Applying EPA's 2015 Final Vapor Intrusion (VI) Guidance to Facilitate Closure of the VI Pathway

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Presenters

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  - NAVFAC Atlantic restoration technical support
  - NAVFAC technical lead for VI since 2008
  - Geologist
  - CERCLA environmental experience since 1983
- Loren Lund, Ph.D
  - VI Practice leader, toxicologist, and risk assessor
  - Lead for Navy VI Web Tool, Background VI Guide, & NESDI VI Database Project
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  - VI assessment/mitigation leader and project manager
  - 15 years consulting to DoD and private industry
  - Co-author/project manager for the NESDI VI Project

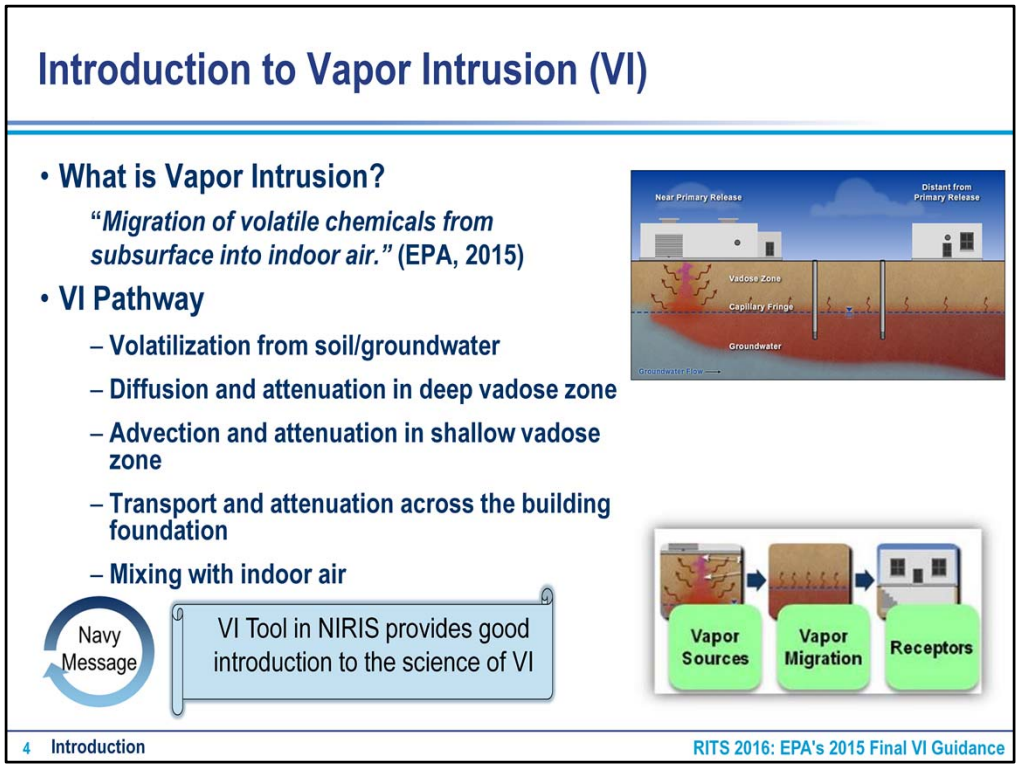
Presentation Overview

Introduction

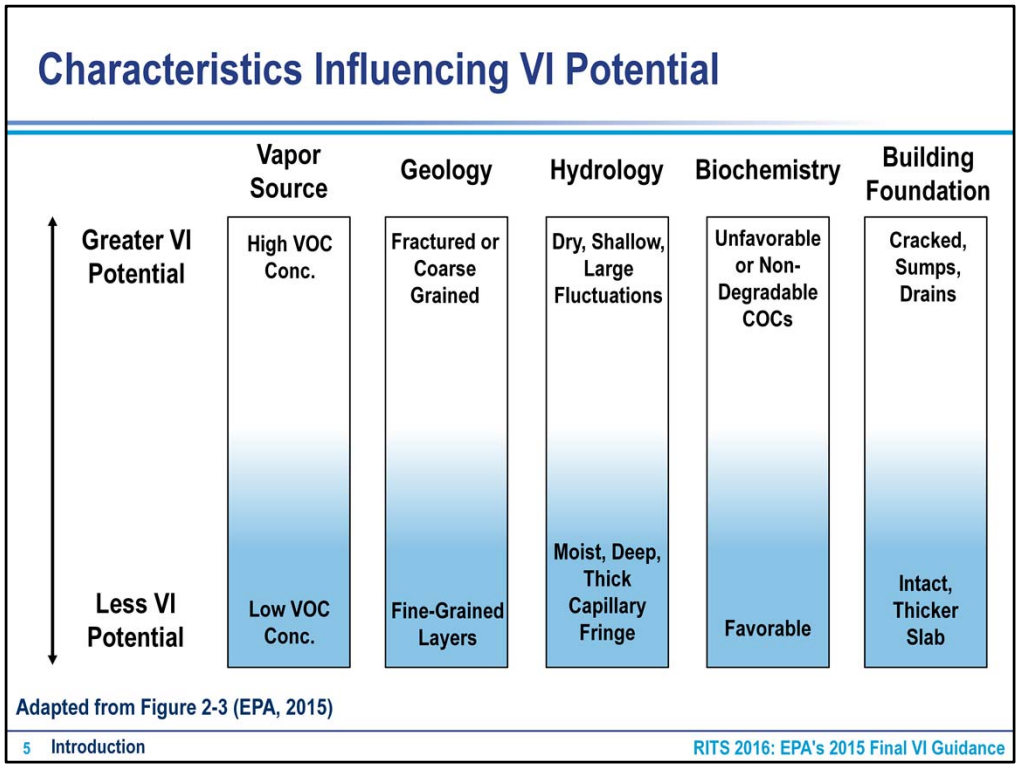
- Key Messages in 2015 EPA Final Guidance
- Closing the VI Pathway: Technical Challenges and Solutions
- Case Studies
- Hands-On Activity – Application of Navy VI Decision Framework
- Wrap-Up

3 RITS 2016: EPA's 2015 Final VI Guidance

- EPA took 13 Years to finalize guidance
- 3 previous RITS on VI (2008, 2011, 2013)
- Will not revisit that info but focus on EPA VI Guide and what's new in VI including Navy VI database of industrial buildings



- VI Tool in NIRIS is excellent resource for basics of VI
- On home page of NIRIS and encourage review of tool
- The Web tool video will not run on today's updated software applications.

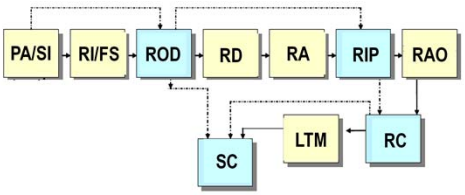


- Graphic from EPA VI Guide
- Although EPA identified building foundation, many building characteristics can influence VI potential

Vapor Intrusion in the CERCLA Process

- Subsurface vapor sources from CERCLA release
  - Focus on CERCLA subsurface VI chemicals of potential concern
- Address VI in any phase of CERCLA process
- Five Year Review challenges
  - Absence of quantitative VI investigation does not default to "Protectiveness Deferred"

NAVFAC Factsheet:
*Vapor Intrusion Five Year Review Protectiveness Statements**



*Link to factsheet is on ERB Secure (CAC-protected). See Resources.

Vapor Intrusion in the CERCLA Process

- Future VI potential when pathway is currently incomplete (No current buildings or no VI in existing building)
  - Manage vapor source and potential future VI pathway (LUCs/monitoring)
- VI pathway currently complete with unacceptable risks
  - Consider short-term exposure
  - Building mitigation while remediating subsurface VI COCs
  - Monitor compliance with health protective indoor air levels
  - Mitigation system maintenance and monitoring
  - VI site closure when subsurface vapor sources remediated to cleanup goals

7 Introduction RITS 2016: EPA's 2015 Final VI Guidance

Emphasize managing VI for future VI potential when subsurface vapor sources present

Emphasize distinction between subsurface vapor remediation goals and building compliance metrics

Separate VI Guidance for CVOCs and Petroleum Hydrocarbons

- **Petroleum VI guidance finalized with main CVOC VI Guide**
  - **Developed by EPA Office of Underground Storage Tanks (OUST)**
- **Accounts for biodegradation**
- **Establishes vertical separation distances**

Media	Benzene	TPH	Vertical Separation Distance (ft)
Soil (mg/kg)	≤10	≤100* ≤250**	6
	≥10 (LNAPL)	≥100* ≥250**	15
Groundwater (mg/L)	≤5	≤30	6
	≥5 (LNAPL)	≥30 (LNAPL)	15

Notes: * un-weathered gasoline
** weathered gasoline, diesel

EPA Message

- *"This PVI guide focuses on releases…USTs regulated under Subtitle I…typically located at gas stations."*
- *"Petroleum contamination…not comparable to UST… should be addressed under…general vapor intrusion guidance."*

Navy Message

- Apply the science of petroleum hydrocarbon degradation regardless of regulatory program

8 Introduction RITS 2016: EPA's 2015 Final VI Guidance

Emphasize vertical separation distance with NAPL level concentrations and effectiveness of natural biodegradation in short distances to minimize VI concerns

Emphasize regardless of regulatory program follow the science of petroleum and VI

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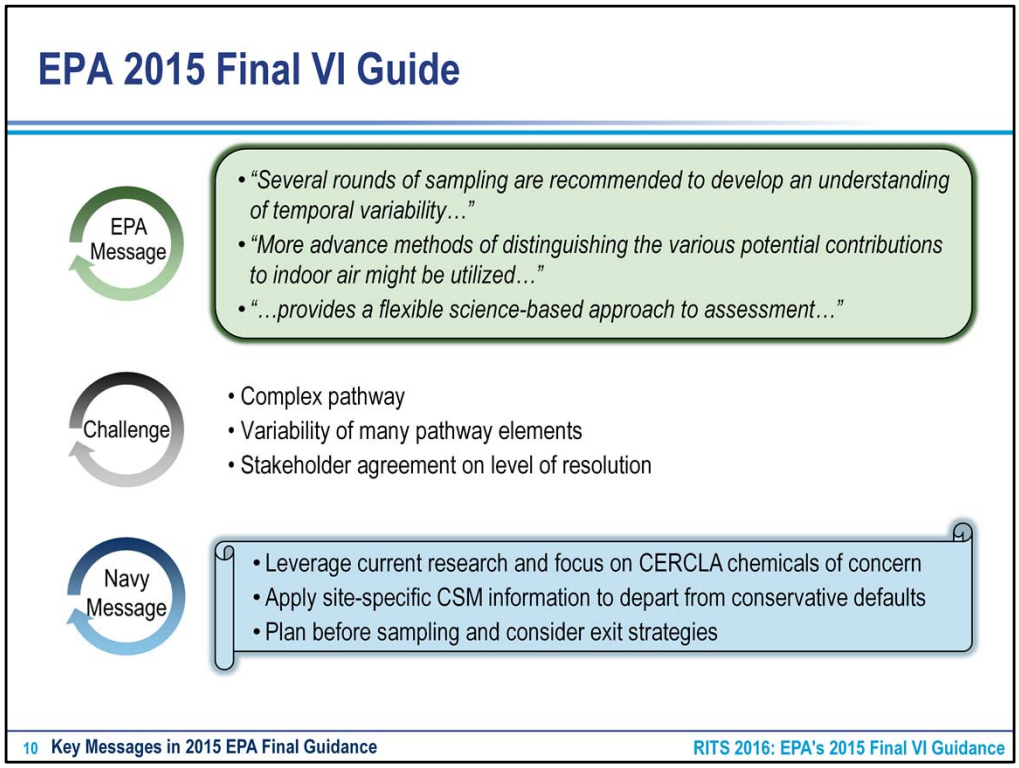
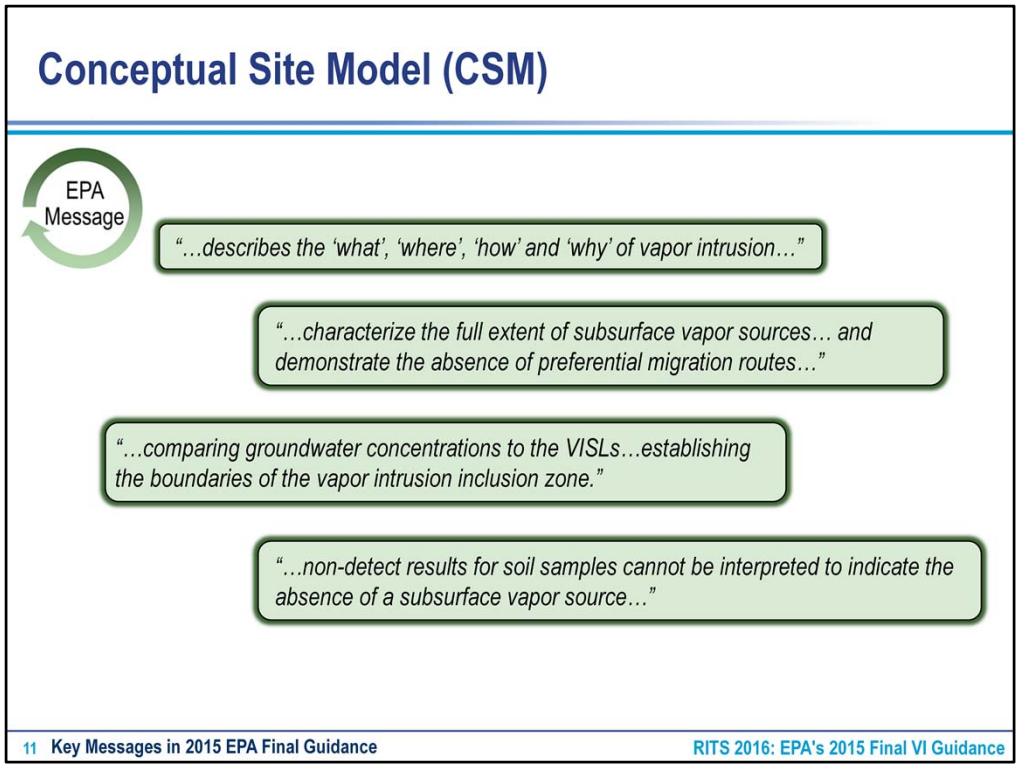


Illustrates format for identifying EPA messages (green box) and Navy Messages (blue banner).

General messages and challenges presented



Emphasize VISL inclusion zone and preference of EPA NOT to use soil data but to rely on soil gas data.

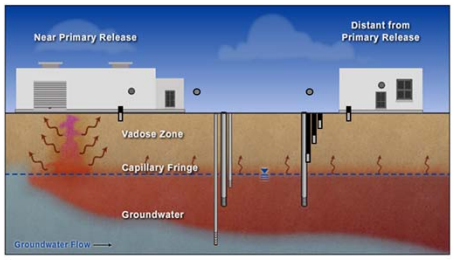
Challenge to prove the negative, EPA added new chemical to VISL (pesticides/PCBs) so keep focus on CERCLA released subsurface vapor forming chemicals , continually refine CSM

Collecting and Evaluating MLE

EPA Message

"… collecting multiple rounds…from multiple locations …"

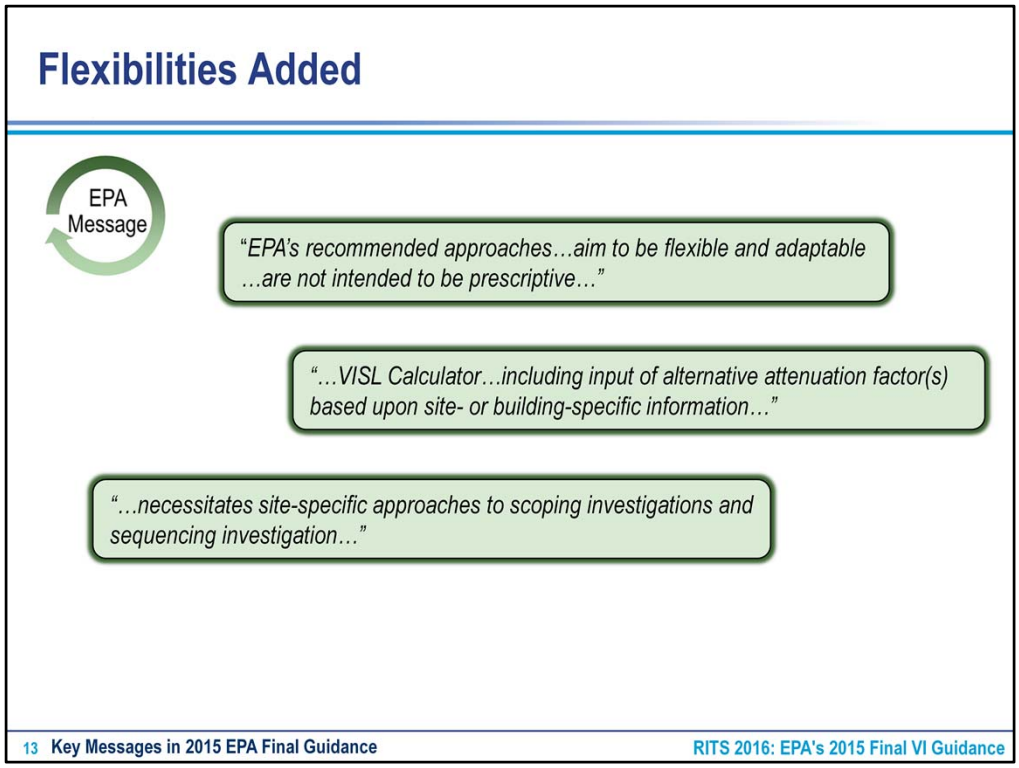
"particularly important for supporting no-further-action decisions…"



"Weigh and assess concordance"
"…unambiguous may be the exception rather than the rule…"

