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Headquarters U.S. Air Force

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AFCEC Emerging Contaminants & Broad Agency Announcement Programs



FRTR

14 Nov 2013

AFCEC/CZTE
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Presentation Outline

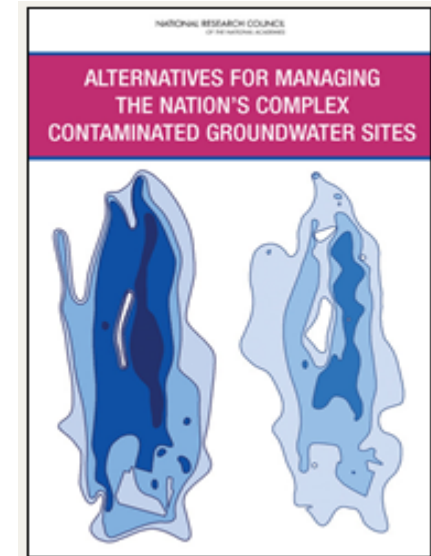
1. Why have an AFCEC EI/EC Program
2. EI/EC Program Process
3. Overview of the AFCEC BAA Program
4. Current list of AFCEC EI/ECs
5. 1,4-Dioxane
6. Per/polyfluorinated compounds (PFCs)
7. Conclusions



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Challenges for Closing Sites Under PBR Initiative

1. **Budget**
2. **Policies**
 - Executive Order Mandate - Green and Sustainable Remediation
 - AF UU/UE Policy
3. **Regulatory Cooperation**
 - Bioavailability concepts
 - Appropriate exposure scenarios
4. **Complex Sites**
 - DNAPL in Fractured Bedrock
5. **Rate Limiting Environmental Processes**
 - Mass Diffusion in Fine-Grain Aquifers
6. **Emerging Issues and Contaminants**
 - Changing Regulatory Standards (e.g. PFCs and 1,4-Dioxane)



http://www.nap.edu/catalog.php?record_id+14668



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AF Definitions:

Emerging Issues are chemicals, materials or items that have the potential to affect the AF's ability to execute programs, impacts schedules, increases cost, alters the technical approach, or necessitate the need to develop new partnerships.

***Environmental* Emerging Contaminants are chemicals that are in the environment that present real or potential unacceptable human health or environmental risks and either:**

- do not have regulatory cleanup standards, or**
- the regulatory standards are changing.**

DoDI 4715.18 Emerging Contaminants, June 2009



Why an AFCEC EI/EC Program?

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- Complement and support OSD's Chemical and Material Risk Management Program (CMRM), EC and MERIT programs
- Focus on AF Environmental Restoration Program (ERP) priorities and needs (restoration and site clean-up/closure)
- Promote state-of-the-science decisions and environmental actions within AFCEC (new health standards/toxicology; new technology)
- Ensure that the AF can achieve site closure by identifying all environmental liabilities and has sufficient guidance and technical information needed to address that EI/ECs:
 - May re-open sites or delay Site Closure (SC)
 - May not be commonly monitored
 - Are often undetectable with current analytical methods
 - Represent "future" potential environmental liability

AFCEC EI/EC Program: Conceptual Approach

>80,000 unregulated
chemicals in the
environment

OSD EC & MERIT Programs

AF EI/EC Program supports
OSD EC Program

~30 of potential
concern DoD

AFCEC EI/EC Program

AF identifies contaminants that likely
impact AF Environmental Restoration
Program (ERP)

~10 potential
concern for AF
ERP

2 AF
ECs

AF EI/EC focuses on ERP *technical* DATA GAPS:

- Can we define remedial objectives (**target risk levels**)
- Can we detect at level of concern (**analytical methods**)
- Can we cleanup to target (**adequate technologies**)
- What is the **cost** impact to ERP





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Technology Data Gap Filling

➤ Internal Function:

- Extent of occurrence
- Programmatic support
 - Budget impact
 - Field guidance

➤ External Function:

- The AF funds demonstration/validation projects through AFCEC Broad Agency Announcement (BAA) Program
 - Pilot scale field studies
- The AF supports SERDP/ESTCP
 - Contribute toward the development of annual Statements of Need
 - Participate in down selects
 - Provide technical support





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AFCEC BAA Approach: Overarching Goals

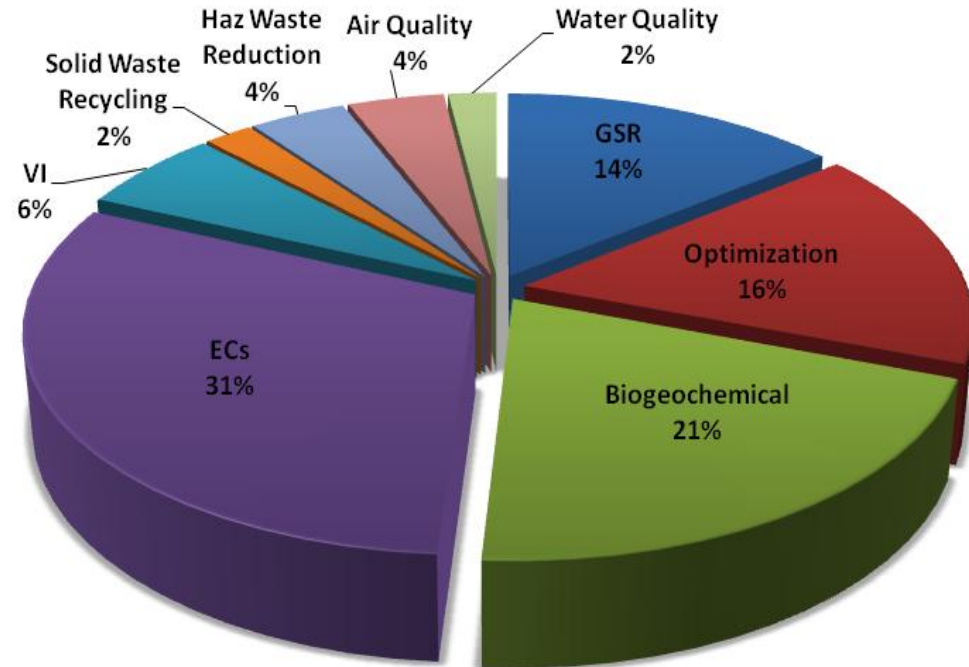
- Environmental Directorate (CZ): Restoration & Compliance/Quality
- Desires unique/creative solutions and/or advances in knowledge, understanding of an innovative technology
- BAA states its requirements in terms of areas of need or interest, rather than specific solutions or outcomes
- Contract mechanism based on technical merit for demonstration and validation of innovative solutions
- **Goals:**
 - Identify more technically advanced, efficient, effective, sustainable, and cost-effective solutions
 - Lead to accelerated site closeout for restoration, prevent future environment pollution, and advance environmental compliance
 - Serve future AF environmental needs



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Environmental BAA Makeup (FY08-FY13)

- 49 total contracts awarded
- ~\$26M ER, ARRA, and EQ
 - 43 ER projects (\$19.3M)
 - 1 ARRA project (\$5.8M)
 - 5 EQ projects (\$1.1M)
- ER projects range from \$97K to \$990K from 1 to 3 years length
 - Average \$450K per project
 - Average 32 months per project



