



Sustainable and Healthy Communities (SHC) Research Program

Update with Program and Regional
Partners: Overview of FY15 Products
on Contaminated Sites and
Environmental Releases of
Oils and Fuels

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Mike Slimak
SHC National Program Director

Andrew Geller
SHC Deputy National Program Director

Karen Chu
SHC IO Staff



Agenda

- **FY15 Product Overviews**
 - **Contaminated Sites (3.61)**
 - **Report on Methods to Evaluate Bioavailability to Reduce Community Exposure to Metals in Soil (2.62)**
 - **Environmental Releases of Oils and Fuels (3.62)**





SHC's Research Topics



Decision Support Tools

Develop tools and approaches to assist community stakeholders in making environmental decisions



Community Well-Being

Provide research and metrics to predict interactions between natural and built environment to promote individual and community well-being and maintain or restore high environmental quality



Sustainable Approaches for Contaminated Sites and Materials Management

Provide science and technical support to assess and manage contaminated sites. Develop science that supports materials reduction, reuse, recycling, and disposal to minimize environmental impacts



Integrated Solutions for Sustainable Communities

Integrated sustainability assessments: Develop tools and research to assist communities in holistically evaluating their decisions so they can optimize economic, societal, ecological, and human health outcomes



Topic 3: Sustainable Approaches for Contaminated Sites and Materials Management

Provide science and technical support to assess and manage contaminated sites. Develop science that supports materials reduction, reuse, recycling, and disposal to minimize environmental impacts.

Project 3.61

Contaminated Sites

(a) Technical Support; (b) Site Characterization, Remediation, & Management; (c) Impacts of Contaminated Ground Water

Project 3.62

Environmental Releases of Oils and Fuels

(a) Oil Spills; (b) LUST

Project 3.63

Sustainable Materials Management

(a) Life Cycle Management; (b) Re-use of Organics & Other Materials; (c) Regulatory Support

EPA Report (EPA/600/R-15-237)

Contact: David Burden

Description: This report summarizes the quick-response support that the GWTSC provided to EPA program staff and regions in 2014. It includes some technical support case studies, analyzes support provided by requestor and issue, and highlights selected quests and support provided.

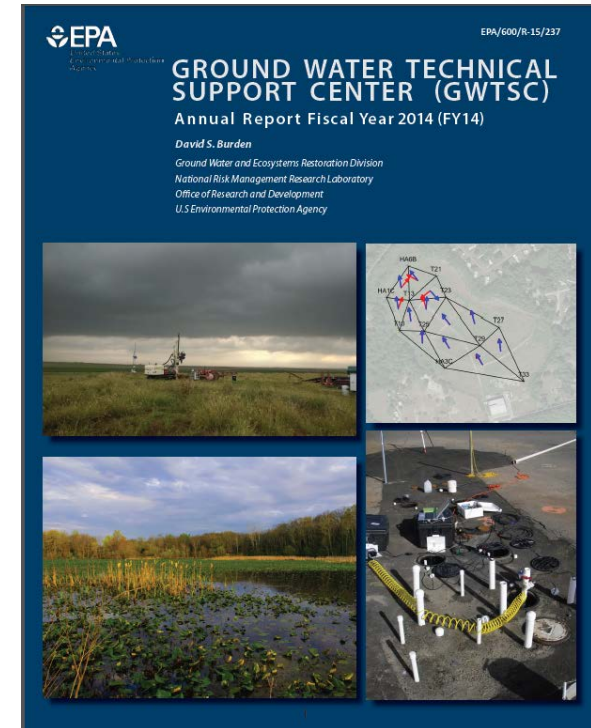
Findings:

- EPA Regions made >40 support requests; 28 States made support requests (1-3 per state).
- Center for Subsurface Modeling Support software remains popular. Biochlor and BioScreen were each downloaded more than 1500 times.

Expected Use: The report will be used by EPA management to understand the volume and nature of ground water technical support needs. Contaminated sites staff can read it with an eye toward cross-site learning.