12 Key Messages in 2015 EPA Final Guidance RITS 2016: EPA's 2015 Final VI Guidance

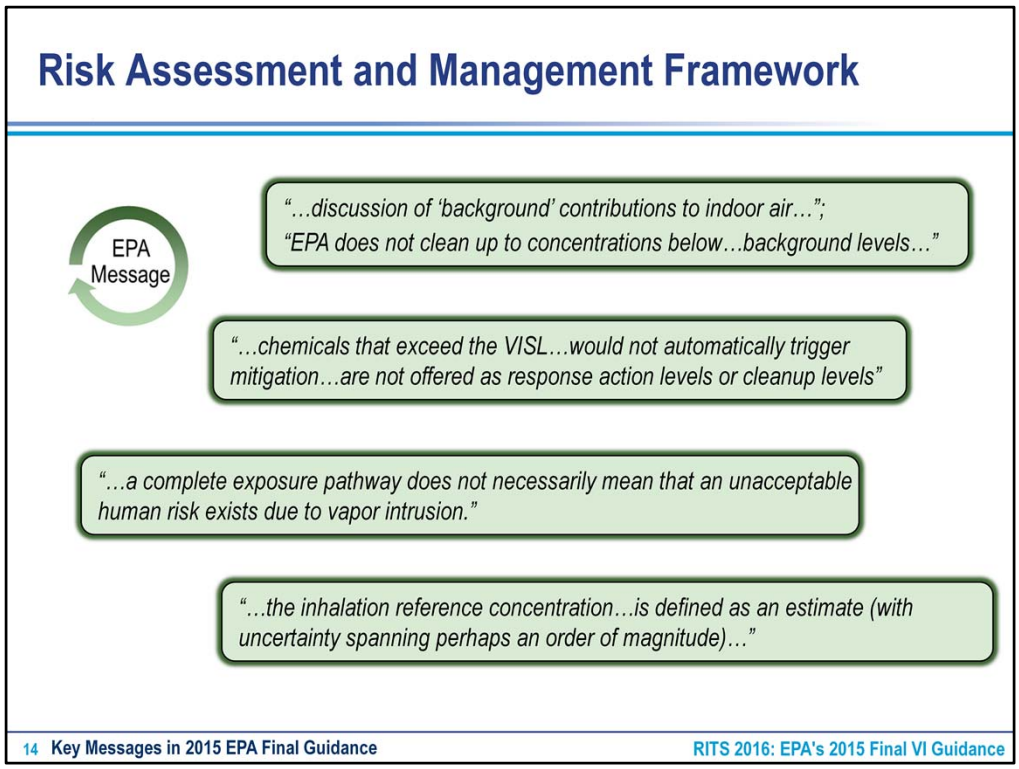
Variability and background contribute to potentially conflicting MLE, leverage research tools and new technologies to understand CSM and weigh MLE accordingly (fundamental truths- not all LOE = and weight of evidence depends on CSM)



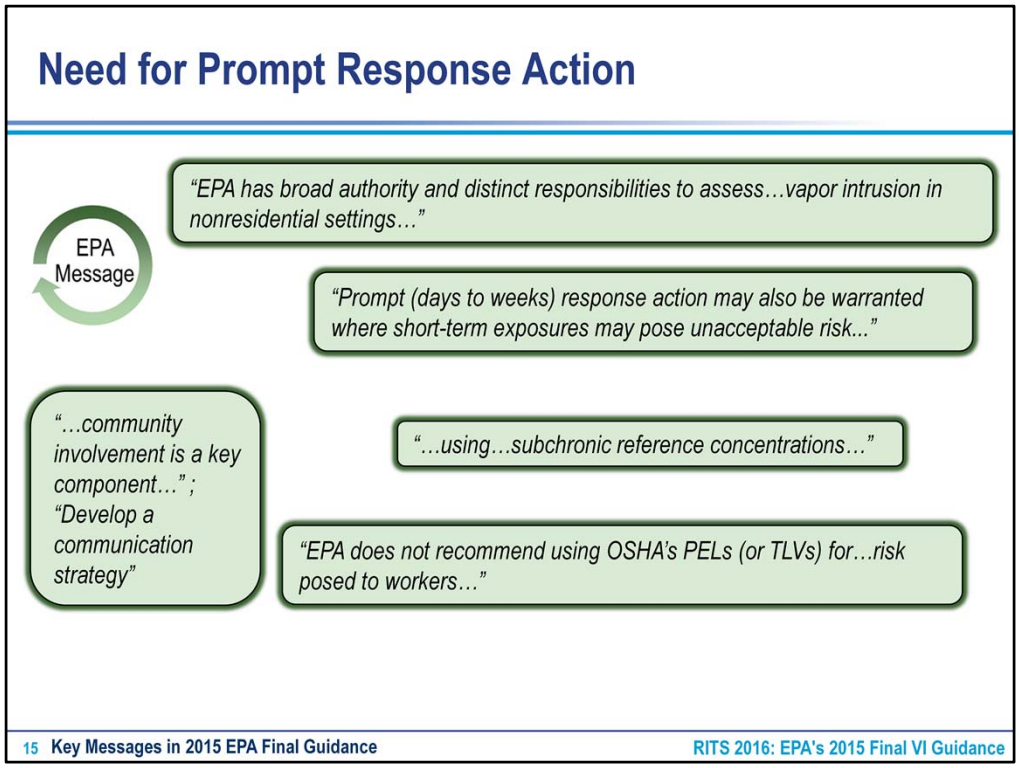
Flexibilities cuts both ways, VI Guide reviewers commented it was too flexible and general and provided no real guidance leaving tendency for cubical specific interpretations

Leverage those flexibilities to apply new technologies and site specific CSM factors to depart from conservative defaults

Recognize residential defaults may not apply to industrial buildings

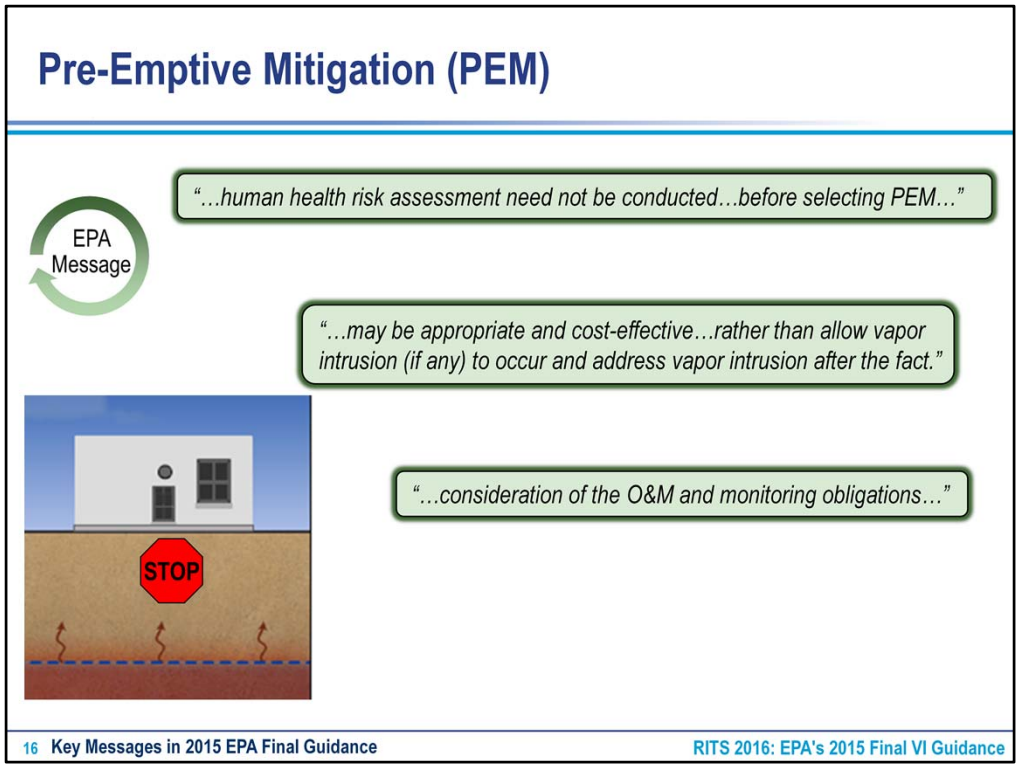


The Navy agrees with these EPA messages
Follow the CERCLA and HHRA process
Focus on CERCLA release subsurface vapor forming chemicals in assessing risk



Challenges for managing this issue are many, including uncertain science of short-term exposure for TCE, the fact that no always possible to tease out background in few days. Implementing prompt response measures will almost always involve some level of mission disruption.

Define trigger levels for prompt response before collecting indoor air data

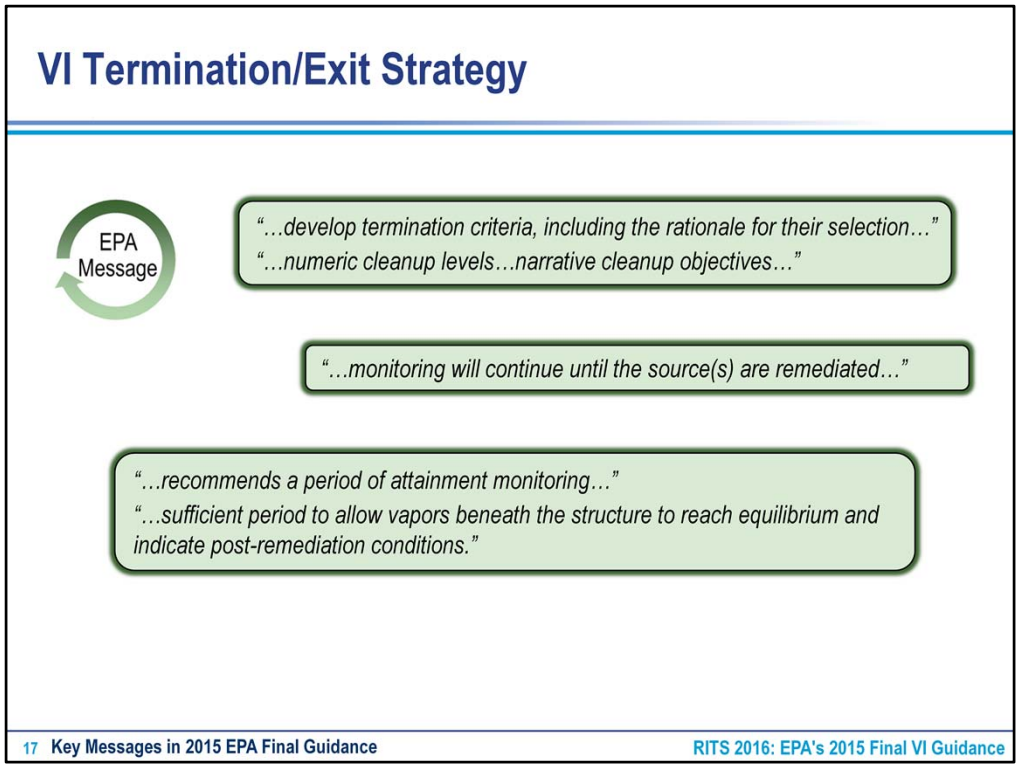


EPA spends a fair amount of time and bias for PEM.

It is not always easy to estimate life cycle costs to balance benefits of PEM with limited info and CSM.

Need clarity of exit monitoring of effectiveness of building mitigation system

May be appropriate for new construction where easy to implement and cost is minimal relative to new construction



Need consensus on building mitigation and indoor air compliance levels
Consider cost-benefit analysis of aggressiveness of vapor source cleanup and O&M of building mitigation for indoor air compliance. Apply site-specific exposure factors when establishing indoor air compliance levels for building mitigation systems

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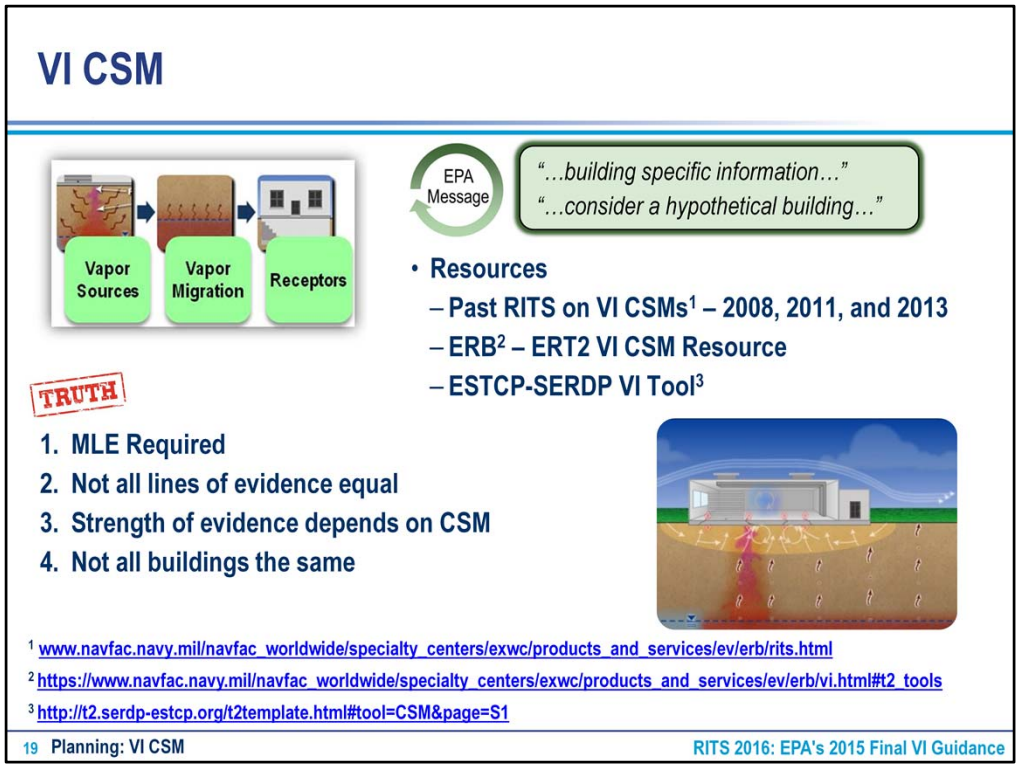
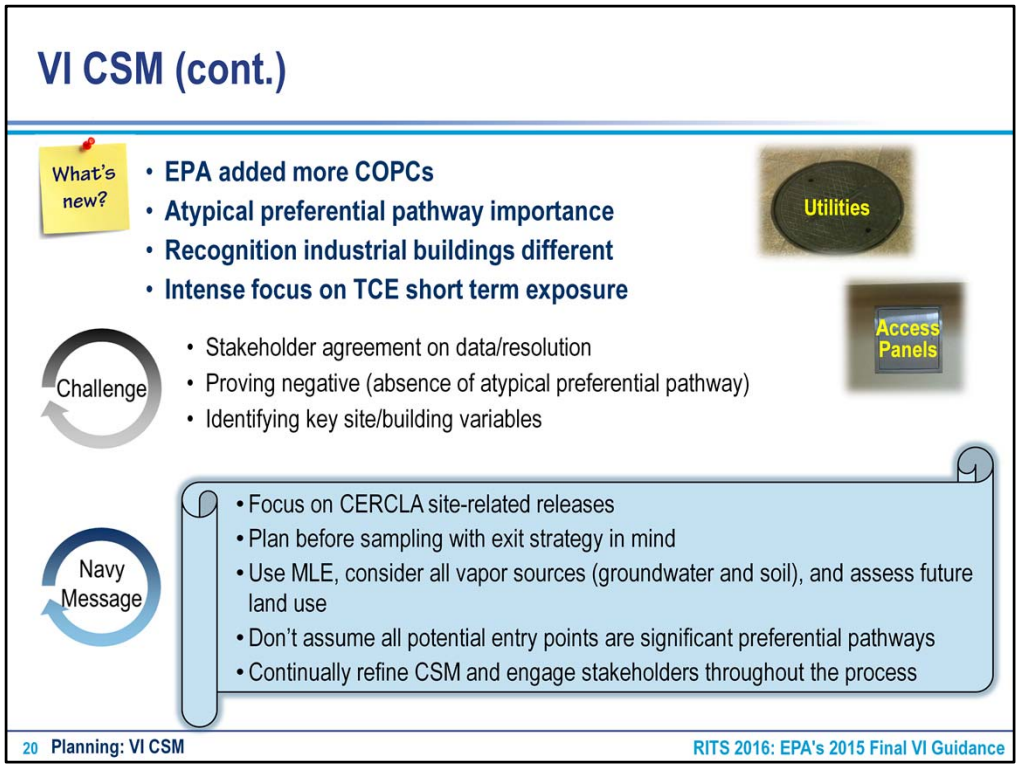
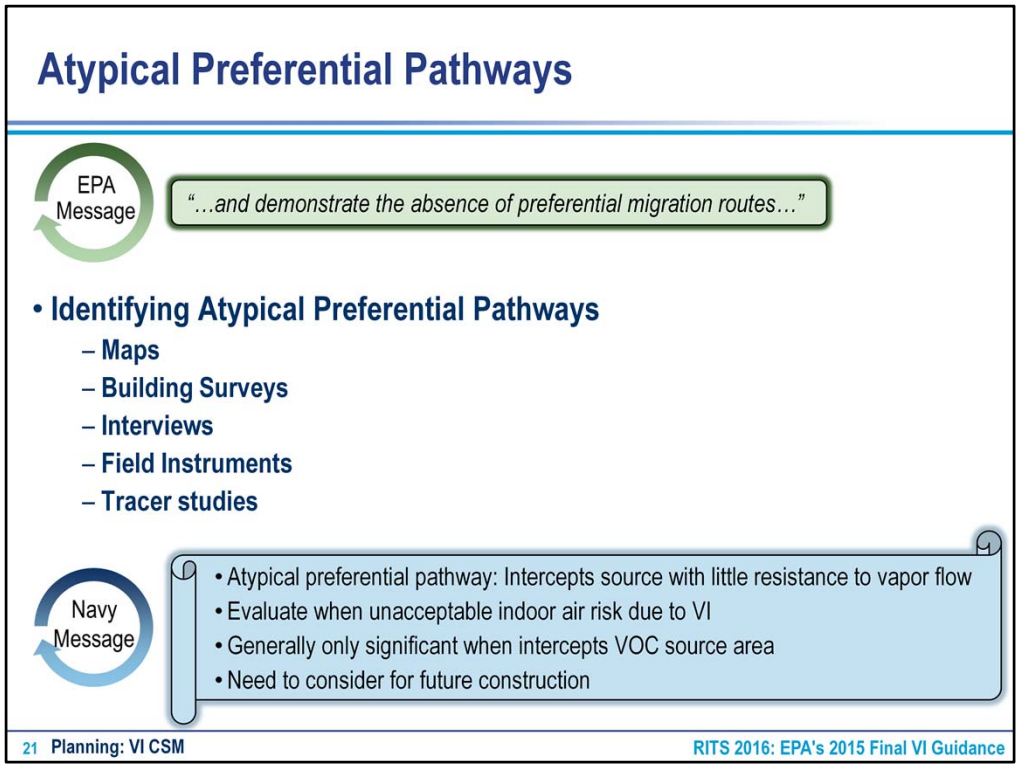


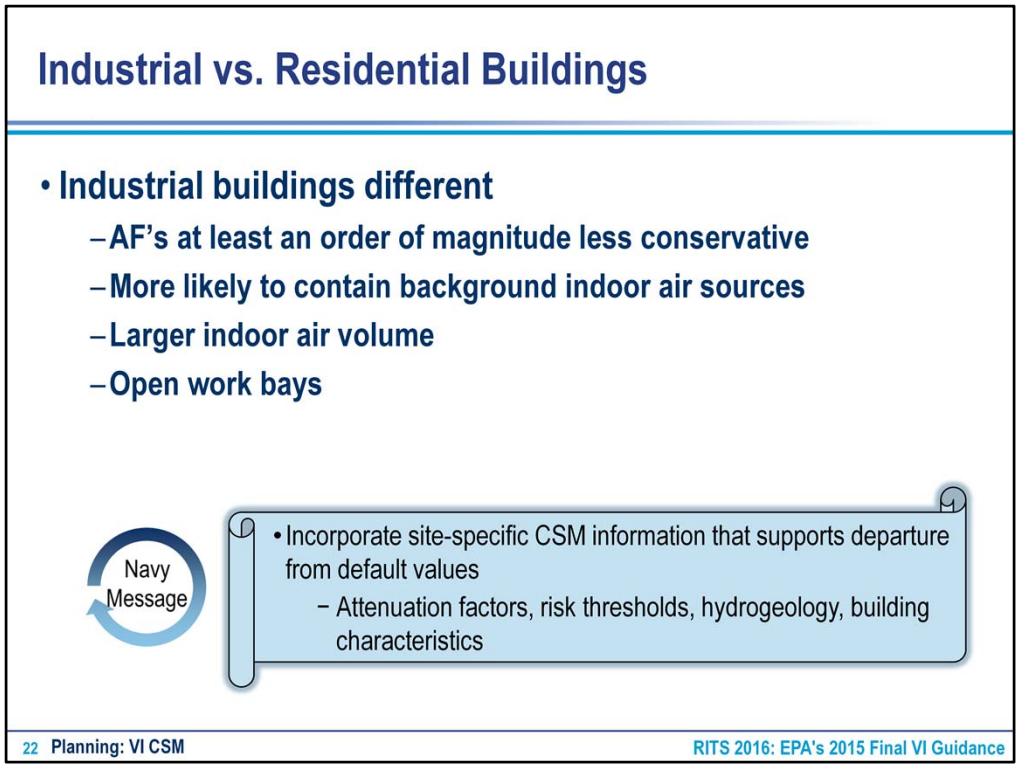
- Building and refining the VI CSM is an important part of a VI evaluation and discussed throughout EPA's 2015 Final VI Guide
- 3 Elements of a VI CSM: 1) vapor sources; 2) vapor migration; and 3) receptors. If you don't have any one of the elements, the VI pathway is incomplete
- The VI practice has come to recognize the importance of building-specific information in understanding the VI CSM.
- The focus of VI investigations the last 10+ years has been on current exposures in occupied buildings; however, it is important to consider a hypothetical future scenario…we'll talk more about this throughout today's training.



