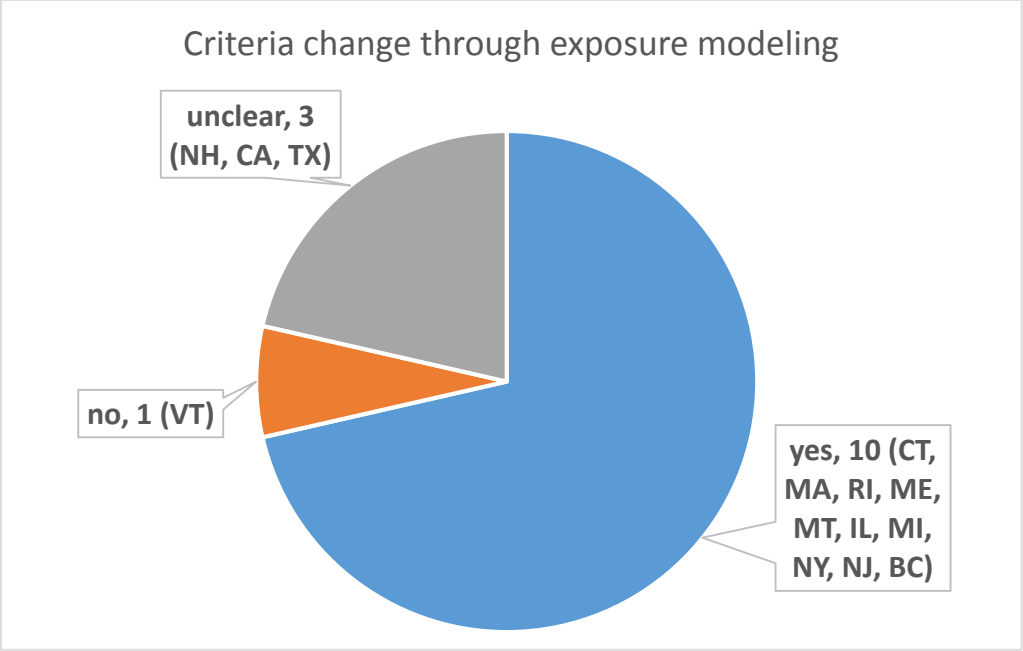
FIGURE C. 8. BAR GRAPH OF STATE RISK PROGRAM TOXICITY VALUE SOURCES.



Toxicity testing as part of the ecological risk process is required by many States (Massachusetts, Rhode Island, Michigan, California and British Columbia). For six of the States evaluated in this review DEEP staff were unable to determine if toxicity testing was a requirement of the program or not. Connecticut, along with New York and Vermont, do not require toxicity testing. However, all of the States that do not require toxicity testing do allow for the testing as part of the risk assessment process.

Risk programs were evaluated for their ability to provide alternate or adjusted criteria through the use of exposure modeling. This sort of change would allow for alternate criteria based on some set of conditions at the site under review. These changes could be based on time of exposure or ability to be exposed to a chemical at a site. In Connecticut, alternative criteria can be proposed by adjusting exposure times and accessibility to receptors. As any changes would be adjustments to the default criteria these were considered as "special" program attributes or practices by the DEEP review. A pie graph has been created based on information found by DEEP staff on the availability of this option in the evaluated States. A large majority, ten states, allow for changes in criteria through modeling. Some details of changes recorded by DEEP staff involved fate and transport models, changes in exposure times, and State approved formulas. An additional detail that DEEP reviewed was a requirement for State approval of use of these alternate exposure formulas and models at a site.

FIGURE C. 9. GRAPH DEPICTING AVAILABILITY OF CRITERIA CHANGES THROUGH EXPOSURE MODELING.



Risk Management Comparisons

Questions regarding risk management proved to elicit responses that were too ambiguous, vague or general for further useful analysis as part of this research.

Water Quality Standards Comparison

Graphs of Water Quality Standard numbers were created for each of the constituents that were utilized in the comparison of remediation criteria. Both consumption of water and consumption of water and organisms graphs were created based on State Water Quality Standards documents. These graphs can help to evaluate the degree of impacts (or lack of impact) of utilizing a target risk level of 1 in 1,000,000 or a less conservative 1 in 100,000 for carcinogens.

Following is a table of States in the CDM Smith report and their target risk levels. All values were obtained from an EPA document cataloguing WQS target risk levels from January 25, 2013.

TABLE C. 5. STATE WQS TARGET CANCER RISK LEVELS

Target Risk Level	**1 in 1,000,000**	**1 in 100,000**
States	New Hampshire, Connecticut, Maine, Massachusetts, Rhode Island, Vermont, New Jersey, New York, California	Illinois, Texas, Michigan, Montana

DEEP staff also compiled all 50 States and their target risk levels for their WQS into an excel file for comparison. New Mexico has a mixture of levels in their WQS and was counted in each category. Washington DC was not included but would be added to the group of States utilizing 1 in 1,000,000 for target risk level.

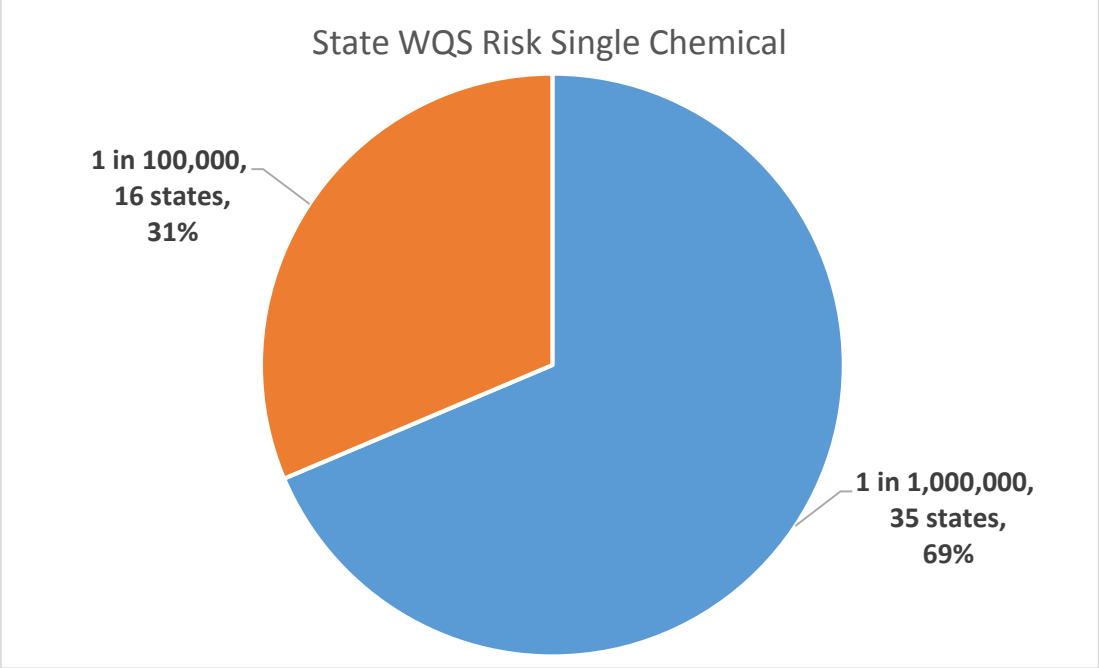
These data comparing WQS risk are relevant when considering remedial risk levels as the sets of protective criteria have many connections. The State WQS values are a broad policy statement on acceptable risk anywhere in the affected State, as such, a consistent application of what is a protective concentration is recognized as important for both sets of criteria. Three of five major RSR criteria have some connections with WQS criteria: SWPC, GWPC, and PMC. An example is found when looking at ground water in the WQS:

- …restoring or maintaining natural quality at GAA, GAAs, or GA level is not technically practicable, the department's policy shall be to:
  - "maintain or restore water quality such that the ground water is suitable for drinking and other domestic uses without treatment;" (22a-426-7 (a)(2)(A).

Further definition of GA waters and expectations increases the risk connection between WQS and RSRs in the next section of the WQS (22a-426-7 (a)(3)(B):

- "Ground water is deemed suitable for drinking and other domestic uses without treatment when no pollutant in ground water:
  - is a carcinogen present at a concentration associated with a 1 x 10^{-6} excess cancer risk."

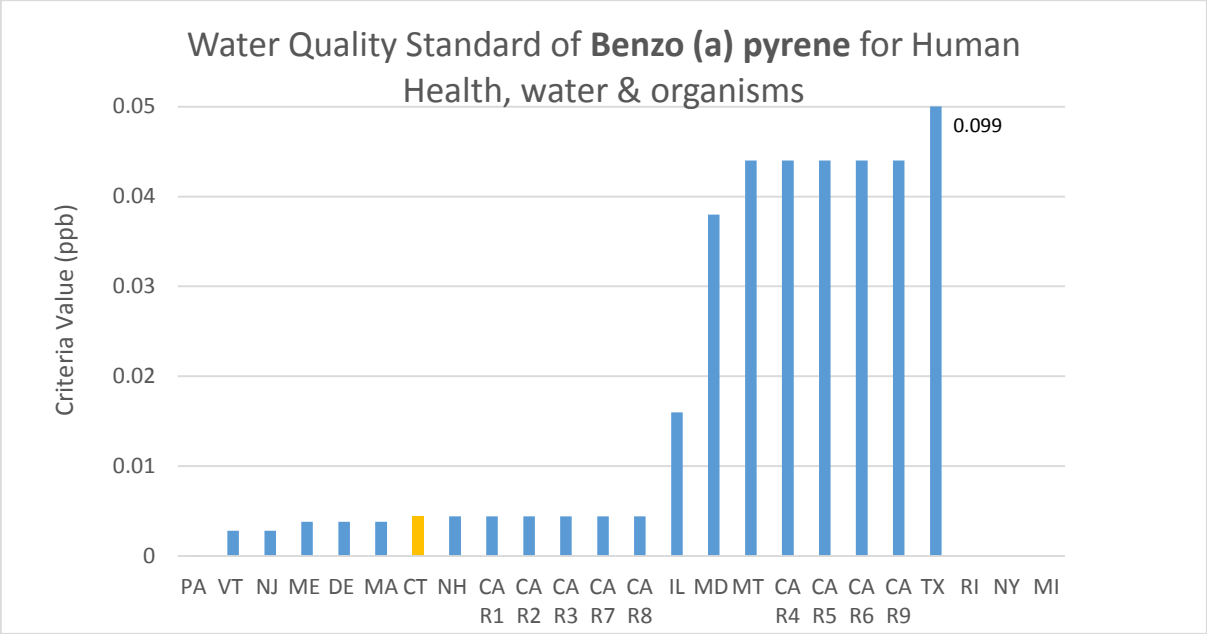
FIGURE C. 10. GRAPH OF ALL 50 STATES WQS TARGET RISK LEVEL



Following is a sample graph comparing a numeric standard value between States that had a standard for the chemical under evaluation. In the graph of WQS for Benzo (a) pyrene, the Connecticut result is highlighted and ranks close to the middle of the results of the data inquiry. California is broken into regions as they utilize different numbers for each geographic area by a Regional Water Board. The California numbers are guidance numbers and all California remediation projects are done on a site specific level, including the development of criteria. One thing to notice in this graph is that many of the largest values come from States that utilize 1 in 100,000 as a target risk level for carcinogenic chemicals such as benzo (a) pyrene. Any States that are included but have no column

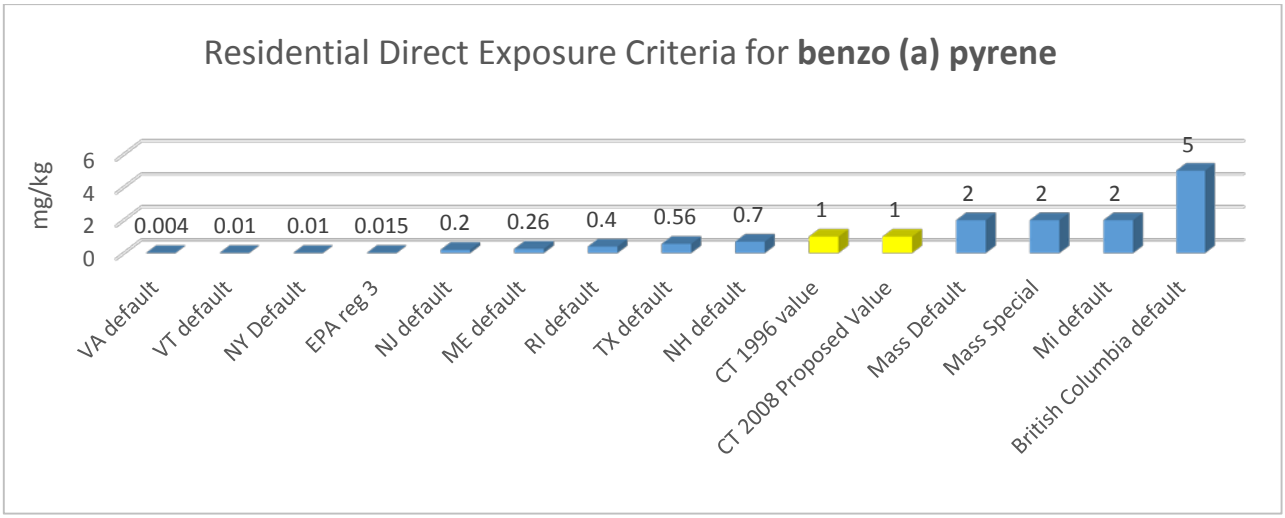
above their abbreviation, have no official Water Quality Standard for the constituent contained in the graph.

FIGURE C. 11. GRAPHICAL COMPARISON OF STATE WQS CONSUMPTION OF WATER AND ORGANISMS.



Also, included is a comparison of Residential Direct Exposure Criteria (RDEC). Numbers are included for each State when they were obtainable during the internet research. The sub-set of constituents is included in the Appendices of this report, but an example, utilizing benzo(a)pyrene follows this text. Connecticut values are highlighted in the table and States with no information are omitted from the display.

FIGURE C. 12. GRAPHICAL REPRESENTATION OF RESIDENTIAL DIRECT EXPOSURE CRITERIA COMPARISON FOR SOIL CONCENTRATIONS.



The evaluation process also looked at more details dealing with toxicity and risk decisions between the set of evaluated States. Some of this information was deemed to be unobtainable in the time period for the current research project or without increased staff workload away from other Department obligations. An example of a question in this category is the basis for ecological risk criteria in each State. Most DEEP staff had difficulty finding this information during their web investigation. Another difficult to answer question was how many sites are cleaned up in a year. In general, differences in State terminology, definitions, laws, how data is captured, retrieved and interpreted, and abbreviations made some of the investigation more difficult to complete for the research team to ensure comparison of "apples-to-apples".

Findings

The CDM Smith Report scores States against a set of Best Practices and then ranks the scores of each State and their program. Connecticut scores at or above the median for each of its six programs as delineated by CDM, and are significantly distanced from the worst scores for State programs.

When DEEP conducted our own review it was focused on direct comparison of risk program practices, features, and criteria. DEEP did not calculate any sort of summarized scores for the States under evaluation. Instead a direct comparison of programmatic components and environmental criteria was conducted.

After reviewing the information, documents, and criteria obtained by DEEP staff, it appears that Connecticut is currently operating its risk program in similar manner as comparable State risk programs. The target cancer risk level for default criteria in all geographically surrounding States is 1 in 1,000,000 per chemical, which is the same as Connecticut. All States allow some type of site specific risk assessments, either as part of their base program or after some set of conditions being met.

Another example of a risk program component evaluated by DEEP is using models to develop criteria changes. Connecticut does allow for criteria changes through exposure modeling and a large majority of the States evaluated also allow this sort of change. This gives risk practitioners the ability to adjust values if site characteristics warrant the changes. This ability is very closely linked to allowing site specific risk assessments and enhances the flexibility available for risk assessments.

The review of water quality standards for target risk levels in States, resulted in similar outcomes as the remediation values. Significantly more States in the CDM evaluation group use 1 in 1,000,000 as their target risk level than 1 in 100,000. DEEP expanded this review to include all 50 States and similar trend was discovered with roughly 2/3 of all States using the 1 in 1,000,000 for target risk level with carcinogenic chemicals.

DEEP ranked States in the CDM evaluation by population density and size and included target risk levels for both remediation and WQS. Almost exclusively the States that utilize the 1 in 100,000 target risk level for a chemical are in the lower half of the targeted States for population density. A 1 in 1,000,000 risk is not a risk to only one person in a million, but is an increase in the risk by the same percentage for everyone in the area who would be exposed to the contaminant(s). In States with high population densities, there may be more people in a geographic area containing polluted sites, thus increased potential exposure risk for a larger number of people. In States with a heavy

industrial past such as Connecticut, and an early development history, there are likely to be multiple remediation sites in an area potentially creating multiple exposure opportunities affecting similar populations of citizens.

Looking at the remediation criteria comparisons, the Connecticut numeric criteria usually fall near the median of the dataset. Bar graphs of RDEC (residential soil) and GWPC (groundwater) values are included in the appendices of this report.

Included in the appendices is also a series of graphs of water quality standards for the same set of chemicals used in the remediation criteria review. The WQS graphs only include the CDM list of States and also show Connecticut values to be similar to many of the other States in the comparison. For some of the chemicals in the review, very few States actually had developed values and no graphs were created due to lack of comparative impacts on the evaluation.

The comparison of environmental criteria directly between State programs covers and accounts for differences in formulas, exposures, and other variables beyond just the cancer target risk level. The fact that Connecticut is usually within the range of criteria values and not defining one of the endpoints of the range (maximum or minimum) is an indicator that the Connecticut risk programs are in line with other States.

The components evaluated in this review assist in the understanding of risk programs with direct comparisons between States. A review of these components and practices for the State risk programs, and the CDM report, indicates Connecticut is currently operating a comparable risk-based remedial program to other States.

Appendix C-1: Comparison: Direct Exposure Criteria

Residential Direct Exposure Criteria (R DEC) are limits established for protection of human health from exposure to contaminants from direct soil contact. The graphs compare criteria from each State for various pollutants. The data was extracted from official documents published on state websites.

FIGUREC-1. 1. COMPARISON OF RESIDENTIAL SOIL CRITERIA FOR MERCURY. UNITS ARE MILLIGRAMS/KILOGRAMS, EQUAL TO PARTS PER MILLION (PPM).

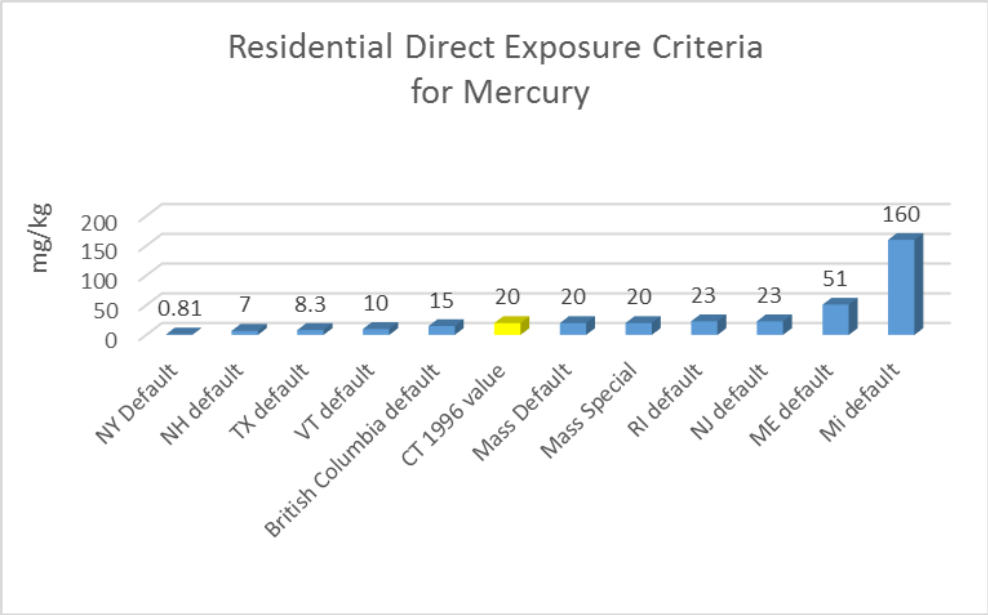
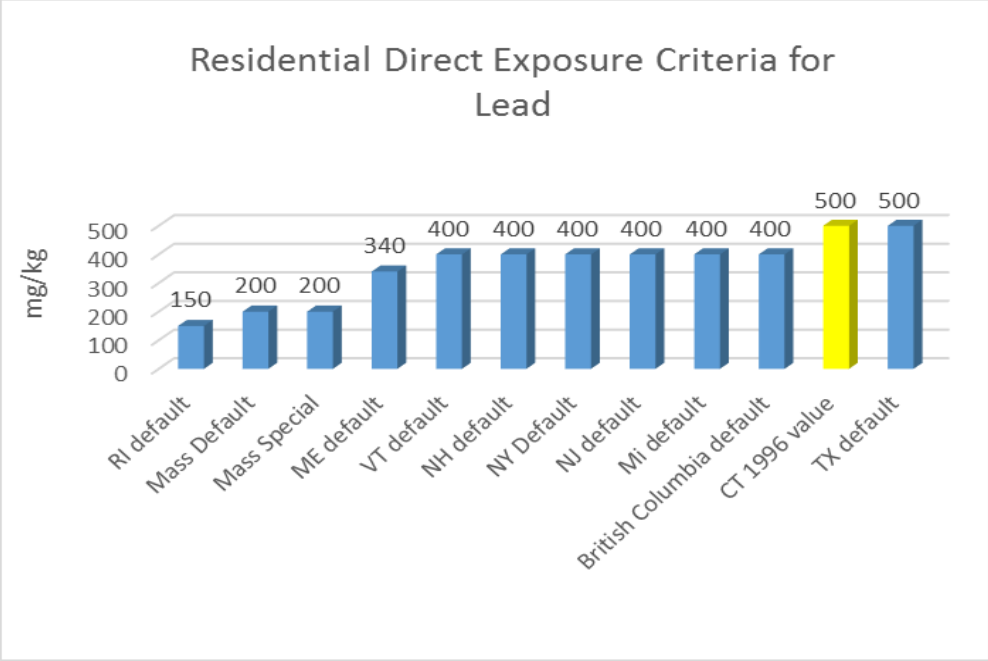


FIGURE C-1. 2. COMPARISON OF RESIDENTIAL SOIL CRITERIA FOR LEAD. UNITS ARE MILLIGRAMS/KILOGRAMS, EQUAL TO PARTS PER MILLION (PPM).



Note: Lead DEC was amended in CT RSRs to 400 mg/kg in 2013.

FIGURE C-1. 3. COMPARISON OF RESIDENTIAL SOIL CRITERIA FOR COPPER. UNITS ARE MILLIGRAMS/KILOGRAMS, EQUAL TO PARTS PER MILLION (PPM).