Available on SHC's Intranet: [Ground Water Technical Support Center Annual Report Fiscal Year 2014](#)

Soon to be on NSCEP: [Ground Water Technical Support Center Annual Report Fiscal Year 2014](#)



EPA Report (EPA/600/R-15/132)

Contact: John McKernan

Description: This annual report provides a brief overview of the types and quantity of services provided by the Engineering Technical Support Center in 2014, and highlights technical support provided to high-profile sites.

Findings:

- ETSC responded to approximately 270 technical support requests from over 120 contaminated sites in all 10 EPA Regions, Territories (Puerto Rico) and internationally (Vietnam and China).
- Seventy-five percent of the Superfund site requests were National Priority List sites.

Expected Use: The goal of this report is to improve the state of remediation technology and science and to facilitate faster and more cost-effective cleanup for contaminated sites. By communicating broadly about technical problems and their solutions, the report facilitates cross-site and cross-regional learning and decision support.

Available online: [Engineering Technical Support Center Annual Report Fiscal Year 2014](#)

EPA Report (EPA/600/S-15/239)

Contact: David Burden, John McKernan, or Felicia Barnett

Description: The Lessons Learned document highlights technical support provided to high-profile sites, and gives a brief overview of the types and quantity of services provided. It also conveys Support Center insights on technology applications and success stories (lessons) from the support provided.

Findings: Six case studies present issues and lessons learned.

- In Situ Chemical Oxidation
- Ground Water Flow Spreadsheet Tool (3PE – 3 Point Estimator)
- Engineering Issue: Biotransformation of Dimethylarsinic Acid
- Engineering Issue: Passive Samplers for Investigations of Air Quality
- ProUCL – Statistical Software for Data Analysis to Support Site Remediation
- Ground Water/Surface Water Interactions and Cross-Media Transfer

Expected Use: These case studies and their lessons learned will help contaminated site decision makers (in OLEM, EPA Regions, and other organizations) incorporate the newest scientific approaches and solutions and learn from others.

Available on SHC's Intranet: [EPA Technical Support Centers: FY14 Lessons Learned](#)

Soon to be on NSCEP: [EPA Technical Support Centers: FY14 Lessons Learned](#)

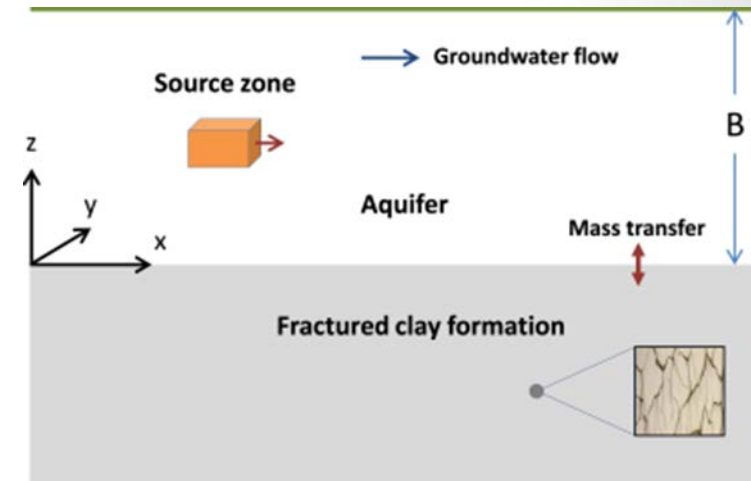
Journal Article

Contact: Junqi Huang

Description: The goal of this study is to develop and apply a model that can be used to simulate the effects of fractures in a low permeability zone on back diffusion, and subsequently, on the evolution of a dissolved contaminant plume.

Findings: The article presents a 3-D analytical model that simulates contaminant transport in a dual layer aquifer system. It accounts for diffusive exchange between the fractures and the low permeability matrix. It provides insights into the process of back diffusion from the fractured clay formation.

Expected Use: These analytical solutions can be used by hydrologists to analyze contaminant fate and transport in a dual-layer aquifer system with various source zone architectures. They can also be used to assess the mass flux through the aquifer/fractured clay formation interface.



Available online: [Semianalytical Solutions for Transport in Aquifer and Fractured Clay Matrix System](#) (Water Resources Research. 2015. 51:9, 7218-7237.)