- Let's talk about what's new or emphasized more strongly in the Final VI Guide.
    1. We'll focus more on each of these "what's new" elements throughout today's training….



- One of the "what's new" topics that is receiving a lot of attention is vapor migration through atypical preferential pathways
- As mentioned on the last slide, EPA is asking responsible parties to "demonstrate the absences of preferential migration routes." Rather than focusing on this phrase to "prove the negative," I'd like to:
  1. Briefly discuss "why" you need to consider preferential pathways in VI investigations;
  2. Highlight the tools you can use to identify atypical preferential pathways; and
  3. Summarize the key Navy Messages related to this topic.
- Soooo….. why all the focus on atypical preferential pathways. Describe slide and then also mention that have been a number of Navy buildings where atypical preferential migration was the primary route of vapor entry into the buildings. We'll discuss a couple when we get to the case studies.
- Tools….. we will discuss some of the field instruments that can be used in later slides.



The 2nd "what's new" VI CSM topic to focus on is statement the empirical observation that VI potential into industrial buildings is different compared with VI into residential buildings.

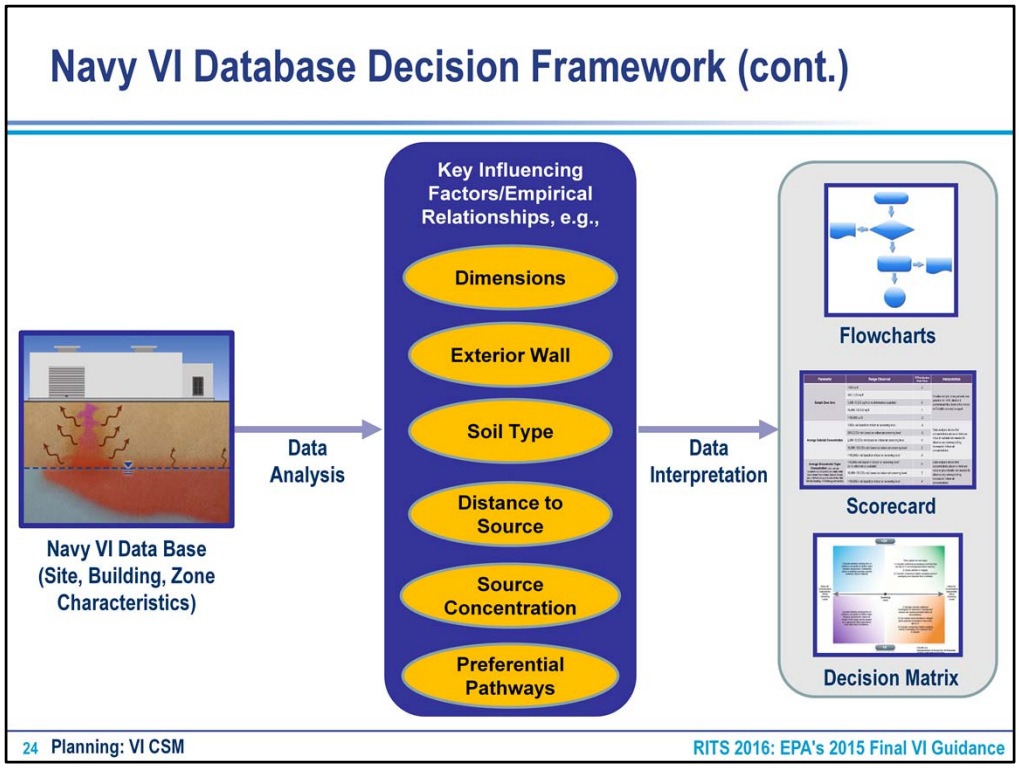
Going to use the next few slides to summarize the Navy VI database project and data analyses that you can use to support the conclusion that industrial buildings are different

Navy VI Database Decision Framework

- **Objectives**
  - Create DoD-specific VI database for industrial buildings
  - Evaluate relationships between factors affecting VI
  - Create framework to assist RPMs in VI decision-making
- **12 installations 13 sites, and 49 buildings**
  - Average age of 55 years
  - Majority of sites have depth to water <10 ft
  - Large (55%), medium (25%), and small (20%) buildings
- **Framework Uses**
  - Building Prioritization (planning)
  - Likelihood of VI occurrence (investigation)
  - Planning for Long-Term Stewardship (LTM)

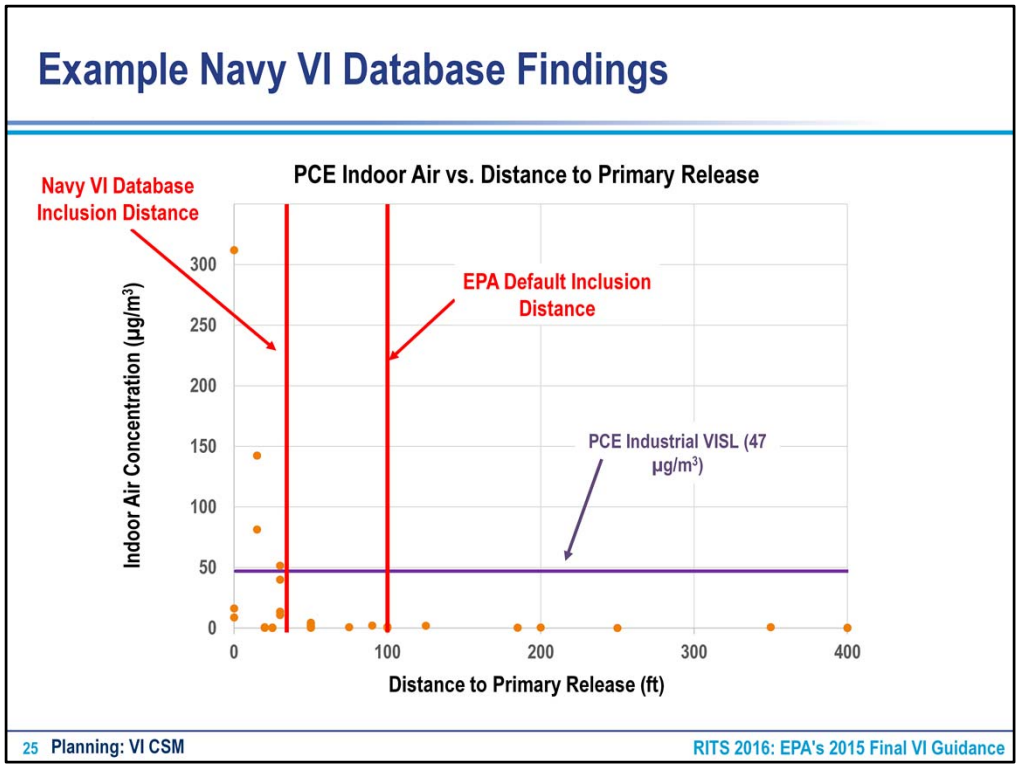
Conducted under NESDI Project #476: Quantitative Decision Framework for Assessing Navy Vapor Intrusion Sites
http://www.nesdi.navy.mil/Files/FinalReports/FR_476.pdf

- Leverage findings to develop the site-specific CSM



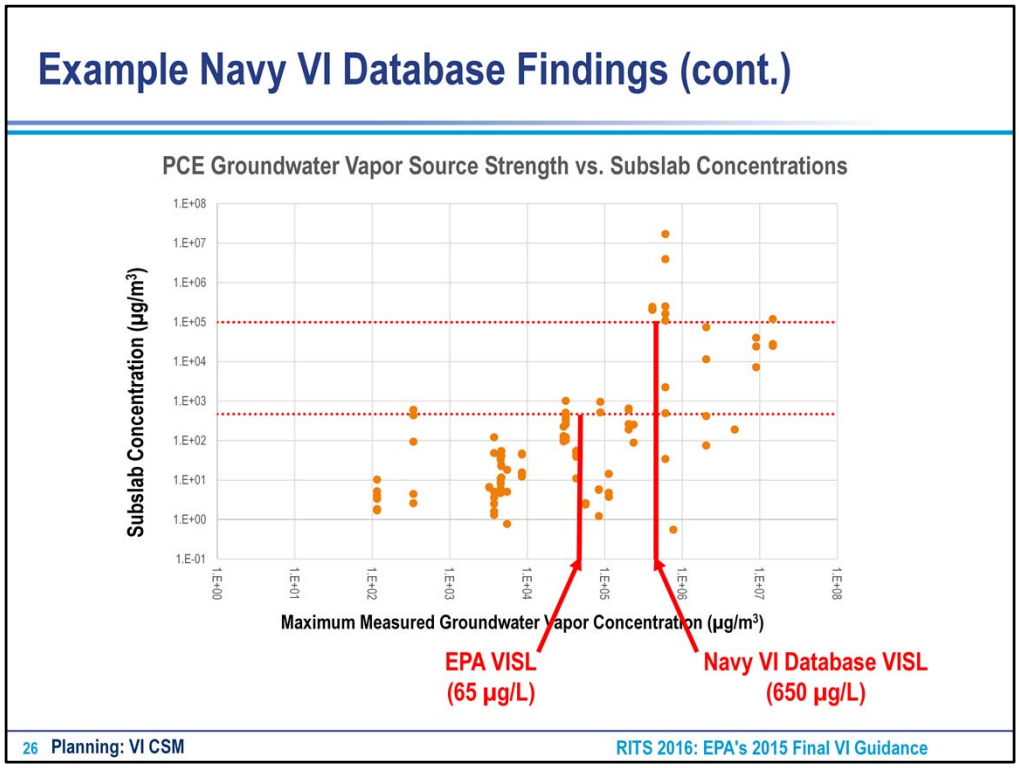
- As mentioned on previous slide, after compiling the database, conducted extensive analyses of multiple factors or characteristics, with potential to affect VI, which are represented by this CSM and the associated CSM characteristics.
- These data analyses successfully identify the key influencing factors shown here, such as…..
- The factors and relationships were used to develop the Navy VI database decision framework, which we incorporate into decision flowcharts, a scorecard for assess/prioritizing VI potential, and a matrix to facilitate decision making.
- We will be talking more about this decision framework in subsequent slides and giving you an opportunity to apply it to a few different scenarios during the hands-on activity.

The next few slides summarize some of the findings used to support the decision framework.



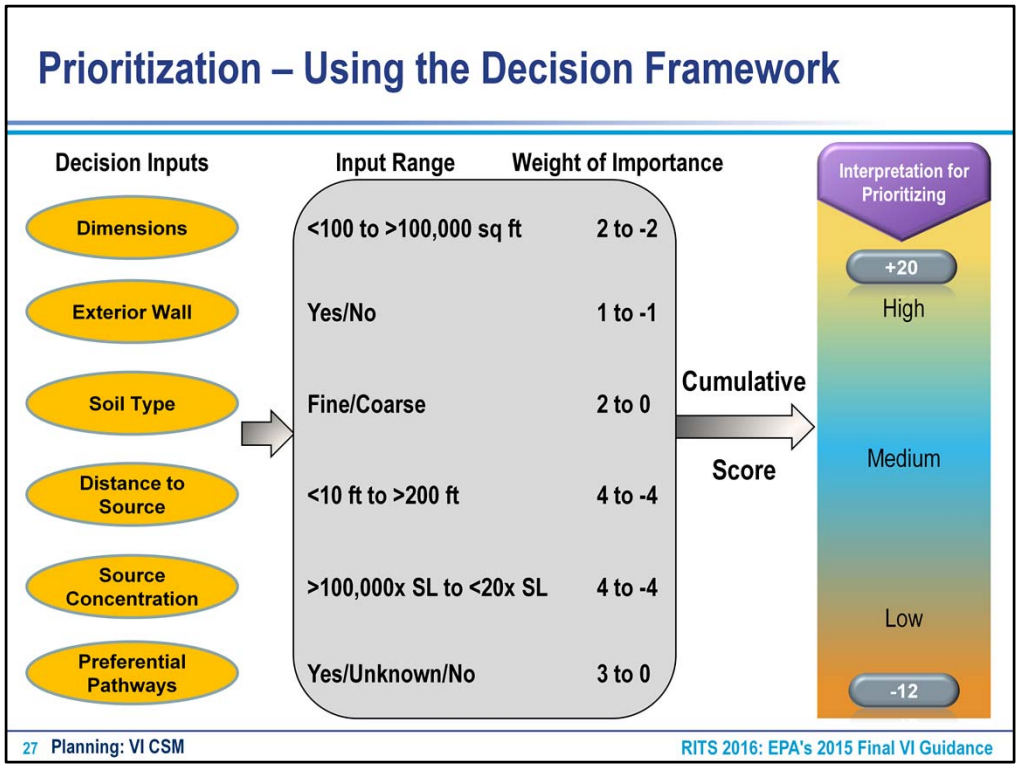
- Let's start with the relationship between the distance of a building to the primary release and the measured indoor air concentrations.
- We applied the same filtering criteria and approaches used by EPA when they evaluated the data in their residential database. Most of you have heard about EPA's default distance criterion of 100 ft, which is shown here w/ the vertical red line.

Take-home point: The distance criterion where observed PCE indoor air concentrations due to VI in industrial buildings began to exceed the EPA industrial vapor intrusion screening level or VISL was significantly less than the EPA 100 ft default that is based primarily on residential structures.



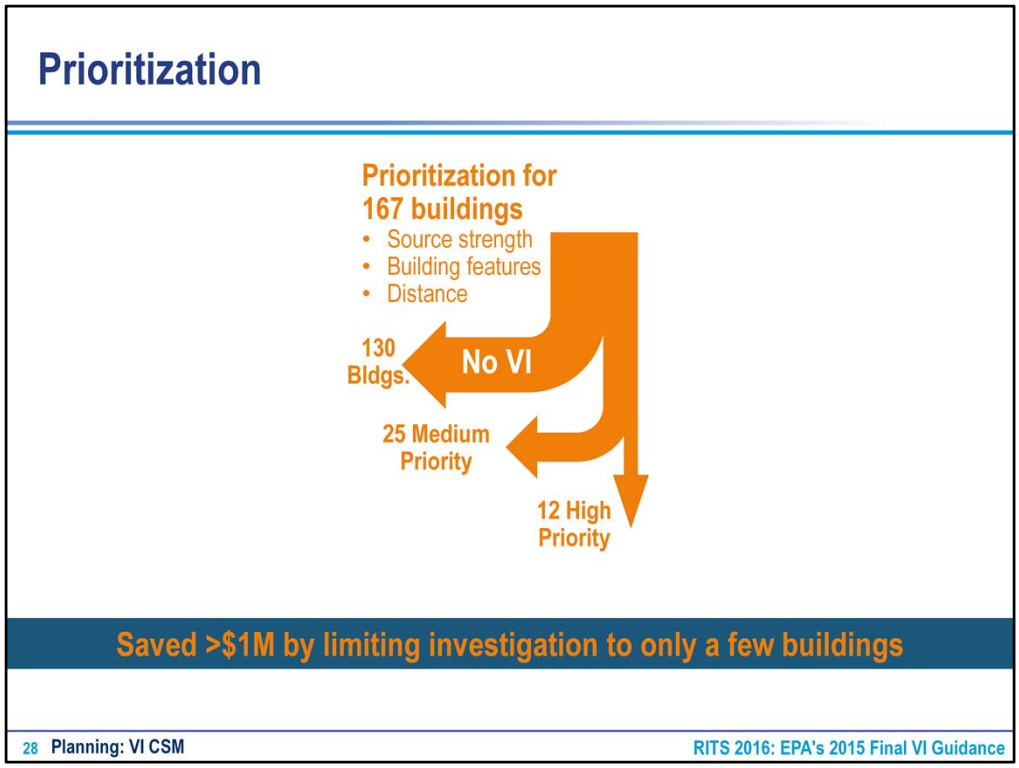
- This slide summarizes the relationship between GW source strength and observed subslab concentrations for PCE.