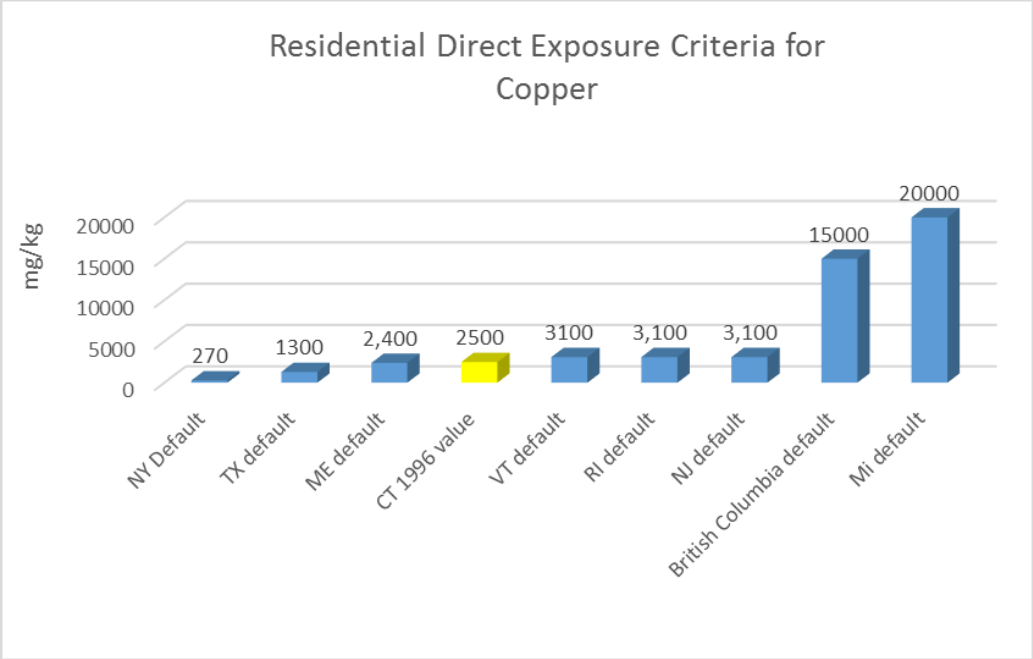


FIGURE C-1. 4. COMPARISON OF RESIDENTIAL SOIL CRITERIA FOR CHROMIUM. UNITS ARE MILLIGRAMS/KILOGRAMS, EQUAL TO PARTS PER MILLION (PPM).

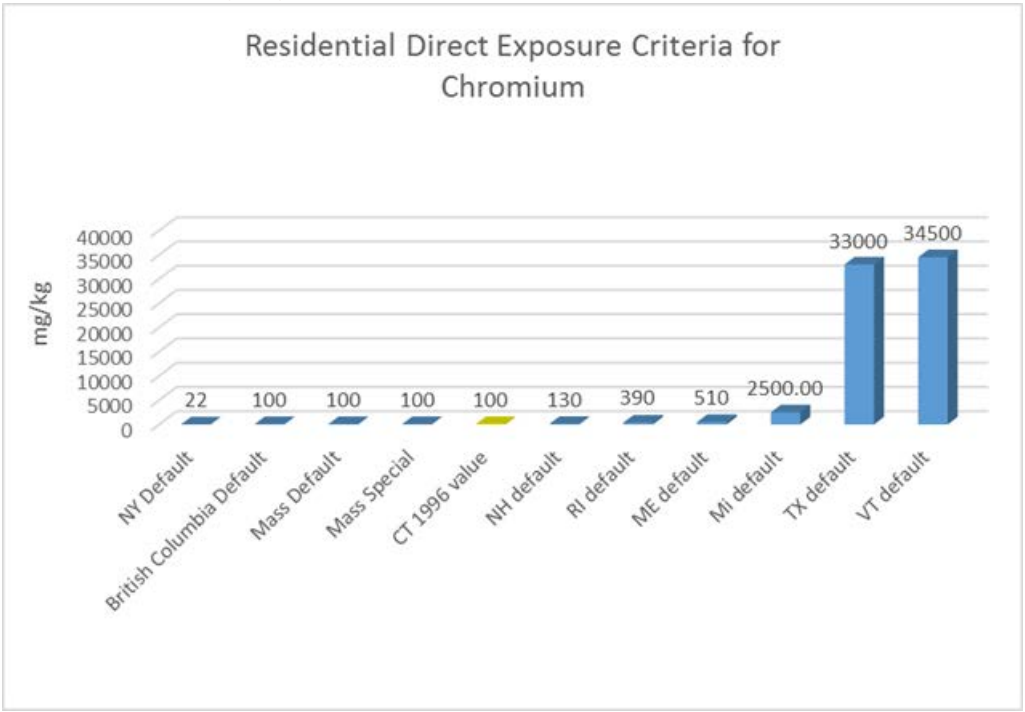


FIGURE C-1. 5. COMPARISON OF RESIDENTIAL SOIL CRITERIA FOR VINYL CHLORIDE. UNITS ARE MILLIGRAMS/KILOGRAMS, EQUAL TO PARTS PER MILLION (PPM).

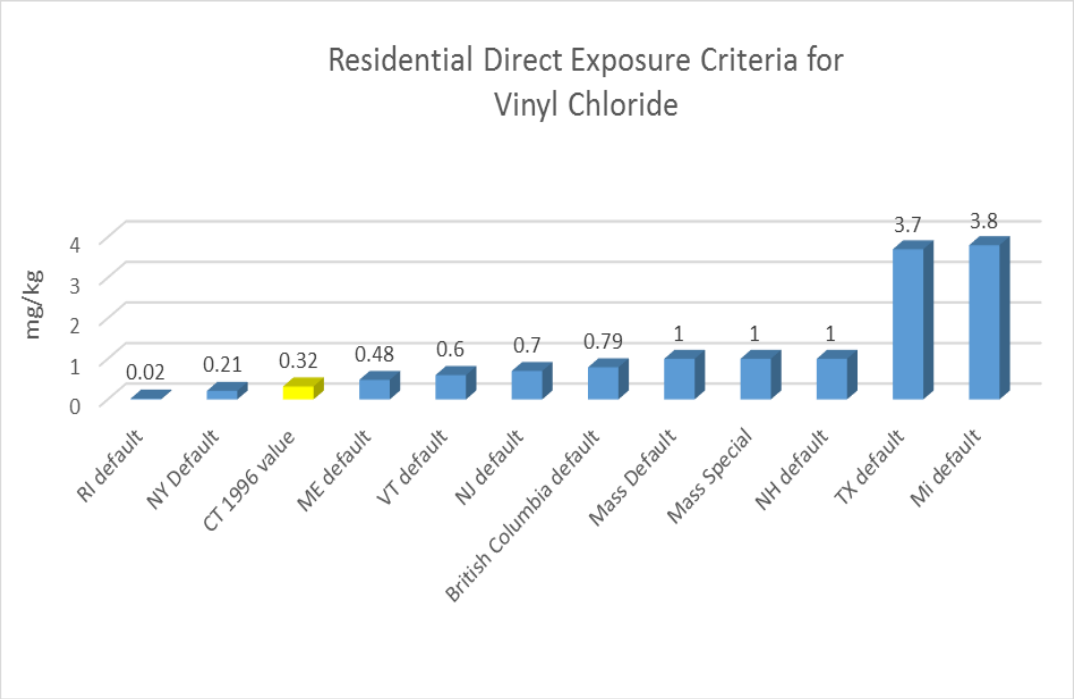


FIGURE C-1. 6. COMPARISON OF RESIDENTIAL SOIL CRITERIA FOR CHLORDANE. UNITS ARE MILLIGRAMS/KILOGRAMS, EQUAL TO PARTS PER MILLION (PPM).

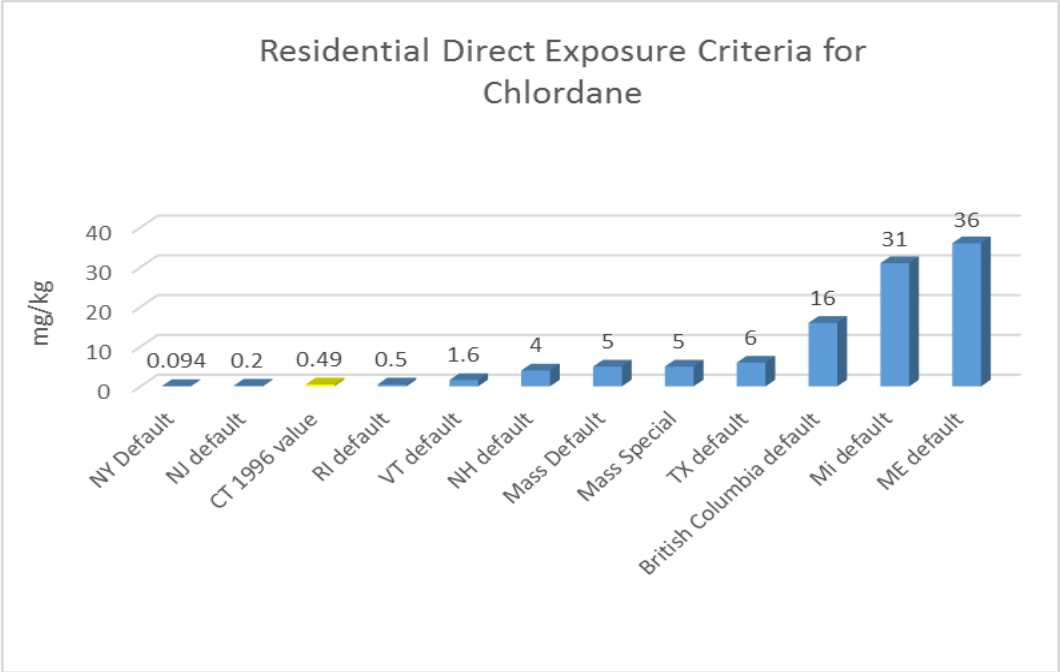


FIGURE C-1. 7. COMPARISON OF RESIDENTIAL SOIL CRITERIA FOR CADMIUM. UNITS ARE MILLIGRAMS/KILOGRAMS, EQUAL TO PARTS PER MILLION (PPM).

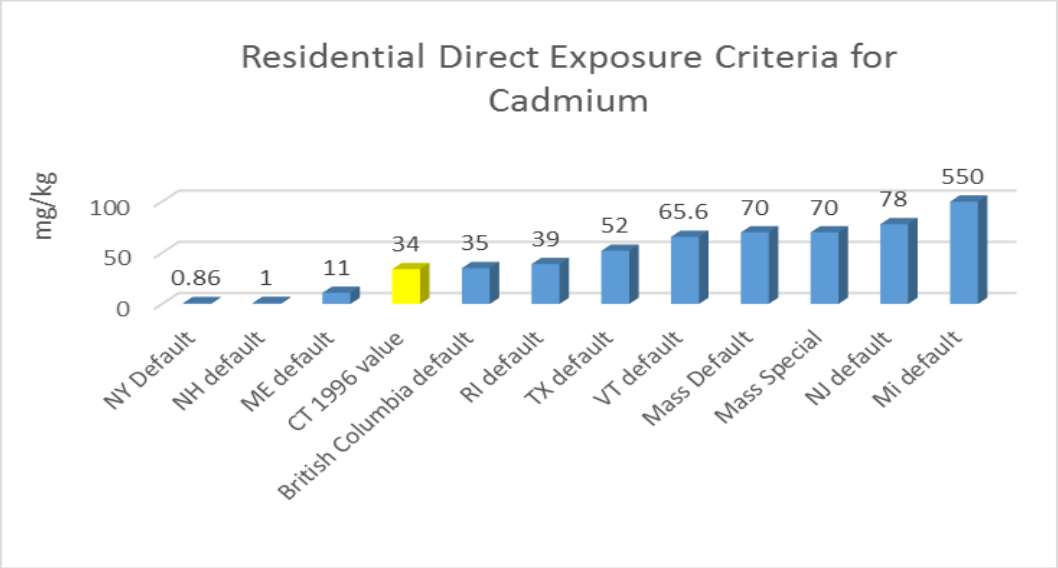


FIGURE C-1. 8. COMPARISON OF RESIDENTIAL SOIL CRITERIA FOR TRICHLOROETHYLENE. UNITS ARE MILLIGRAMS/KILOGRAMS, EQUAL TO PARTS PER MILLION (PPM).

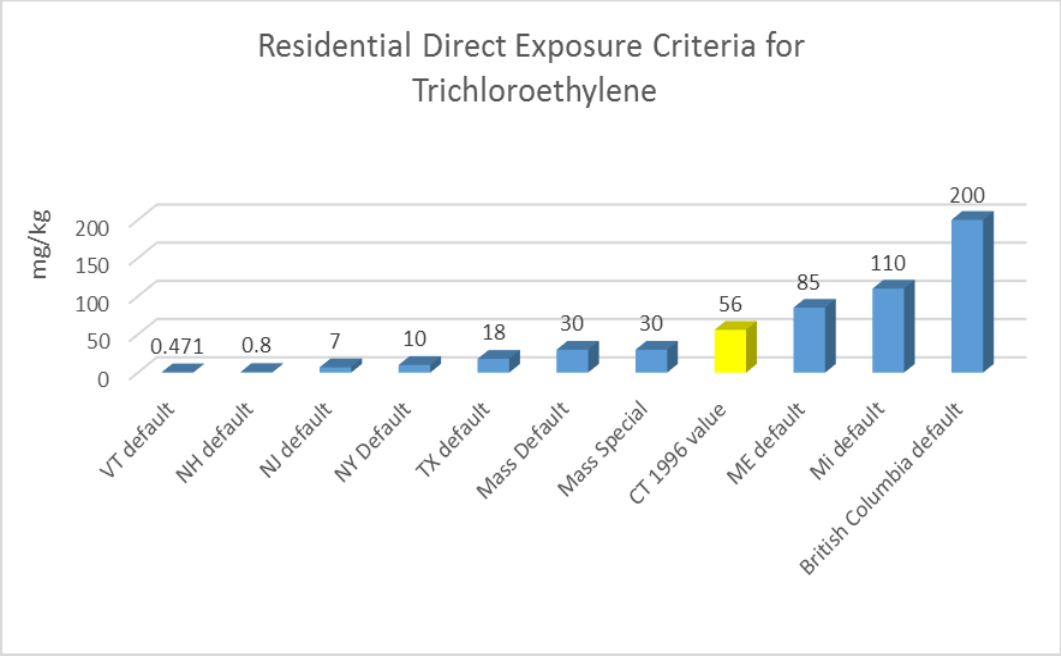


FIGURE C-1. 9. COMPARISON OF RESIDENTIAL SOIL CRITERIA FOR TOTAL PCBS. UNITS ARE MILLIGRAMS/KILOGRAMS, EQUAL TO PARTS PER MILLION (PPM).

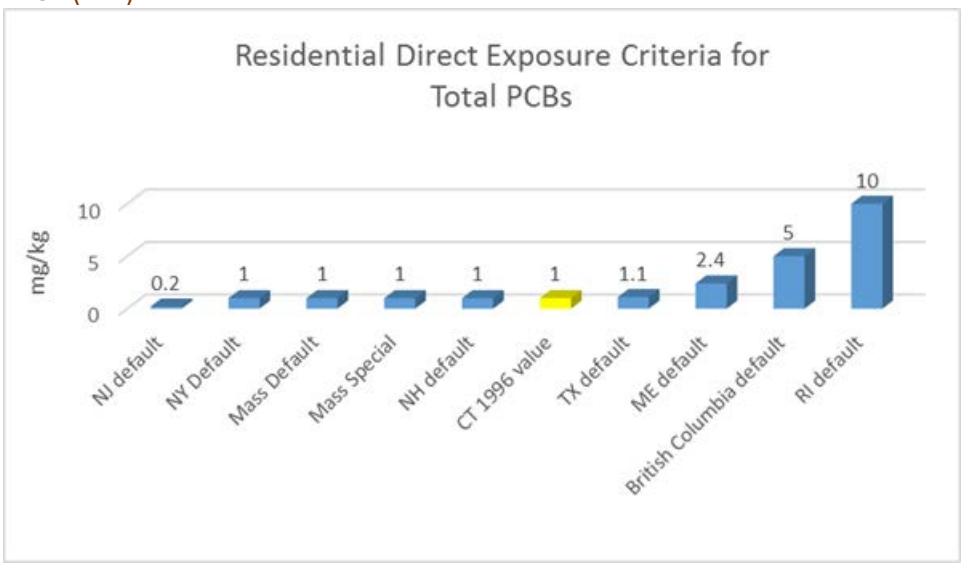


FIGURE C-1. 10. COMPARISON OF RESIDENTIAL SOIL CRITERIA FOR DIELDRIN. UNITS ARE MILLIGRAMS/KILOGRAMS, EQUAL TO PARTS PER MILLION (PPM).

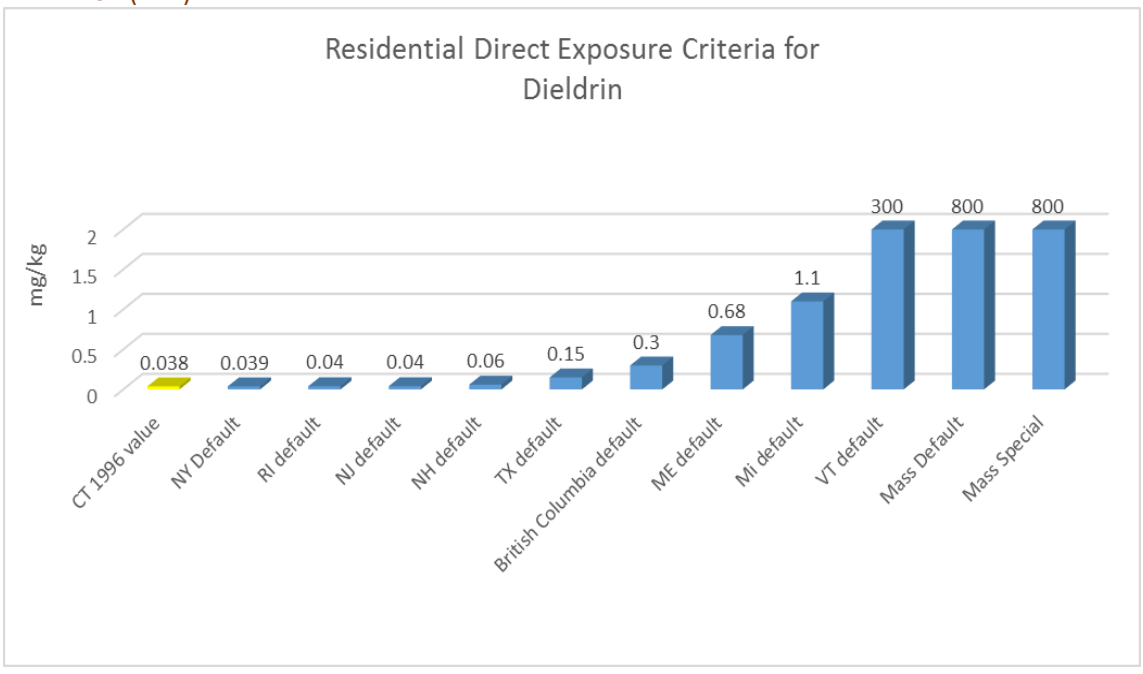


FIGURE C-1. 11. COMPARISON OF RESIDENTIAL SOIL CRITERIA FOR 1, 1, 1- TRICHLOROETHANE. UNITS ARE MILLIGRAMS/KILOGRAMS, EQUAL TO PARTS PER MILLION (PPM).

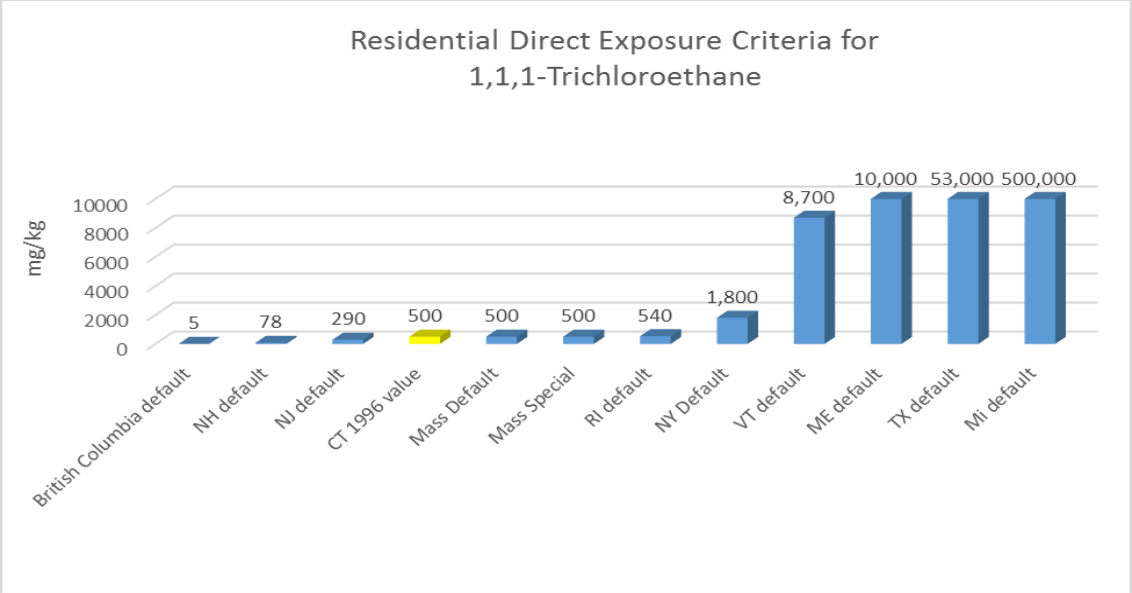


FIGURE C-1. 12. COMPARISON OF RESIDENTIAL SOIL CRITERIA FOR TETRACHLOROETHYLENE. UNITS ARE MILLIGRAMS/KILOGRAMS, EQUAL TO PARTS PER MILLION (PPM).

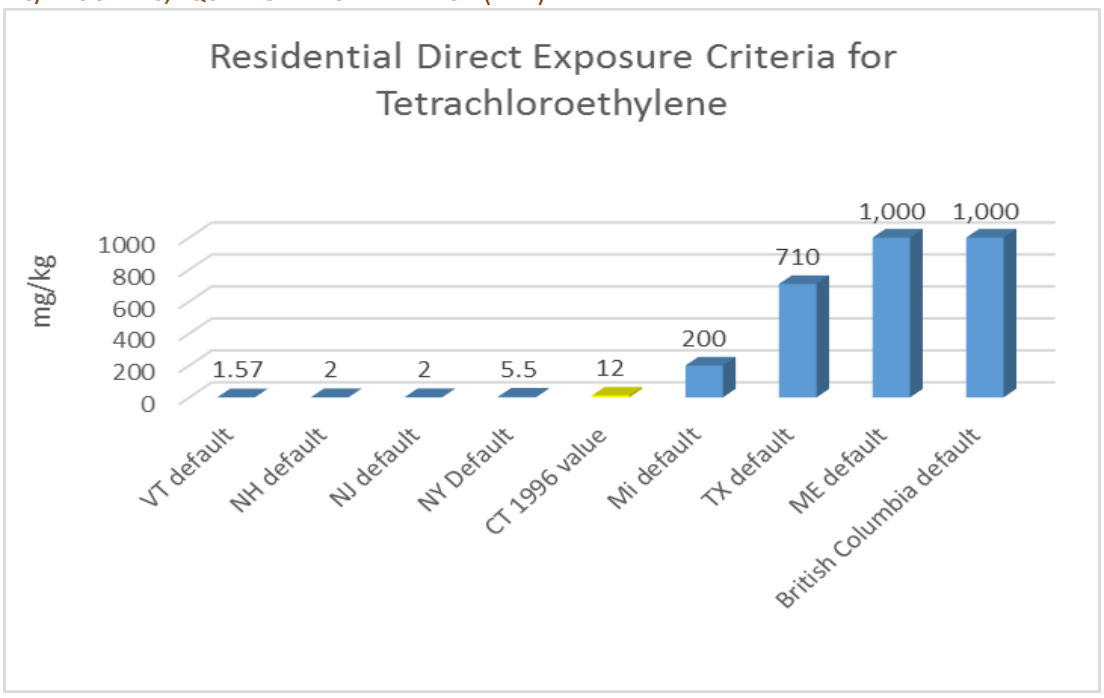


FIGURE C-1. 13. COMPARISON OF RESIDENTIAL SOIL CRITERIA FOR 1, 1-DICHLOROETHYLENE. UNITS ARE MILLIGRAMS/KILOGRAMS, EQUAL TO PARTS PER MILLION (PPM).