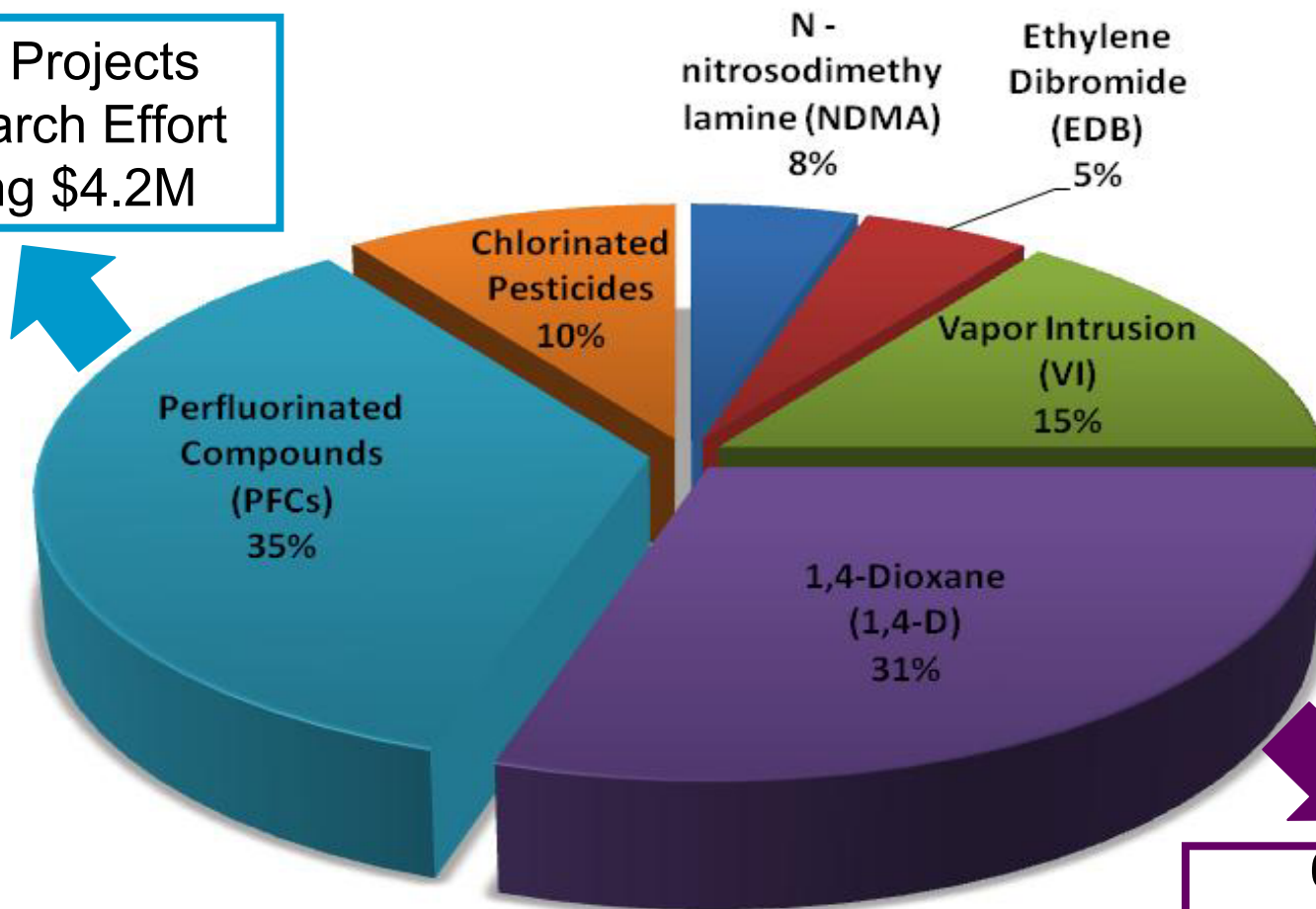
61% large business
24% small business
10% academia
5% Federal Agency



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AFCEC ER BAA Focus EC (FY11-13)