Take-home point: It took more than an order of magnitude higher GW concentrations than the EPA residential-base default predicted before the observed subslab concentrations approached levels that would result in indoor air impacts above VISLs



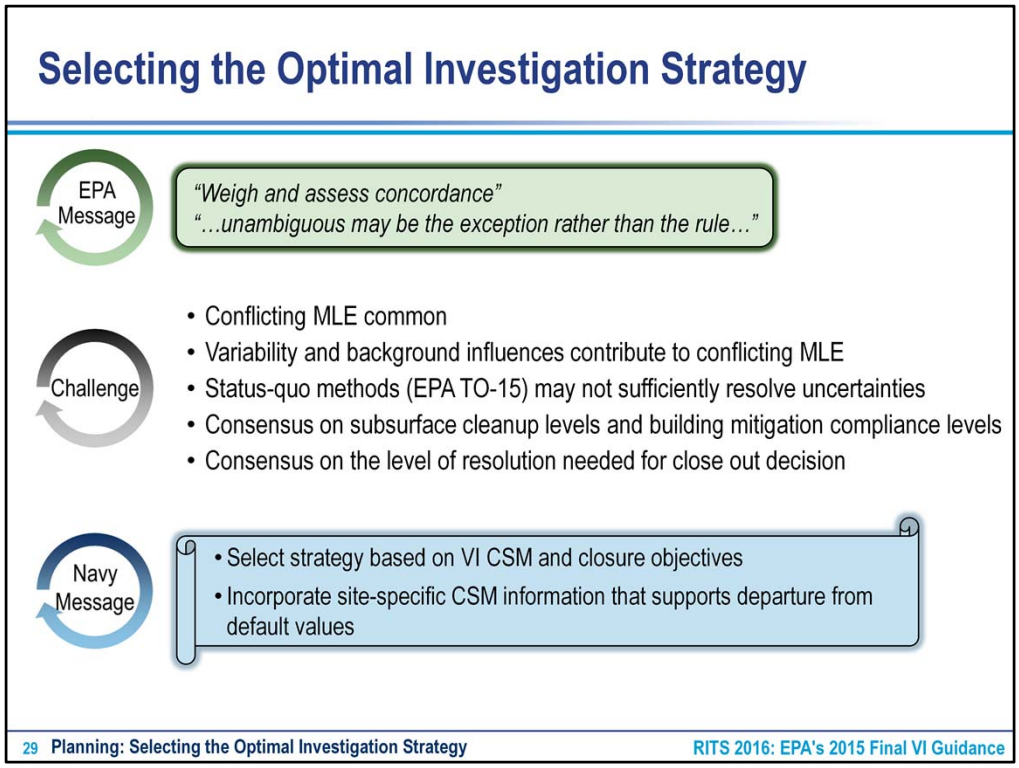
- This slide shows how the Navy VI Decision Framework can be used during the planning phase to prioritize VI potential at your base. We'll discuss later how the decision framework can be used to help you assess VI after you've collected your data.
- We developed a scorecard that you can use to prioritize VI potential at your buildings. It is based on assigning scores to the key influencing factors. The weights of importance for each of these factors were developed based on the strength of the observed relationships in the VI database. For example…..
- Sum the weights to get an overall cumulative priority score for each building… the higher the score, the higher the potential for VI.

Note: This priority score is not an actual quantitative estimate of VI, but rather, a relative ranking between buildings as to their likely potential for VI impacts.

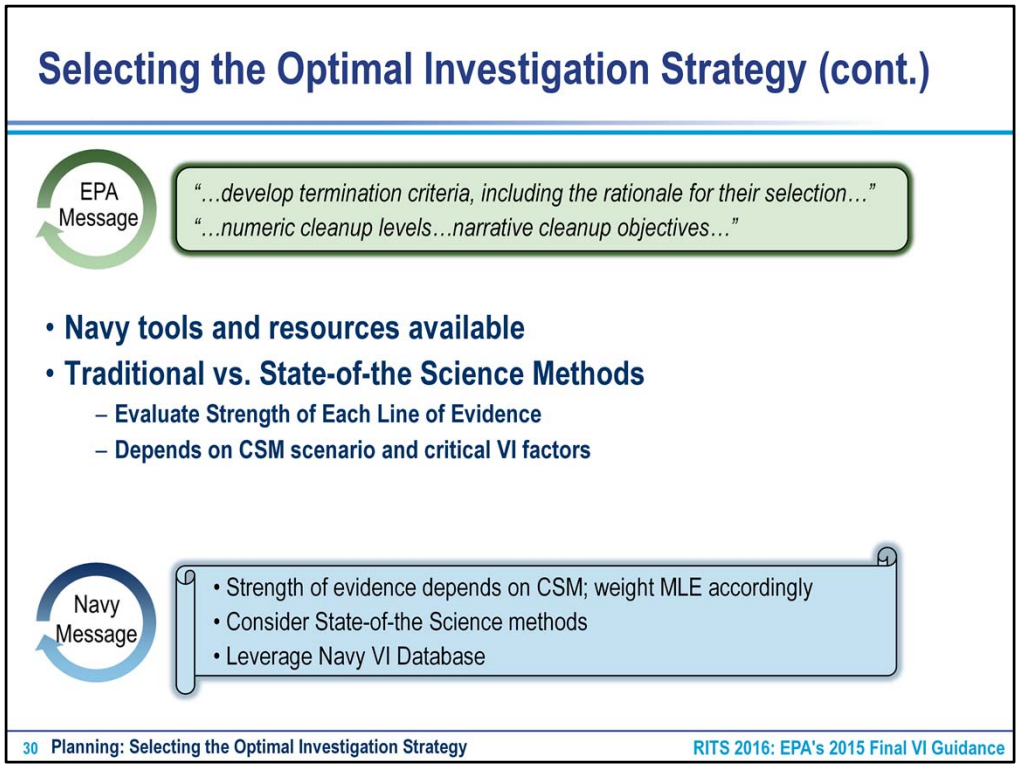


- This slide highlights the importance of applying a prioritization process. It is an aerial view of one operable unit at NAS JAX in FL, where we started with 167 buildings, prioritized VI potential based on factors such as source strength, building features, and distance to the source.

Ultimately, we identified the 12 highest priority buildings for investigation and saved over a million dollars by being able to limit the investigation to only a few buildings.

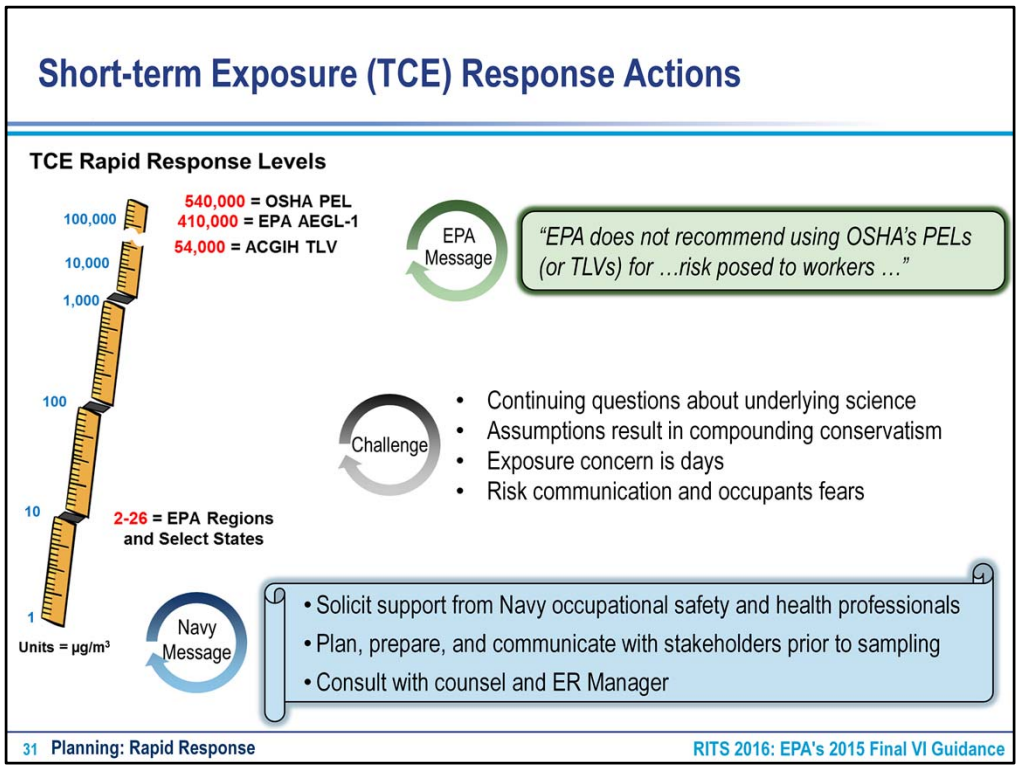


- Once you have identified the highest priority buildings, you will need to select the optimal investigation strategy
- The ultimate goal is to collect the right lines of evidence and per EPA, "weight and assess the concordance" of multiple lines of evidence. EPA states that having all the lines of evidence be concordant and unambiguous may be the exception rather than the rule.

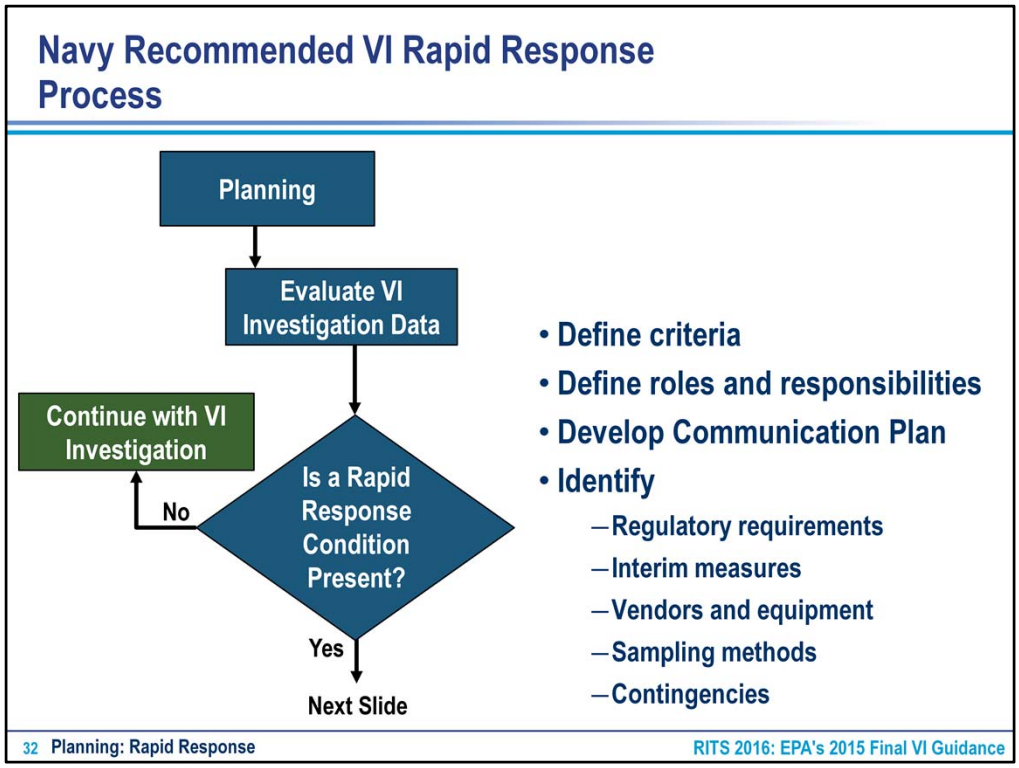


- It is important to keep the end-in-mind when selecting the investigation strategy. Be thinking about termination criteria and the rationale during the planning phase.
- The VI CSM and stakeholder goals are critical considerations.
- The Navy has numerous tools and resources available to help you select the optimal strategy, including multiple past RITS training events.
- Consider the strength of each line of evidence, how it fits into building the overall VI CSM, and what we have learned about the critical VI factors when deciding whether to use traditional versus state-of-the science methods.

Remember, …. (Navy Messages). Encourage you to use state-of-the science methods and leverage VI database….. more defensible results while saving time and money…. may be able to achieve closure sooner.

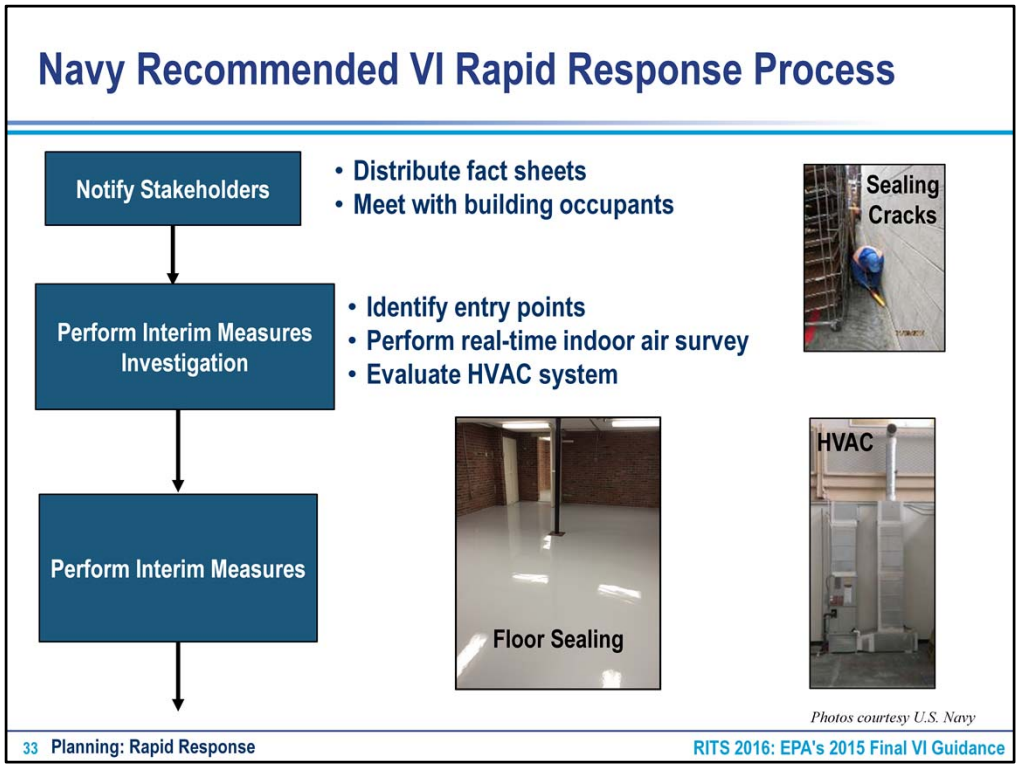


- Don't forget to plan for the possibility of short-term exposure at TCE sites.
- It is likely most of you have heard about the focus on TCE rapid response in the last few years.



- We wanted to spend a few minutes discussing the TCE rapid response process
- This and the next few slides show a flow chart that you can use to guide you through this process.
- The first and probably most important step is planning, where you define criteria, roles…

This is followed by collecting and evaluating the data and determining if rapid response condition is present. Appropriate planning is critical because these responses may need to occur within “days or weeks” according to a number of regulators.



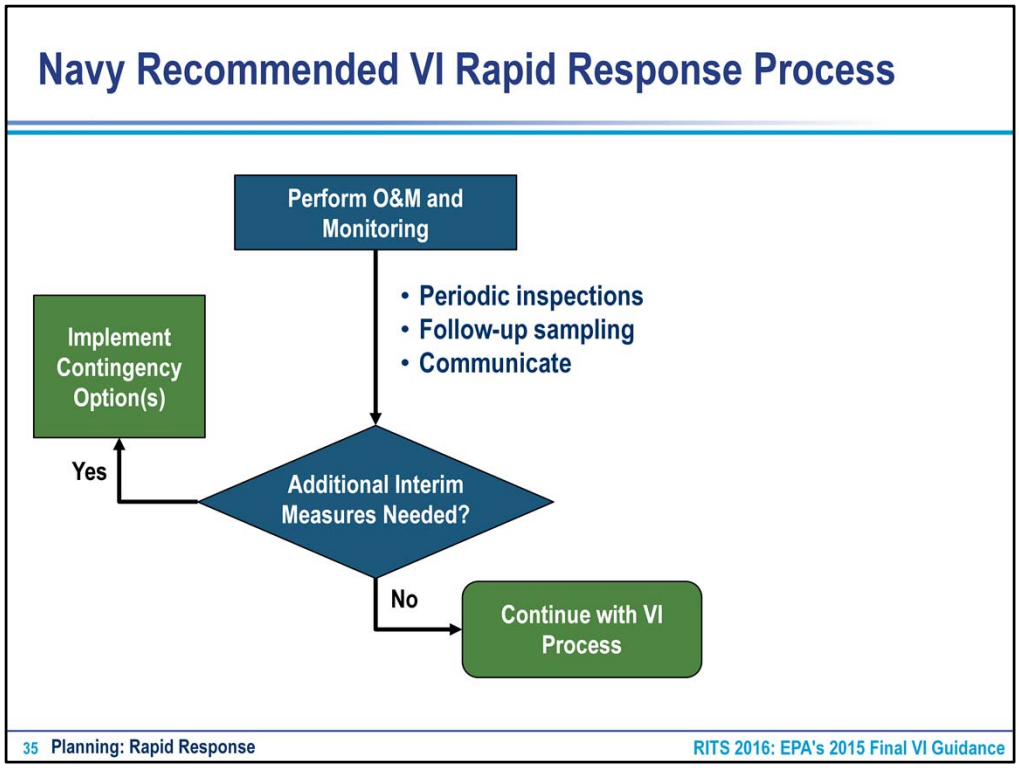
You may also need to notify stakeholders, identify vapor entry points, and perform interim measures within that timeframe for days to weeks. Examples of interim measures include sealing cracks, HVAC, air purifier, floor sealing.

Rapid Response Mitigation Technologies

Technology	Small Building and Low Source Strength	High Source Strength, Large Building, and/or Preferential Pathways	Time Factors	
			Procurement	Implementation
Sealing entry points	+	-	1-2 Weeks	1-5 Days
Air filtration	+	-	1-2 Weeks	1-5 days
Adjust existing HVAC	+	-	1-5 days	1-5 days
Temporary high-volume ventilation	+	+	1-6 weeks	1-5 days

34 Planning: Rapid Response RITS 2016: EPA's 2015 Final VI Guidance

- This slide provides examples of interim or what are often called rapid response VI mitigation technologies



- Don't forget to plan for potential OM&M and the possibility that additional interim measures may be needed during OM&M. We've see this need at some Navy bases.

The ultimate goal in planning for the potential for TCE rapid responses is to make defensible decisions and respond in a timely manner if needed so you can continue with the VI process and incorporate VI into the overall CERCLA process, which is something we'll discuss further today.