Journal Article

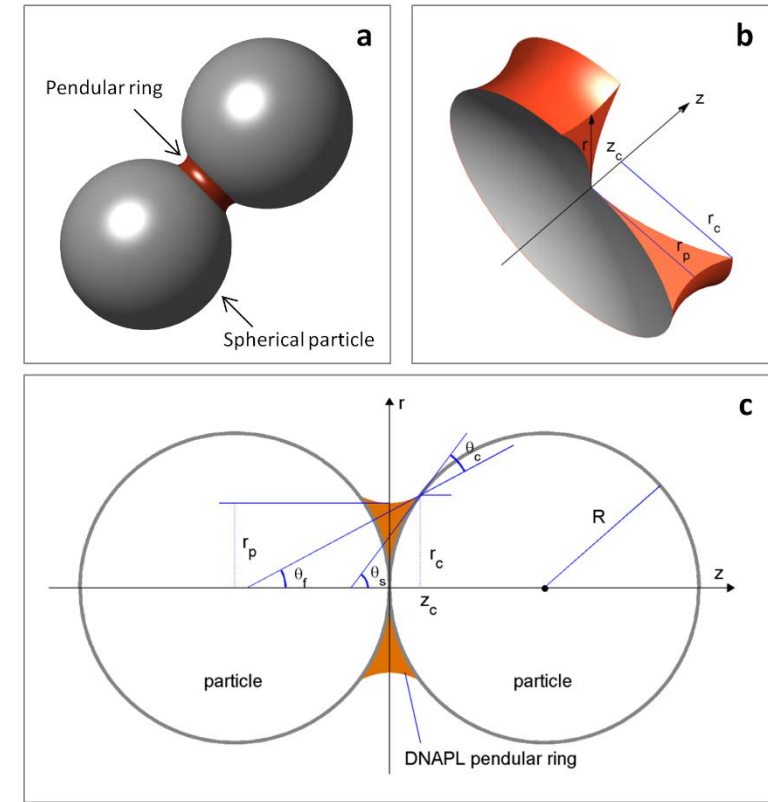
Contact: Junqi Huang

Description: The goal of this study is to provide a theoretical means of calculating the rate of dissolution of NAPL in organic-wetting situations where the NAPL is immobilized as pendular rings surrounding the contact point between spherical soil particles.

Findings: An exact solution to the Young-Laplace equation, assuming NAPL resides as pendular rings in porous media, is presented. This analytic expression for interfacial area is then coupled with an exact solution to the advection-diffusion equation in a capillary tube assuming Hagen-Poiseuille flow to provide a theoretical means of calculating the mass transfer rate coefficient for dissolution at the NAPL-water interface.

Expected Use: This research will be used by ground water remediation experts (in EPA, States, and other organizations) to guide remediation strategies. It may be necessary to include long-term source containment as a component of the source remediation strategy.

Available online: [Modeling NAPL dissolution from pendular rings in idealized porous media](#) (Water Resources Research. 2015. 51:10, 8182–8197, doi:10.1002/2015WR016924.)



Journal Article

Contact: Michael Brooks

Description: This study investigated the uncertainty of mass discharge measurements associated with point-scale measurement techniques by deriving analytical solutions for the mass discharge coefficient of variation for two simplified conceptual models.

Findings: Simplified equations for uncertainty were investigated to facilitate screening-level evaluations of uncertainty as a function of sampling network design. Results were used to express uncertainty as a function of the length of the control plane and number of wells, or alternatively, as a function of the sample spacing. Uncertainty was also expressed as a function of a new parameter, ω , defined as the ratio of the maximum local flux to the product of mass discharge and sample density.

Expected Use: This research can be used to estimate mass discharge measurement uncertainty. An iterative investigation approach (where current knowledge is used to design field tests to collect more data) is recommended if the level of uncertainty is unacceptable.

Available online: [Screening-Level Estimates of Mass Discharge Uncertainty from Point Measurement Methods](#)
(Journal of Contaminant Hydrology. 177-178 (2015) 167-182)

EPA Report (EPA/600/R-15/454)

Contact: Bob Lien or Robert Ford

Description: This report reviews the theoretical basis for calculating seepage flux, the requirements for design of the temperature monitoring network, and examples of data processing and calculations of seepage flux for standing and moving surface water systems.

