

Implementation of a Strategic Approach for Complex Vapor Intrusion Assessment at a Large Military Facility

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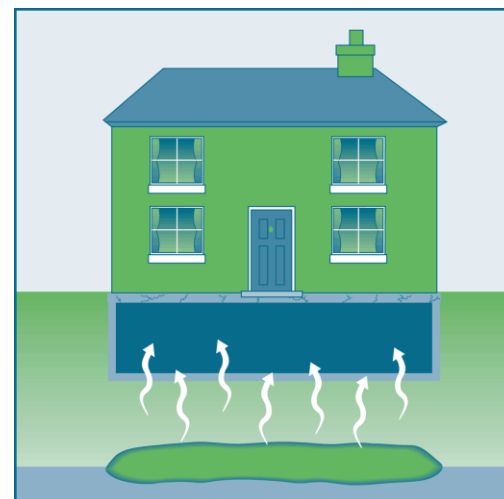
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What is Vapor Intrusion?

- Vapor intrusion (VI) is the transport of gas-phase contaminants from the subsurface to indoor air
- Typically originates from groundwater and/or soil contamination --- volatile organic compounds (VOCs)
- Exposures of contaminants to building occupants are a major concern
- Relatively new regulatory emphasis on assessing VI risk

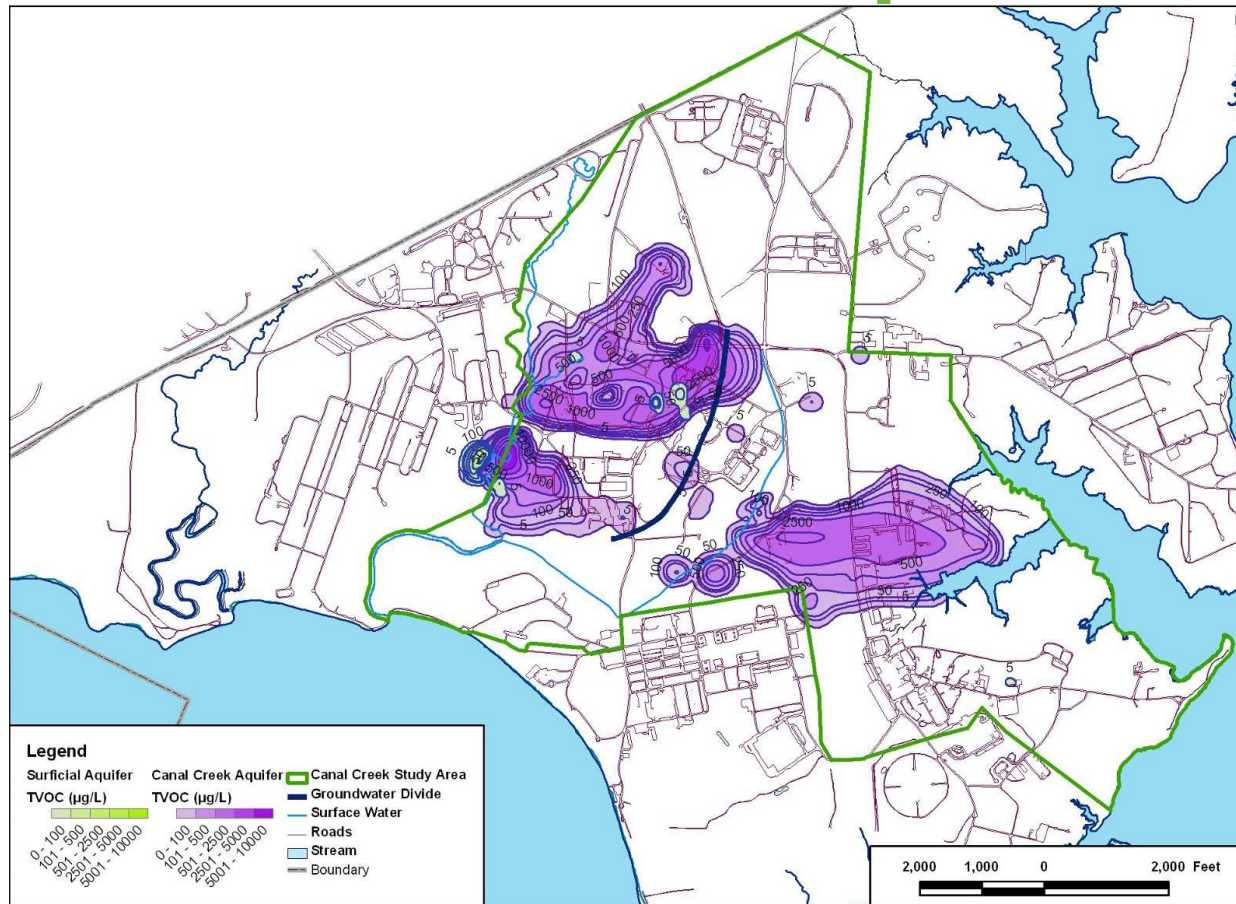


ITRC Vapor Intrusion Team logo; http://www.itrcweb.org/teampublic_Vapor.asp

Aberdeen Proving Ground (APG)

- Established in 1917 in northwestern region of Chesapeake Bay
- R&D, manufacture of military chemical agents
- Portion of APG placed on NPL site in 1990
- Canal Creek Study Area (CCSA)
 - 700-acre parcel
 - Chemical manufacturing 1918 – end of WWII
 - Current use is lab and pilot scale facilities
 - Over 20 years of soil and groundwater investigations