6 BAA Projects
1 Research Effort
Totaling \$4.2M



6 BAA Projects
Totaling \$3.8M



Current AFCEC EI/ECs

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EMERGING ISSUE	CURRENT ACTION	Aug 2013
AF ERP ECs: Response/Action List		
1,4-Dioxane	AF Guidance & Monitor EPA and State actions	
Chromium VI	Monitor EPA and state actions	
PFCs (PFOA/PFOS)	AF Guidance & On-going investigations	
TCE (short-term, Vapor Intrusion risks)	Monitor State & EPA Region implementation, participate in Tri-Service working group	
In Review/Assessment List		
1-Bromopropane	Preliminary evaluation	
Benzo[a]pyrene	Preliminary evaluation/ Monitor regulatory actions	
Chemical Mixtures (PAHs & PCBs)	Preliminary evaluation/ Review of scientific methods/ Monitor regulatory actions	
Munitions-related Metals	Preliminary evaluation	
Actions Completed List		
Perchlorate		
Manganese		
Dioxin	Q&A for Tri-Service RPMs	
Lead	Final evaluation – no impact to ERP	



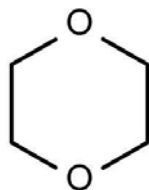
AFCEC Interest 1,4-Dioxane

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What is 1,4-Dioxane?

Solvent stabilizer:

- 1,1,1-TCA (~5% v/v)
- TCE (<1% v/v)



Cyclic ether, C₄H₈O₂

	VP (mm Hg)	Solubility (mg/L)
1,4-Dioxane	38	Infinite
Water	24	Infinite
1,1,1-TCA	124	1,290
TCE	69	1,280

We know that:

- 1,4-DX is a listed CERCLA hazardous substance but is NOT a common environmental contaminant of concern (COC) due to lack of an MCL
- Known AF liability with chlorinated solvents reflects potential for significant liability with 1,4-DX (known and unknown)
 - Vapor degreasers concentrate 1,4-DX (>10X) in waste solvent
- Analytical detection limits are only recently sensitive enough to detect concentrations of concern (~0.67 µg L⁻¹)
- Much (inadvertent) data exists to evaluate due to the fact that 1,4-DX is a standard analyte reported by commercial labs using USEPA 8270

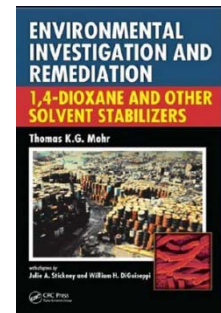
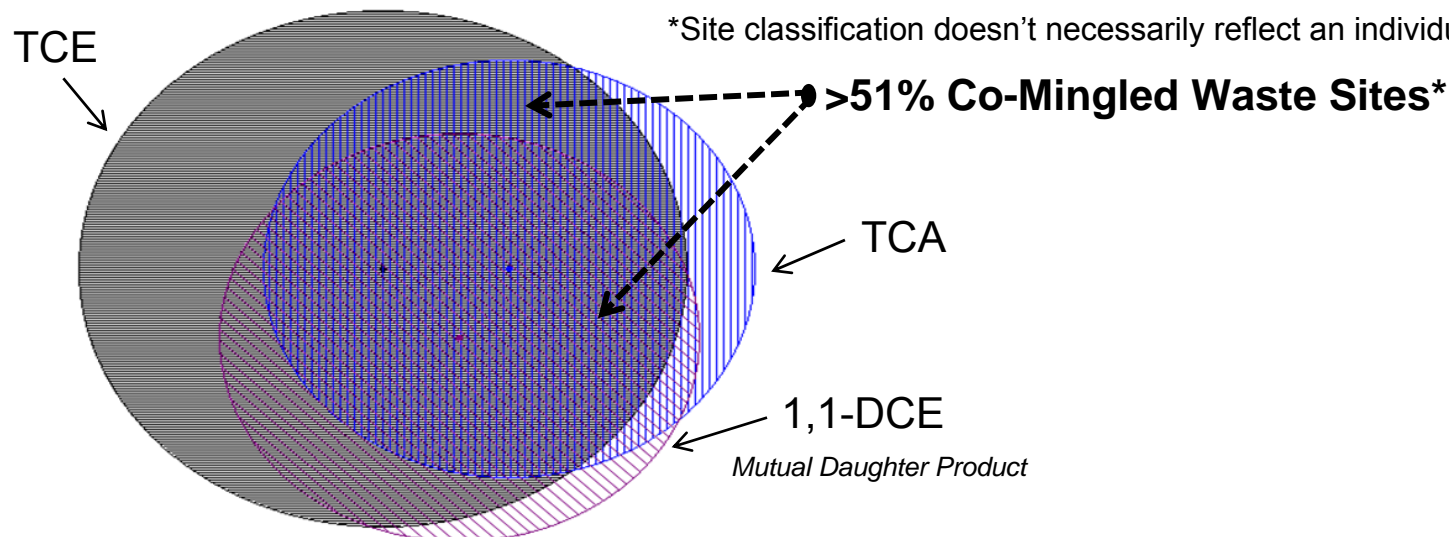