Community Involvement

EPA Message

- *"Develop a community involvement plan (CIP) or update the existing CIP."*
- *"…recommends…community involvement be conducted from the earliest stage.. throughout the entire process"*
- *"…provide validated sampling results and interpretation…within 30 days…"*

Challenge

- Community/individuals input and responses can vary
- Preparing for fear and anger from community
- Meeting community expectations; conveying information they do not want to hear

Navy Message

- Use NAVFAC & NMCPHC Risk Communication Guidance (http://www.navfac.navy.mil/navfac_worldwide/specialty_centers/exwc/products_and_services/ev/erb/vi.html)
- Coordinate with Base Commanders and Public Affairs Office
- Communicate early and throughout VI Assessment

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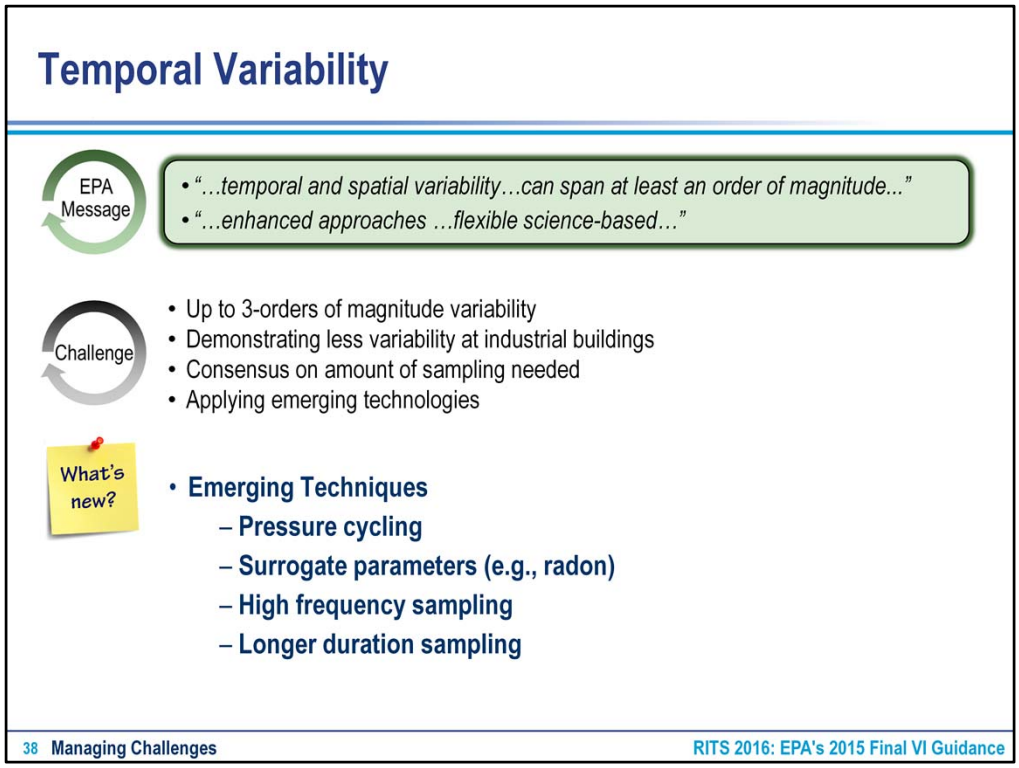
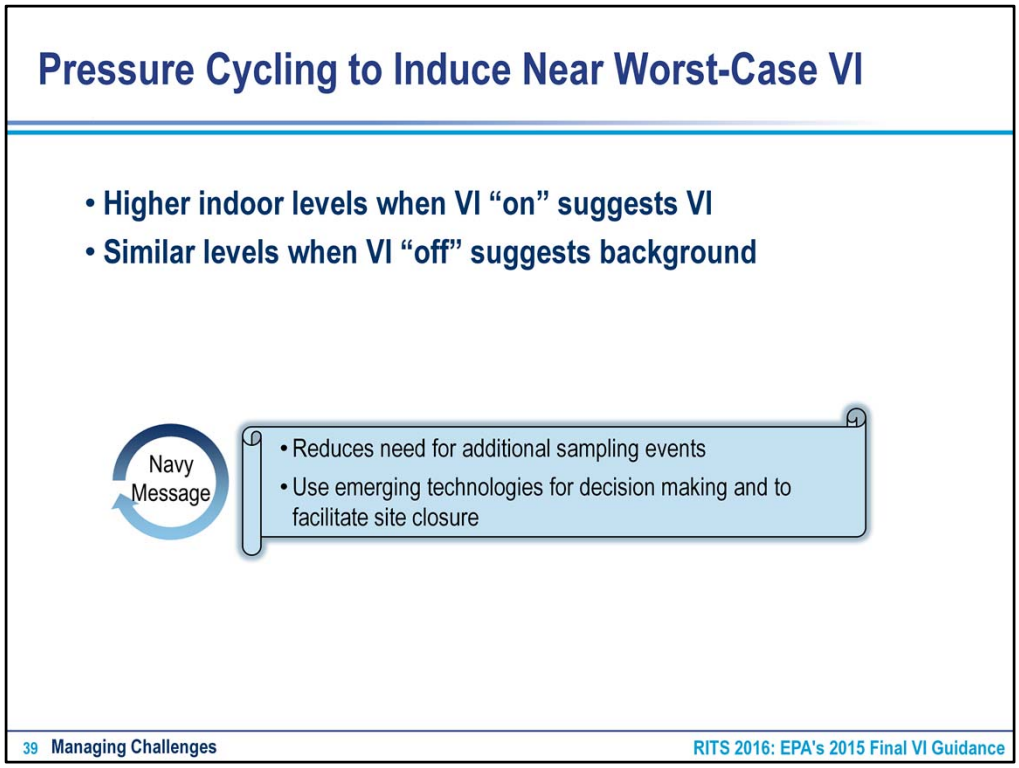


- The first site investigation challenge we want to discuss is temporal variability.

We won't be able to talk about all of the emerging techniques listed here. Sooooo…. we are going to focus on one of the methods… pressure cycling…. that is getting a lot of attention and has the potential to help us overcome this challenge of temporal variability and uncertainty that seems to hang some investigations up.

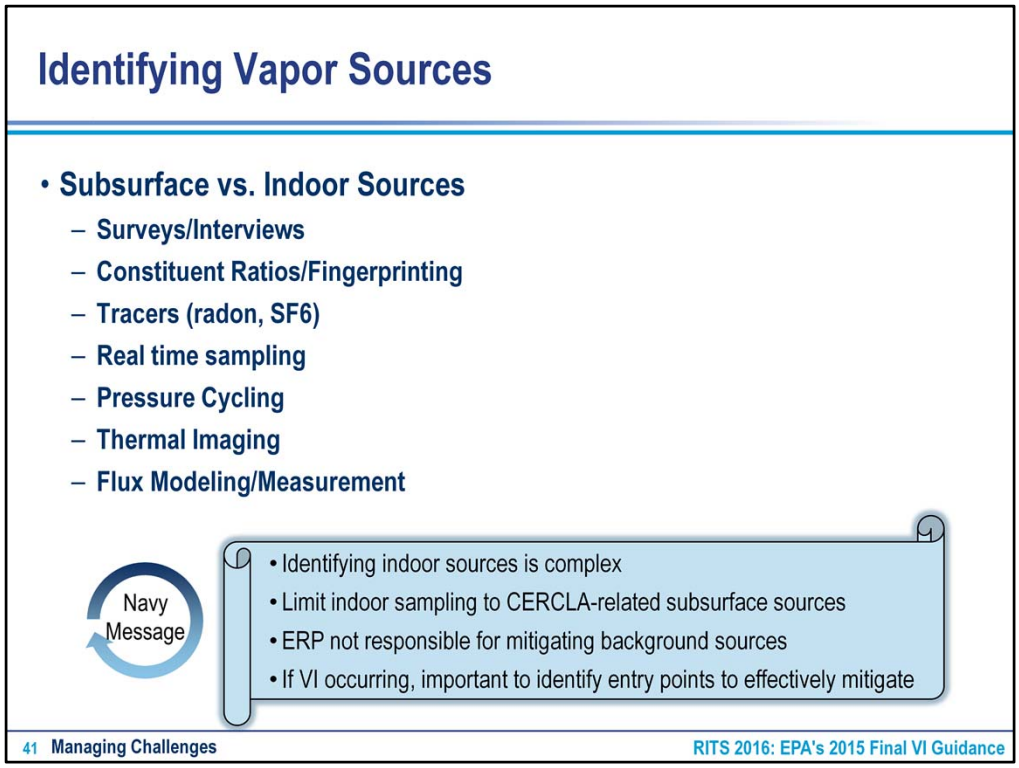


- This slide provides a summary of how pressure cycling may be used to induce near worst-case VI, resolve concerns about temporal variability, and avoid getting into never-ending sampling situations.

Pressure Cycling

- **Pros**
  - **Addresses temporal variability with a single "one-and-done" event**
  - **Useful in identifying background VOC sources and vapor entry points**
- **Cons**
  - **Ongoing refinements to method**
    - Length of Test
    - Target Pressures
  - **May be technically challenging in some buildings/compartments**

Photos courtesy U.S. Navy



- Pressure cycling can also be used to help identify vapor sources by increasing vapor flow into the building and increasing your chances of detecting it with real-time sampling methods.
- However, there are also these other methods listed on this slide that can help you identify the vapor source..

It is very important to identify your vapor source when VI is occurring above regulatory targets given the potential for background indoor or outdoor sources to affect your indoor air measurements.

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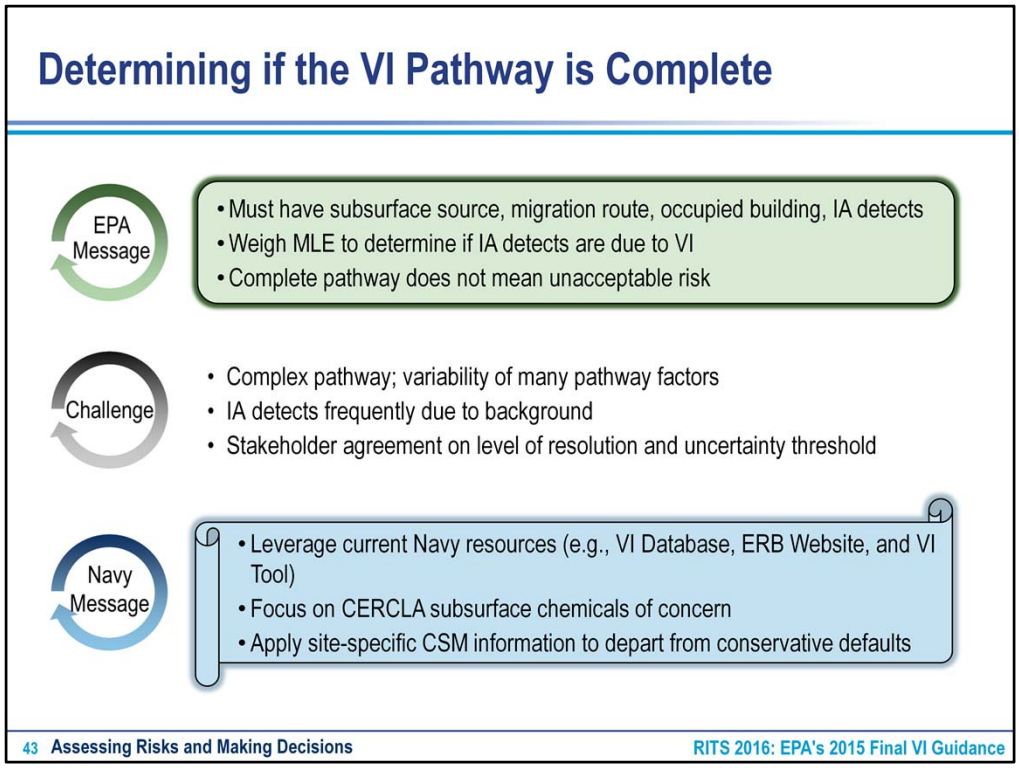
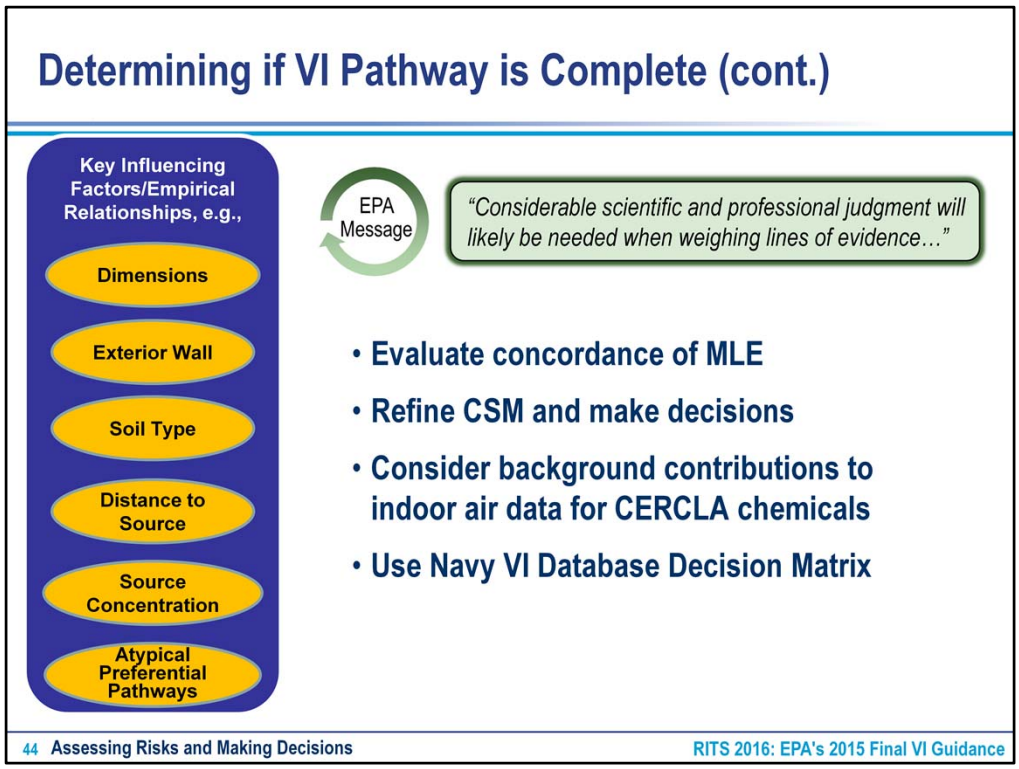
- Closing the VI Pathway: Technical Challenges and Solutions
  - Incorporating EPA Guidance into Site Investigation Planning
  - Managing Site Investigation Challenges Using Traditional and State-of-the-Science Methods
  - Assessing Risks and Making Decisions
- Case Studies
- Hands-On Activity – Application of Navy VI Decision Framework
- Wrap-Up



How do we determine if the pathway is complete? Need indoor air data and a demonstration it is due to VI not background. Can be challenging to distinguish VI and background and likely requires MLE, so leverage current Navy resources and new tools/technologies

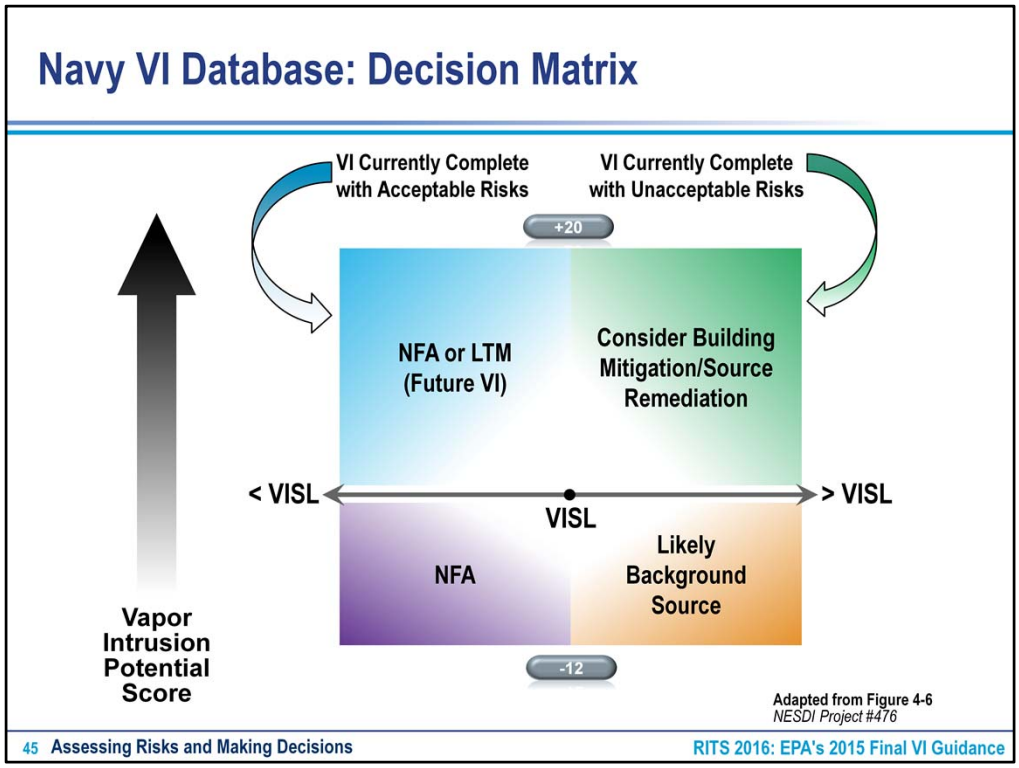
Focus on CERCLA subsurface chemicals of concern

Apply site-specific CSM information to depart from conservative defaults

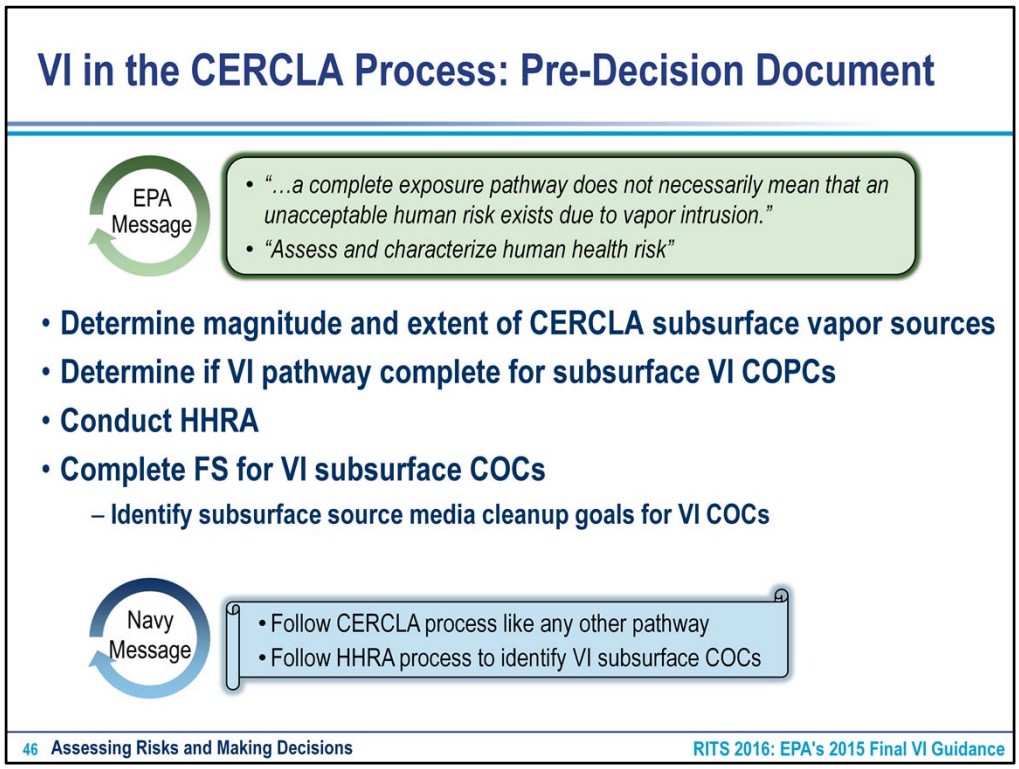


Refine the CSM as information on key influencing variables are understood and evaluate concordance of MLE.