CCSA Groundwater Impacts



(Courtesy of WESTON Solutions)

Key Project Challenges

- Large number of buildings on Site (317)
- Unique contaminants uncommon for VI assessments
- Co-mingled contaminant plumes
- Complex hydrogeology below large site
- Working constructively to meet needs of US Army Federal, and State regulators

Proposed VI Assessment Strategies

- Regulatory Agencies
 - Collect indoor air samples from all buildings
- Geosyntec
 - Proposed phased approach for VI evaluation
 - Conceptual Site Model (CSM) development
 - Data collection to refine CSM
 - Follow-up indoor air sampling for sub-set of buildings
 - Evaluate mitigation needs and options

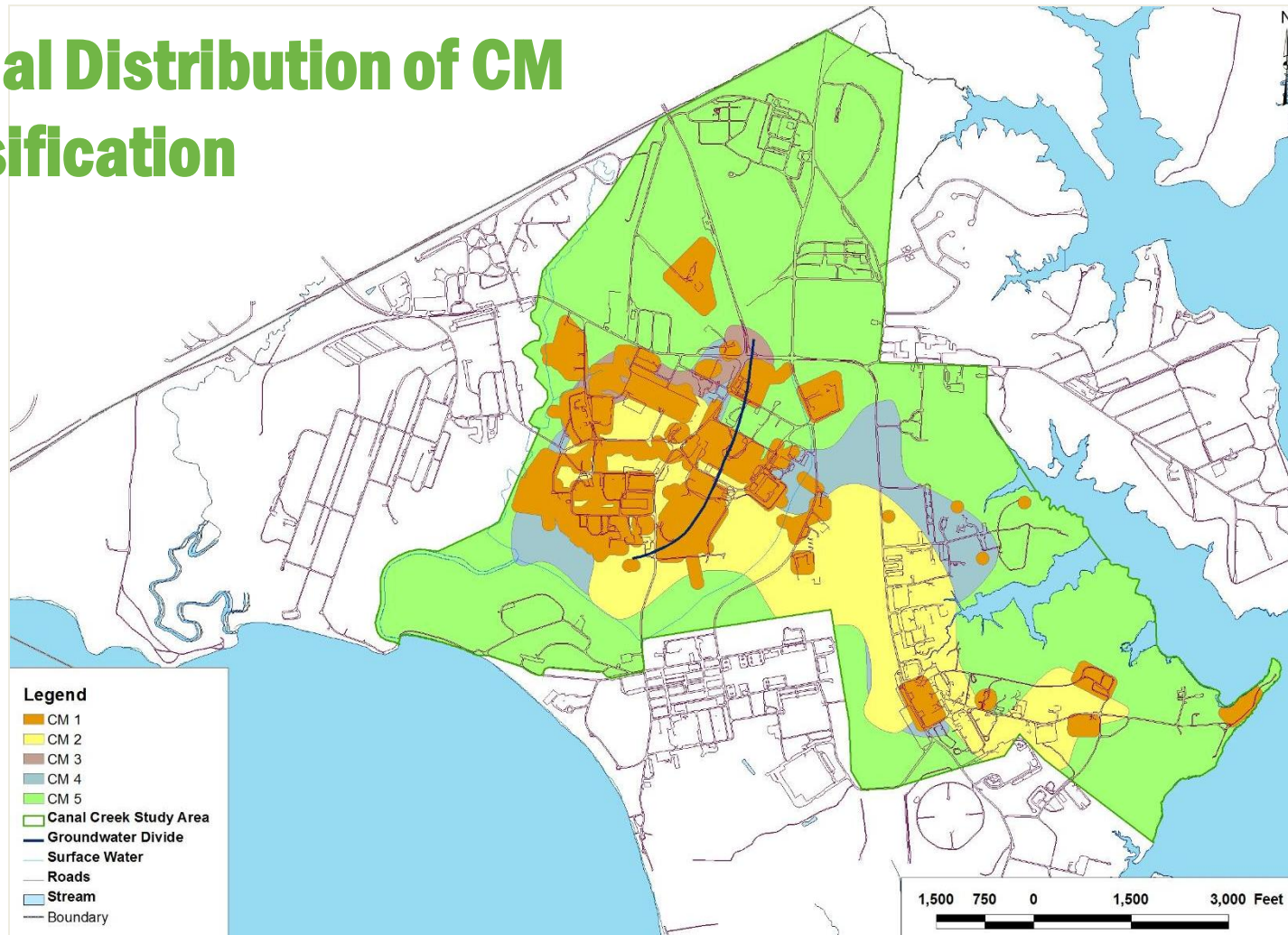
- Develop list of COPCs based on:
 - Calculated screening levels based on risk to building occupants (no VI screening levels available)
 - Detection frequency analysis
 - Generic VI attenuation factors
- COPC screening results
 - 15 of 90 contaminants retained for groundwater
 - 46 of 160 contaminants retained for soil
 - COPCs include VOCs, SVOCs, PCBs, chemical warfare material (CWM) degradation products, and mercury