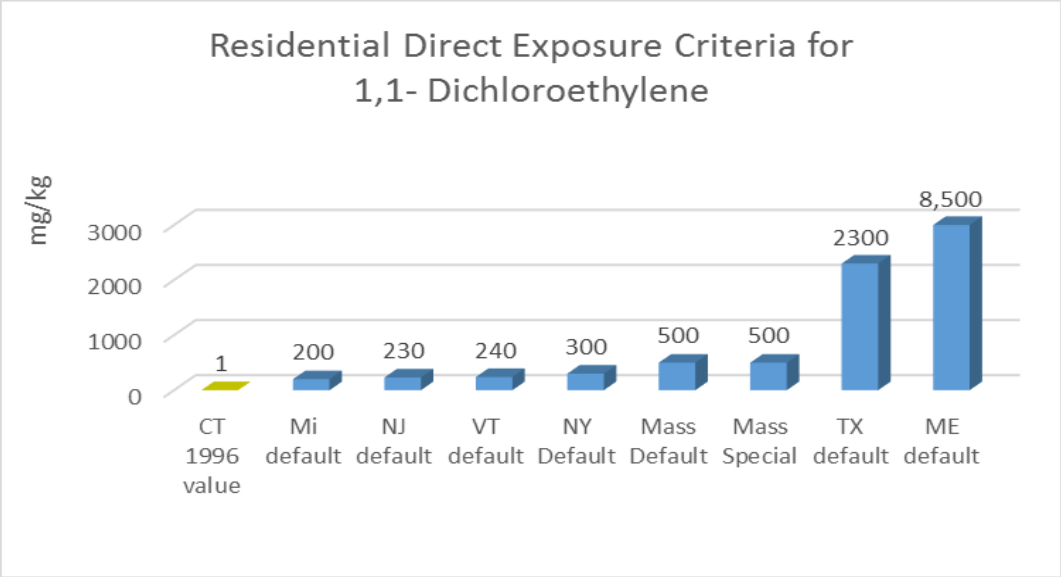


FIGURE C-1. 14. COMPARISON OF RESIDENTIAL SOIL CRITERIA FOR NAPTHALENE. UNITS ARE MILLIGRAMS/KILOGRAMS, EQUAL TO PARTS PER MILLION (PPM).

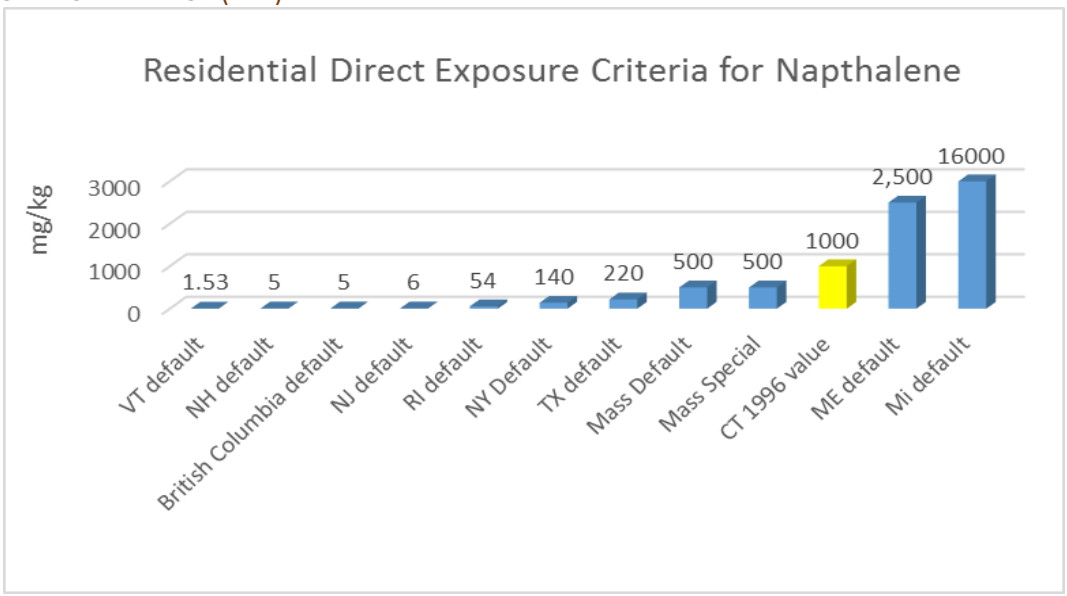


FIGURE C-1. 15. COMPARISON OF RESIDENTIAL SOIL CRITERIA FOR PHENANTHRENE. UNITS ARE MILLIGRAMS/KILOGRAMS, EQUAL TO PARTS PER MILLION (PPM).

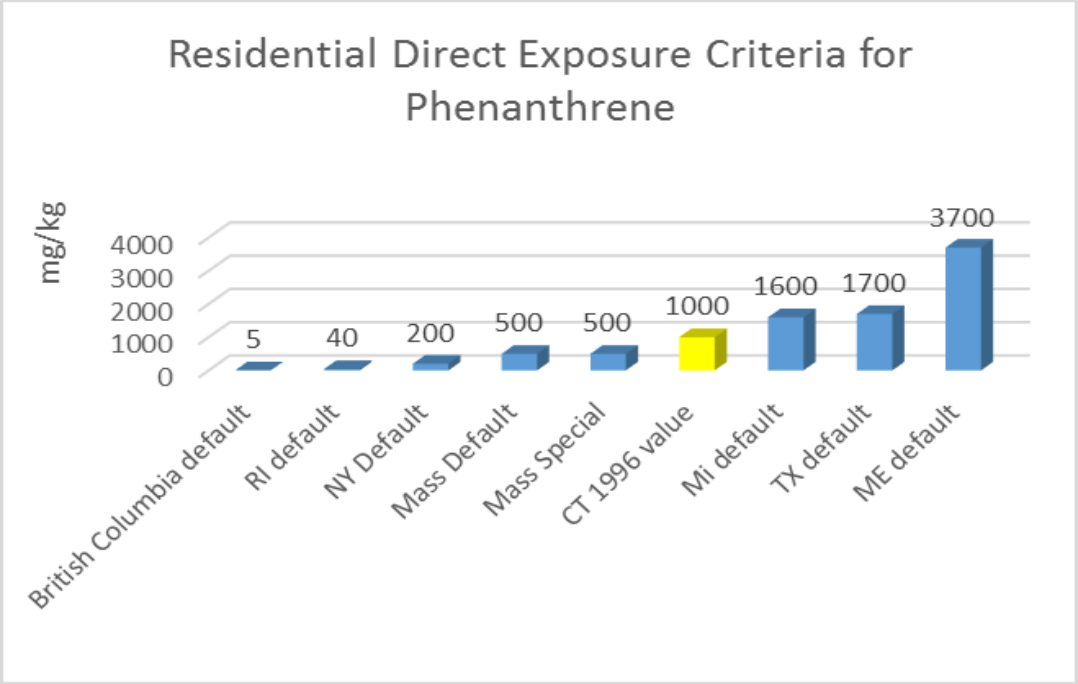


FIGURE C-1. 16. COMPARISON OF RESIDENTIAL SOIL CRITERIA FOR BENZO (A) PYRENE. UNITS ARE MILLIGRAMS/KILOGRAMS, EQUAL TO PARTS PER MILLION (PPM).

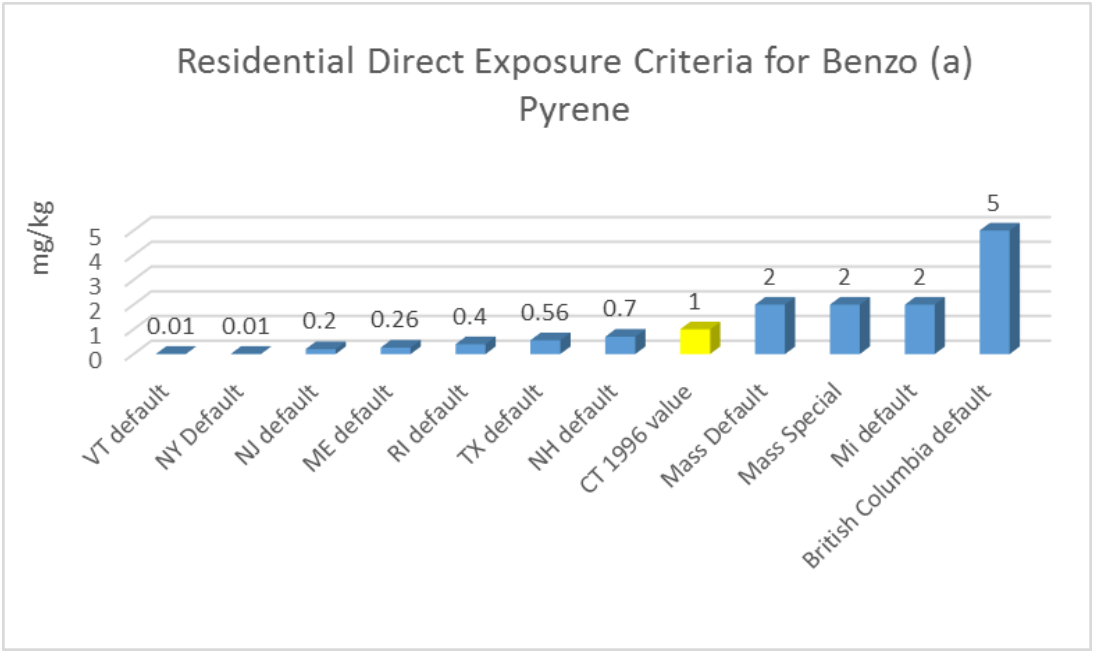


FIGURE C-1. 17. COMPARISON OF RESIDENTIAL SOIL CRITERIA FOR ANTHRACENE. UNITS ARE MILLIGRAMS/KILOGRAMS, EQUAL TO PARTS PER MILLION (PPM).

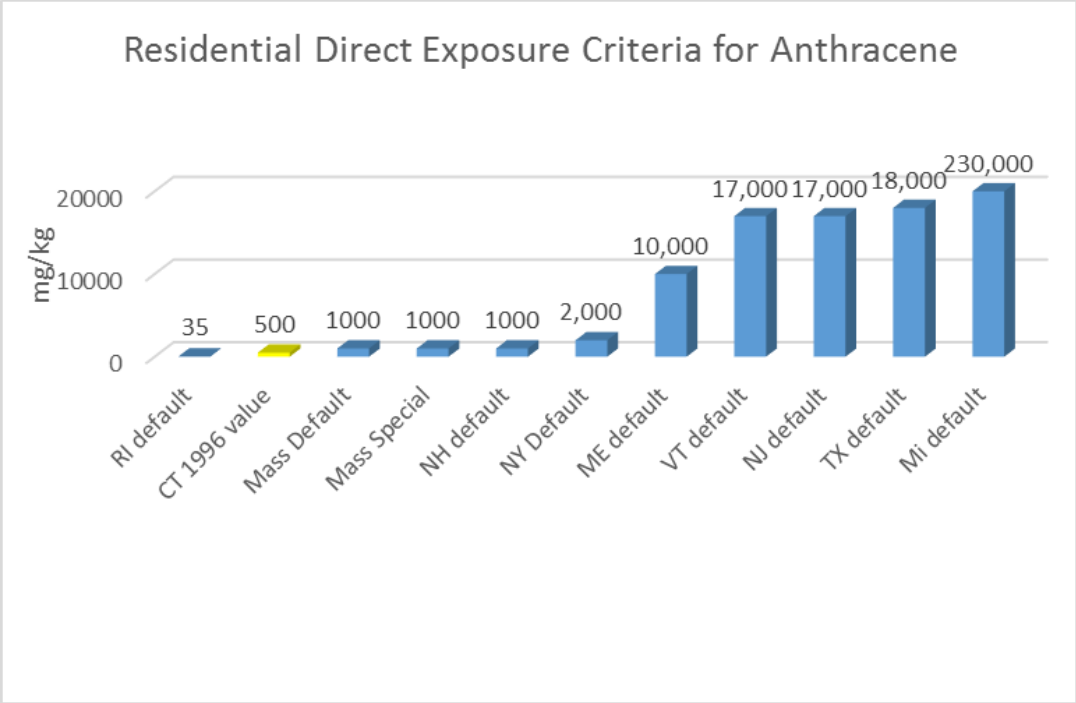


FIGURE C-1. 18. COMPARISON OF RESIDENTIAL SOIL CRITERIA FOR TOLUENE. UNITS ARE MILLIGRAMS/KILOGRAMS, EQUAL TO PARTS PER MILLION (PPM).

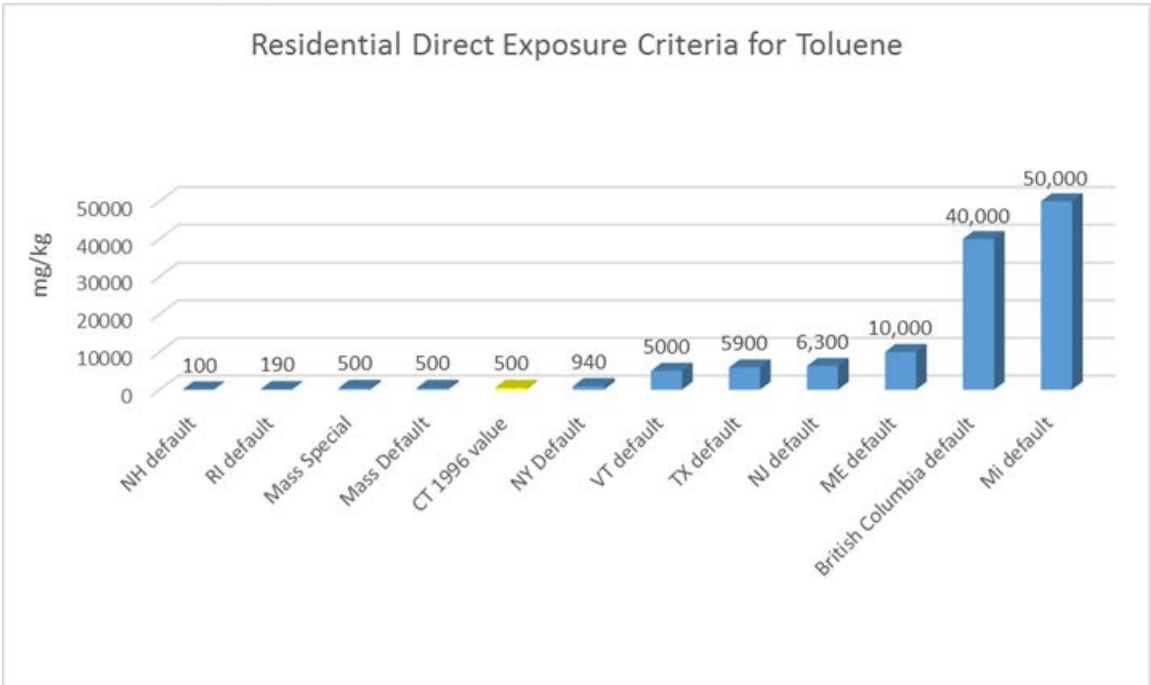


FIGURE C-1. 19. COMPARISON OF RESIDENTIAL SOIL CRITERIA FOR 1, 2-DICHLOROETHANE. UNITS ARE MILLIGRAMS/KILOGRAMS, EQUAL TO PARTS PER MILLION (PPM).

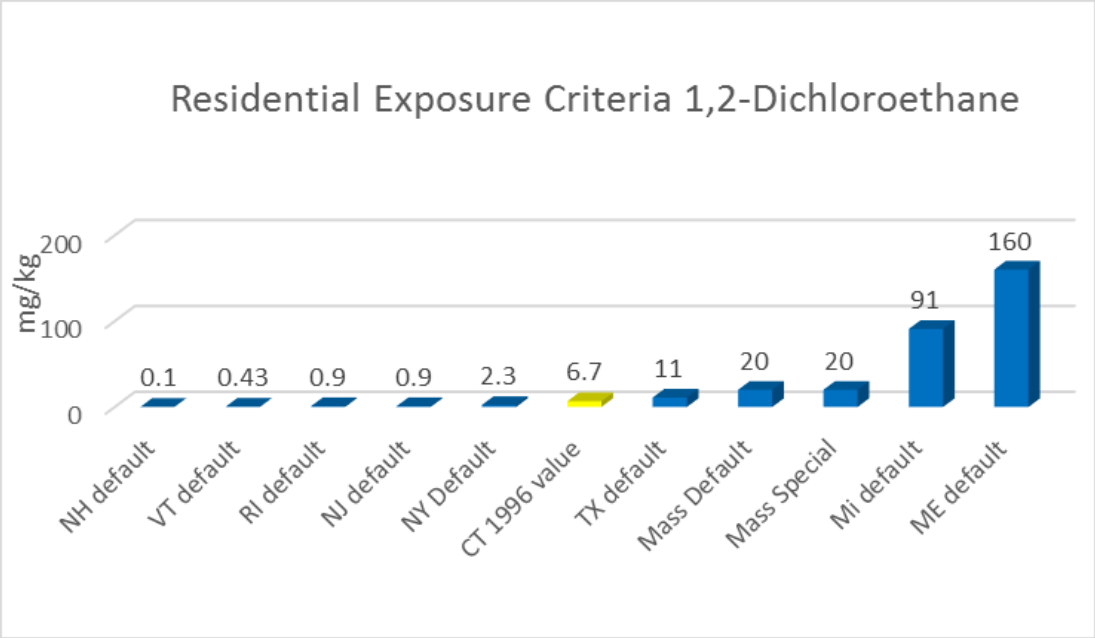
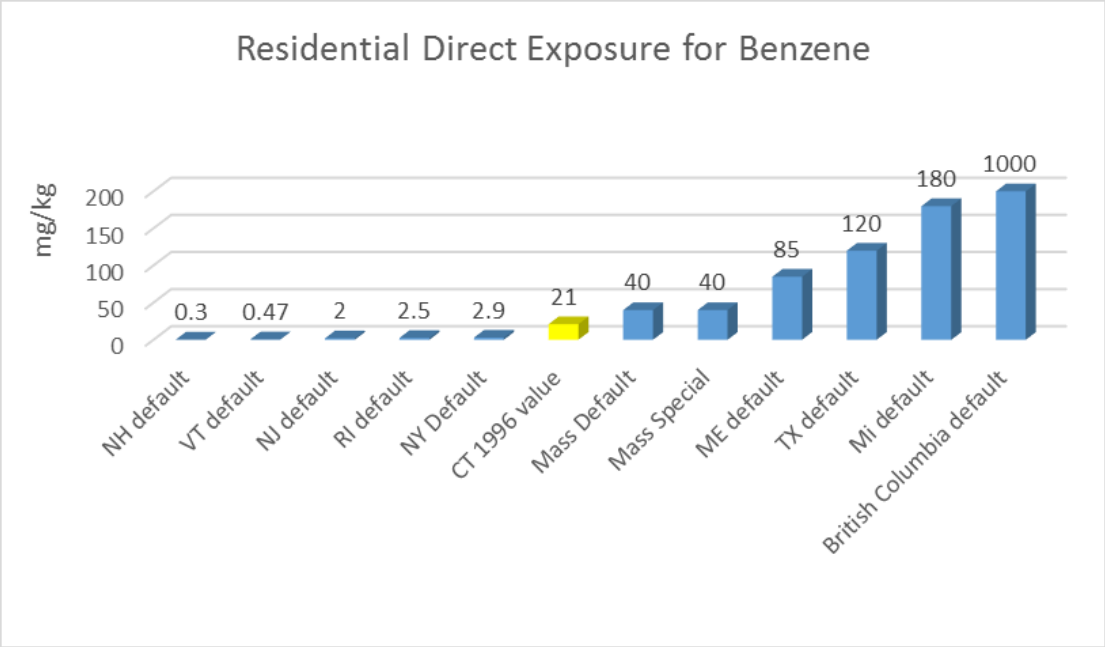


FIGURE C-1. 20. COMPARISON OF RESIDENTIAL SOIL CRITERIA FOR BENZENE. UNITS ARE MILLIGRAMS/KILOGRAMS, EQUAL TO PARTS PER MILLION (PPM).



Appendix C-2: Comparison: Groundwater Protection Criteria

State Groundwater Protection Criteria (GWPC) was obtained from official documents published on state's websites. Below are figures comparing the available criteria for the evaluated pollutants. However, a graph depicting GWPC for Total PAHs is not included due to lack of established values.

FIGURE C-2. 1. BAR GRAPH COMPARING MULTIPLE STATES AND THEIR TRICHLOROETHYLENE GROUNDWATER PROTECTION CRITERIA (GWPC). UNITS ARE MICROGRAMS/LITER, EQUAL TO PARTS PER BILLION (PPB).

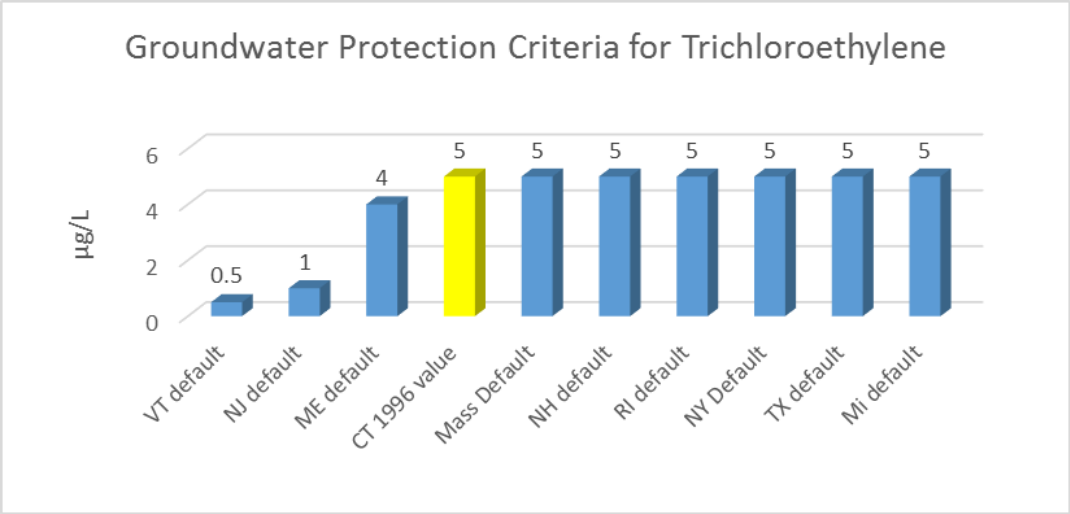


FIGURE C-2. 2. BAR GRAPH COMPARING MULTIPLE STATES AND THEIR BENZENE GROUNDWATER PROTECTION CRITERIA (GWPC). UNITS ARE MICROGRAMS/LITER, EQUAL TO PARTS PER BILLION (PPB).