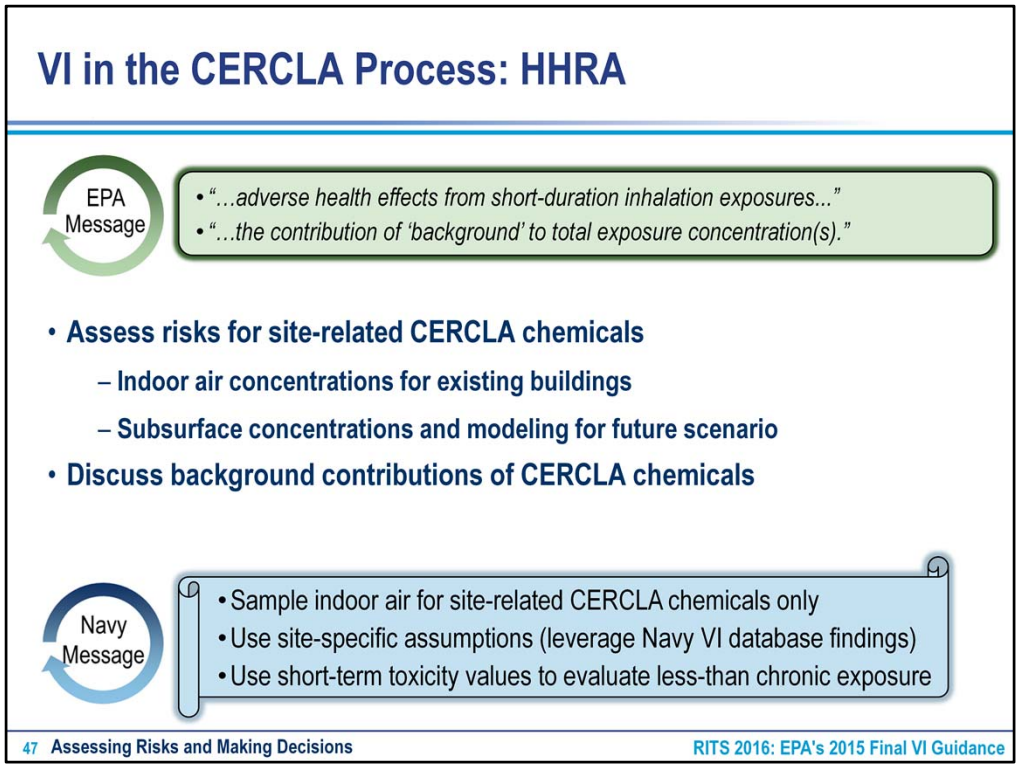
Likely requires professional judgment. Use Navy VI database scored card to assess potential for VI



Navy VI database and research have resulted in the development of this Decision Matrix. Arrow on right reflects VI potential score with high score at top and low VI potential score at bottom. VISL is reflected on the horizontal axis < VISL on left and > VISL on right.



How do we incorporate VI into the CERCLA process? If there is no ROD we treat VI like any other pathway and follow the CERCLA process. Identify magnitude and extent of vapor sources, conduct HHRA and if necessary FS, PP and ROD



Assess risk only for site related subsurface vapor forming chemicals. For current risk use measured indoor air concentrations for existing buildings and for potential future risk use subsurface concentrations and modeling. Use site specific info to depart from conservative defaults and leverage VI database findings

VI in the CERCLA Process: Alternative Analysis

EPA Message

"Preferred long-term response is to remediate the subsurface vapor source."

CERCLA Criteria	Alt 1 No Action	Alt 2 Monitoring (Building & Source)	Alt 3 Mitigating Exposure	Alt 4 Source Remediation	Alt 5 Combination of Alts. 2-4
Threshold Criteria	• Cost-benefit analysis: source remediation vs. building mitigating – Balancing current vs. future risks – Consider lifecycle cost and remediation timeframe • Develop subsurface cleanup levels and indoor air compliance levels – Apply site-specific information to depart from conservative defaults				
Balancing Criteria	• Sites with Decision Documents – Evaluate impacts to existing subsurface remedies – Evaluate whether VI remedy can stand alone				

KEY POINTS

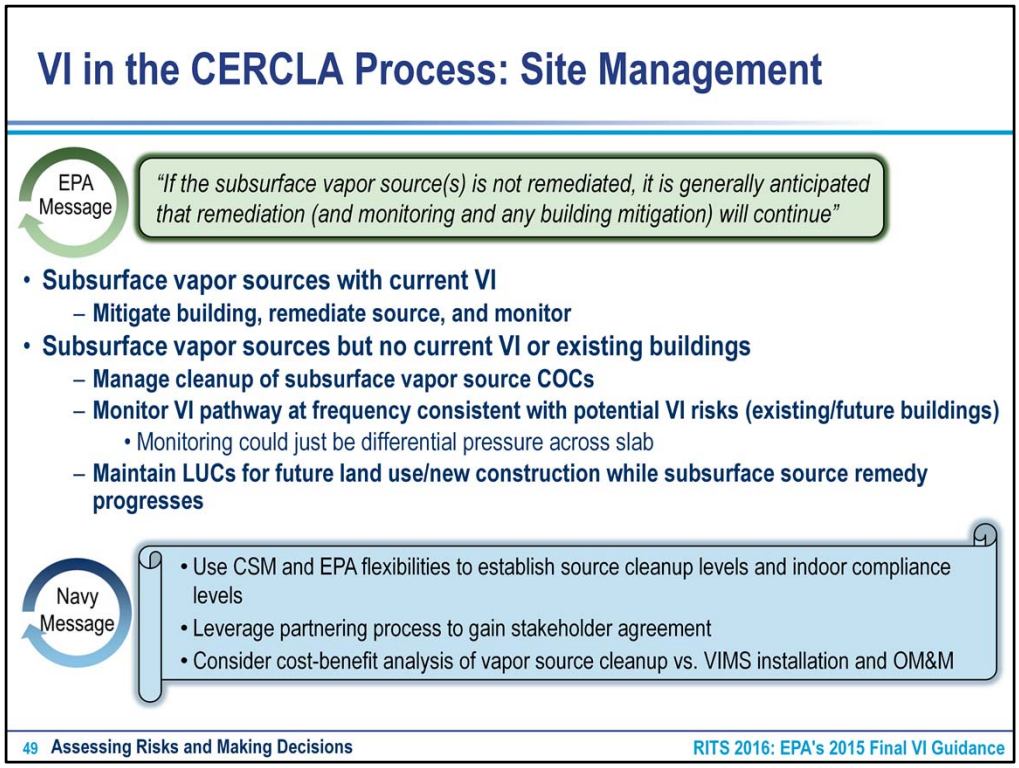
48 Assessing Risks and Making Decisions RITS 2016: EPA's 2015 Final VI Guidance

If subsurface vapor forming chemicals require a remedy for VI pathway because they are present at levels above UUUE then follow the CERCLA process and evaluate alternatives. If existing buildings have current VI risks then incorporate both subsurface source remedy and building mitigation as appropriate. Develop RGs for subsurface source chemicals and IA compliance levels for building mitigation systems

Alternative (in addition to baseline No Action) may be a combination of source remediation, building mitigation, monitoring and LUCs

Follow CERCLA FS process for comparative analysis of NCP Threshold and Balancing Criteria

For sites with existing RODs, consider VI alternative impacts on existing subsurface remedies. Evaluate if VI remedy components can stand alone or ESD or ROD Amendment is needed



As long as subsurface vapor sources are present at levels that can pose potential VI risk then VI pathway needs to be managed.

Mitigate buildings with IA that shows current VI occurring and risk is unacceptable. Development plan to manage mitigation system and demonstrate indoor air is acceptable and meets mitigation system compliance levels

Manage subsurface vapor sources with remedy that could be aggressive active treatment or monitoring and LUCs during natural degradation of subsurface chemicals. Monitor at a frequency consistent with VI potential

Maintain LUCs for new construction

Incorporating VI into the CERCLA Process: Post-Decision Document

- **Five Year Review VI pathway assessment**
  - **Can be qualitative and non-analytical lines of evidence of VI potential**
  - **Does not default to "Deferred" protectiveness if VI not yet assessed**
  - **Consider potential for current uncontrolled unacceptable risk exposures**
    - No: Short-term protective
    - Yes: Deferred protectiveness
  - **Does current remedy warrant modification for VI?**
    - ESD or ROD Amendment

Navy Message

- Do not default to "deferred" protectiveness; consider qualitative lines of evidence to support short-term protectiveness

50 Assessing Risks and Making Decisions RITS 2016: EPA's 2015 Final VI Guidance

Consider VI in FYR process. The lack of a quantitative VI assessment does not default to protectiveness deferred determination. Use CSM and MLE qualitatively to demonstrate no current uncontrolled exposure/risk and support short-term protective determination

Presentation Overview

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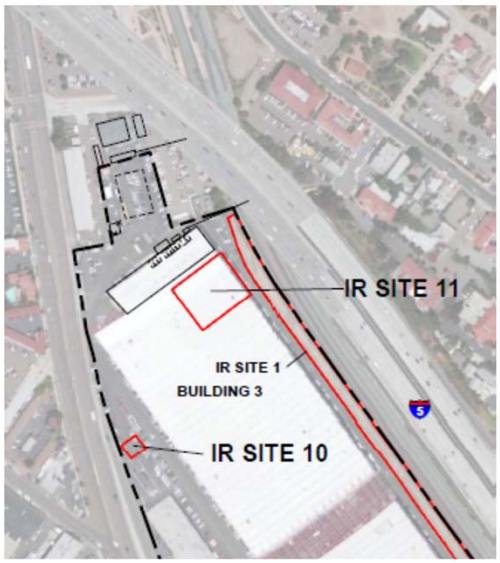
Point Loma, San Diego, CA: Building 3

- **Site Background**
  - Historical aircraft assembly and manufacturing activities
  - Chlorinated VOC impacts to groundwater and soil gas (IR Sites 10 and 11)
  - Aircraft hanger (850 x 350 x 50 ft) with offices and work areas
- **Investigations**
  - Nature/extent of subsurface impacts investigated in mid-1990s to 2014
  - Indoor air investigations at Bldg. 3 conducted from 2011through 2015



Objectives

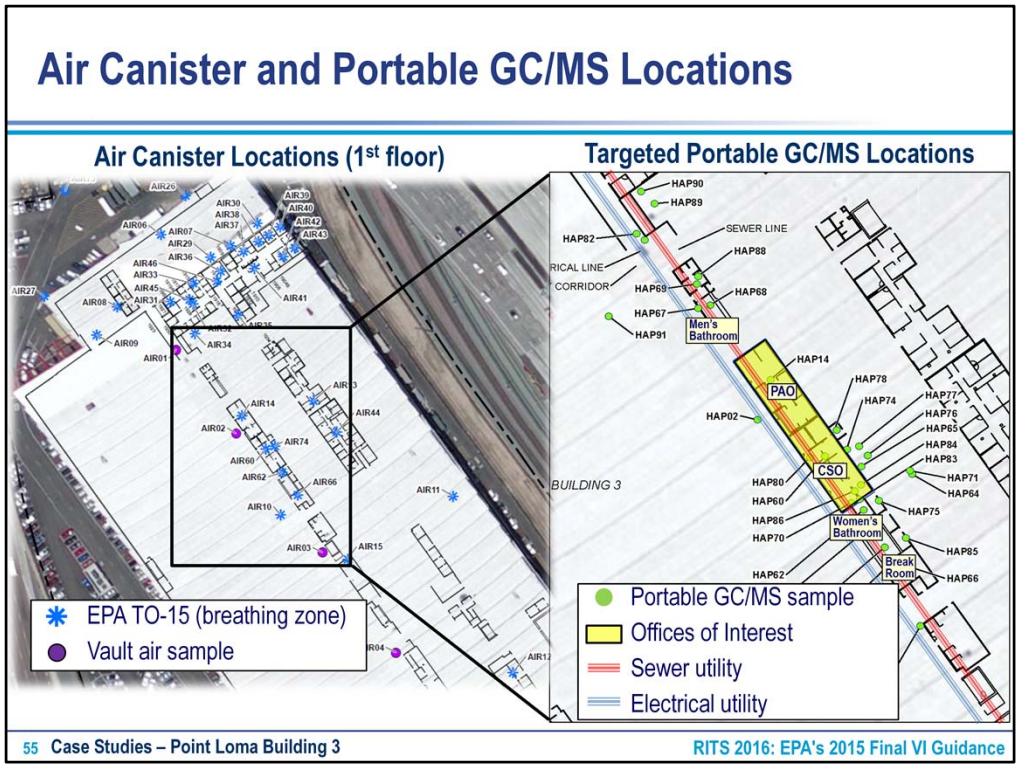
- Illustrate comparability and relative value of portable gas chromatograph/mass spectrometer (portable GC/MS) and air canister sampling (EPA Method TO-15) data
- Identify vapor source(s) and entry points using portable GC/MS / pressure cycling

Interior View

Introduction/Background

- Four air canister sampling (ERA TO-15) events (2011-2015) at a total of 51 locations
  - 1 of 10 samples in 2011 exceeded EPA 2014 RAL; triggered 2014/2015 sampling
  - 3 of 51 (2014) and 2 of 4 (2015) locations exceeded RAL
- Portable GC/MS baseline sampling and pressure control investigation in 2015
  - Targeted the two offices with exceedances and nearby spaces

Photos courtesy U.S. Navy


Air Canister and Portable GC/MS Locations
Air Canister Locations (1st floor)
Targeted Portable GC/MS Locations
EPA TO-15 (breathing zone)
Vault air sample
Portable GC/MS sample
Offices of Interest
Sewer utility
Electrical utility
SEWER LINE
BUILDING 3
Men's Bathroom
Women's Bathroom
Break Room
PAO
CSO
55 Case Studies – Point Loma Building 3
RITS 2016: EPA's 2015 Final VI Guidance

EPA TO-15 and Portable GC/MS / Pressure Cycling

Air Canister

- EPA accepted method (TO-15)
- 8 or 24 hr. sampling duration
- Standard turnaround times of 3-4 weeks
- Multiple rounds needed to assess VI
- Can be difficult to distinguish vapor sources

Portable GC/MS / Pressure Cycling

- Screening data (comparable to TO-15)
- Short sampling duration (e.g., 1 min), which facilitates real-time decisions
- Reduces temporal/spatial uncertainty
- Facilitates identification of vapor sources and entry points

EPA Message

- *"The science and technology to assess and mitigate VI have evolved significantly over the past decade"*

Navy Message

- Although historical precedent is to use EPA TO-15, portable GC/MS and/or pressure cycling data provide more defensible results, reduce uncertainties, and save time/money

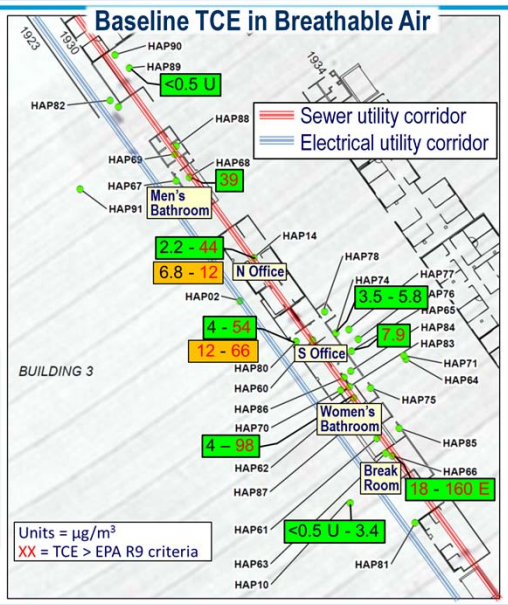
Comparability and Value of Portable GC/MS Data

2015 Portable GC/MS (1 min)
2011 - 2015 EPA TO-15 (8 hr.)

- **Portable GC/MS and Air Canister (EPA TO-15) comparable**
- **Portable GC/MS varied ~10X over 1 week**
- **Air Canister varied ~5X over 4 yrs.**
- **More spatial coverage with Portable GC/MS**

Navy Message

- Difference between Air Canister and Portable GC/MS results low (2X)
- Portable GC/MS reduces spatial uncertainties, time, and costs



Identifying Vapor Entry Points and Migration Pathway

Photo courtesy U.S. Navy

Baseline (no pressure control) Portable GC/MS Survey of Possible Vapor Entry Points

Photo courtesy CH2M

Pressure Cycling to Facilitate Identification of Vapor Source(s) and Migration Pathway

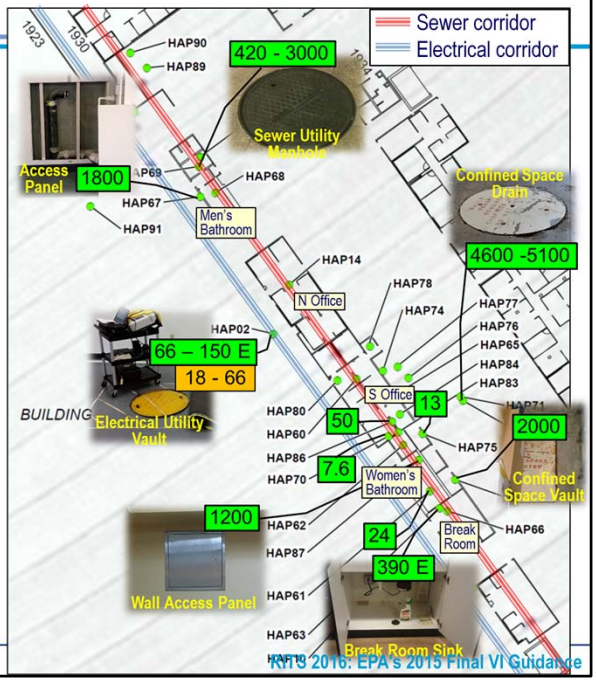
Baseline TCE in Possible Vapor Entry Points

2015 Portable GC/MS (1 min)
2011 - 2015 EPA TO-15 (8 hr.)

- **TCE orders of magnitude higher in utility spaces**
- **Suggested VI through preferential pathways**
- **Supported use of pressure cycling for further assessment**