1,4-Dioxane Key Data Gaps

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TCE is primary chlorinated solvent used/released by the AF

- Various alternative solvents (e.g., TCA) were used due to evolving health and safety regulations throughout the mid-century
- Authoritative reference (Mohr 2010) acknowledges possibility of 1,4-DX in historic TCE formulations but considers the source of 1,4-DX in GW at environmental sites exclusively a result of TCA release
- No literature on the extent to which TCE, TCA, and 1,4-DX co-occurs in GW



Mohr (2010)

Source: Environmental Restoration Program Information Management System (ERPIMS)



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1,4-Dioxane Data Gap Summary


Weight of Evidence:

1. Definitive association with TCA
2. Significant statistical association with TCE
 - Categorical (presence/absence)
 - Quantitative (quantile regression)
3. Majority of sites are contaminated with both TCE and TCA
 - Combined association ~18%
4. Sites don't necessarily reflect a release

Phased Execution Approach:

1. Confirmation
2. Nature and Extent
3. Remediation

Programmatic Guidance



DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON, DC

16 AUG 2013

MEMORANDUM FOR SEE DISTRIBUTION LIST


FROM: HQ USAF/A7C
1260 Air Force Pentagon
Washington, DC 20330-1260

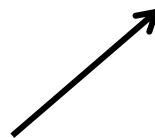
SUBJECT: Guidance on 1,4 Dioxane, Environmental Restoration Program

This memorandum serves as Air Staff guidance for responding in a standardized way to 1,4 Dioxane, a solvent stabilizer. Some regulatory agencies have expressed concerns regarding 1,4 Dioxane during the cleanup process. Due to evolving science and regulatory standards, 1,4 Dioxane presents a potentially unacceptable human health or environmental risk. As a result, the Air Force will respond to 1,4 Dioxane subject to DoDI 4715.18, *Emerging Contaminants*. The following actions apply:

- a. AFCEC and the NGB should implement the DoDI and the attached guidance at active installations, BRAC installations, transferring properties, GOCO properties, NGB properties, other than operational ranges and active ranges (for the non-munitions constituents) accordingly by providing technical guidance to the MAJCOMs and installations as necessary.
- b. AFCEC and the NGB should program and budget for appropriate response actions when warranted.

MAJCOMs and installations should refer requests for sampling and other response actions to Mr. William Ryan, AFCEC/CZR, DSN 969-8783, william.ryan.1@us.af.mil. NGB installations should contact Mr. Russ Dyer, NGB/A7OR, DSN 612-8149, russell.dyer@ang.af.mil, and BRAC installations should contact Dr. Steve Termaath, AFCEC/CIB, DSN 969-9428, stephen.termaath@us.af.mil. Any further questions on Emerging Contaminants should be addressed to Ms. Elaine Ross, A7CEV, DSN 612-4260, elaine.ross@pentagon.af.mil.