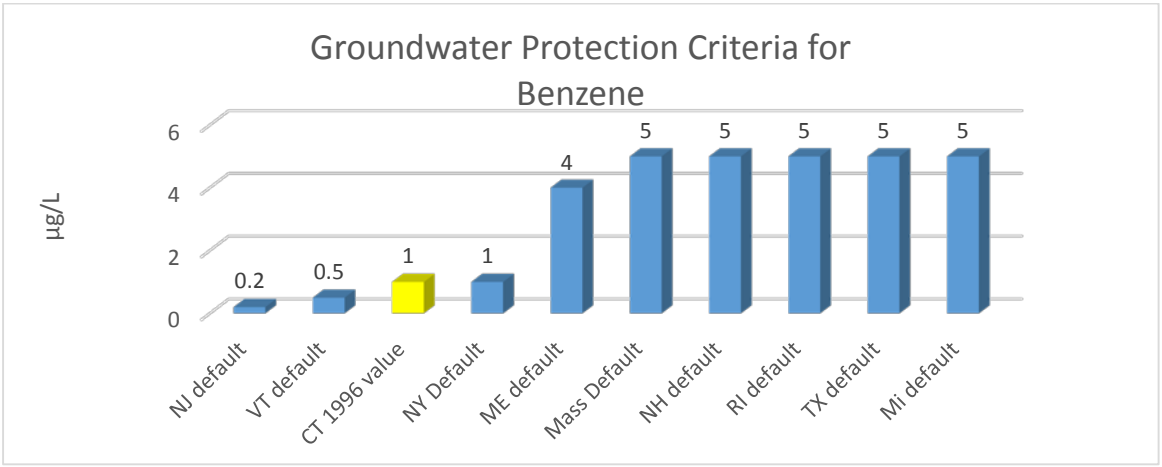


FIGURE C-2. 3. BAR GRAPH COMPARING MULTIPLE STATES AND THEIR 1,2-DICHLOROETHANE GROUNDWATER PROTECTION CRITERIA (GWPC). UNITS ARE MICROGRAMS/LITER, EQUAL TO PARTS PER BILLION (PPB).

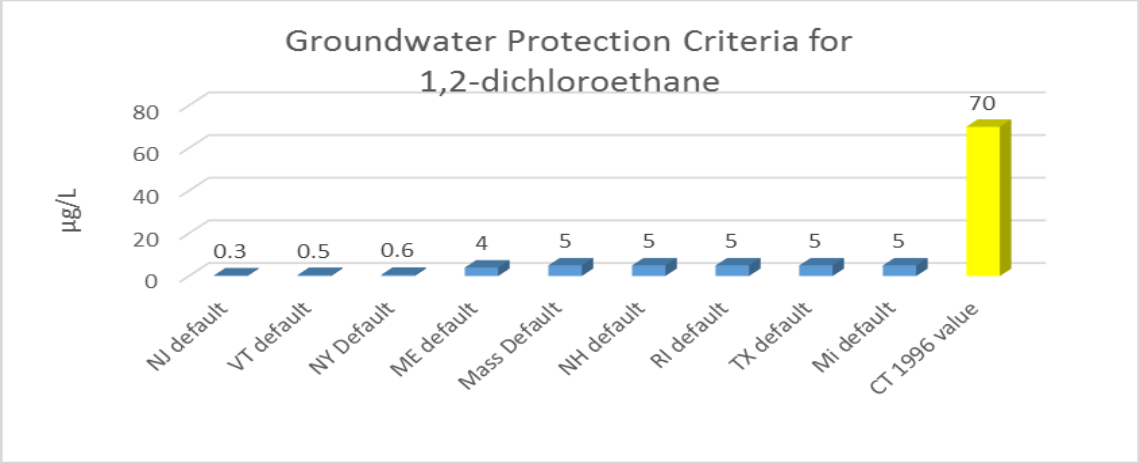


FIGURE C-2. 4. BAR GRAPH COMPARING MULTIPLE STATES AND THEIR TOLUENE GROUNDWATER PROTECTION CRITERIA (GWPC). UNITS ARE MICROGRAMS/LITER, EQUAL TO PARTS PER BILLION (PPB).

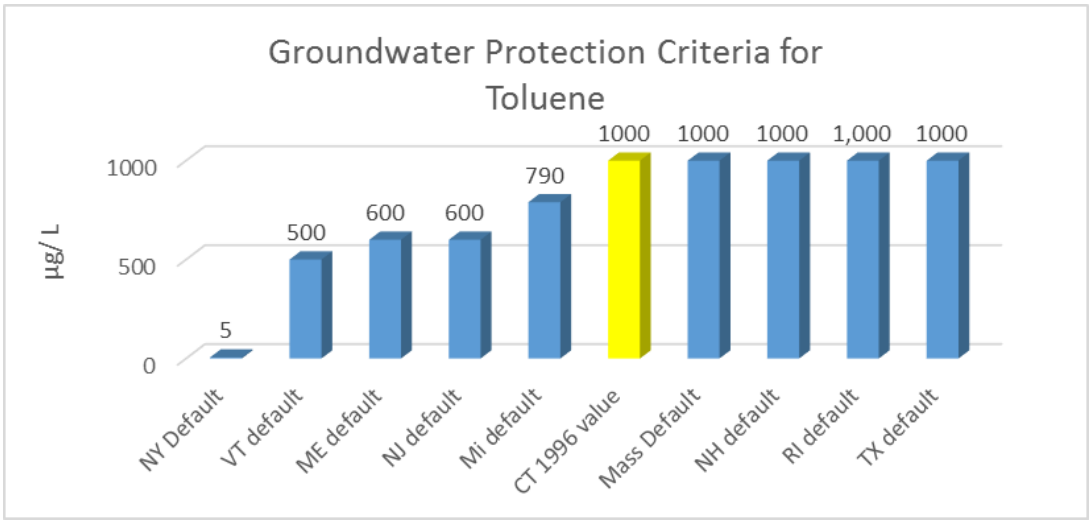


FIGURE C-2. 5. BAR GRAPH COMPARING MULTIPLE STATES AND THEIR ANTHRACENE GROUNDWATER PROTECTION CRITERIA (GWPC). UNITS ARE MICROGRAMS/LITER, EQUAL TO PARTS PER BILLION (PPB).

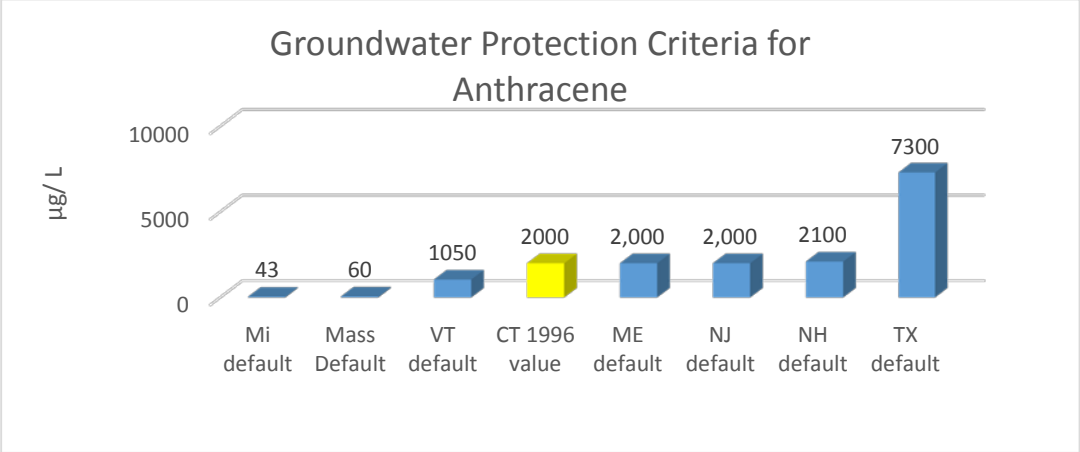


FIGURE C-2. 6. BAR GRAPH COMPARING MULTIPLE STATES AND THEIR BENZO(A) PYRENE GROUNDWATER PROTECTION CRITERIA (GWPC). UNITS ARE MICROGRAMS/LITER, EQUAL TO PARTS PER BILLION (PPB).

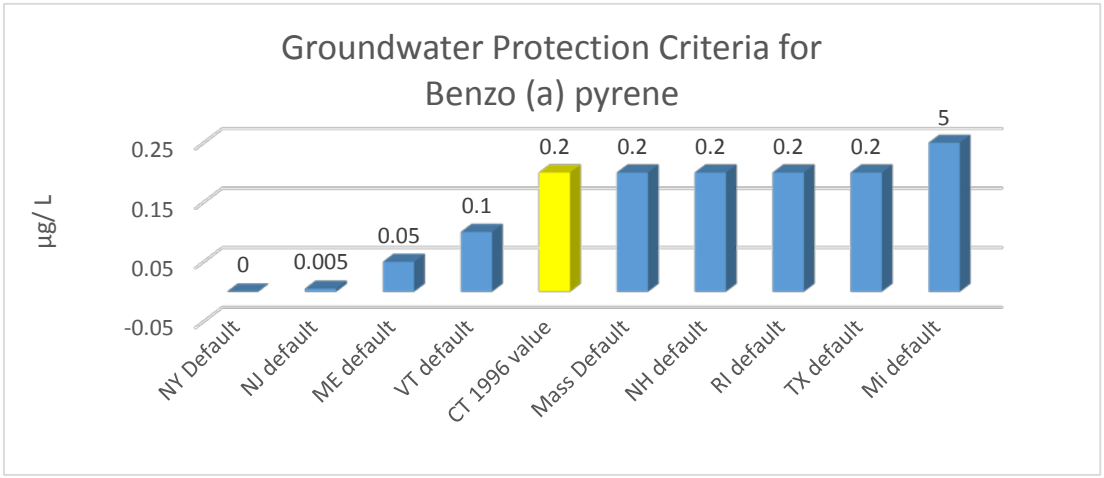


FIGURE C-2. 7. BAR GRAPH COMPARING MULTIPLE STATES AND THEIR PHENANTHRENE GROUNDWATER PROTECTION CRITERIA (GWPC). UNITS ARE MICROGRAMS/LITER, EQUAL TO PARTS PER BILLION (PPB).

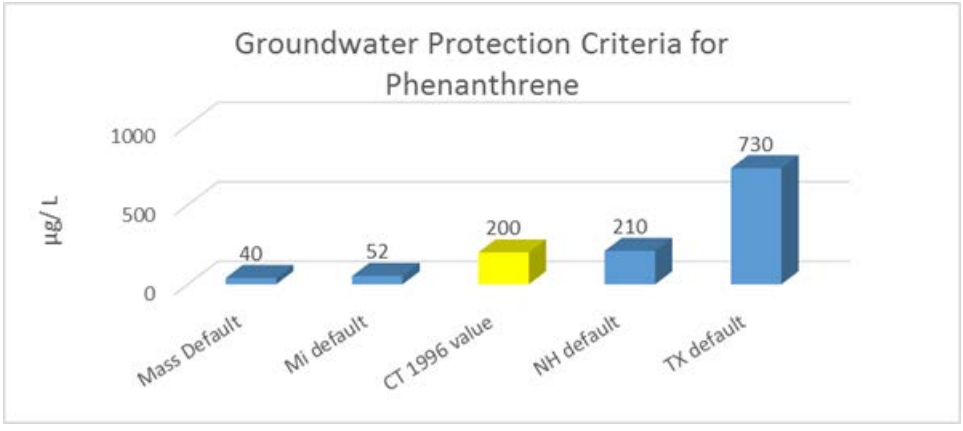


FIGURE C-2. 8. BAR GRAPH COMPARING MULTIPLE STATES AND THEIR NAPTHALENE GROUNDWATER PROTECTION CRITERIA (GWPC). UNITS ARE MICROGRAMS/LITER, EQUAL TO PARTS PER BILLION (PPB).

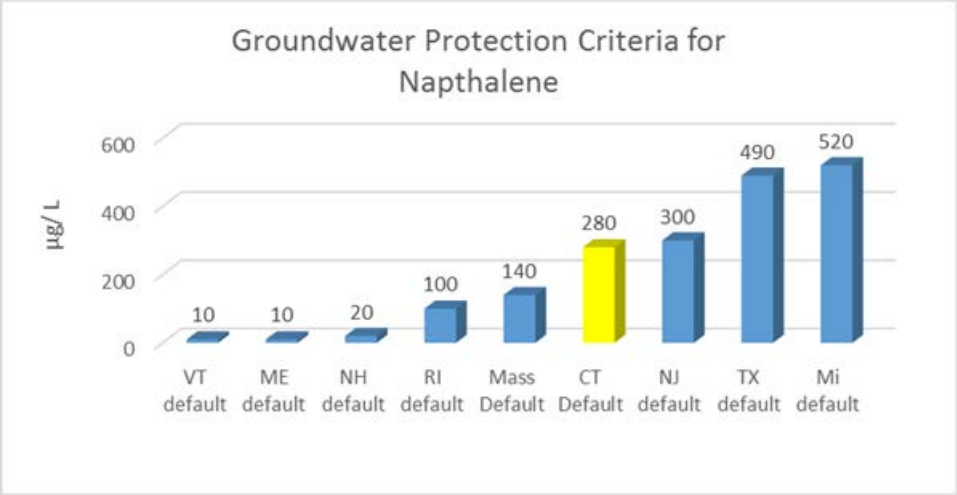


FIGURE C-2. 9. BAR GRAPH COMPARING MULTIPLE STATES AND THEIR 1,1-DICHLOROTHYLENE GROUNDWATER PROTECTION CRITERIA (GWPC). UNITS ARE MICROGRAMS/LITER, EQUAL TO PARTS PER BILLION (PPB).

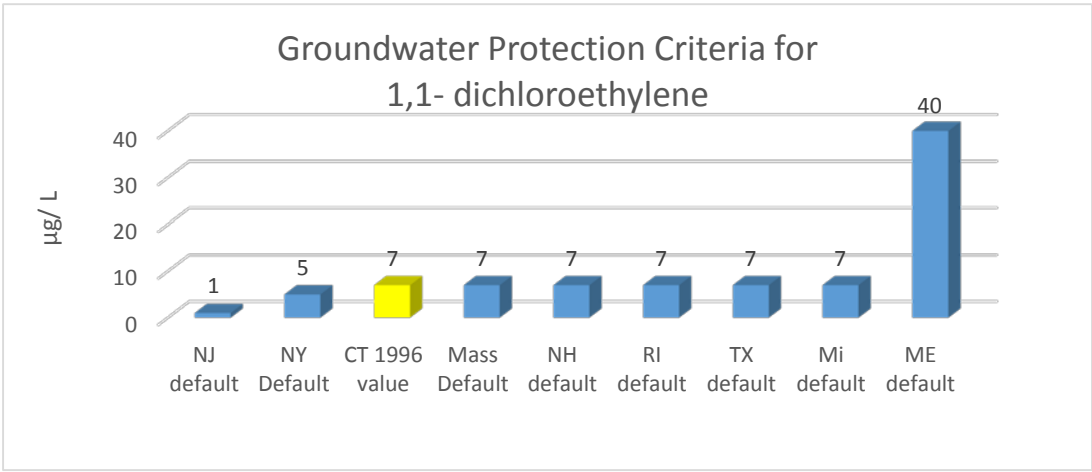


FIGURE C-2. 10. BAR GRAPH COMPARING MULTIPLE STATES AND THEIR TETRACHLOROETHYLENE GROUNDWATER PROTECTION CRITERIA (GWPC). UNITS ARE MICROGRAMS/LITER, EQUAL TO PARTS PER BILLION (PPB).

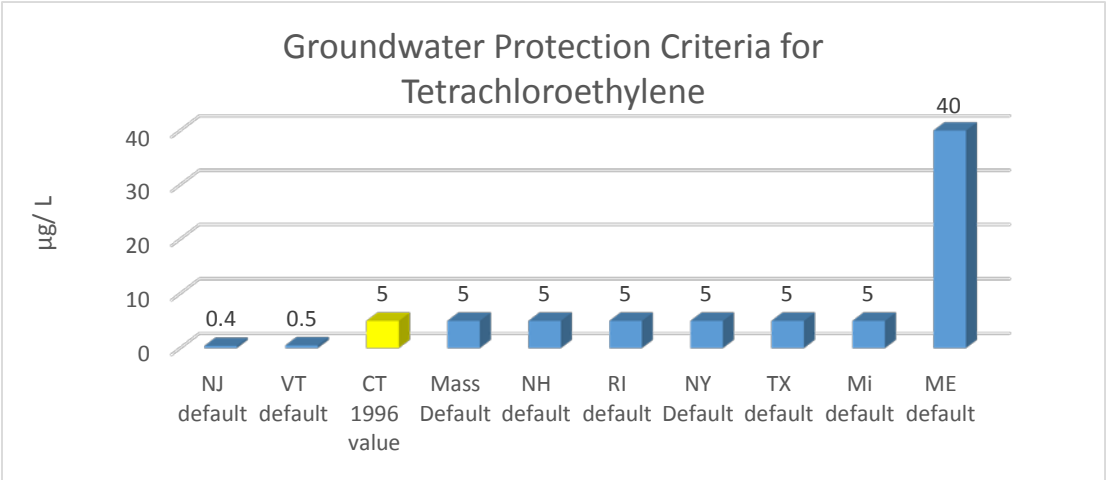


FIGURE C-2. 11. BAR GRAPH COMPARING MULTIPLE STATES AND THEIR 1,1,1-TRICHLOROETHANE GROUNDWATER PROTECTION CRITERIA (GWPC). UNITS ARE MICROGRAMS/LITER, EQUAL TO PARTS PER BILLION (PPB).

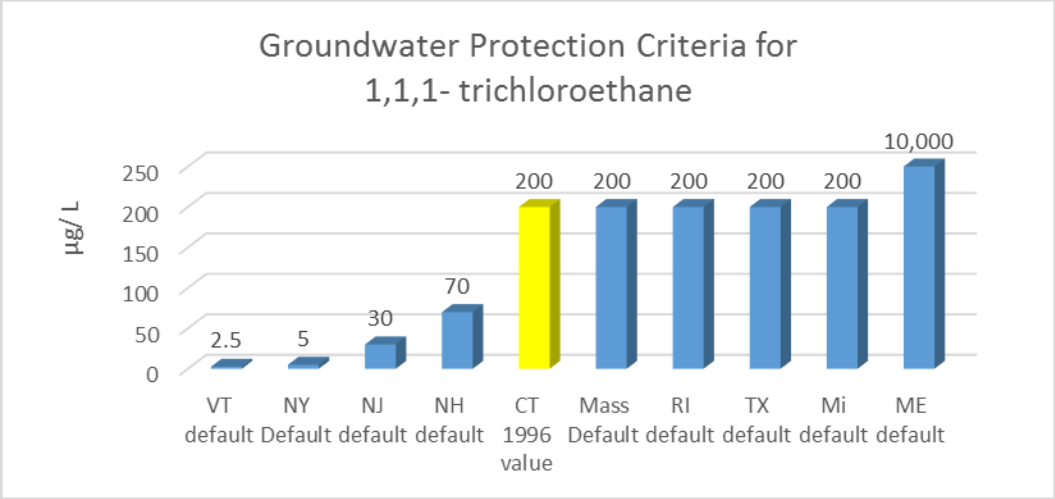


FIGURE C-2. 12. BAR GRAPH COMPARING MULTIPLE STATES AND THEIR VINYL CHLORIDE GROUNDWATER PROTECTION CRITERIA (GWPC). UNITS ARE MICROGRAMS/LITER, EQUAL TO PARTS PER BILLION (PPB).

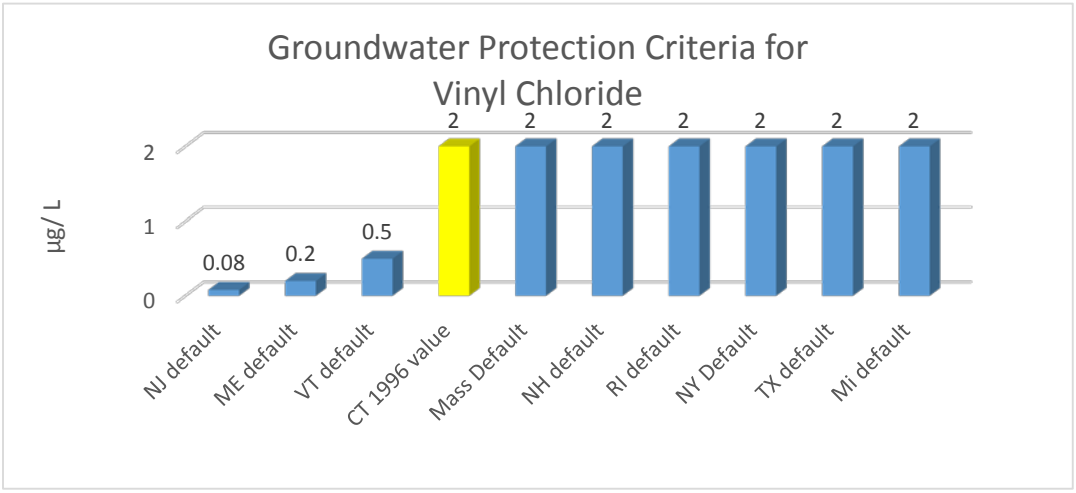


FIGURE C-2. 13. BAR GRAPH COMPARING MULTIPLE STATES AND THEIR CADMIUM GROUNDWATER PROTECTION CRITERIA (GWPC). UNITS ARE MICROGRAMS/LITER, EQUAL TO PARTS PER BILLION (PPB).

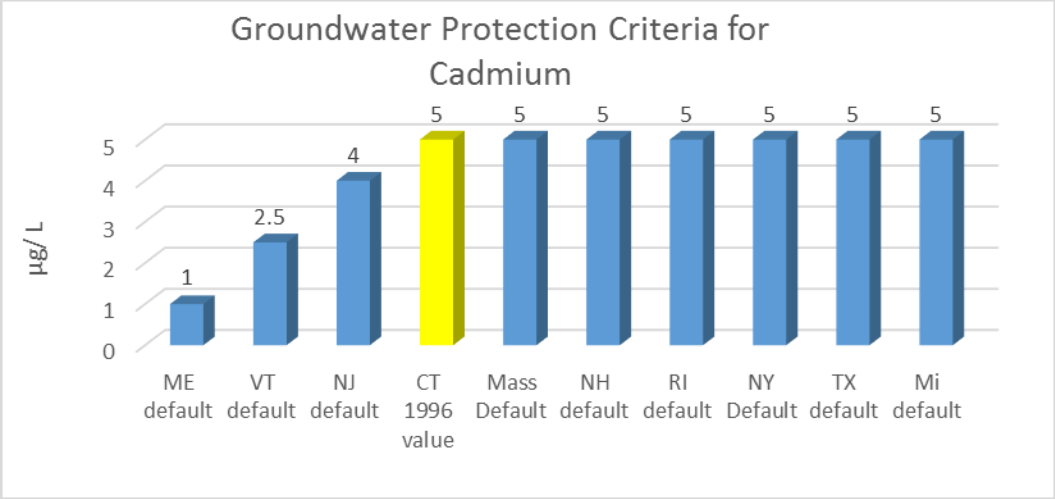


FIGURE C-2. 14. BAR GRAPH COMPARING MULTIPLE STATES AND THEIR CHROMIUM GROUNDWATER PROTECTION CRITERIA (GWPC). UNITS ARE MICROGRAMS/LITER, EQUAL TO PARTS PER BILLION (PPB).