Findings: The sediment temperature method provides a flexible and relatively simple alternative to the traditional techniques of seepage flux quantification.

Expected Use: Agency scientists and programs involved in site restoration and watershed revitalization/protection decisions can use the seepage flux measurement and analysis methods in this report to evaluate potential risk management procedures at sites where contaminant exchange across the groundwater-surface water transition zone occurs.

Available online: [Quantifying Seepage Flux Using Sediment Temperatures](#)

Internal Report

Contact: Mohamed Hantush

Description: As a first step in the development of a watershed-scale fate and transport model of metals, this report presents the construction and calibration of a hydrogeologic model for the Spring River Watershed using SWAT (Soil and Water Assessment Tool).

Findings: The SWAT model results show an overall satisfactory goodness of fit for base flow and surface flow. However, further improvement of the hydrologic account and performance measures is desirable. Model performance needs to be validated. Limitations include accounting for the complex karst geology and improper account for daily water withdrawals and return flows from industrial and municipal water users during calibration. Additional research on increased spatial resolution of soil data and precipitation is planned to address issues identified to date.

Expected Use: The primary goal of this watershed modeling effort is to estimate annual average mass flux for sediment and contaminants of concern for the Spring River and its tributaries draining to Empire Lake. The modeling will support CERCLA or other regulatory mitigation decisions.

Available on SHC's Intranet: [Hydrologic Modeling in the Tri-State Mining District Using SWAT](#)

EPA Report (EPA/600/R-15/289) (In EPA External Peer Review)

Contact: Lawrence Burkhard

Description: This document provides guidance on procedures for deriving IWRGs for the protection of benthic organisms living in and on the sediments. It addresses IWRGs for nonionic organic chemicals including polycyclic aromatic hydrocarbons, a few ethers, low molecular weight compounds, many pesticides, and some phthalates.

Findings: It provides information on passive sampling techniques and the selection of adverse effect concentrations. It shows how to develop IWRGs for a single toxicant and for multiple toxicants with the same mode of action. It is the first methodology for developing remediation goals using the bioavailable form of the chemical. Therefore, costs associated with sediment site remediation should decrease.

Expected Use: This guidance will be used by OLEM/Superfund to set remediation goals at sites with contaminated sediments to protect benthic invertebrates. It is applicable in fresh and marine aquatic ecosystems.

Available on SHC's Intranet: [Deriving Sediment Interstitial Water Remediation Goals for the Protection of Benthic Organisms from Direct Toxicity](#)

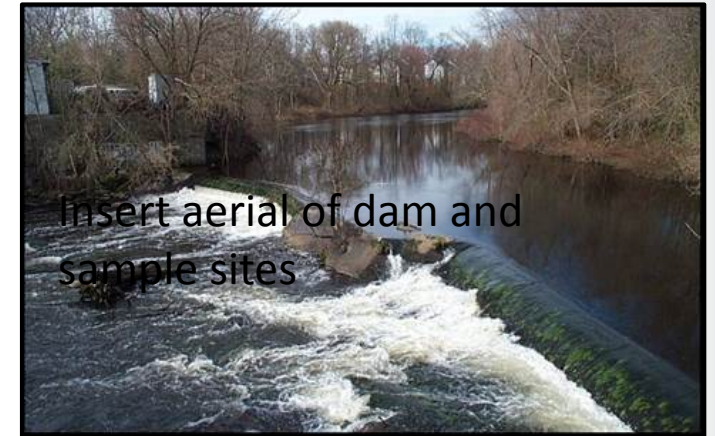
Journal Article

Contact: Mark Cantwell, Robert Burgess

Description: This journal article summarizes a study that developed and evaluated a new passive sampling approach for measuring contaminant fluxes in riverine systems prior to and following dam removal.

Findings: Use of passive sampling technology and sediment traps was highly effective in monitoring the concentrations and flux of contaminants moving through the riverine system. Overall, dam removal did not cause measurable sediment disturbance or increase the concentrations or fluxes of dissolved or particulate PAHs and PCBs.

Expected Use: Remedial project managers and others managing contaminated sites can use these study results to improve methods and approaches that assess the short- and long-term impacts that ecological restoration activities have on the release and transport of sediment-bound contaminants.