MARK A. CORRELL, SES, P.E.
The Deputy Civil Engineer
DCS/Logistics, Installations & Mission Support



1,4-Dioxane Technology Data Gap

- Funding dem/val projects through AFCEC BAA Program

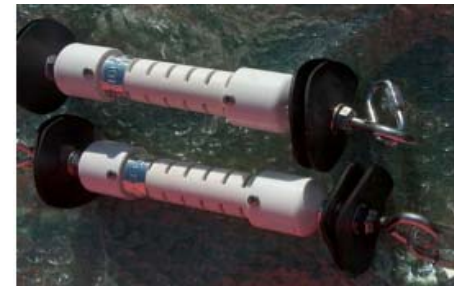
In situ bioremediation

Demonstrate biodegradation of 1,4-dioxane metabolically or by propanatrophs



Molecular biomarkers of natural attenuation

Demonstrate the application of biomarkers for assessing in situ monooxygenase-catalysed biodegradation of 1,4-dioxane



- Strategically align with DoD SERDP/ESTCP on Statement of Needs



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AFCEC EI/EC Program 1,4-Dioxane Conclusions

- AF guidance lays out the roadmap for prioritizing responses using data-driven logical process
 - IDs “applicable” sites for initial sampling
 - Provides technical recommendations for analytical methods, and levels of concern
- Treatment technologies are an important component to the AF strategy and AFCEC Environmental BAA is committed financially:
 - **In Situ Remediation** of 1,4 Dioxane Contaminated Aquifers (CBI, Dr. Robert Steffan)
 - Development of **Molecular Biomarkers** to Support **Natural Attenuation and Bioremediation** of 1,4-Dioxane (U of California-Los Angeles, Dr. Shaily Mahendra)
 - Documenting **enhanced biodegradation** of NDMA and 1,4-Dioxane under methane-oxidizing conditions (CBI, Dr. Paul Hatzinger)
 - Novel Substrate Application for **Bioremediation** of Comingled 1,4-Dioxane and Chlorinated Solvent Plumes (Solutions-IES, Mrs. Jessica Keener)
 - Concurrent In-Situ **Cometabolic Biodegradation** of 1,4-Dioxane and Chlorinated Ethenes Using Recirculation (Haley Aldrich, Dr. Jacob Chu)
 - **Bioaugmentation** to Enhance Biodegradation of 1,4-Dioxane (AECOM, Mrs. Rebecca Mora)



AFCEC Interests in PFCs

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- **Operationally, PFC*-based aqueous film forming foam (AFFF) *the* product of choice for fuel fires in the AF**
 - Nearly 1M gallons of PFOS-based AFFF in stock
- **As an emerging contaminant, not analyzed during site characterization; little sampling data exists**
 - Preliminary results show PFCs in groundwater 3-4 orders of magnitude > USEPA's health advisory
- **Scope of potential impact:**
 - Environmental release from historical fire fighter training exercises (>100 sites)
 - Environmental release from emergency response
 - Environmental release from testing or emergency activation of fire suppression systems in AF hangars
 - Other spills and releases