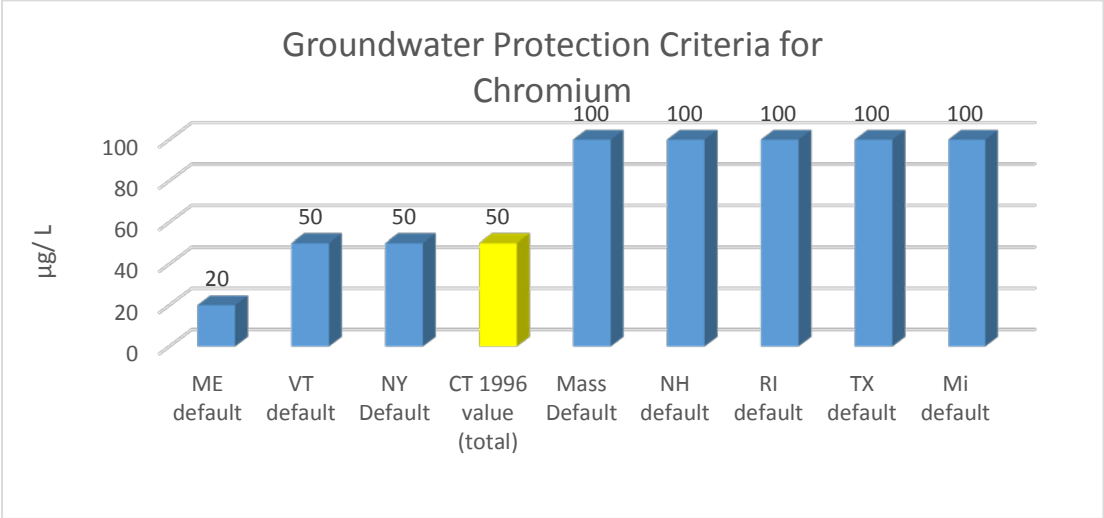


FIGURE C-2. 15. BAR GRAPH COMPARING MULTIPLE STATES AND THEIR COPPER GROUNDWATER PROTECTION CRITERIA (GWPC). UNITS ARE MICROGRAMS/LITER, EQUAL TO PARTS PER BILLION (PPB).

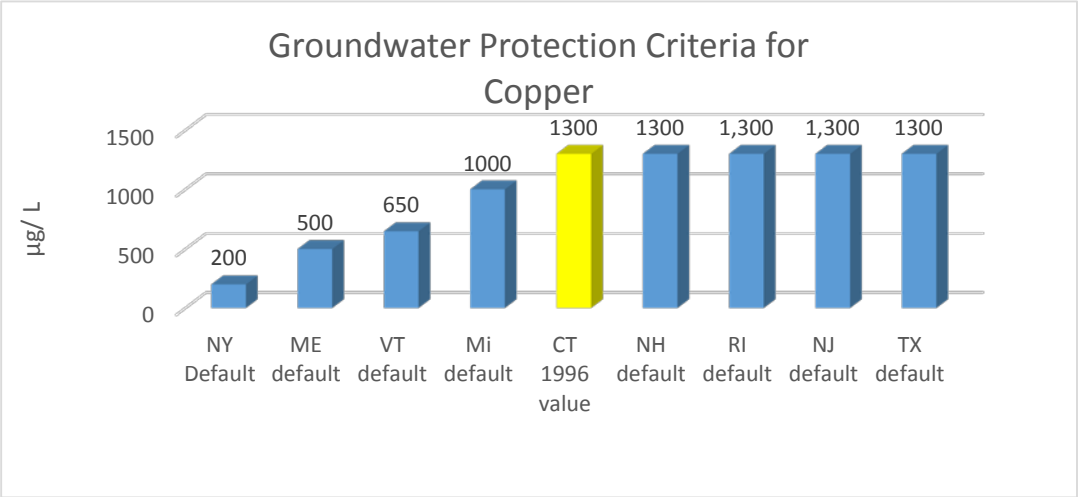


FIGURE C-2. 16. BAR GRAPH COMPARING MULTIPLE STATES AND THEIR LEAD GROUNDWATER PROTECTION CRITERIA (GWPC). UNITS ARE MICROGRAMS/LITER, EQUAL TO PARTS PER BILLION (PPB).

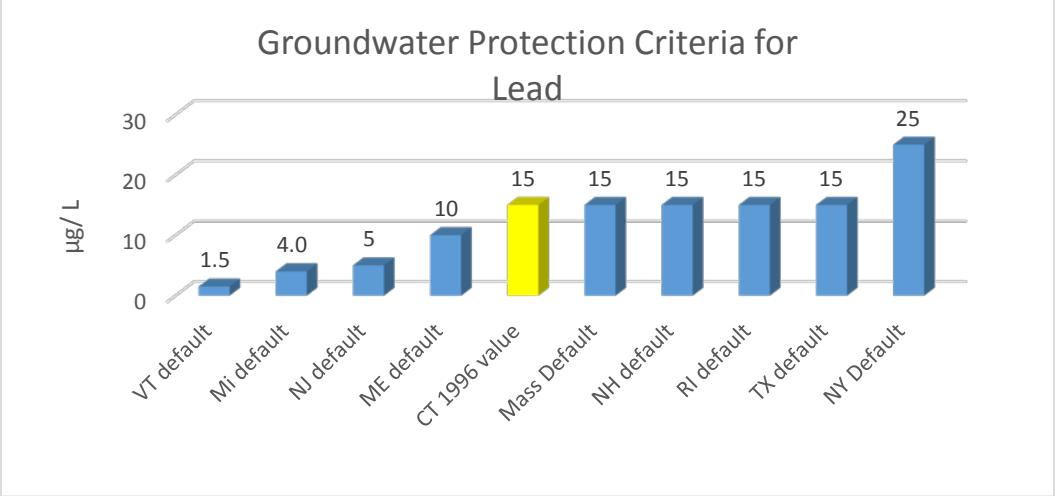


FIGURE C-2. 17. BAR GRAPH COMPARING MULTIPLE STATES AND THEIR MERCURY GROUNDWATER PROTECTION CRITERIA (GWPC). UNITS ARE MICROGRAMS/LITER, EQUAL TO PARTS PER BILLION (PPB).

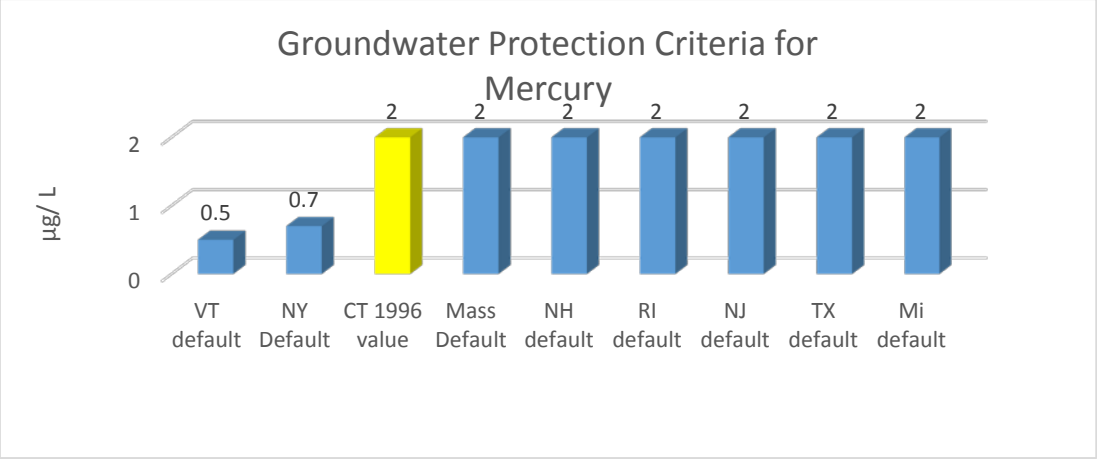


FIGURE C-2. 18. BAR GRAPH COMPARING MULTIPLE STATES AND THEIR DIELDRIN GROUNDWATER PROTECTION CRITERIA (GWPC). UNITS ARE MICROGRAMS/LITER, EQUAL TO PARTS PER BILLION (PPB).

FIGURE C-2. 19. BAR GRAPH COMPARING MULTIPLE STATES AND THEIR CHLORDANE GROUNDWATER PROTECTION CRITERIA (GWPC). UNITS ARE MICROGRAMS/LITER, EQUAL TO PARTS PER BILLION (PPB).

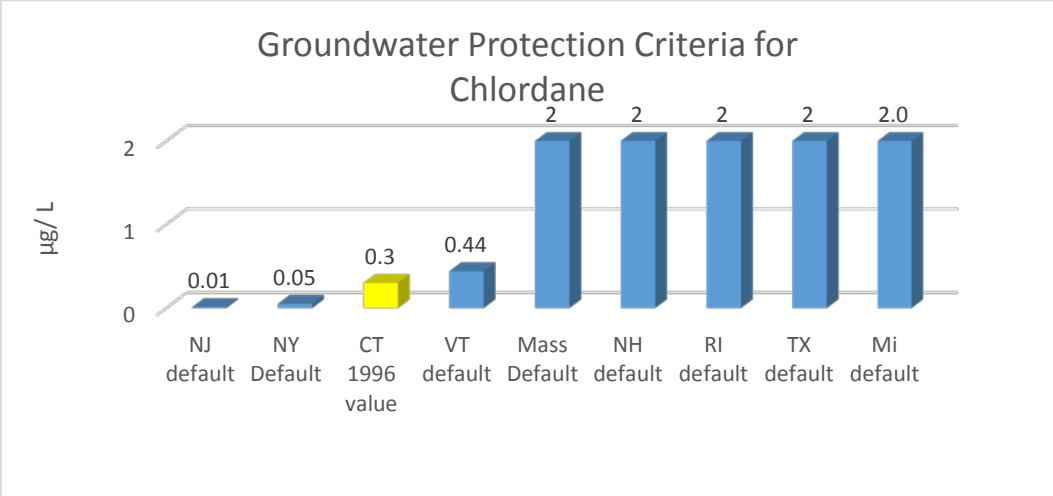
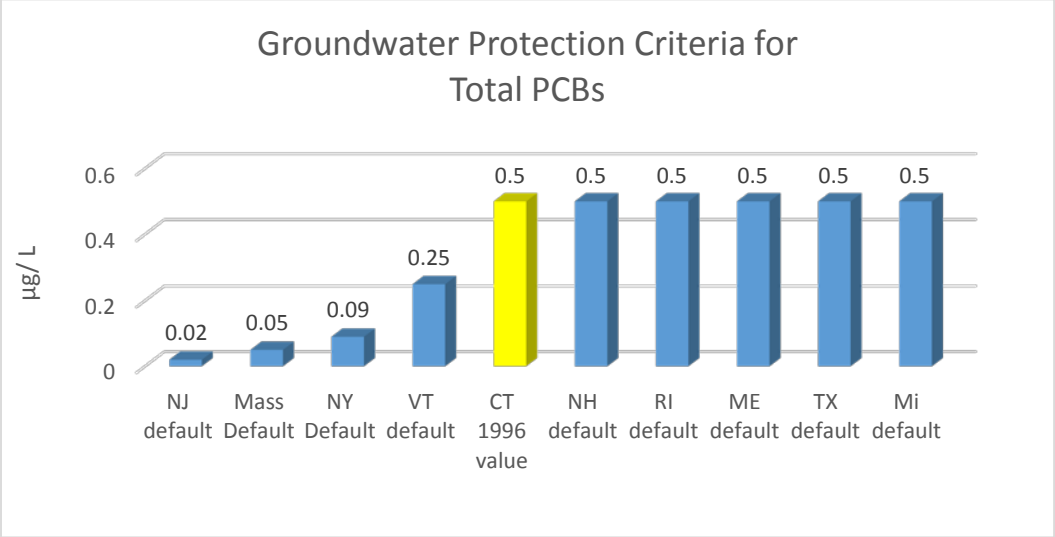


FIGURE C-2. 20. BAR GRAPH COMPARING MULTIPLE STATES AND THEIR TOTAL PCBS GROUNDWATER PROTECTION CRITERIA (GWPC). UNITS ARE MICROGRAMS/LITER, EQUAL TO PARTS PER BILLION (PPB).



Appendix C-3: Comparison: Water Quality Criteria

Water Quality Standards (WQS) help protect the nation's surface waters and meet the requirements set by the Clean Water Act. The data was extracted from each state's, "State Numeric Criteria Report." Massachusetts's criteria is uniform with EPA's "National Recommended Water Quality Criteria for Priority Toxic Pollutants". Graphs comparing state WQS of anthracene, phenanthrene, and naphthalene are not included due to lack of established criteria.

FIGURE C-3. 1. BAR GRAPH COMPARING MULTIPLE STATES AND THEIR BENZENE WATER QUALITY STANDARD (WQS). THESE VALUES ARE THE HUMAN HEALTH CRITERION FOR CONSUMPTION OF BOTH WATER AND ORGANISMS. NUMBERS IN PARTS PER BILLION.

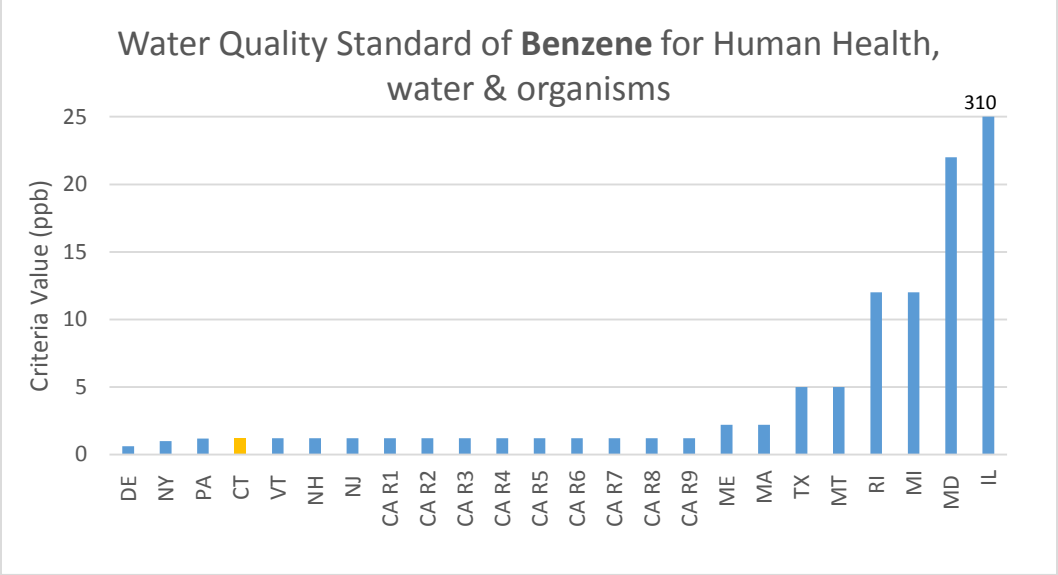


FIGURE C-3. 2. BAR GRAPH COMPARING MULTIPLE STATES AND THEIR 1, 2- DICHLOROETHANE WATER QUALITY STANDARD (WQS). THESE VALUES ARE THE HUMAN HEALTH CRITERION FOR CONSUMPTION OF BOTH WATER AND ORGANISMS. NUMBERS IN PARTS PER BILLION.

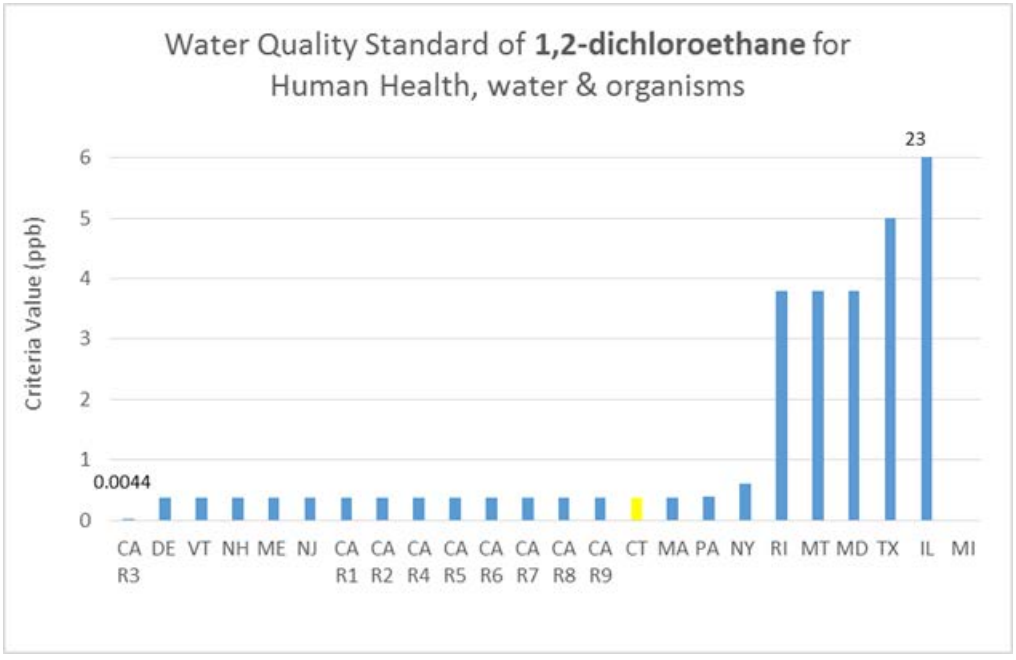


FIGURE C-3. 3. BAR GRAPH COMPARING MULTIPLE STATES AND THEIR BENZO (A) PYRENE WATER QUALITY STANDARD (WQS). THESE VALUES ARE THE HUMAN HEALTH CRITERION FOR CONSUMPTION OF BOTH WATER AND ORGANISMS. NUMBERS IN PARTS PER BILLION.

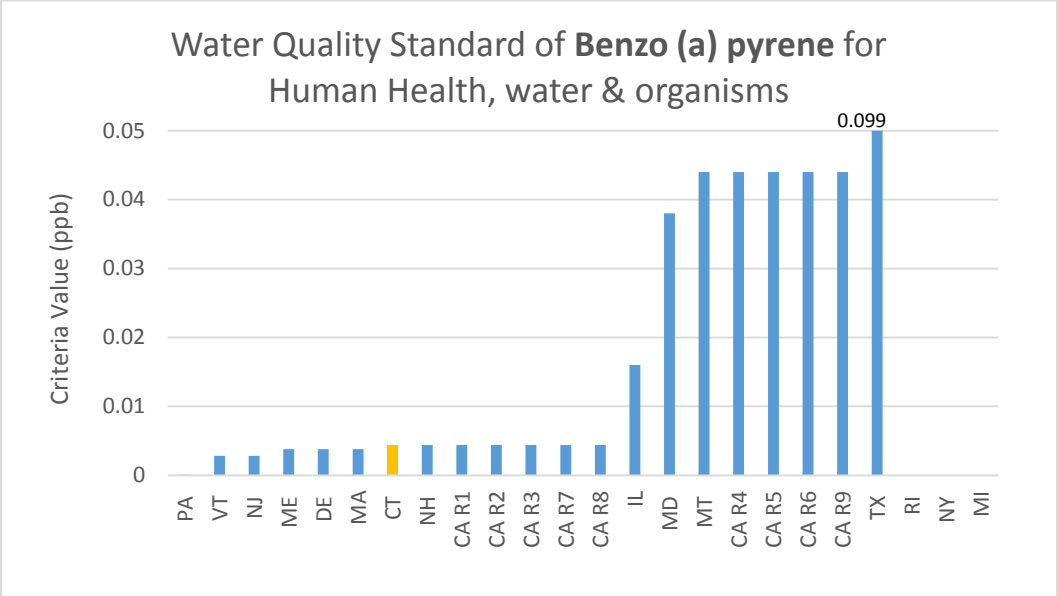


FIGURE C-3. 4. BAR GRAPH COMPARING MULTIPLE STATES AND THEIR TOLUENE WATER QUALITY STANDARD (WQS). THESE VALUES ARE THE HUMAN HEALTH CRITERION FOR CONSUMPTION OF BOTH WATER AND ORGANISMS. NUMBERS IN PARTS PER BILLION.

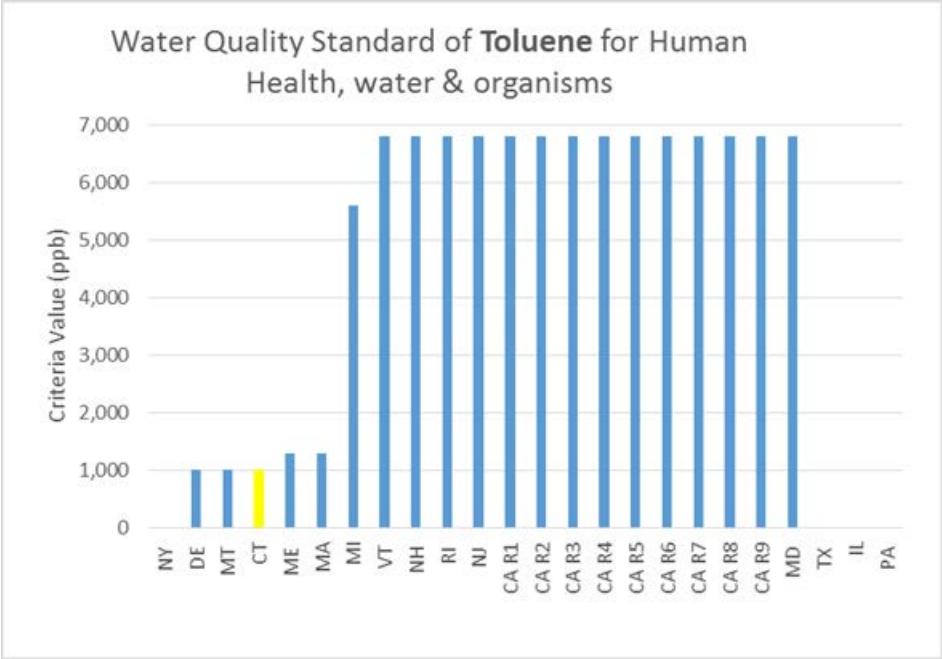


FIGURE C-3. 5. BAR GRAPH COMPARING MULTIPLE STATES AND THEIR 1, 1- DICHLOROETHYLENE WATER QUALITY STANDARD (WQS). THESE VALUES ARE THE HUMAN HEALTH CRITERION FOR CONSUMPTION OF BOTH WATER AND ORGANISMS. NUMBERS IN PARTS PER BILLION.

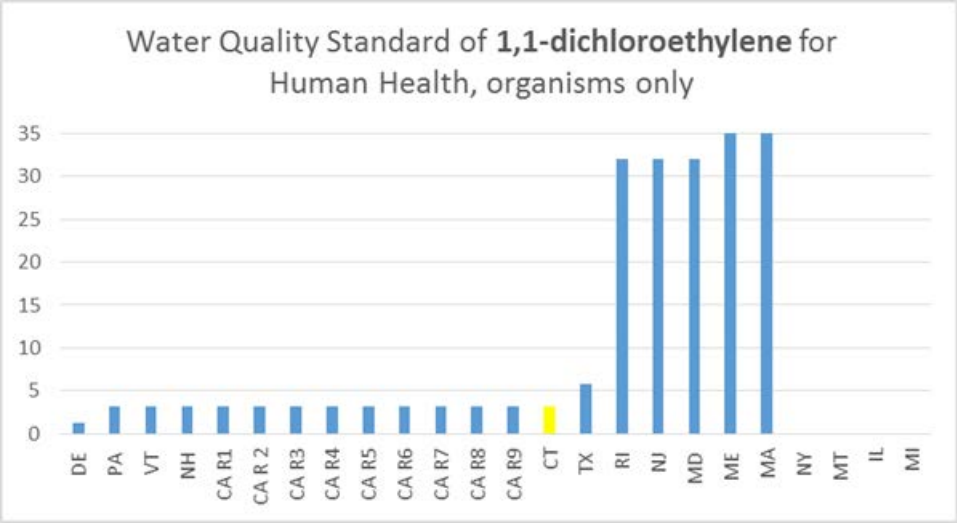


FIGURE C-3. 6. BAR GRAPH COMPARING MULTIPLE STATES AND THEIR TETRACHLOROETHYLENE WATER QUALITY STANDARD (WQS). THESE VALUES ARE THE HUMAN HEALTH CRITERION FOR CONSUMPTION OF BOTH WATER AND ORGANISMS. NUMBERS IN PARTS PER BILLION.