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- Sources of Contamination
 - Primary – Locations of Former Activities
 - Secondary – Subsurface Contaminant Distribution
 - Pathways
 - Geology
 - Hydrogeology
 - Receptors (Building) Characteristics
 - Buildings (Use, Occupancy, Foundation, HVAC)

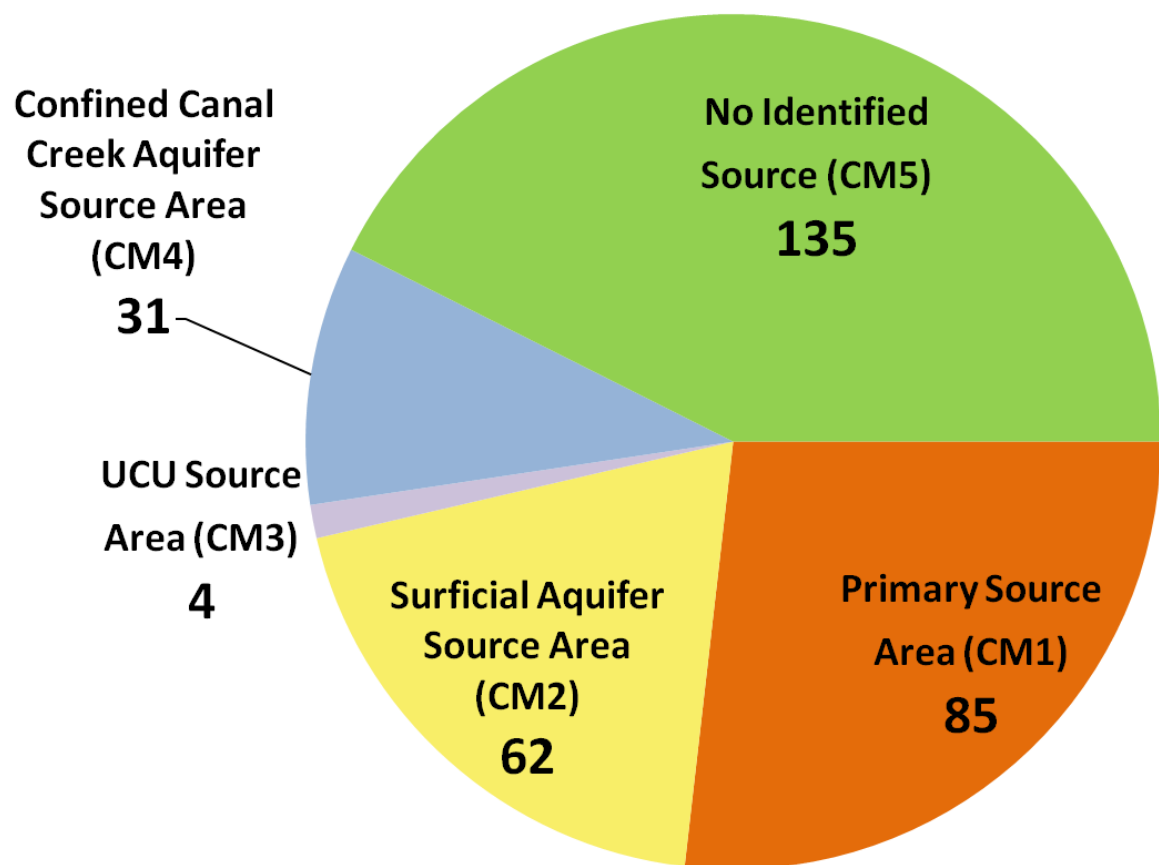
Conceptual Site Model Development

Conceptual Model ID	Description
Conceptual Model #1 Primary Source Areas	Residual COPCs in the Vadose Zone near or beneath buildings
Conceptual Model #2 Surficial Aquifer Source Areas	COPCs present in unconfined aquifer with no confining unit above the water table
Conceptual Model #3 Upper Confining Unit (UCU) Source Areas	COPCs present in the UCU, and materials above the UCU are unsaturated
Conceptual Model #4 Confined Canal Creek Aquifer (CCA) Source Areas	COPCs are present in the CCA, and the UCU is present above the CCA
Conceptual Model #5 Areas with No Identified Source or No Existing Buildings	No sources or receptors identified

Spatial Distribution of CM Classification



Buildings per CM Classification



CM 1	27%
CM 2	20%
CM 3	1%
CM 4	10%
CM 5	43%

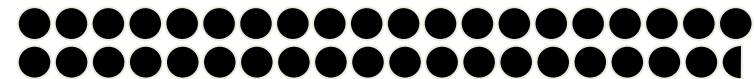
Conceptual Site Model Development

Evaluation Step

Building Count

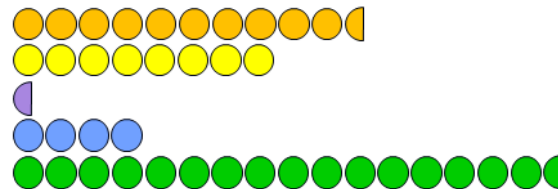
**Database/GIS
Analysis and
Risk Screening**