**Per/poly fluorinated compounds*



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PFCs Occurrence Data Gaps

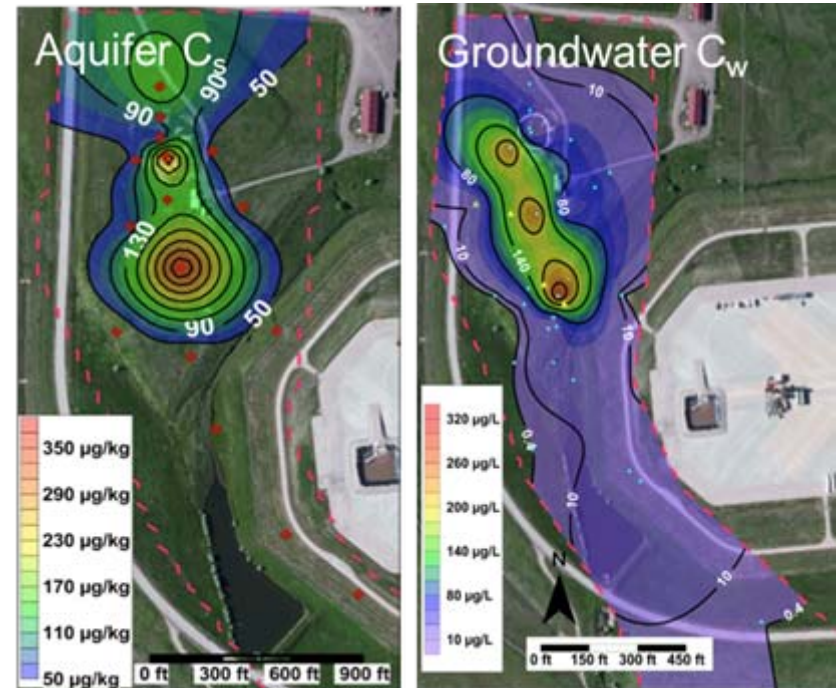
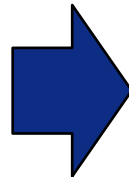
■ Site investigations: 2009-2011

- Randolph AFB, TX,
- Robins AFB, GA,
- Beale AFB, CA
- Eglin AFB, FL
- FE Warren AFB, WY
- McClellan AFB, CA

■ 100% frequency of occurrence



Programmatic response at FTAs



Phased Execution Approach

1. Confirmation
2. Nature and Extent
3. Remediation



AF PFC Guidance – Sep 2012

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- Regulatory Requests for Sampling:
 - Receive documented request with basis for sampling
 - Determine if an exposure pathway exists
 - Program for initial sampling as a standalone action
 - Confirmation sampling only at candidate AFFF release locations
 - Fire Training Areas (FTAs) operable 1970-2000
- AF Enterprise-wide strategy for PFCs:
 - AFCEC will program validated funds requests and authorize response as three discrete steps
 - Confirm release at FTAs; program \$ FY14, sample FY15
 - Define extent, assess pathway; program \$ FY16, sample FY17
 - Mitigate confirmed exposures; program FY17+
- Provide technical information for analysis, risk assessment
- AFCEC Technical Division to sample non-FTA sites



PFC Cleanup Challenges

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- Many conventional treatment approaches are not effective for PFCs in water (e.g., direct oxidation, air stripping, vapor extraction)
- Technologies currently available to treat PFCs in water
 - Granular activated carbon (GAC) is most effective method
 - Drinking water treatment (municipal and private wells)
 - Landfill water treatment
 - Reverse osmosis is effective for higher concentration industrial waste streams
- Bench-scale research to develop alternative treatment approaches continues
 - AFCEC BAA – focus on emerging issues, pollution prevention
 - Half of the funded projects for environmental restoration address PFOS/PFOA



PFC BAA and Technology Research Efforts

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- Use of Boron-Doped Diamond **Electrodes** for Treatment of Perfluorinated Compounds (CBI, Dr. Charles Schaefer)
- Is **bioremediation** a relevant attenuation mechanism for perfluorinated compounds? (U of California-Los Angeles, Dr. Shaily Mahendra)
- **Chemical Oxidation and Inclusion Technology** for Expedited Soil and Groundwater Remediation (EnChem Engineering, Dr. Raymond Ball)
- **Chemical Treatment** of Soil and Groundwater Contaminated with Perfluorinated Compounds found in Aqueous Fire Fighting Foams (US Army Engineer R&D Center, Victor Medina)
- **In-situ Enzymatic Oxidative** Treatment for Perfluorinated Compounds (U of Georgia, Dr. Qingguo “Jack” Huang)
- Focused Remedial Investigation of Potential **Ecological Effects** of Perfluorinated Compounds and Associated Human Exposures from Fish Consumption (Texas Tech University, Dr. Chris Salice)
- Complete **Mineralization** of Fluorochemicals in Aqueous Fire-Fighting Foams Using A Novel Dual-Frequency Based Sonochemical Process (U of Arizona, Dr. Manish Keswani)