EPA Message

"A preferential migration route can be a 'significant' influence on VI…"



59 Case Studies – Point Loma Building 3

RITS 2016: EPA's 2015 Final VI Guidance

Pressure Cycling

- Target pressure Δ's of -1 and -5 Pa
- Depressurized up to ~2 hrs.
- Portable GC/MS readings during test
- Used to identify/confirm vapor entry points and assess migration route(s)

Photo courtesy U.S. Navy

Portable GC/MS / Pressure Cycling

HAP60

Condition	Time (Δ)	TCE (µg/m³)
Baseline	0:00	35.8
Baseline	0:00	31.2
Baseline	0:00	16.4
dP=-1 Pa	0:01	12.1
dP=-1 Pa	0:19	70.8
dP=-1 Pa	0:36	103
dP=-1 Pa	1:26	126
Baseline	0:00	31.7
dP=-5 Pa	0:06	26.1
dP=-5 Pa	0:31	113
dP=-5 Pa	0:51	140 E
dP=-5 Pa	1:46	143 E

HAP74

Condition	Time (Δ)	TCE (µg/m³)
Baseline	0:00	5.1

HAP84

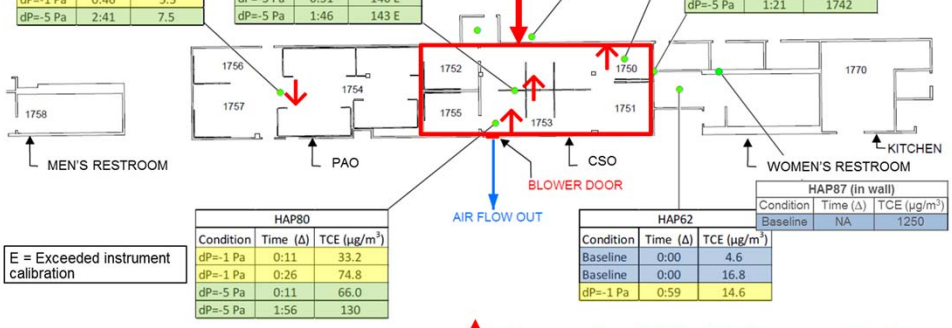
Condition	Time (Δ)	TCE (µg/m³)
dP=-5 Pa	0:41	168 E

HAP83 (in drop-ceiling)

Condition	Time (Δ)	TCE (µg/m³)
dP=-5 Pa	0:21	930 E
dP=-5 Pa	1:21	1742

HAP14

Condition	Time (Δ)	TCE (µg/m³)
Baseline	0:00	37.4
Baseline	0:00	32.6
dP=-1 Pa	0:46	5.5
dP=-5 Pa	2:41	7.5



HAP87 (in wall)

Condition	Time (Δ)	TCE (µg/m³)
Baseline	NA	1250

HAP80

Condition	Time (Δ)	TCE (µg/m³)
dP=-1 Pa	0:11	33.2
dP=-1 Pa	0:26	74.8
dP=-5 Pa	0:11	66.0
dP=-5 Pa	1:56	130

HAP62

Condition	Time (Δ)	TCE (µg/m³)
Baseline	0:00	4.6
Baseline	0:00	16.8
dP=-1 Pa	0:59	14.6

E = Exceeded instrument calibration

↑ = Increasing TCE with depressurization
↓ = Decreasing TCE with depressurization

61 Case Studies – Point Loma Building 3 RITS 2016: EPA's 2015 Final VI Guidance

Portable GC/MS / Pressure Cycling (cont.)

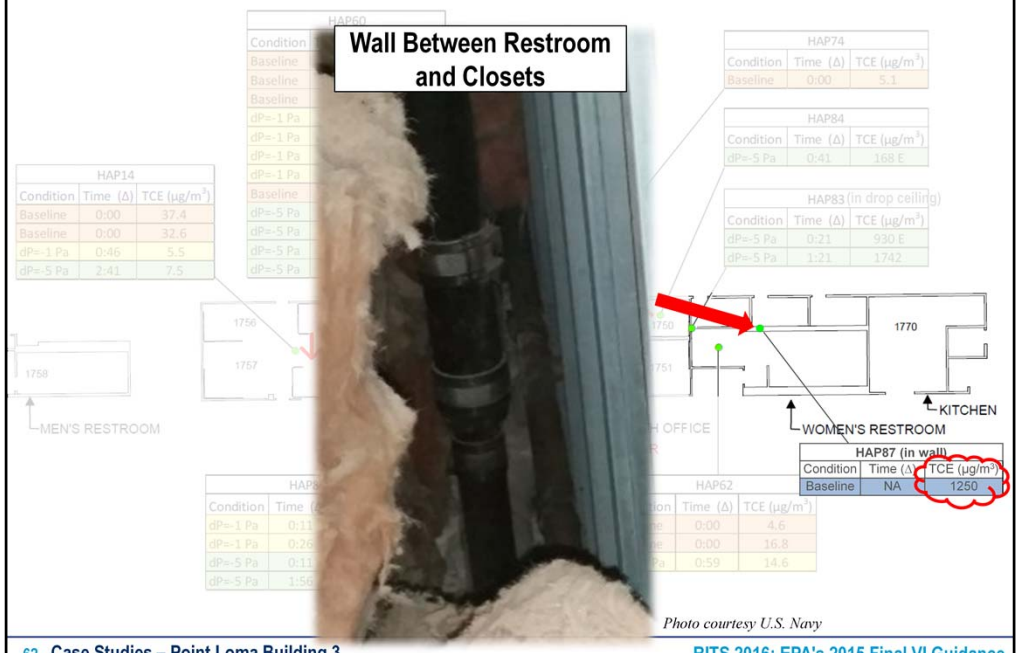
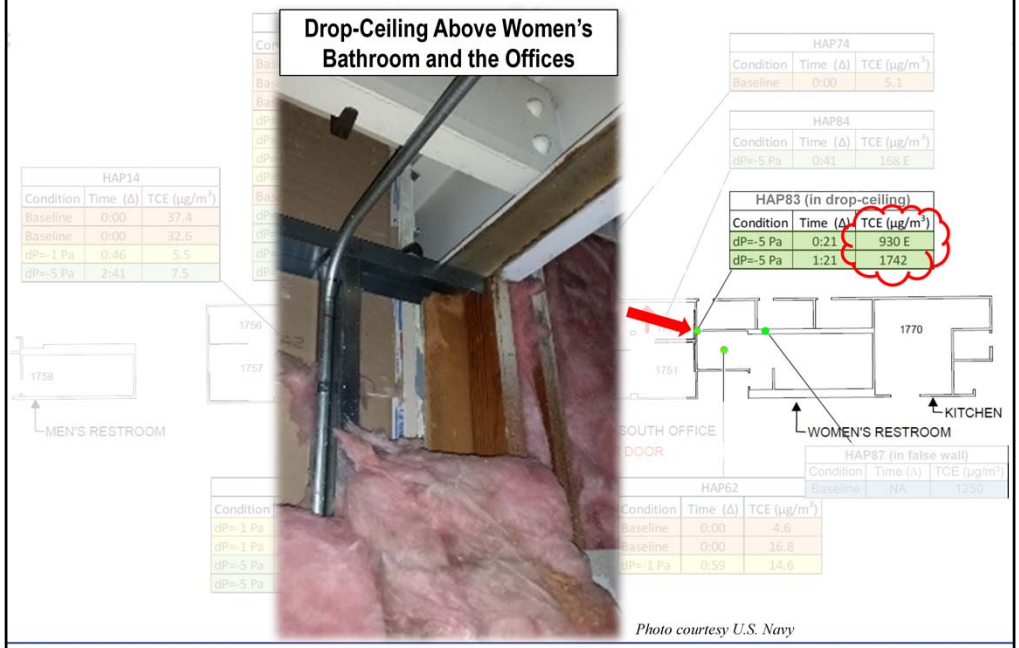


Photo courtesy U.S. Navy

62 Case Studies – Point Loma Building 3 RITS 2016: EPA's 2015 Final VI Guidance

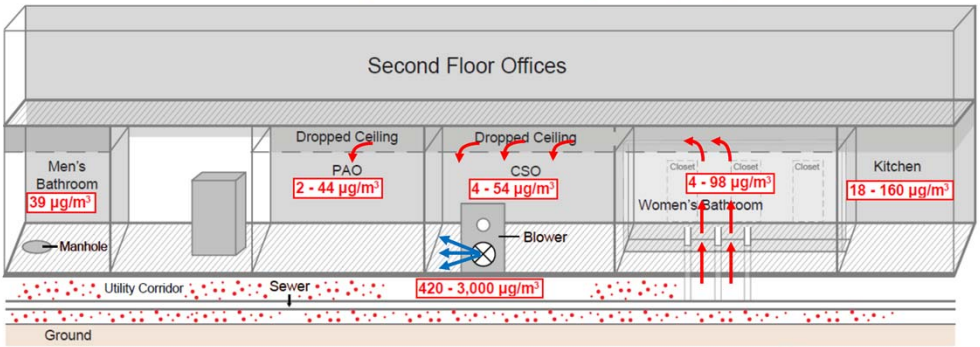
Portable GC/MS / Pressure Cycling (cont.)



63 Case Studies – Point Loma Building 3 RITS 2016: EPA's 2015 Final VI Guidance

Portable GC/MS / Pressure Cycling Key Findings

- **Depressurization increased TCE in office (up to 10X)**
  - **TCE higher near the women's bathroom**
- **Elevated TCE in wall cavity and drop-ceiling during depressurization**



Navy Message

- Portable GC/MS data with depressurization allows identification of vapor entry points and migration pathways

TCE Rapid Response Case Studies: Introduction

- TCE toxicity revised in 2011 (2 µg/m^3)
  - Non-cancer endpoint included adverse affect on fetus resulting in short-term exposure concern and consideration of rapid response with elevated TCE in indoor air
  - EPA regions and States remain inconsistent in response criteria and approach
- DoD ERP leadership currently working with DoD Occupational Safety and Health (OSH) leadership for guidance to RPMs
- Case studies reflect site-specific approach to rapid response
  - Yorktown Naval Weapons Station – 2012
  - Joint Expeditionary Base Little Creek – 2015
  - Allegany Ballistics Lab – 2015

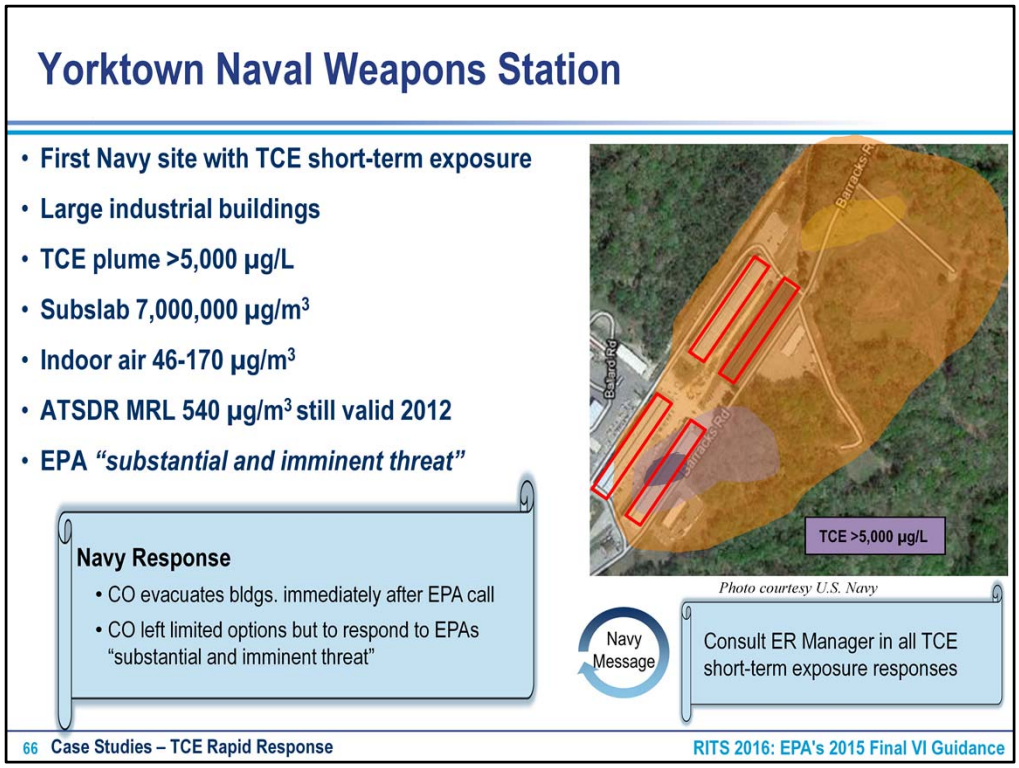
Toxic Substances Portal

- Trichloroethylene (TCE)
  - ToxFAQs
  - Public Health Statement
  - ▶**Toxicological Profile**
  - ToxGuide
  - Medical Management Guidelines (MMG) for Acute Chemical Exposure
- ... More Resources

65 Case Studies – TCE Rapid Response RITS 2016: EPA's 2015 Final VI Guidance

Present 3 case studies associated with TCE short term exposure to illustrate how the issue was managed and the decisions made by RPM and Base Commanders/decision makers

Refer back to slides identifying TCE short term exposure issue Loren/Keri presented. Acknowledge DoD leadership efforts to provide guidance and direction



Because ATSDR MRL was still in effect 2012 it was appropriate for Navy to consider MRL comparison to measured IA data to consider sub-chronic risk, and because IA levels < MRL there was no expectation of short term rapid response concerns. EPA R3 chose to consider IA a substantial and imminent threat and stated a letter to the CO was forthcoming stating the threat. The CO had little response option but to comply with EPA to evacuate the buildings, which he did immediately following the call with EPA and their notice of intent to send letter.

Joint Expeditionary Base Little Creek

- TCE plume adjacent to Barracks
- VI investigation 2011: No VI
- Groundwater in-situ remedy
  - Post-remedy GW monitoring 2014 increased TCE to 110 µg/L
- VI Planning prior to sampling:
  - Use Portable GC/MS all first floor rooms
  - Residential screening metrics
    - TCE > 6 µg/m^3 (3x RSL) collect 24 hr. air canister Q-TAT
    - TCE > 20 µg/m^3 (10 x RSL) collect 24 hr. air canister Q-TAT then immediately deploy APU at retrieval of canister
  - Portable GC/MS < RAL, collect air canister samples standard TAT

Photos courtesy U.S. Navy

67 Case Studies – TCE Rapid Response

RITS 2016: EPA's 2015 Final VI Guidance

Joint Expeditionary Base Little Creek is a TCE plume adjacent to a Barracks. VI investigations in 2011 demonstrated no VI concerns. Subsequent groundwater in-situ remedy was implemented and post remedy monitoring identified an increase in TCE groundwater concentrations which triggered need for additional VI monitoring in 2015. Prior to sampling however the team developed a detailed plan for how they would respond to potential TCE short-term exposure. The Navy/EPA/State agreed on the plan which consisted of

Use portable GC/MS all first floor rooms

Residential screening metrics

TCE > 6 µg/m3 (3x RSL) collect 24 hr. canister Q-TAT

TCE > 20 µg/m3 (10 x RSL) collect 24 hr. canister for Q-TAT then immediately deploy APU
at retrieval of canister

Portable GC/MS < RAL, collect canister samples standard TAT

Joint Expeditionary Base Little Creek (cont.)

- Briefing with Base stakeholders prior to sampling
  - Commanding Officer decision to pre-emptively relocate all women in first floor barracks rooms to higher floors
- Open house for barracks residents
- Implemented sampling: No VI, no rapid response required
- Notified stakeholders of results
- Continue monitoring through five year review process

Following a briefing with the CO and Navy stakeholders, the CO made a decision to pre-emptively relocate all women in first floor barracks rooms to higher floors. Because these are all active duty personnel there are no labor issues you simply follow the CO's orders.

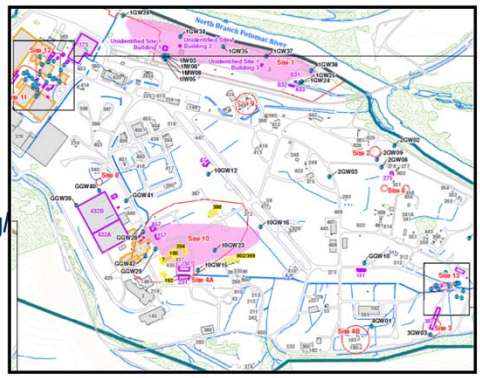
An open house meeting at the barracks was held for all occupants with SMEs available to answer questions.

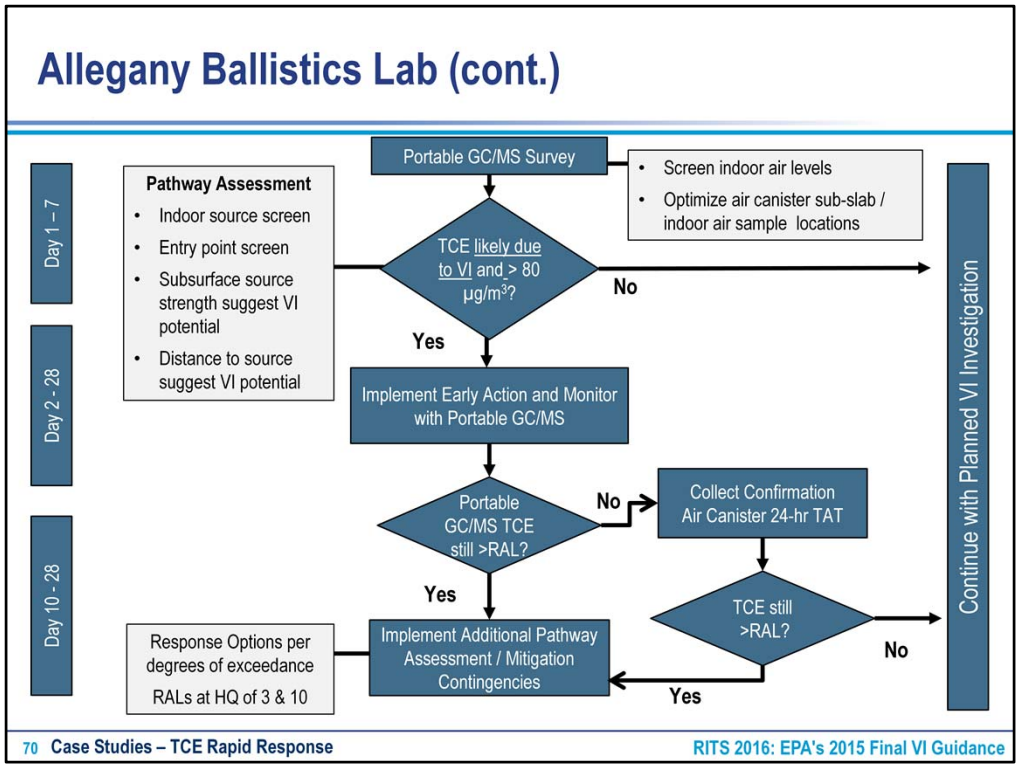
Sampling was implements and no indoor air rapid response trigger levels were needed and all agreed the pre-planning was NOT a wasted effort

The EV PM notified all stakeholders of the results and the project continues to monitor for VI as part of the FYR process

Allegany Ballistics Lab

- Multiple site plumes & buildings
- DoD-Owned Contractor-Operated facility
- Mission critical operations
- Collaboration with contractor occupational health professionals
- Navy, Contractor, and Regulatory agreements on trigger levels
  - Portable GC/MS measurement > 80 µg/
  - Air canister (TO-15) result > 24 µg/m^3





This is an example of the flow chart included in the SAP for ABL. Their rapid response approach begins with portable GC/MS survey to initially screen indoor air levels and optimize locations of canister subslab and IA samples. Based on portable GC/MS results if TCE > 80 ug/m3 and a pathway assessment that includes it is likely due to VI based on

- background indoor source screen
- vapor entry point screen
- subsurface source strengths evaluation
- and distance of plume to the building assessment

… then an early action response will be implement. Early action effectiveness will be confirmed with portable GC/MS. A canister 24 hr sample result by fixed lab is required to confirm there is no exceedance of a rapid response trigger level.