Available online: [Assessing Organic Contaminant Fluxes from Contaminated Sediments Following Dam Removal in an Urbanized River](#) (Environmental Monitoring and Assessment. 2014. 186:4841-4855)

Internal Report and Peer-Reviewed Journal Articles

Contact: Karen Bradham

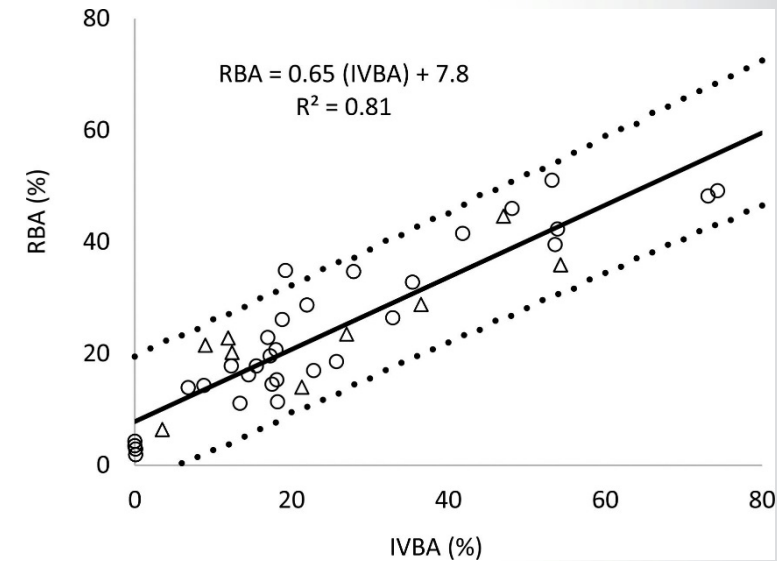
Description: The research conducted for this product evaluated bioavailability methods and provided data that support the efforts of Regions and communities to assess potential human exposures to arsenic (As) contaminated soils and reduce economic impacts.

Findings: The in vivo-in vivo comparison, in vivo–in vitro correlation, and independent data validation presented for the in vitro bioaccessibility method provide critical supporting information for use in human health risk assessment.

Expected Use: The 2014 and 2015 journal articles are currently being used by OSWER and EPA’s Bioavailability Committee in the development of guidance and policy for a validated arsenic bioaccessibility method in human health risk assessments of contaminated soils. This research is helping drive reduced cleanup costs and limiting volumes of contaminated media through less intrusive remedial options.

Available on SHC's Intranet: [Report on Methods to Evaluate Bioavailability to Reduce Community Exposure to Metals in Soils](#)

- [Independent Data Validation of an in Vitro Method for the Prediction of the Relative Bioavailability of Arsenic in Contaminated Soils.](#) Environmental Science & Technology. 2015, 49, 6312–6318.
- [Variability Associated with As in Vivo–in Vitro Correlations When Using Different Bioaccessibility Methodologies.](#) Environmental Science & Technology. 2014, 48, 11646–11653.
- [Mouse Assay for Determination of Arsenic Bioavailability in Contaminated Soils.](#) Journal of Toxicology and Environmental Health, Part A: Current Issues. 76:13, 815-826.



EPA Report (EPA/600/R-15/070)

Contact: Brian Schumacher

Description: This 3rd report of the Vapor Intrusion series continues to fill in practitioner knowledge gaps identified by OLEM and Regions. It focusses on the need to determine the optimal timing to collect determinative vapor intrusion samples. It presents a first-ever how to forecast temporal variations in vapor intrusion. It also evaluates whether different sampling strategies would yield different cancer risk and noncancer hazard outcomes, and which strategies might provide a better estimate of the true mean exposure.

Selected Findings: 1) Vapor intrusion strength appears to be a function of multiple independent weather and hydrogeological variables (as many as 10) interacting in complex ways. 2) The week-to-week change in the differential temperature was more important than the absolute value of the differential temperature. 3) In a hypothetical TCE/cancer risk scenario, daily samples had a higher false-negative rate than weekly samples.