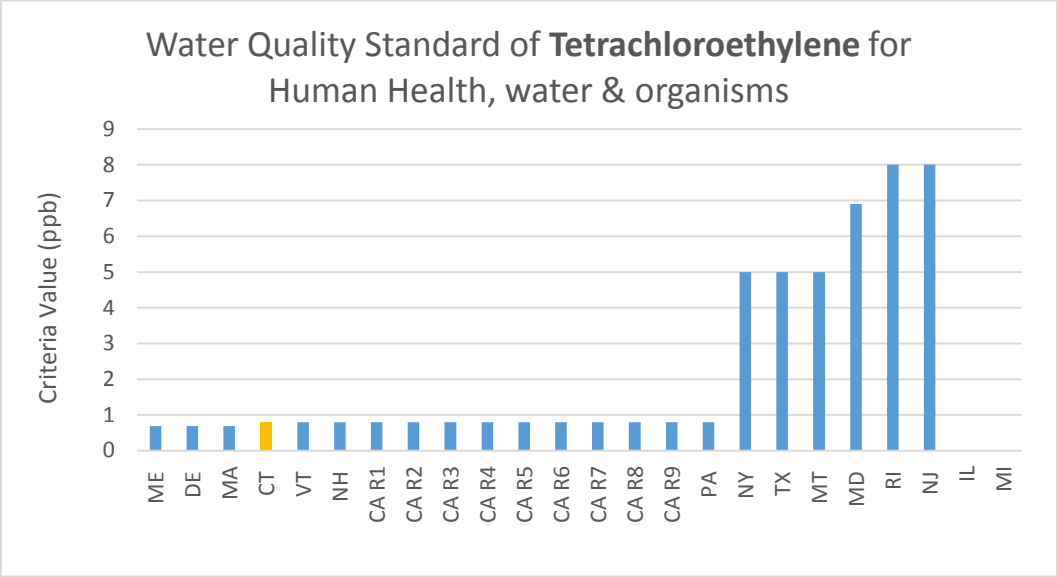


FIGURE C-3. 7. BAR GRAPH COMPARING MULTIPLE STATES AND THEIR 1, 1, 1-TRICHLOROETHANE WATER QUALITY STANDARD (WQS). THERE IS NO CONNECTICUT STANDARD FOR 1,1,1-TRICHLOROETHANE. THESE VALUES ARE THE HUMAN HEALTH CRITERION FOR CONSUMPTION OF BOTH WATER AND ORGANISMS. NUMBERS IN PARTS PER BILLION.

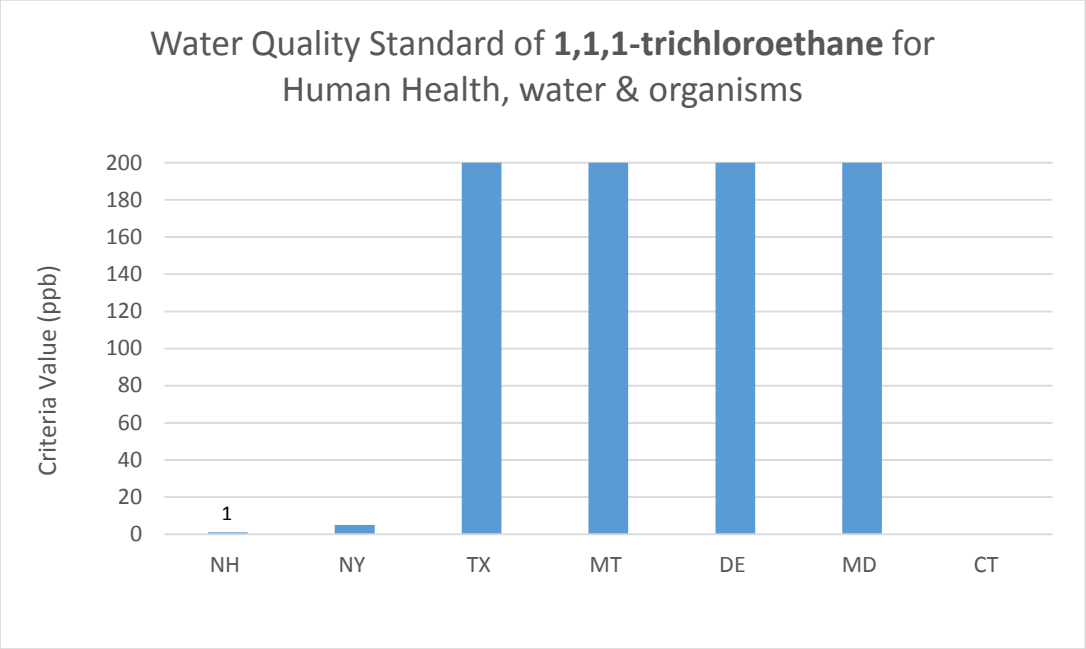


FIGURE C-3. 8. BAR GRAPH COMPARING MULTIPLE STATES AND THEIR TRICHLOROETHYLENE WATER QUALITY STANDARD (WQS). THESE VALUES ARE THE HUMAN HEALTH CRITERION FOR CONSUMPTION OF BOTH WATER AND ORGANISMS. NUMBERS IN PARTS PER BILLION.

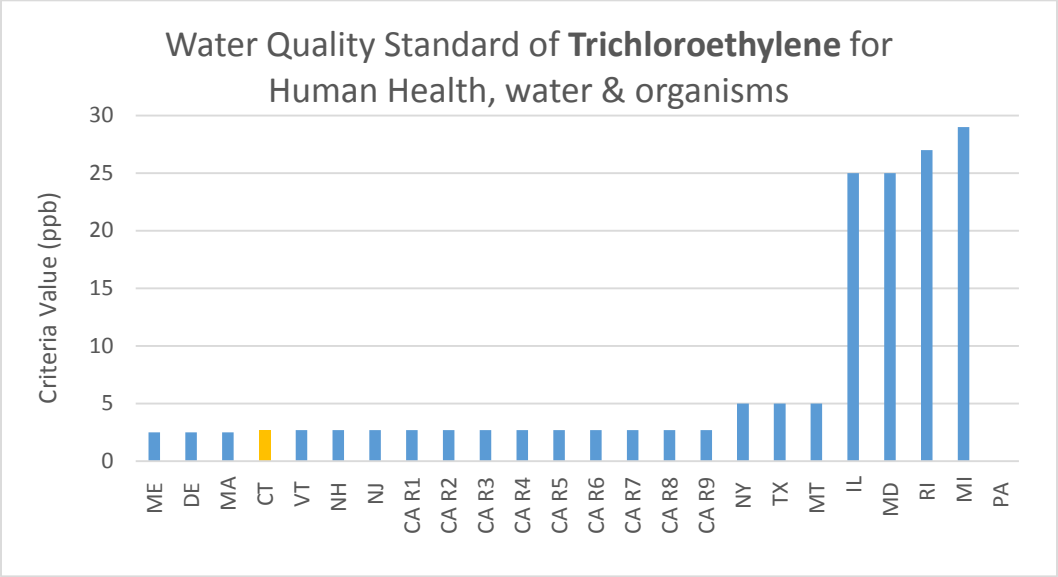


FIGURE C-3. 9. BAR GRAPH COMPARING MULTIPLE STATES AND THEIR VINYL CHLORIDE WATER QUALITY STANDARD (WQS). THESE VALUES ARE THE HUMAN HEALTH CRITERION FOR CONSUMPTION OF BOTH WATER AND ORGANISMS. NUMBERS IN PARTS PER BILLION.

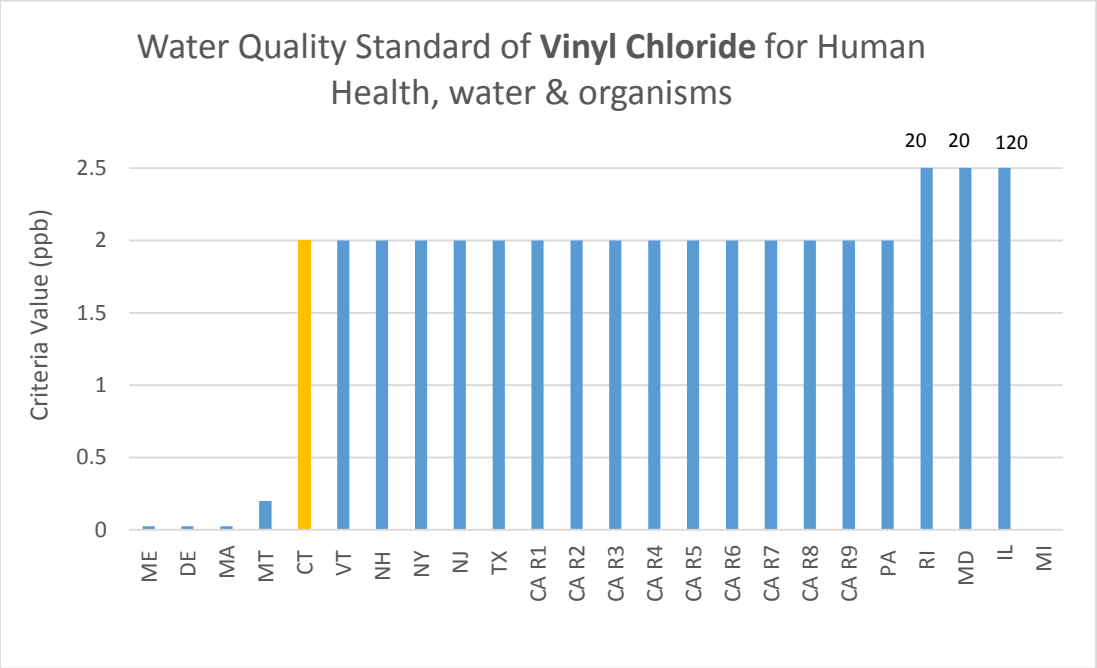


FIGURE C-3. 10. BAR GRAPH COMPARING MULTIPLE STATES AND THEIR CADMIUM WATER QUALITY STANDARD (WQS). THESE VALUES ARE THE HUMAN HEALTH CRITERION FOR CONSUMPTION OF BOTH WATER AND ORGANISMS. NUMBERS IN PARTS PER BILLION.

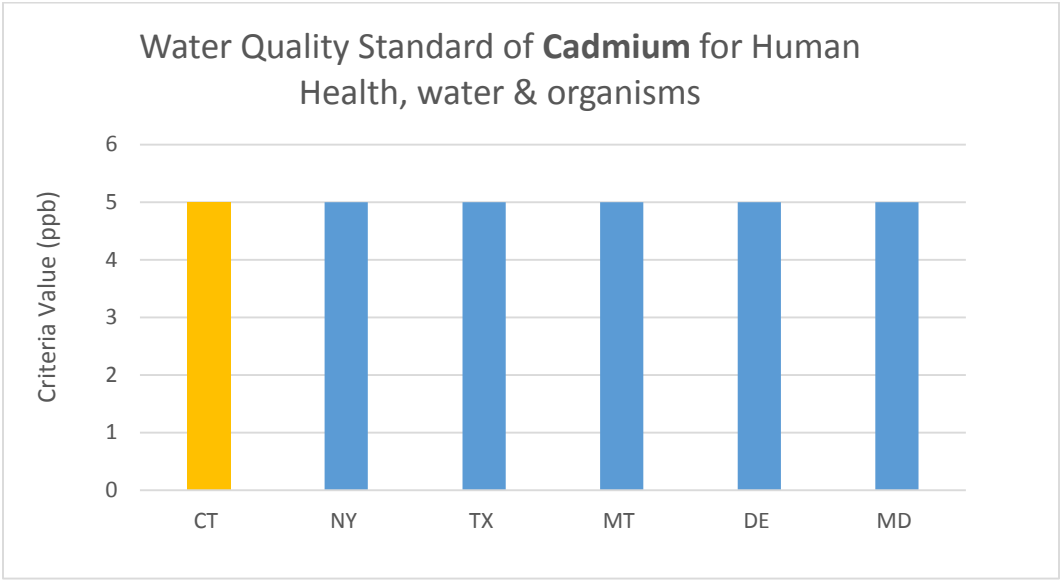


FIGURE C-3. 11. BAR GRAPH COMPARING MULTIPLE STATES AND THEIR COPPER WATER QUALITY STANDARD (WQS). THESE VALUES ARE THE HUMAN HEALTH CRITERION FOR CONSUMPTION OF BOTH WATER AND ORGANISMS. NUMBERS IN PARTS PER BILLION.

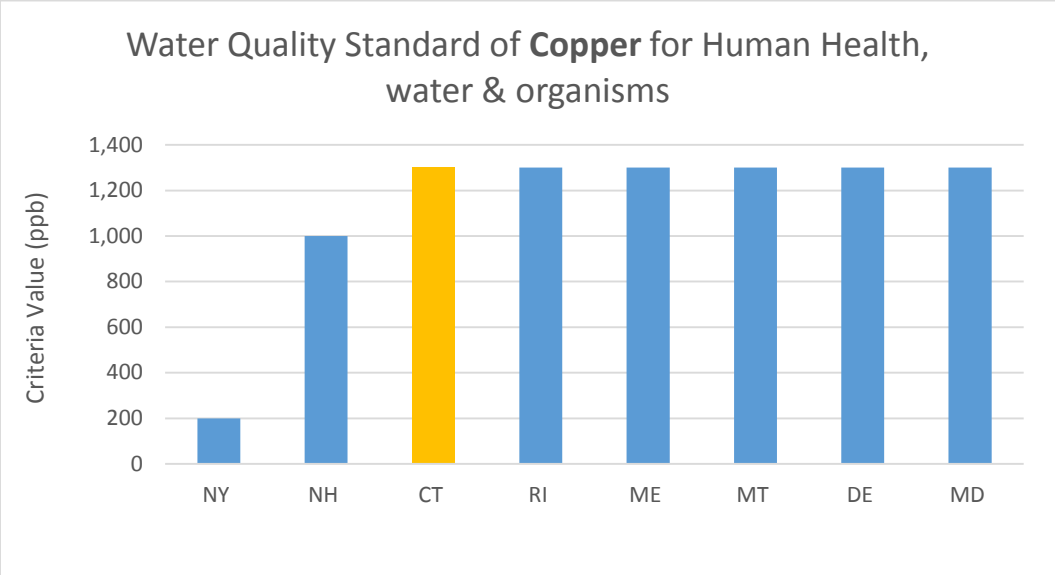


FIGURE C-3. 12. BAR GRAPH COMPARING MULTIPLE STATES AND THEIR LEAD WATER QUALITY STANDARD (WQS). THESE VALUES ARE THE HUMAN HEALTH CRITERION FOR CONSUMPTION OF BOTH WATER AND ORGANISMS. NUMBERS IN PARTS PER BILLION.

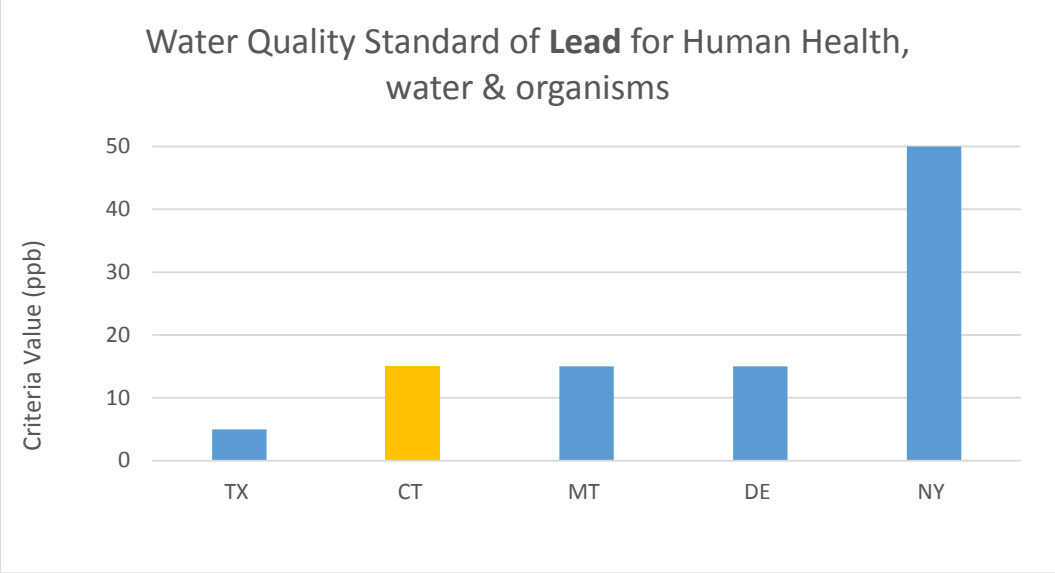


FIGURE C-3. 13. BAR GRAPH COMPARING MULTIPLE STATES AND THEIR MERCURY WATER QUALITY STANDARD (WQS). THESE VALUES ARE THE HUMAN HEALTH CRITERION FOR CONSUMPTION OF BOTH WATER AND ORGANISMS. NUMBERS IN PARTS PER BILLION.

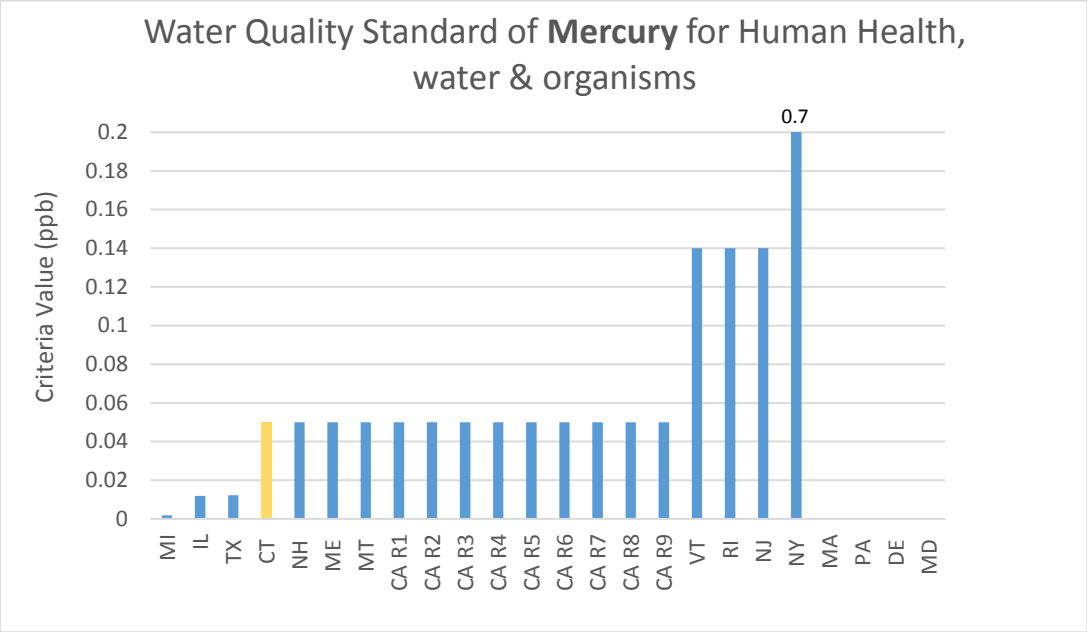


FIGURE C-3. 14. BAR GRAPH COMPARING MULTIPLE STATES AND THEIR CHLORDANE WATER QUALITY STANDARD (WQS). THESE VALUES ARE THE HUMAN HEALTH CRITERION FOR CONSUMPTION OF BOTH WATER AND ORGANISMS. NUMBERS IN PARTS PER BILLION.

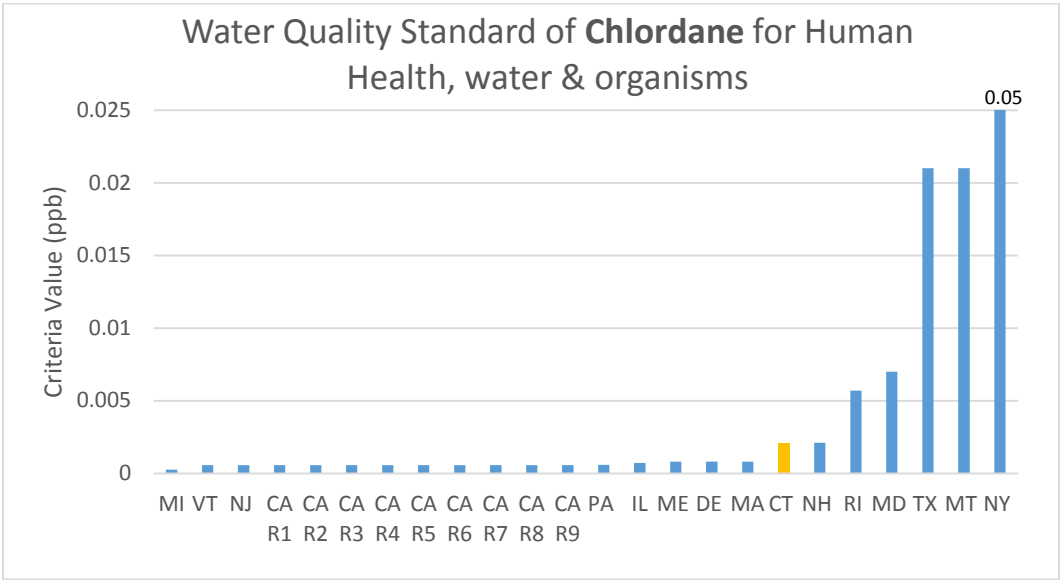
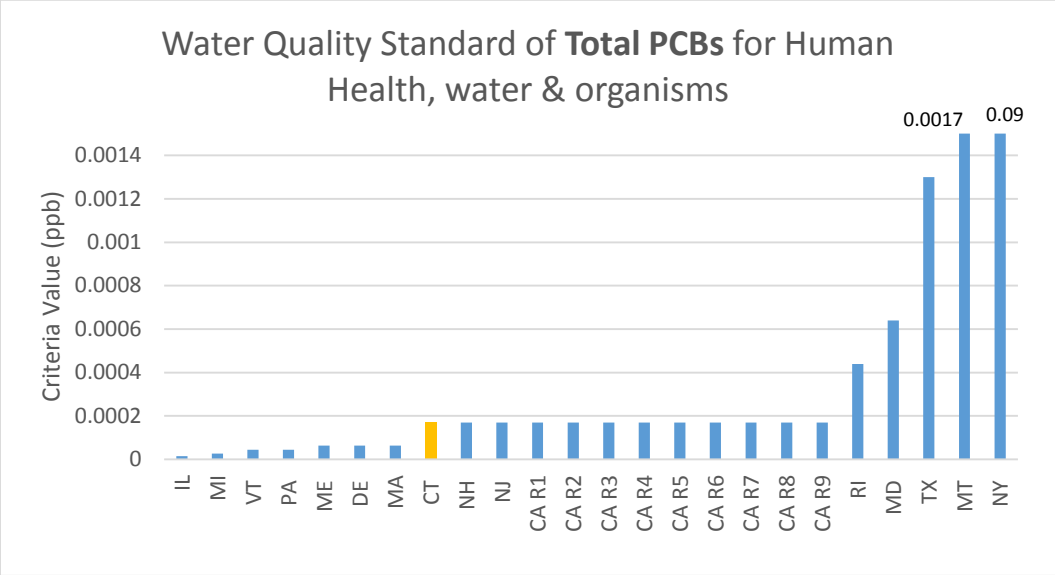


FIGURE C-3. 15. BAR GRAPH COMPARING MULTIPLE STATES AND THEIR TOTAL PCBS WATER QUALITY STANDARD (WQS). THESE VALUES ARE THE HUMAN HEALTH CRITERION FOR CONSUMPTION OF BOTH WATER AND ORGANISMS. NUMBERS IN PARTS PER BILLION.