317



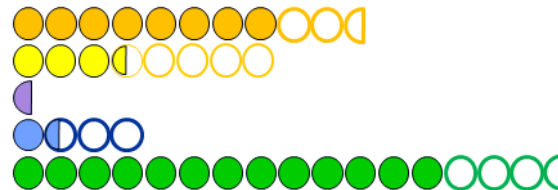
**CSM
Development**

CM1 85
CM2 62
CM3 4
CM4 31
CM5 131



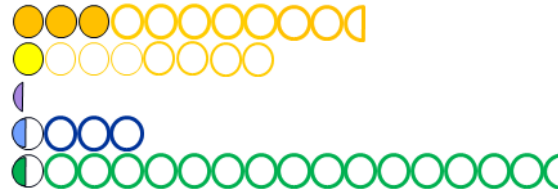
**Building
Occupancy
Screening**

CM1 62
CM2 29
CM3 4
CM4 12
CM5 104

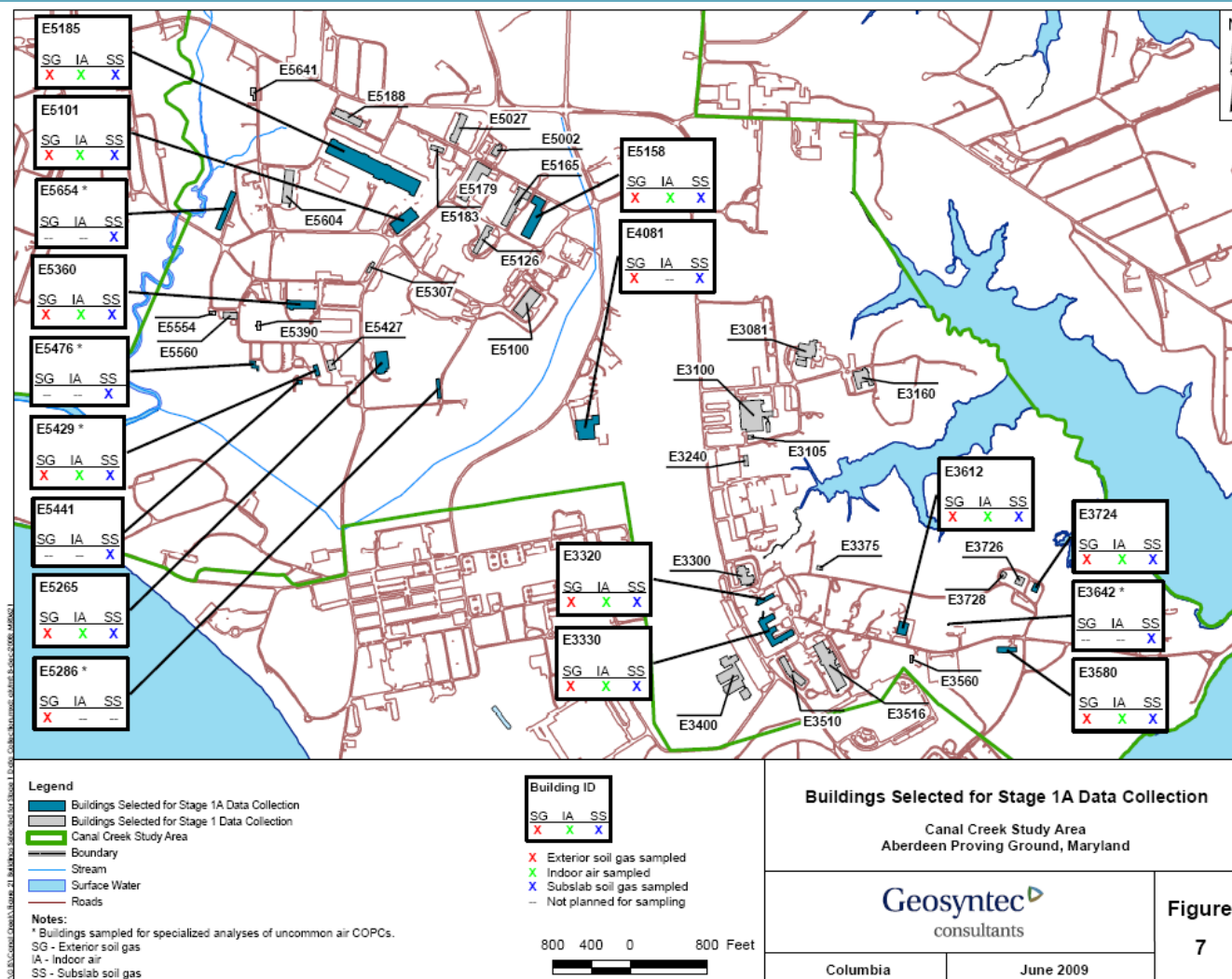


**Stage I Field
Investigation**

CM1 26
CM2 9
CM3 1
CM4 3
CM5 2



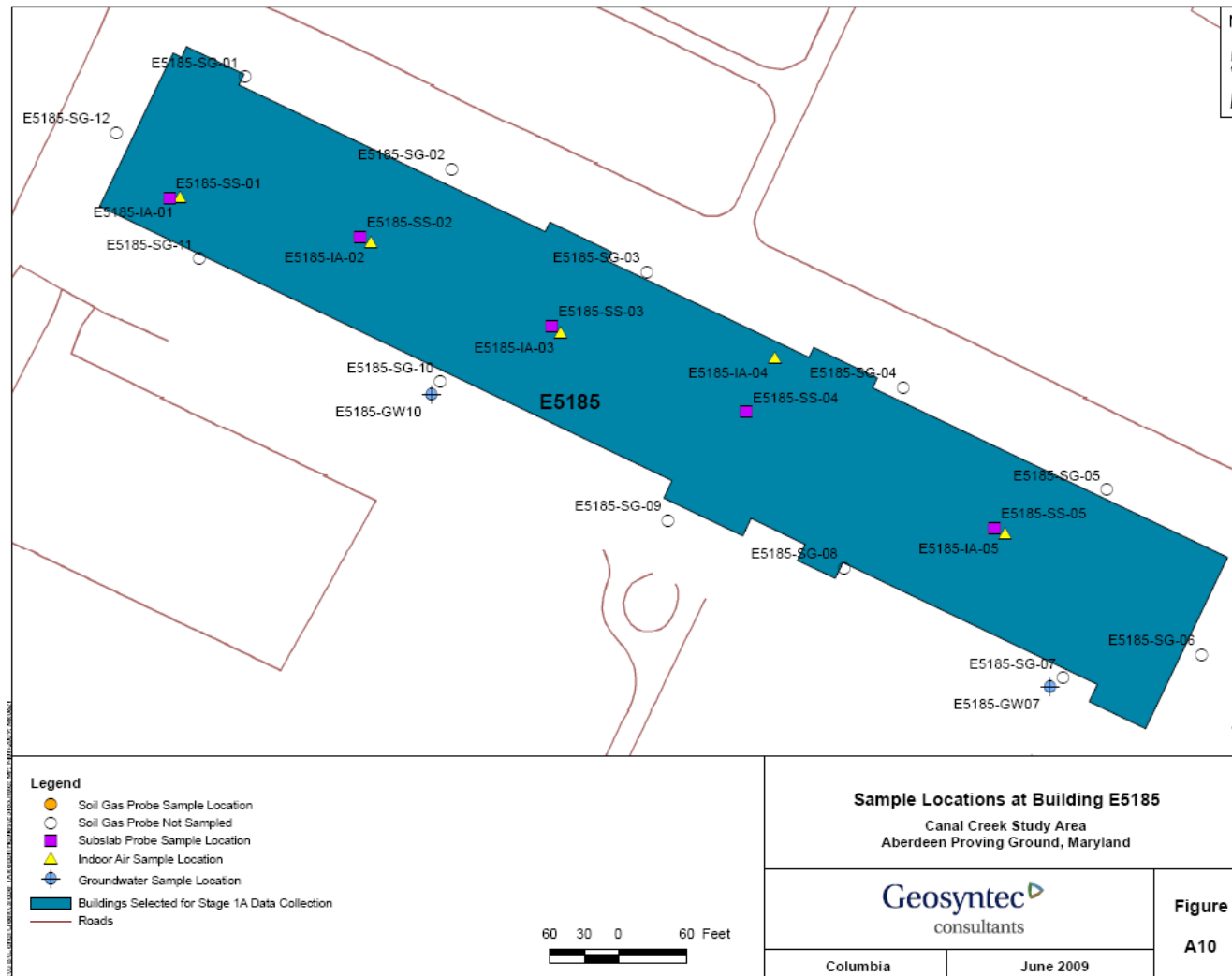
Conceptual Site Model Development



- Building-specific sampling plans were developed
- Assessment of uncommon and analytically-challenging COPCs at locations of maximum historical concentration
- Groundwater, soil gas, and sub-slab samples around target buildings to assess subsurface vapor sources
- Indoor Air sampling to assess receptor air quality
- Extensive Quality Assurance/Quality Control procedures
 - Pneumatic testing
 - Tracer testing
 - Building ventilation survey
 - Inter-method comparisons
 - Equipment blanks