Additional AF Studies

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- Current – sampling at non-FTA sites at up to ten AF bases
 - Preliminary assessment/site inspection (PA/SI)
 - Soil, groundwater, surface water, sediment
 - AFFF Lagoons/ponds, aircraft maintenance hangars (and associated oil/water separators), fire stations, chrome plating, etc.

- Future – investigations at 181 AF FTAs
 - FY14 – preliminary assessments
 - FY15 – site inspections
 - FY16 and beyond – remedial investigations, possible mitigation



DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON DC

17 SEP 2012

MEMORANDUM FOR ALL MAJCOM/A7
AFCEE/DR
NGB/A7O
AF/SG3
AFRPA/DR

FROM: HQ USAF/A7C

SUBJECT: Interim Guidance on Perfluorinated Compounds

Perfluorinated compounds (PFCs) are classified as emerging environmental contaminants based on increasing regulatory interest, potential risk to human health and the environment, and evolving regulatory standards. Some Air Force installations have received requests from regulators for environmental sampling for PFCs. MAJCOMs and active installations should refer such requests to Col Jeff Knippel, AFCEE/ER, DSN 969-8784, jeff.knippel@us.af.mil. AFCEE, NGB and AFRPA are the AF POCs for cleanup and will implement the attached guidance in accordance with DoDI 4715.18, *Emerging Contaminants* at active installations, ANG installations and closure properties, respectively.

All Air Force installations in the United States, territories, possessions, Base Realignment and Closure (BRAC) properties, active ranges, and other than operational ranges, as well as Air Force Government-Owned, Contractor-Operated (GOCO) facilities, are subject to the attached guidance. Responses to regulator requests to sample for PFCs and response actions based on the documented presence of PFCs at an Air Force installation or GOCO facility will be in accordance with the attached guidance. This guidance has been coordinated with the NGB, AFCEE and AFRPA and will be incorporated into AFI 32-7020, *Environmental Restoration*. My POC for this matter is Ms. Elaine Ross, DSN 612-4260, elaine.ross@pentagon.af.mil.


MARK A. CORRELL, SES, P.E., USAF
The Deputy Civil Engineer
DCS/Logistics, Installations & Mission Support

Attachments
1. PFC Guidance



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AFCEC EI/EC Program PFC Conclusions

- AF guidance on PFCs lays out the near-term (FY14-19) roadmap for addressing fire training areas
- While our predictions about AFFF use at fire training areas are solid, less is known about other potential releases
 - Current study at non-FTAs will close data gaps
- Treatment technologies are an important component to the AF strategy
- AF financial commitment through the AFCEC BAA Program





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AFCEC EI/EC Program Overall Conclusions

- Achieving site closeout – law of diminishing returns
 - Difficult-to-treat sites are increasingly all that remain
 - New/changing requirements make achieving SC increasingly difficult

- The AF has adopted a pro-active approach to address emerging issues and contaminants to mitigate programmatic impacts
 - Conduct high-level data mining and analysis
 - Fund and support research initiatives
 - Develop data-driven guidance to ensure systematic responses and practices





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Need Additional Information or Have Questions?

- General information can be found on the AFCEC CZTE EI/EC Program public website

<http://www.afcec.af.mil/environment/technicalsupportdivision/environmentalrestorationtechnicalsupportbranch/emergingissuesemergingcontaminantsprogram.asp>

- Questions can be emailed to Program's organizational mailboxes:

AFCEC/CZTE Emerging Issues

afcec.czte.emergingissues.1@us.af.mil

AFCEC/CZTE BAA

afcec.czte.baa@us.af.mil