Appendix C-3a

The Water Quality Standards (WQS) for Human Health, organisms only, was retrieved from each state's "State Numeric Criteria Report." Massachusetts's criteria is uniform with EPA's "National Recommended Water Quality Criteria for Priority Toxic Pollutants". Graphs depicting comparisons of state's WQS are not included for: anthracene, phenanthrene, naphthalene, cadmium, chromium, copper, lead, dieldrin, and total PAHs due to lack of established criteria.

FIGURE C-3A. 1. BAR GRAPH COMPARING MULTIPLE STATES AND THEIR BENZENE WATER QUALITY STANDARD (WQS). THE HUMAN HEALTH CRITERION VALUE FOR CONSUMPTION OF ORGANISMS ONLY, WITHOUT WATER. NUMBERS IN PARTS PER BILLION.

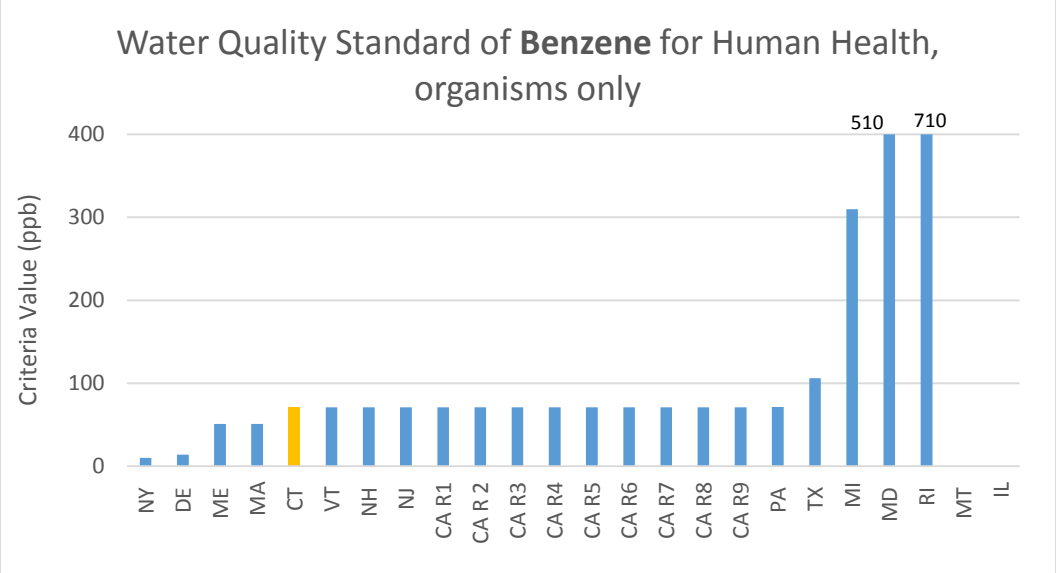


FIGURE C-3A. 2. BAR GRAPH COMPARING MULTIPLE STATES AND THEIR 1, 2- DICHLOROETHANE WATER QUALITY STANDARD (WQS). THE HUMAN HEALTH CRITERION VALUE FOR CONSUMPTION OF ORGANISMS ONLY, WITHOUT WATER. NUMBERS IN PARTS PER BILLION.

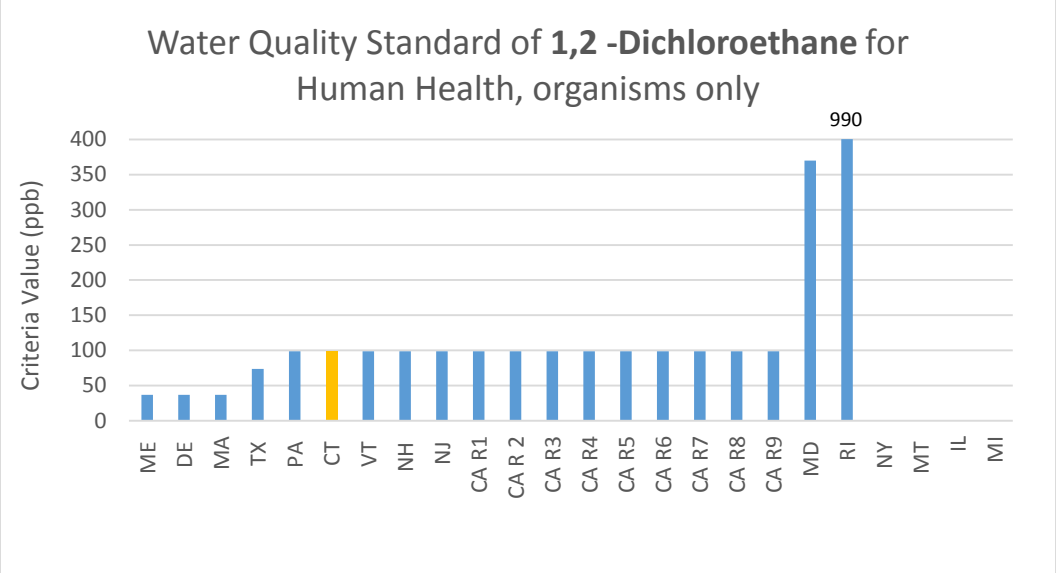


FIGURE C-3A. 3. BAR GRAPH COMPARING MULTIPLE STATES AND THEIR BENZO (A) PYRENE WATER QUALITY STANDARD (WQS). THE HUMAN HEALTH CRITERION VALUE FOR CONSUMPTION OF ORGANISMS ONLY, WITHOUT WATER. NUMBERS IN PARTS PER BILLION.

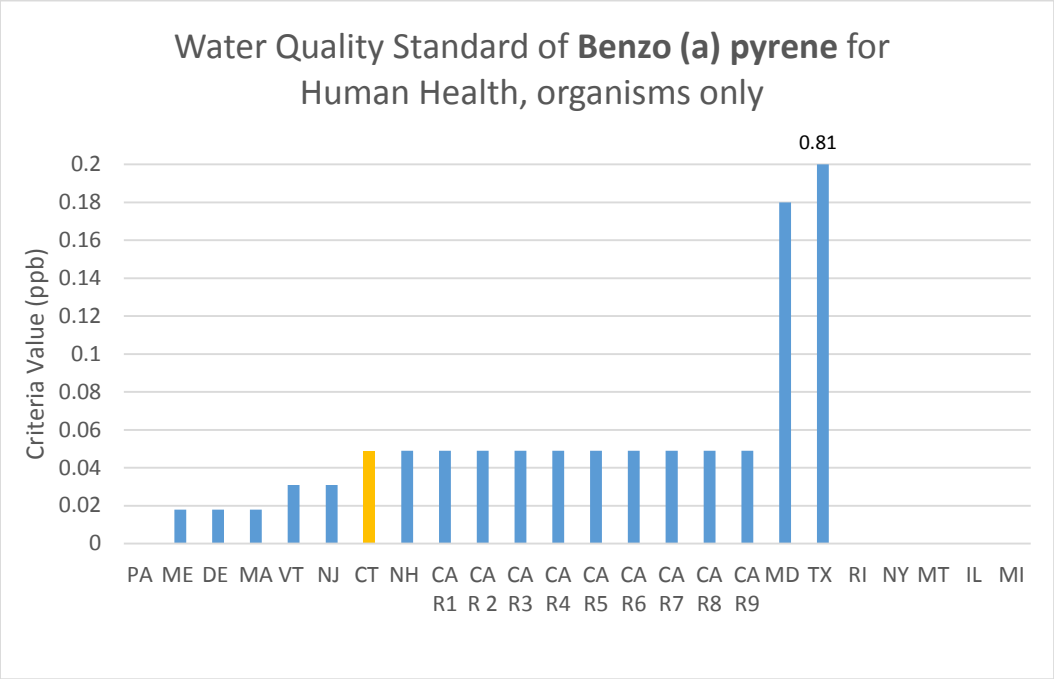


FIGURE C-3A. 4. BAR GRAPH COMPARING MULTIPLE STATES AND THEIR TOLUENE WATER QUALITY STANDARD (WQS). THE HUMAN HEALTH CRITERION VALUE FOR CONSUMPTION OF ORGANISMS ONLY, WITHOUT WATER. NUMBERS IN PARTS PER BILLION.

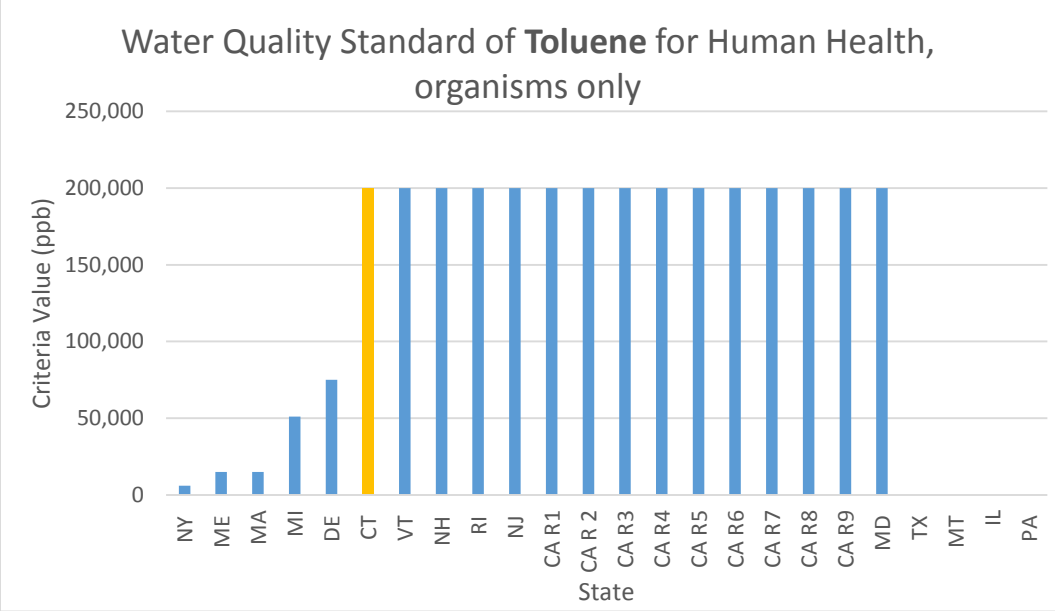


FIGURE C-3A. 5. BAR GRAPH COMPARING MULTIPLE STATES AND THEIR 1, 1-DICHLOROETHYLENE WATER QUALITY STANDARD (WQS). THE HUMAN HEALTH CRITERION VALUE FOR CONSUMPTION OF ORGANISMS ONLY, WITHOUT WATER. NUMBERS IN PARTS PER BILLION.

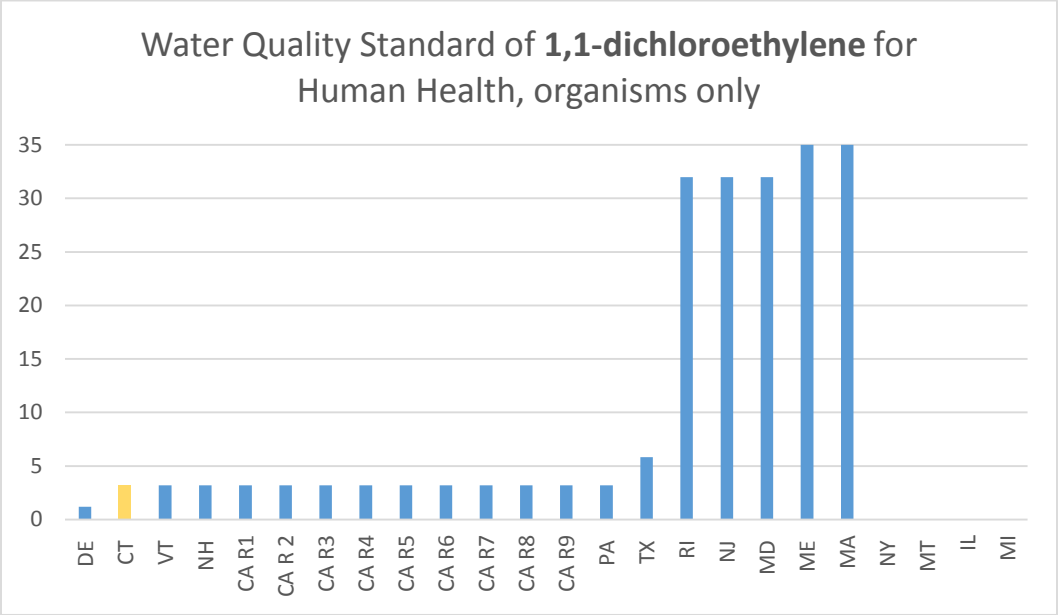


FIGURE C-3A. 6. BAR GRAPH COMPARING MULTIPLE STATES AND THEIR TETRACHLOROETHYLENE WATER QUALITY STANDARD (WQS). THE HUMAN HEALTH CRITERION VALUE FOR CONSUMPTION OF ORGANISMS ONLY, WITHOUT WATER. NUMBERS IN PARTS PER BILLION.

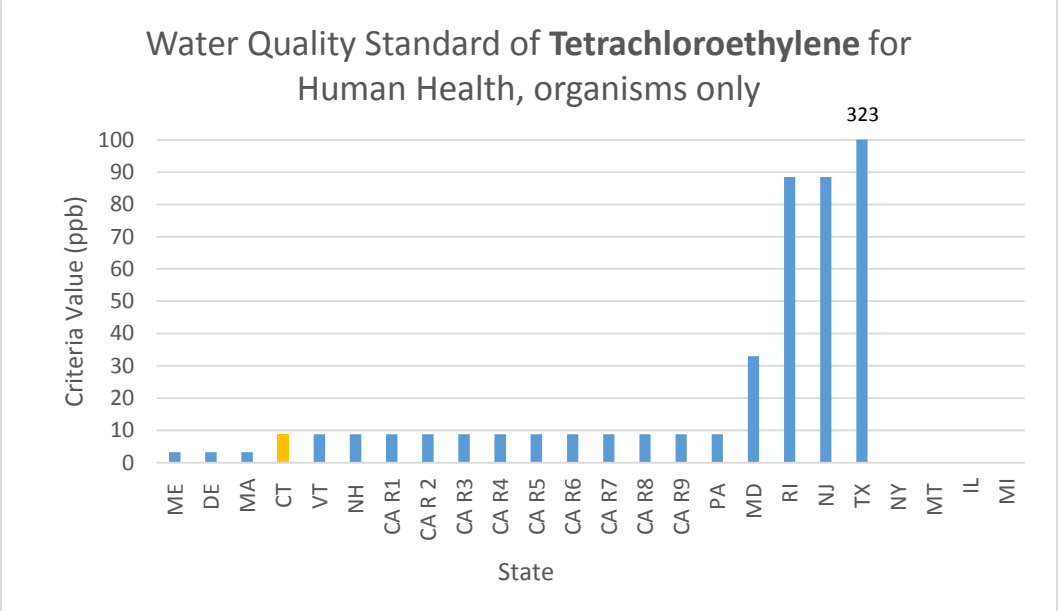


FIGURE C-3A. 7. BAR GRAPH COMPARING MULTIPLE STATES AND THEIR TRICHLOROETHYLENE WATER QUALITY STANDARD (WQS). THE HUMAN HEALTH CRITERION VALUE FOR CONSUMPTION OF ORGANISMS ONLY, WITHOUT WATER. NUMBERS IN PARTS PER BILLION.

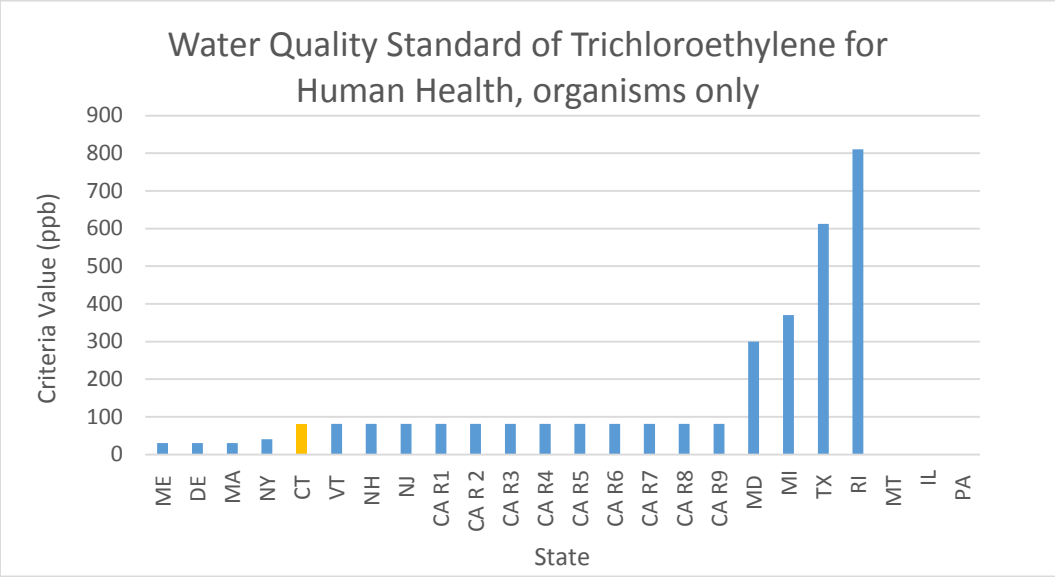


FIGURE C-3A. 8. BAR GRAPH COMPARING MULTIPLE STATES AND THEIR VINYL CHLORIDE WATER QUALITY STANDARD (WQS). THE HUMAN HEALTH CRITERION VALUE FOR CONSUMPTION OF ORGANISMS ONLY, WITHOUT WATER. NUMBERS IN PARTS PER BILLION.

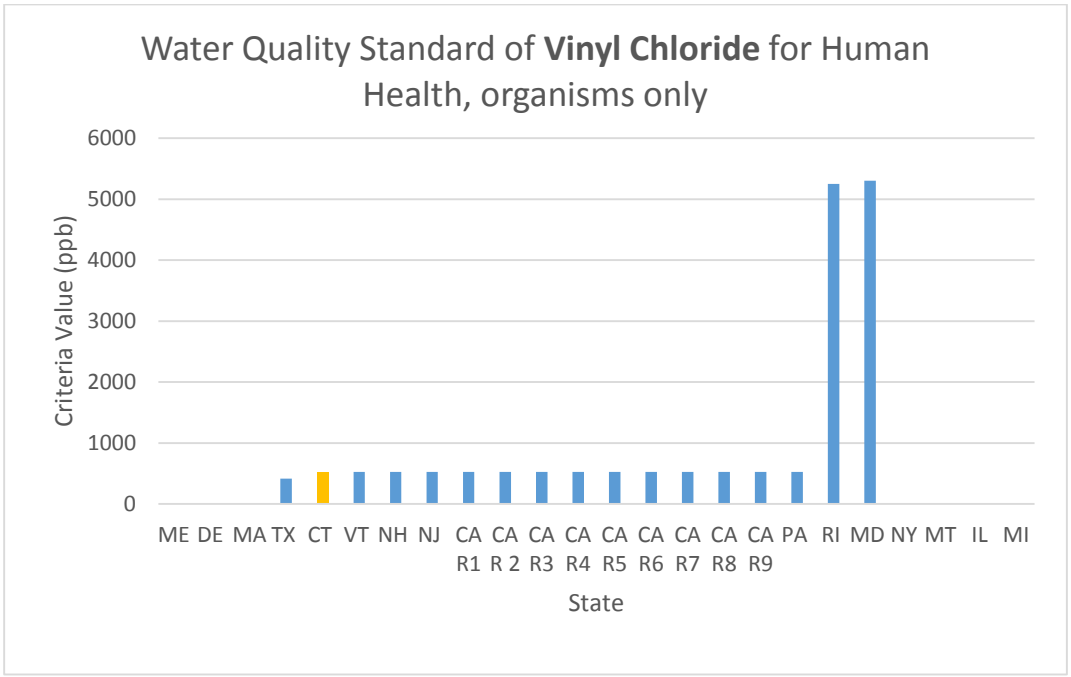


FIGURE C-3A. 9. BAR GRAPH COMPARING MULTIPLE STATES AND THEIR MERCURY WATER QUALITY STANDARD (WQS). THE HUMAN HEALTH CRITERION VALUE FOR CONSUMPTION OF ORGANISMS ONLY, WITHOUT WATER. NUMBERS IN PARTS PER BILLION.

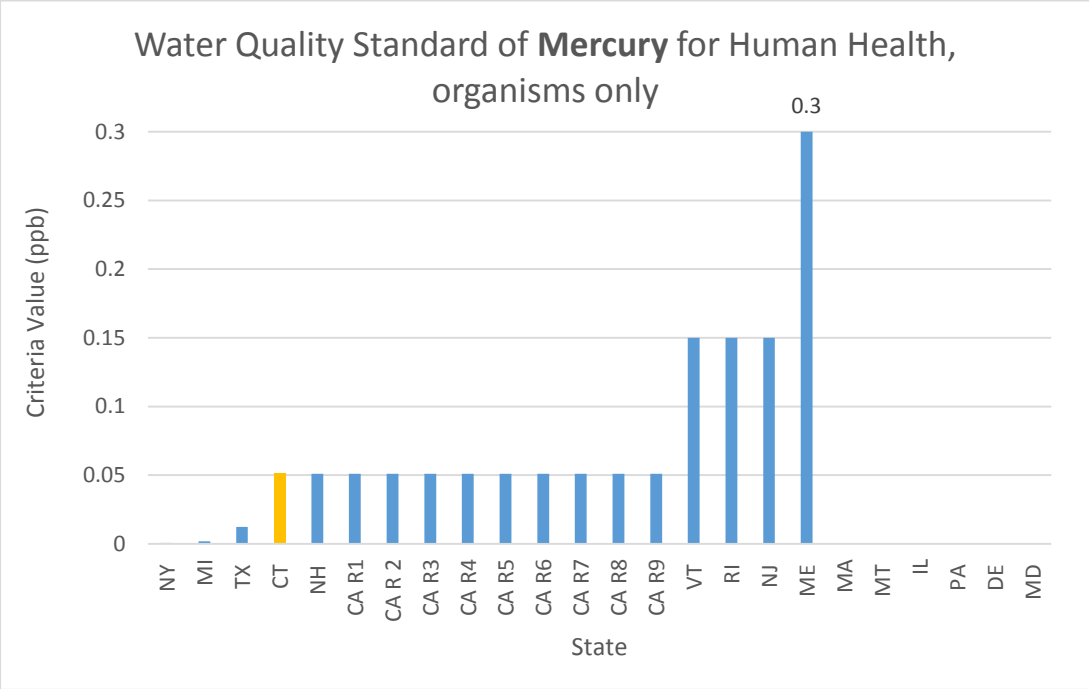


FIGURE C-3A. 10. BAR GRAPH COMPARING MULTIPLE STATES AND THEIR CHLORDANE WATER QUALITY STANDARD (WQS). THE HUMAN HEALTH CRITERION VALUE FOR CONSUMPTION OF ORGANISMS ONLY, WITHOUT WATER. NUMBERS IN PARTS PER BILLION.