Note that the team agreed to consider response options per degrees of exceedance based on TCE hazard quotient of 1, 3, or 10 and that the recognize that the timetable for implementation could be anywhere from 7-28 days depending on site-specific conditions

Allegany Ballistics Lab (cont.)

- Response Options
  - Sealing vapor entry points
  - Adjustment HVAC
  - APUs
  - Temporary high-volume ventilation & pressure control
  - Relocation of occupants (mission critical concerns)

Building	Room	Critical level Operation	Volume (ft^3)
7	Office	Low	1,200
7	Work Space	Low	25,000
432A	Work Space	High	266,000

- Detailed building surveys and room-specific mitigation matrix

Applicability of Early Action Options						
Building	# APUs	Recommended Option		Contingent/Follow-On Option(s)		
		APU	High Volume Ventilation	Sealing Entry Points	Window/Door Ventilation	HVAC Adjustments
7 office	1	Yes	--	Yes	Yes	No
7 work area	7	Yes	--	Yes	Yes	Yes
432A	48	--	Yes	Yes	Yes	Yes

- Sampling completed 2016; No VI rapid response levels measured in indoor air

71 Case Studies – TCE Rapid Response RITS 2016: EPA's 2015 Final VI Guidance

Response options considered included:

Sealing vapor entry points
Adjustment HVAC
APUs
Temporary high-volume ventilation &
pressure control
Relocation of occupants as last resort due to mission critical concerns

The team developed a detailed room-specific mitigation options table prior to sampling so they would be better prepared to implement the optimal mitigation measure for a given work space. So for example they determined that in the large space of building 432A that if rapid response was need it would take 48 APUs and therefore that technology would be optimal for that space. They also realized that in a small office space in a large building that adjusting the HVAC would have little effect on that specific individual small office space.

The good new for this is sampling was completed in February 2016 and no VI rapid response trigger levels were exceeded in indoor air.

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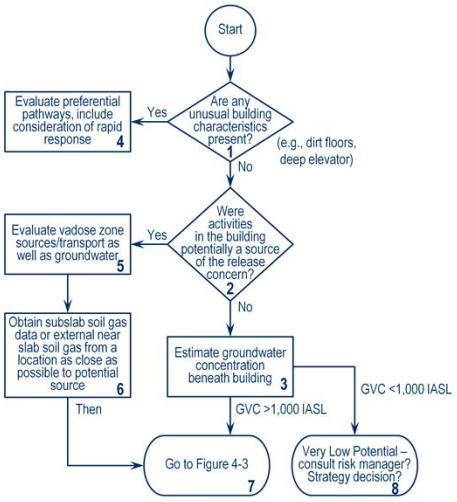
- Wrap-Up

Hands-On Activity

Application of Navy VI Decision Framework – Page 1

Steps for applying Navy VI Decision Framework

1. Identify presence of known atypical preferential pathways
2. Screen out buildings with very low VI potential using Groundwater Vapor Concentrations and/or Sub-slab Soil Gas Concentrations
3. Calculate VI prioritization scores using multiple lines of evidence
4. Interpret VI prioritization scores



GVC = Groundwater Vapor Concentration (µg/m³)
IASL = Indoor Air Screening Level (µg/m³)

Hands-On Activity

Application of Navy VI Decision Framework – Page 2

- Scenario — Screen building for VI potential and evaluate whether measured indoor air results are consistent with other lines of evidence
- Each Group
  - Use Navy VI Decision Framework to address assigned scenario
  - Review results

Students will be divided up into three groups. Each group will be assigned a different scenario and given a handout with site specific information and instructions/forms for applying the NESDI Framework.

Hands-On Activity

Application of Navy VI Decision Framework – Page 3

- Identify presence of known atypical preferential pathways
  - Utility corridor/conduits
  - Elevator pits and shafts
  - Dirt floors/unlined crawlspace
  - Sumps/drainage pits
  - Open wall cavities/significant cracks in foundations or floors
- Evaluate potential significance
- Consider rapid response

75 Hands-On Activity RITS 2016: EPA's 2015 Final VI Guidance

First step is always to identify presence or possibility of any atypical preferential pathways, evaluate the significance of potential pathways and consider whether some sort of rapid response is warranted.

Hands-On Activity

Application of Navy VI Decision Framework – Page 4

- **Screen out buildings with very low VI potential**
  - **Groundwater Vapor Concentration (GW VC)**
    - Interpolation of GW concentration from nearby monitoring wells
    - Use Henry's Law to calculate GW VC
    - GW VC < 1000x Indoor Air Screening Level (IASL) = Very Low VI Potential
  - **Maximum Sub-slab Soil Gas Concentration (SS SG)**
    - Measured SS SG concentrations or soil gas sampling results near building
    - SS SG < 33x Indoor Air Screening Level (IASL) = Very Low VI Potential

Next step is to use the GWVC and/or maximum SSSG concentration to screen out those buildings with very low VI potential. You still may want to score those buildings based on additional lines of evidence to further validate your decision.

Hands-On Activity

Application of Navy VI Decision Framework – Page 5

- Calculate VI Prioritization Score using multiple lines of evidence
  - Sample zone area
  - Average SS SG concentration
  - Average GW VC
  - Soil Type
  - Solvent Use History
  - Sample zone on exterior wall of building
  - Presence of atypical preferential pathway
  - Distance to primary release

77 Hands-On Activity RITS 2016: EPA's 2015 Final VI Guidance

Next, using the table in the handout, those buildings which have not screened out as having very low VI potential are scored based on multiple lines of evidence. Information used for scoring can be collected from site visits, PA, SI and RI reports, etc. Scores can then be used to

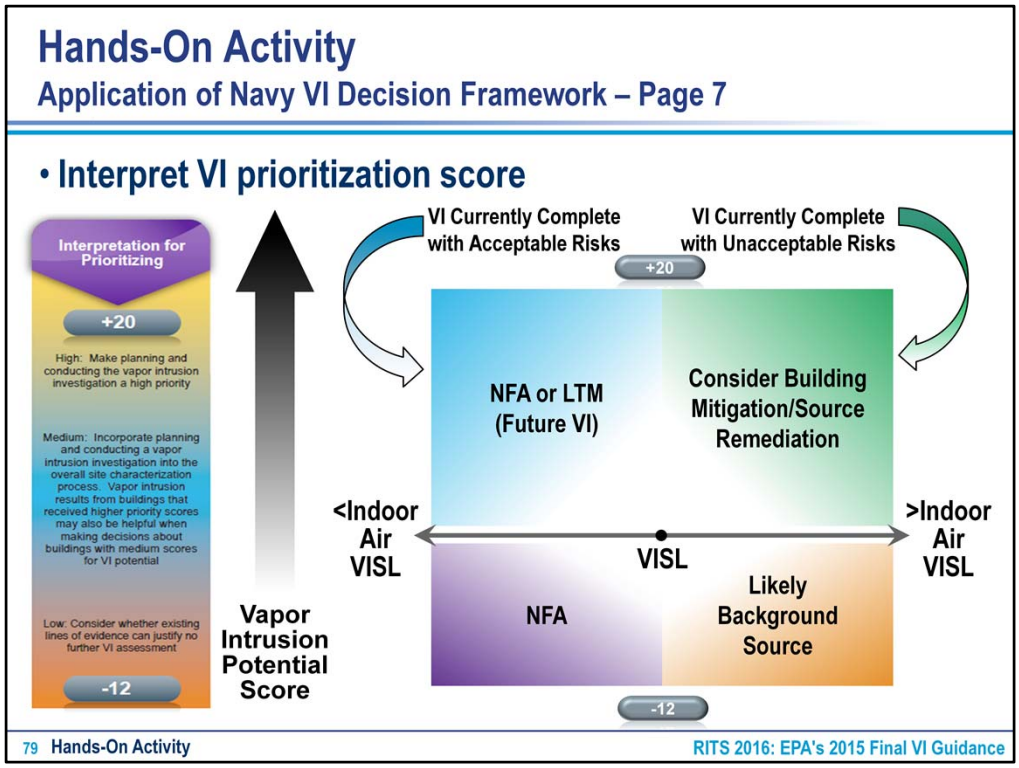
1) further screen buildings for VI potential;
2) prioritize multiple buildings for VI investigations;
3) evaluate whether indoor air results are consistent with other lines of evidence; or
4) plan for long-term stewardship of VI sites.

Hands-On Activity

Application of Navy VI Decision Framework – Page 6

Vapor Intrusion Potential Scorecard

Parameter	Range Observed	VI Prioritization Point Value	Interpretation
Sample Zone Area	<100 sq ft	2	Smaller sample zones provide less potential for VOC dilution if contaminant flux (from either indoor or Subslab sources) is equal.
	100-1,000 sq ft	1	
	1,000-10,000 sq ft (or no information available)	0	
	10,000-100,000 sq ft	-1	
	>100,000 sq ft	-2	
Average Subslab Concentration	<300x risk based on indoor air screening level	-4	Data analysis shows that concentrations above a minimum value in subslab are needed to observe any corresponding increase in indoor air concentrations.
	300-2,000x risk based on indoor air screening level	-2	
	2,000-10,000x risk based on indoor air screening level	0	
	10,000-100,000x risk based on indoor air screening level	2	
	>100,000x risk based on indoor air screening level	4	
Average Groundwater Vapor Concentration (Deep soil gas concentration) (Calculated Using Interpolated Groundwater Concentration Beneath Sample Zone and Henry's Law or Results of Near Slab Soil Gas Sampling >15 ft below ground surface)	<10,000x risk based on indoor air screening level (or no information available)	0	Data analysis shows that concentrations above a minimum value in groundwater are needed to observe any corresponding increase in indoor air concentrations.
	10,000-100,000x risk based on indoor air screening level	2	
	>100,000x risk based on indoor air screening level	4	

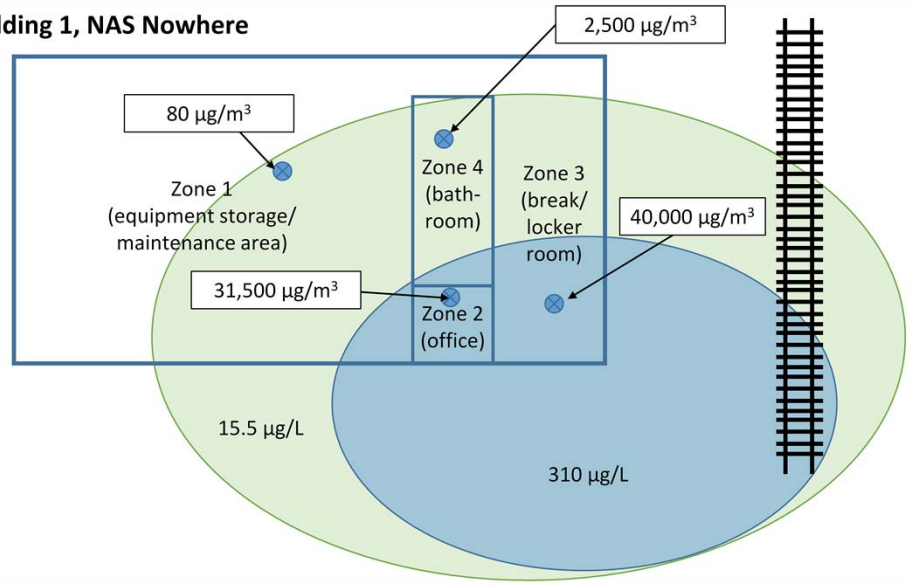


Last step is to interpret the VI prioritization score. Risk managers, stakeholders and regulators should be involved as appropriate in the process.

Hands-On Activity

Application of Navy VI Decision Framework – Page 8

Building 1, NAS Nowhere



Hands-On Activity

Application of Navy VI Decision Framework – Page 9

PARAMETER	ZONE 1 (Equip Area)	ZONE 2 (Office)	ZONE 3 (Break Room)	ZONE 4 (Bathroom)
Initial Screening	Value	Value	Value	Value
Chemical of Concern	TCE	TCE	TCE	TCE
IASL	3 µg/m^3	3 µg/m^3	3 µg/m^3	3 µg/m^3
Max GW Concentration (µg/L)	15.5	310	310	15.5
Max GW Vapor Concentration (µg/m^3)	3,191 (1,060x IASL)	63,800 (21,300x IASL)	63,800 (21,300x IASL)	3,191 (1,060x IASL)
GW VC >1,000x IASL?	Yes	Yes	Yes	Yes
Highest SS SG Concentration (µg/m^3)	80 (27x IASL)	31,500 (10,500x IASL)	40,000 (13,300x IASL)	2,500 (833x IASL)
SS SG >33x IASL?	No	Yes	Yes	Yes
Very Low VI Potential?	Yes	No	No	No

Hands-On Activity

Application of Navy VI Decision Framework – Page 10

	ZONE 1 (Equip Area)	
Scoring	**Value**	**Score**
Sample Zone Area (ft^2)	44,000	
SS SG Concentration ($\mu g/m^3$)	80 (27x IASL)	
GW Vapor Concentration ($\mu g/m^3$)	3,191 (1,064x IASL)	
Soil Type (Fine/Coarse)	Coarse	
Solvent Use/Disposal History (Yes/No)	Yes	
Sample Zone on Exterior Wall (Yes/No)	Yes	
Preferential Pathway Present?	No	
Distance to Primary Release	300	
TOTAL SCORE		
Indoor Air Concentration ($\mu g/m^3$)		15

Presentation Overview

- Introduction
- Key Messages in 2015 EPA Final Guidance
- Closing the VI Pathway: Technical Challenges and Solutions
- Case Studies
- Hands-On Activity – Application of Navy VI Decision Framework
- Wrap-Up

Key Navy Messages

- **VI CSM**
  - **Focus on CERCLA site-related releases**
  - **Incorporate site-specific CSM information that supports departure from default values**
    - Leverage the Navy VI Database
  - **Continually refine CSM and engage stakeholders throughout the process**
  - **Don't assume all potential entry points are significant preferential pathways**
- **Selecting the Optimum Investigation Strategy**
  - **Plan with the exit strategy in mind**
  - **Strength of evidence depends on CSM; weight MLE accordingly**
  - **Consider State-of-the-Science methods**

Key Navy Messages (cont.)

- **Short-term Toxicity**
  - If TCE is a suspected COC for indoor air, plan for rapid response prior to sample collection
- **Community Involvement**
  - Use NAVFAC & NMCPHC Risk Communication Guidance
  - Coordinate with Base Commanders and Public Affairs Office
- **Assessing Risks and Making Decisions**
  - Follow the CERCLA process like any other pathway
  - Sample indoor air for site-related CERCLA chemicals only
  - Use short-term toxicity values to evaluate less-than chronic exposure
  - Use Navy VI Database Decision Matrix to assist in decision-making

Key Navy Messages (cont.)

- Site Management
  - Use CSM and EPA flexibilities to establish source cleanup levels and indoor compliance levels
  - Leverage partnering process to gain stakeholder agreement
  - Consider cost-benefit analysis of vapor source cleanup vs. VIMS installation and OM&M

Resources

- NAVFAC Factsheet: V*apor Intrusion Five Year Review Protectiveness Statements* (Link to factsheet is on ERB Secure – CAC-protected)
  - https://hub.navfac.navy.mil/webcenter/portal/exwc/Business_Program_Lines/page142/page190;jsessionid=qvZXrFR0hDS5FOoVMlttz5eePF2B5Q3SD8Q9GNlY1494CWGRKhJ!219705999!2111032779?_adf.ctrlstate=qf6sc1w6_60&wc.contextURL%3D%2Fspaces%2Fexwc%26=&_afrLoop=2881679388726#!%40%40%3F_afrLoop%3D2881679388726%26centerWidth%3D100%2525%26lastReviewedDate%3D27%2BOct%2B2014%26leftWidth%3D0%2525%26pocEmail%3Dbarbara.a.johnson1%2540navy.mil%26rightWidth%3D0%2525%26showFooter%3Dfalse%26showHeader%3Dfalse%26wc.contextURL%253D%252Fspaces%252Fexwc%2526%3D%26_adf.ctrl-state%3Daxmgplg0h_4
- Past RITS on VI CSMs – 2008, 2011, and 2013
  - www.navfac.navy.mil/navfac_worldwide/specialty_centers/exwc/products_and_services/ev/erb/rits.html
- ERB – ERT2 VI CSM Resource
  - https://www.navfac.navy.mil/navfac_worldwide/specialty_centers/exwc/products_and_services/ev/erb/vi.html#t2_tools
- ESTCP-SERDP VI Tool
  - http://t2.serdp-estcp.org/t2template.html#tool=CSM&page=S1

Resources

U.S. Environmental Protection Agency (EPA). 2015. OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air. Office of Solid and Waste Emergency Response (OSWER) Publication 9200.2-154. June.

United States Environmental Protection Agency (U.S. EPA). 2016. Vapor Intrusion Website: www.epa.gov/vaporintrusion/

United States Navy, RITS presentations: http://www.navfac.navy.mil/navfac_worldwide/specialty_centers/exwc/products_and_services/ev/erb/rits.html

Venable P., T. Chaundry, D. Caldwell, I. Rivera-Duarte, L. Lund, C. Lutes, K. Hallberg. 2015. "Quantitative Decision Framework for Assessing Navy Vapor Intrusion Sites" Revised Draft Final Report of Navy Environmental Sustainability Development to Integration (NESDI) Project #476, June.

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