 - Trip blanks

- MEC clearance and monitoring during subsurface activities
- High Purge Volume sub-slab sampling to increase spatial footprint of sample
- Sorbent tubes for mercury, pesticides, PCBs, SVOCs, and chemical warfare agents
- Waterloo Membrane Samplers for long-term average indoor air concentrations; selected verification via 8-hr Summa canisters







- Only 2 of 15 buildings in the initial phase of investigation showed potential for VI possessing a complete VI pathway
 - Contaminants detected in subsurface and in indoor air above screening levels
 - Carbon tetrachloride, chloroform, PCE, TCE, hexachloroethane (HCA)
 - Confirmatory sampling during “heating season” verified results
 - Long-term monitoring suggested with mitigative actions possible
- Uncommon COPCs, mercury, pesticides, and most SVOCs were not found to pose unacceptable exposures

- Quality Assurance and Quality Control procedures well received well by all stakeholders
 - Important when relying on the data for scoping decisions
- Results to date support limiting additional investigations – significant cost savings to the Army



- US Army was tasked with assessing Vapor Intrusion at a Site with greater than 300 buildings and significant groundwater/soil impacts
- The large number of buildings and unique contaminants created a challenging scenario and led to regulatory stalemate
- Geosyntec was able develop and implement a systematic CSM to prioritize buildings and identify receptors most at risk to potential VI
- Initial field investigations indicate only 2 of 15 high priority buildings have potential VI concerns
- Results to date support limiting additional investigations – significant cost savings to the Army

Thank You for Your Attention!
Questions?

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