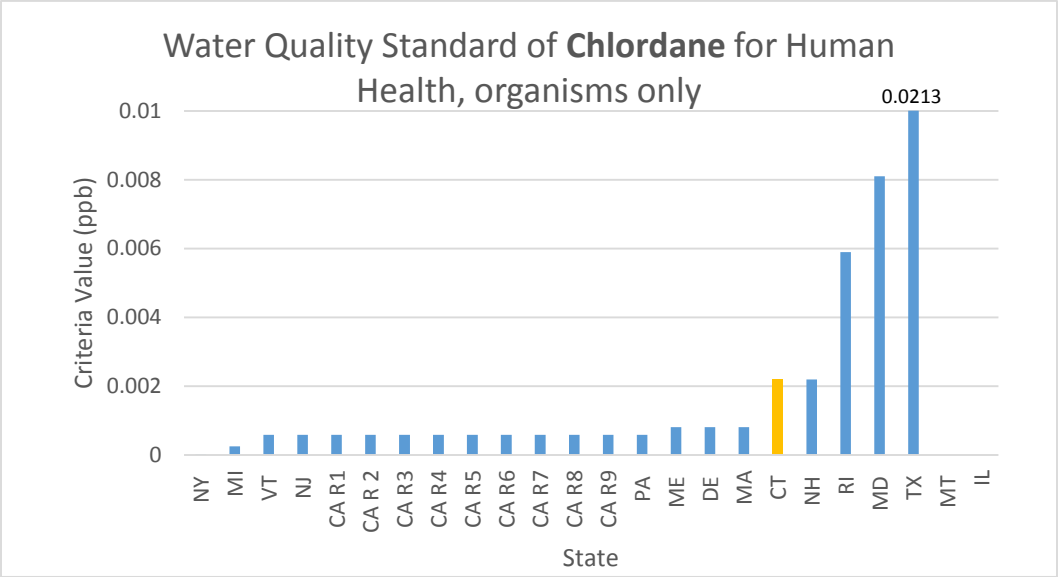
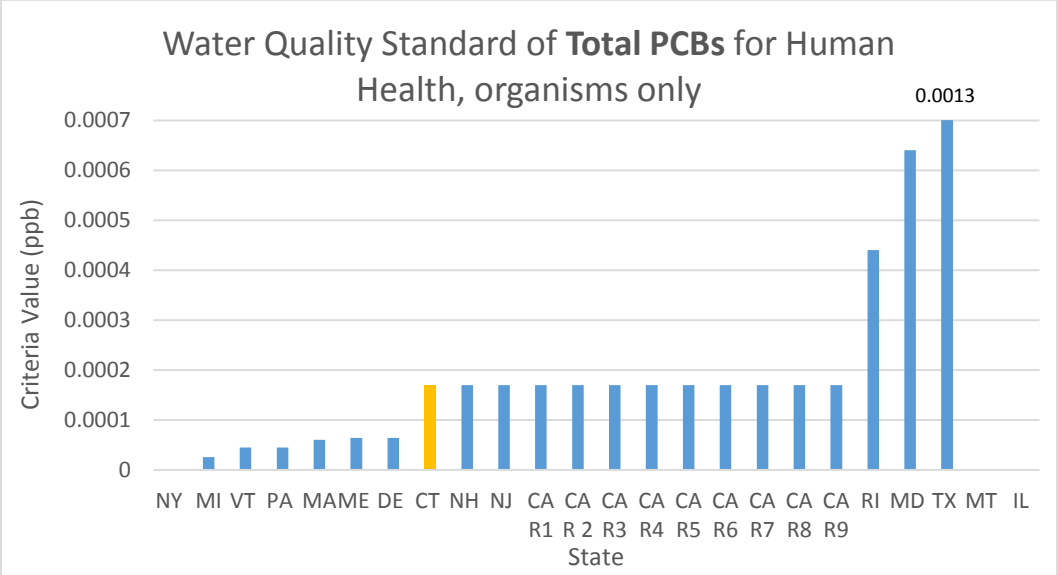


FIGURE C-3A. 11. BAR GRAPH COMPARING MULTIPLE STATES AND THEIR TOTAL PCBS WATER QUALITY STANDARD (WQS). THE HUMAN HEALTH CRITERION VALUE FOR CONSUMPTION OF ORGANISMS ONLY, WITHOUT WATER. NUMBERS IN PARTS PER BILLION.



VIII. Appendix D
Ground Water Classification Process under the Connecticut Water Quality Standards

Introduction

The water quality classification maps are an element of the Connecticut's Water Quality Standards and designate the class assigned to each surface water and ground water resource throughout the state. The Water Quality Classification Maps have been adopted and are amended from time to time pursuant to the statutory process described in section 22a-426 of the Connecticut General Statutes. The maps are used to assign the designated uses of the resource and the applicable water quality standards and criteria for each class of surface and ground water resource to a specific location.

The administrative process for a change in the ground water classification is set out in Section 22a-426 of the C.G.S., and the specific criteria for changing a ground water classification is in the Water Quality Standards. The reclassification application requirements and considerations are outlined in Section 22a-426-7(k) of the RSCA1. See DEEP: Water Quality Reclassification.

Reclassification from GA (drinking water) to GB (non-drinking water).

Approximately 95% of the state is classified GA or higher and 5% class GB. Most Class GB areas were mapped according to the WQS criteria during the 1980's on a state-wide basis with opportunity for public comment. However, detailed information on specific areas was not necessarily available at the time. Given the new level of detailed information on the land use, ground water quality, existing and potential use of the ground water, and extension of public water at a particular areas, it may be appropriate to reclassify certain ground water for areas that may meet the criteria for GB based on new information more. As the ground water protection criteria in the RSRs are usually the limiting clean up criteria, it is desirable to better refine GB areas to make remediation programs more efficient.

There are two ways that ground water reclassifications occur, by the commissioner and by individual requests for a person to request a change in the ground water classification of a particular site.

- Individual Reclassification Process: Applications for individual changes to ground water classifications have been taken once a year since 1996. Over 120 sites have been reclassified under this process. The procedure is set out in section 22a-426(f) of the Connecticut General Statutes and the criteria for consideration are set out in Section 22a-426-7(k)(2) of the Regulations of Connecticut State Agencies. Both the requirements of the regulations and the administrative process of the statutes have been incorporated into a guidance document to help streamline this process http://www.ct.gov/deep/lib/deep/water/water_quality_standards/reclass_guidance.pdf. The DEEP plans to continue this process to assist property owners.

- Statewide Reclassification Process: DEEP has been conducting a broad review of the state given new level of detailed information on the land use, ground water quality, existing and potential use of the ground water, and extension of public water. There appear to be some opportunities where it may be appropriate to reclassify certain broader areas that may meet the criteria for GB based on new information. However these areas must be assured they met all the criteria and a process must be established with local officials to do that. The most significant information needed locally is that all persons within or potentially downgradient from the area proposed for reclassification have no existing water supply wells and are served by an adequate public water supply drawn from outside the area. This is the most fundamental and absolute requirement for reclassification needing local verification. DEEP proposes to begin this process in 2016.

IX. Appendix E
Summary of Specific Comments Raised by Public

The full text of all comments received is online at DEEP: RSR Revision Concepts - Risk-Based Decision Making.

Below is a summary of the public comments submitted to DEEP on the CDM Smith Report. Though many of the specific public comments are not contained in the general summary below, all comments were reviewed and considered in developing DEEP's recommendations.

CDM Smith Report Recommendations:

1. Move HHRA to DEEP

For:

- The current system with split responsibility is inefficient and time consuming especially regarding the development of Alternative Pollutant Criteria, site specific human and ecological risk assessments done by self-implementing actions

Against:

- DPH has appropriate expertise, mission and oversight.

2A Involve local stakeholders

For:

- No comments were in favor.

One commenter mentioned that input from the public, local agencies, and others can be helpful in identifying current and future goals for the site, concerns of the public and local officials.

Against:

- Political judgments and pressures should not be allowed to play a roll.
- While stakeholder input is important, it is the regulators, using the best science, which must be determining what is necessary to protect the public health.
- In this scenario, responsibility for safety is given to the local health departments which have no experience in risk assessment and rely on the DPH for guidance assessing health threats on contaminated sites which they will no longer have. DEEP needs to stay involved in the decision making process.

2B Non-standard solutions

For:

- Allow more flexibility with workable guidance with respect to nonstandard solutions in certain cases where ecological restoration would not provide reasonable environmental benefit to make remediation economically feasible.

Against:

- Concern about "conflicts of interest" and the lack of limits to the term "non-standard solutions."

- ❒ The entire remediation program should be redeveloped to account for "non-standard solutions" rather than allowing industry or politicians make health decisions or place people at higher risk.

2C Allow off-site remediation as alternative

For:

- ❒ In lieu of costly restorations of low value habitats allow resources to be allocated to open space and "green corridors"

Against:

- ❒ Performing off-site improvements as opposed to more costly on-site improvements, again, this cannot be used as a justification to increase exposures above acceptable risk levels.

3(i) Electronically document assumptions

For:

- ❒ The criteria and standards for clean-up should be generally available to the public, electronically.
- ❒ Centralized, electronically documented, fully transparent information on assumptions, models, exceptions and other aspects of default criteria.
- ❒ Mathematical errors and/or inconsistencies in exposure assumptions used.

Against:

- ❒ Regarding the need to continually update criteria, the financial responsibility to be constantly reassessing all RSR values can be prohibitive.
- ❒ In the current RSRs persons who are remediating sites are provided an opportunity to - upgrade the RSR based on current science.

3(ii) Use British Columbia criteria

For:

- ❒ No comments were in favor.

One commenter mentioned that use of guidance-based ecological screening values, in the context or performing site-specific ecological assessments where ecological resources are identified at a site.

Against:

- ❒ Instituting RSR regulatory criteria may have the unintended result of habitat destruction, rather than the intended level of protection.
- ❒ Criteria-based screening does not account for the ecosystem services provided by the high quality wetland habitat.
- ❒ The broad application of criteria based on risks to invertebrates, plants, and other items up the food chain plants similar to British Columbia could be problematic if applied and enforced broadly.

4. Adapt ERA and ERM programs from Mass. & BC

For:

- ❒ Sites that offer minimal habitat value should be eliminated early in the site investigation process.
- ❒ Specific *de minimis* areas necessary to trigger an ERA should be adopted. Most contaminated sites and areas of impact are too small to cause ecologically significant impacts.

- ❒ Massachusetts and New Jersey have established site remediation professional programs similar to regulatory program in Connecticut with tiered approaches as currently proposed by CTDEEP.
- ❒ One commenter indicated default risk-based criteria should serve only as "screening levels" as is the case in Massachusetts and as recommended by EPA.

Against:

- ❒ Need to clearly state how the adoption of such practices will help Connecticut's remediation policy protect human health and the environment.
- ❒ Tiered approaches, although used in some other states, will require proof that they actually work in protecting critical habitats.
- ❒ Many widely used Ecological Screening Values occur in the range of background concentrations, too low to be either believable or useful.
- ❒ The British Columbia methodology is a beneficial reference, but is not based on the current state of the practice of Ecological Risk Assessment within the United States.
- ❒ The scientific basis for these standards be independently researched and evaluated

5. Encourage the use of advanced, site-specific risk assessments

For:

- ❒ The primary goal is to work with legislature to allow for a framework by which site-specific risk characterization can be conducted in Connecticut.
- ❒ There needs to be an expeditious methodology for establishing site-specific, self-implementing "non-standard" solutions.
- ❒ Address the DPH and DEEP resistance to allowing more site-specific risk characterization the use of such approaches, since direct regulatory oversight is limiting, in the otherwise LEP decision-based regulatory program.
- ❒ Mass DEP has been and continues to develop "Best Practices" guidance for mitigating potential exposures to residual chemical contaminants in site soils, especially in the root zones of fruits, vegetables and other cultivated produce destined for human consumption, primarily in the residential setting, but also for use in public cultivated allotments, etc.
- ❒ Site-specific risk assessments help mitigate uncertainty associated with default criteria, providing better transparency of the risk analysis process and more scientifically-defensible risk management decisions.
- ❒ It would provide additional risk management options where appropriate and allow for greater flexibility, effectiveness, and "potentially accuracy".
- ❒ For some properties, strict reliance on RSR default criteria might well suggest site-actions that are wasteful of resources and not likely to produce actual improvement in public health or ecological health.

Against:

- ❒ "Use of advanced, site-specific risk assessment" just means "remediation to a lesser standard."
- ❒ We need strong standards for when deviations can be made, as well as strong oversight to control the great amounts of discretion given to LEPs and developers to document and assure that the deviation will not meaningfully increase the risk to human health and the environment.

6. Adopt risk management goals of 10^{-5}

For:

- Risk evaluation should consider the size of the affected population, the nature of the risk, and other factors. Most risk assessments for contaminated sites deal with small areas and small numbers of exposed people.
- Given the small number of people typically exposed, we agree with the Report's recommendation that 10^{-6} target cancer risk level is usually too conservative.
- Under certain circumstances, based on the: size of the impacted population; nature of risk and the size and type of uncertainties.
- Use of inflexible "bright lines" has always been problematic in Risk Assessments.
- One commenter stressed the need for estimates of exposure and risk to clarify how exposure is being measured.

Against:

- This would unfairly and unjustifiably increase the lifetime exposure risks of poorer demographics, who tend to live in closer proximity to contaminated sites.
- We advise caution in proposing less stringent target risk management criteria based on consideration of currently exposed populations this must also identify how potential future site use will be addressed.
- Risk management criteria for Connecticut (10^{-6} per chemical, 10^{-5} site wide) are consistent with regional, neighboring regulatory agencies (i.e. Massachusetts) where site-specific risk characterization is embraced and effective at facilitating contaminated site closure, as opposed to relying on more distant agencies (i.e. British Columbia, California, Michigan, Texas) to support less stringent risk management criteria.
- Other critical aspects of the Remediation Program such as short term exposure risks (significant environmental hazards) per were not evaluated.

Other General Comments from the Public:

The following general comments were also received during the public comment period, but which were not directly related to CDM's six main recommendations.

- "The report is limited in the understanding of how similar regulatory changes have been successfully implemented in other state regulatory programs, which is essential to CTDEEP's success."
  - DEEP Response: we agree that the CDM Report, while providing concepts on best practices, did not include some factors in the analysis such as frequency of use in those other states, ease of use and success rate in terms of cleaning up sites faster or other benchmarks.

- "Risk-based evaluation of sediments was not explicitly discussed. Site-specific approaches are almost always less conservative than generic sediment quality guidelines, but provide a much more accurate determination of ecological risk that is specifically linked to the desired levels of protection needed."
  - DEEP response: we agree to a certain extent; see DEEP response to CDM Recommendation 4, above, for additional information.

- A workgroup is needed to support the development of draft Ecological Risk Assessment guidance documents for Connecticut.
  - DEEP response: draft documents will be provided for public feedback prior to being finalized.
- "There has been tremendous pressure on the legislature and DEEP to steer the regulatory system controlling remediation of contaminated sites toward one that is less protective of human health and the environment, to one that is more economically productive." Also, "There are a number of suggestions in the report that de-emphasize the need to protect human health. Any conclusions taken from the report should re-instate this emphasis."
  - DEEP response: we agree to a certain extent, but note that many changes to applicable regulations are not less protective but instead identify alternative approaches to protection.

- "The risk assessment regulatory process that has been used for several decades in CT is not well understood by involved stakeholders and generally results in overly conservative and cost-ineffective remedial programs."
  - DEEP response: there are many components to this comment. To the extent it is a comment for greater transparency, DEEP will post information on the 1996 derivation of RSR numeric criteria. To the extent it is a comment for greater risk management flexibility and efficiency, DEEP has adopted RSR amendments in 2013 to increase both, and is pursuing a second "wave" RSR amendments in 2015. Finally, regarding the level of understanding by stakeholders, excellent educational programs on the RSRs and remediation are offered by the organization Environmental Professionals of Connecticut. DEEP also hosts the DEEP: Remediation Roundtable throughout the year as a forum to communicate on cleanup programs and new initiatives, including establishment of public/private workgroups to analyze issues and make recommendations for improvement.

X. Appendix F
Ecological Risk Assessment - Tiered Approach

Scoping Level ERA:

A Scoping Level ERA is designed to provide an initial evaluation of the potential for ecological risks to occur as a result of site-related conditions in order to determine if a more detailed evaluation of ecological risks is needed. It focuses on determining whether or not chemical or non-chemical stressors may have occurred at the site. Additionally, an inventory of ecological resources is conducted to determine the potential presence of ecological communities on the site and in the surrounding area.

Phases 1 and 2 of the Site Characterization process provides information on site location and history, associated land and water uses, known or suspected releases and potentially affected media. This is paired with information from site visits and other sources to determine ecological resources and habitats at or in the vicinity of the site as well as the potential presence of threatened and endangered species. Together, this information allows for an initial assessment of whether or not ecological populations could have been exposed to a chemical or non-chemical stressor. A definitive finding of either no potential for releases to have occurred or no potential for ecological resources to exist in the area concludes the risk assessment process for the site. However, if information is either definitive about the potential for a release to have occurred within the presence of potential ecological receptors, or if there is uncertainty, then the risk assessment process continues.

CTDEEP has provided additional guidance, included in Appendix A to this document, to assist in the conduct of a Scoping Level ERA.

Screening Level ERA:

A Screening Level ERA is conducted in order to determine the potential for ecological risks to occur currently or in the future as a result of site related activities. It should be conducted after Phase 3 Site Characterization has been completed and potential risk to ecological populations has not been ruled out through the Scoping Level ERA process. Phase 3 Site Characterization provides detailed information on the nature and extent of releases from the site for all environmental media as well as an updated Conceptual Site Model. **Complete definition of the nature and extent of environmental contamination must be finalized prior to any meaningful assessment of ecological risks associated with site related activities**. Without a complete delineation of the nature and extent of contamination, the results of the ERA will not be accurate.

In a Screening Level ERA, complete and incomplete exposure pathways are identified, chemical concentrations in the various media are compared with environmental benchmarks to evaluate the potential for ecological risks and potential food chain impacts are evaluated through models. Non-chemical stressors are evaluated on a case by case basis. Risks are estimated based on these evaluations. If site related conditions have created a potential for ecological risks based on a complete Phase 3 Site Characterization and the Screening Level ERA, then a decision must be made

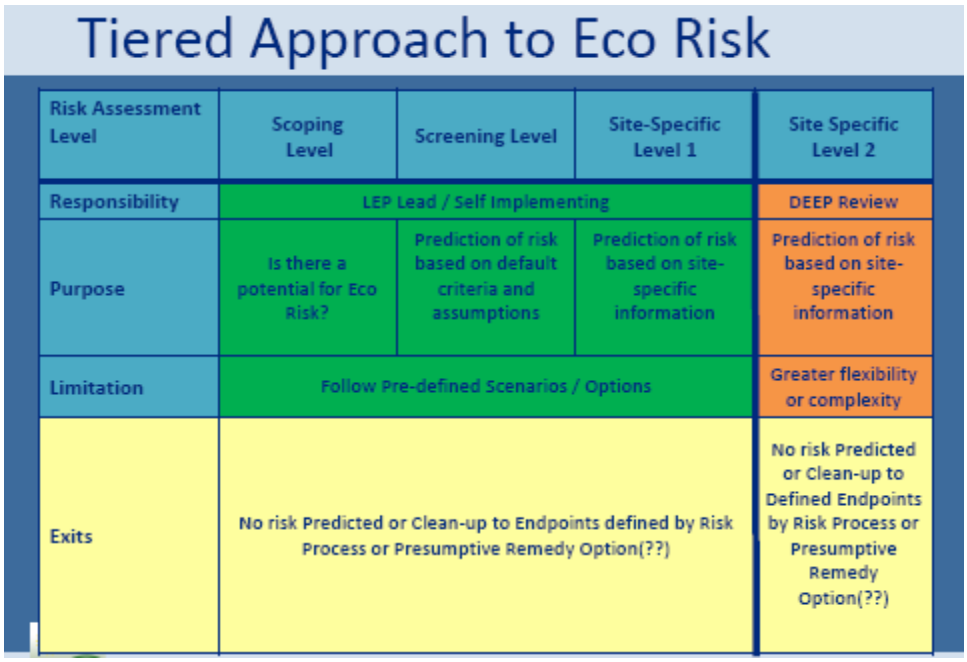
as whether to submit a Remedial Action Plan to address the potential ecological risks or to proceed to a Site Specific ERA. In many cases, that decision can be made by the site owner or the environmental professional without consultation with CTDEEP.

Site Specific Ecological Risk Assessment:

In order to better define the potential current or future ecological risks due to site related activities, a Site Specific ERA may be conducted. It is typically initiated after Phase 3 Site Characterization and the Screening Level Ecological Risk Assessment have been completed. The purpose for conducting a site-specific risk assessment is to reduce uncertainly regarding the conclusion of risk reached within the screening level evaluation by providing more definitive evaluation of how site related conditions may affect potentially exposed ecological populations. Development of a scope of study for submittal to and review by DEEP prior to conducting a site-specific risk assessment is recommended. Within this assessment, the results of the screening level risk assessment are augmented with the results of biological studies conducted on appropriate site related populations. These studies may include the collection of plant or animal tissue data, benthic community evaluations, toxicity tests for the various media, bioaccumulation testing or other studies as needed.

If the results of a Site Specific Ecological Risk Assessment indicate risk, then a Remedial Action Plan to address such risk should be prepared and incorporated into the remedial strategy for the site. The evaluation of appropriate remedial measures, ranging from no action to source removal to options in between should be considered within the Remedial Action Plan and is not a part of the ecological risk assessment process.

Delineation between Site-specific Level 1 and Level 2 to be determined. This model for ERA has been identified to the public through the Wave 2 Remediation discuss draft on Sediments available at:
http://www.ct.gov/deep/lib/deep/site_clean_up/remediation_regulations/discussiondraft_sediment.pdf



Consideration of Risk Assessment during Site Characterization Activities

Integration of Ecological Risk Assessment into the Site Characterization Process

Ecological Risk Assessment (ERA) has been defined by the USEPA as a "process for evaluating scientific information on the adverse effects of stressors on the environment" (EPA 1992). Within this context, EPA defines stressors as any chemical, physical or biological entity that may have an adverse impact on the environment. The process outlined within federal guidance includes components that address characterization of the contamination, identification of ecological resources potentially affected, characterization of exposures and effects and finally, a characterization of risk to ecological resources. Integration of this process into the site characterization process will effectively identify whether or not environmental conditions at a site are protective of the ecological populations.

CT DEEP developed the *Site Characterization Guidance Document* (DEEP: Final SCGD), to assist facilities in the investigation of their sites. The purpose of the Site Characterization is to determine whether or not releases of pollutants have occurred at the site and, if so, provide a comprehensive description of the nature and extent or the release and its potential for impact on human health and the environment. Like EPA, CT DEEP endorses the development of a Conceptual Site Model as a dynamic tool used to accomplish the site characterization goals. CT DEEP's Site Characterization Guidance describes three phases of investigation, as needed, for each site.

Phase I: The goal of a Phase I assessment is to provide a physical description of the site. Existing and past uses of the site must be determined in order to identify pollutants that may have been used on site and any potential areas where releases have occurred.

Phase II: Phase II assessments build on the results of Phase I with the goal of determining whether or not a release has occurred. The Phase II investigation must address pollutant migration pathways and receiving media as well as identify potential receptors, both human and ecological.

Phase III: If the results of the Phase II assessment indicate that a release has occurred, a comprehensive study is undertaken in Phase III. The purpose of this assessment is to define the nature and extent of any releases. Migration of contaminants must be defined. Potential exposures to human and ecological receptors must be identified.

The *Site Characterization Guidance Document* provides a flexible framework for defining site conditions. DEEP has developed a framework to integrate the evaluation of ecological risks into the site characterization process. Like the Site Characterization process, the ecological risk assessment process is conducted in phases: Scoping Level ERA, Screening Level ERA and Site-specific ERA. Integration of the ERA process into Site Characterization is expected to improve the overall remediation process at a site. It allows for better integration of data collection and evaluation activities leading to a more comprehensive evaluation of the site which should support reaching decision points regarding the need for remediation of ecological risks sooner rather than later in the process. This should facilitate timely project completion potential reduce project costs and reduce uncertainties for the project manager.