Expected Use: Audiences for this research include OLEM, EPA Regions, DOD, vapor intrusion researchers, and parts of the private sector that deal with VI issues and mitigation. This report can be used to guide sampling efforts nationwide. The improved exposure information it affords will improve decisions on whether to mitigate and what the associated risks are.

Available online: [Simple, Efficient, and Rapid Methods to Determine the Potential for Vapor Intrusion into the Home](#)

Journal Article

Contact: Robyn Conmy

Description: This study investigated the anaerobic biodegradation of flaxseed biodiesel under methanogenic and sulfate-reducing conditions using the Biochemical Methane Potential test and the primary disappearance rate of target compound. The behavior of flaxseed biodiesel was compared to that of soybean biodiesel. The objective was to determine how changes in the fatty acid methyl ester profile affect biodegradation.

Findings: Flaxseed biodiesel could be effectively degraded under both methanogenic and sulfate-reducing conditions. Under methanogenic conditions, no inhibition in biodegradation was observed at petrodiesel loads between 1.0-7.5 μl ; the inhibitory effect began to prevail when the petrodiesel volume was $\geq 15 \mu\text{l}$. Under sulfate-reducing conditions, the physiochemical properties of the FAME compounds determine degradation rather than the abundance of FAME compounds. Degradation 1) decreased as carbon chain length for saturated FAMES increased, and 2) increased with increases in the number of double bonds.

Expected Use: This research will be used by EPA's Office of Emergency Management and others involved in site remediation. External audiences include USDA and DOE's Office of Energy Efficiency and Renewable Energy. This research contributes to the body of knowledge about the relative merits of alternative fuels.

Available online: [Anaerobic biodegradation of soybean biodiesel and diesel blends under methanogenic conditions](#) (Water Research. Volume 87, 15 December 2015, Pages 395–402)

Draft Report and Screening Protocol Recommendations

Contact: Robyn Conmy

Description: This draft report presents the results of lab tests that evaluate the surface washing effectiveness of 28 products on fresh Prudhoe Bay crude oil. It identifies modifications to the sand-washing method (Koran et al, 2007) that improve repeatability and reproducibility, use commonly found shoreline substrates, and reduce testing costs.

Findings: For the products tested in the round robin experiment, Surface Washing Agent Effectiveness (SWAE) as measured by LCL95 values ranged between 3-56%. Adding subsequent rinses to the protocol improved the removal efficiency and the coefficient of variation, thereby increasing the LCL95 values and repeatability. Suggested protocol modifications allow for a wider distribution of SWAE for products and for better differentiation between products. Thus, cutoff criteria should be easier to establish.

Expected Use: The SWA Effectiveness test should be further developed using the new EPA reference oils that OLEM is selecting. This improved effectiveness test can serve as a basis for proposed new listing criteria for surface washing agents in the National Contingency Plan. Results of the test will also provide emergency responders with comparative data on the effectiveness of products.

Available on SHC's Intranet: [Development of a Surface Washing Agent Effectiveness Protocol for the National Contingency Plan Product Schedule](#)

Journal Article (pending publication)

Contact: James Weaver

Description: This pilot study developed 2 methods (a wells added method and a net housing unit method) to update the 1990 estimates of private domestic well (PDW) usage from publicly-available data. OK was selected as the geographic focus because the state of OK freely distributes required data.

Findings: Both methods give similar results. Their estimates are best viewed as indicators of areas with high or low PDW usage, as groundtruthing and data analysis identified limitations. Patterns of high PDW density are related to the provision of public water in both urban and rural areas, as well as whether the area overlies productive aquifers. In Enid, OK, a 2012 ban on the use of city water for lawn watering led to a dramatic increase in drilling of new wells.

Expected Use: These 2 methods will be used to develop nationwide estimates of areas likely to depend on private domestic wells. This information can then be used by OLEM to consider the proximity of high PDW areas to hazardous release sites. This high PDW information can also be used for other water provision, public health, planning, and emergency notification purposes.

Draft available on SHC's Intranet: [Environmental and Demographic Factors for Estimating Private Domestic Well Use in the United States: A Pilot Study in Oklahoma.](#)

[Presentation](#) at the Groundwater Protection Council Forum