

CURRICULUM VITAE

Court D. Sandau, PhD, PChem

Profile

Dr. Sandau is the principal and senior chemist at Chemistry Matters. Previously, Dr. Sandau was president of TRIUM Environmental Inc. and a senior lead and laboratory manager at the Centers for Disease Control and Prevention (CDC).

Dr. Sandau specializes in expert witness & litigation support; environmental forensics investigations; geoforensics investigations; scientific advisor; biomonitoring studies & data interpretation; data quality/data validation; and arson investigations.

Dr. Sandau has written over 100 publications and has given numerous presentations internationally to his peers. Dr. Sandau is respected globally for his expertise and has worked in multiple countries.

Education

Carleton University, Ottawa, ON, 2001 – Doctorate of Philosophy in Chemistry

University of Western Ontario, London, ON, 1995 - Bachelor of Sciences in Chemistry and Environmental Science

Career Summary

2011-present Chemistry Matters Inc., Calgary, AB - Principal and Senior Chemist

2011-present University of Calgary, Calgary, AB - Adjunct Professor, Department of Civil Engineering

2006-2011 Trium Environmental Inc., Calgary, AB - President and Senior Chemist

2004-2006 Jacques Whitford Limited, Calgary, AB - Senior Risk Assessor and Western Regional Practice Lead

2000-2004 Centers for Disease Control and Prevention, Atlanta, GA – Senior Lead and Laboratory Manager

1995-2000 National Wildlife Research Center, Gatineau, PQ - Researcher

Memberships and Associations

- Association of the Chemical Profession of Alberta (ACPA), Board of Directors
- American Chemical Society (ACS), Member
- International Association of Arson Investigators (IAAI)
- Fire Investigation Association of Alberta (FIAA)
- Journal reviewer: Analytical Chemistry, Environmental Health Perspectives, Environmental Toxicology and Chemistry, Environmental Science & Technology, International Journal of Exposure Analysis and Environmental Epidemiology, Chemosphere, Environmental Forensics, Atmospheric Environment

Selected Project Experiences

EXPERT WITNESS & LITIGATION SUPPORT

Source Determination and Fingerprinting of Polycyclic Aromatic Hydrocarbons (PAHs) and Petroleum Hydrocarbons in the Gowanus Canal

Hess Corporation, USA

2015-present

Review and data interpretation to guide environmental forensics investigation to establish likely source fingerprints and allocate source of PAHs and PHCs in sediment and other environmental samples in the Gowanus canal.

Environmental Forensics Investigation into Historical Contamination of River Sediments

Three Rivers Management Inc, Pittsburgh, USA

2012-present

Reviewing historical reports and statistically analyzing environmental contaminant data from Portland Harbour Superfund site to evaluate chemical fingerprints of contaminants on site and in river sediments. The case involves the chemical fingerprinting of polychlorinated dibenzo-*p*-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), polycyclic aromatic hydrocarbons (PHCs), petroleum hydrocarbons (PHCs) and other environmental contaminants associated with manufactured gas plants and wood treatment facilities.

Environmental Forensics Investigation of Environmental Contaminants in Centredale Manor Restoration Project Superfund Site

Stanley Black&Decker, Rhode Island, USA

2012-2015

Used historical sampling reports, data and records to determine fingerprints for potential sources of polychlorinated dibenzo-*p*-dioxins and polychlorinated dibenzofurans (PCDD/Fs) and other contaminants measured as part of previous site investigations. Developed expert reports and testified on fundamentals of PCDD/Fs as well as the fingerprinting PCDD/Fs resulting from the different manufacturing processes and waste streams involved with Agent Orange and 245-TCP manufacturing.

Petroleum Hydrocarbon Fingerprinting for Source Allocation of Soil and Groundwater Contamination

ATCO Electric and Imperial Oil, Alberta

2012-2015

Conducting review of historical environmental reports to assess data quality and data gaps for a potential source allocation of a historical spill. Developed sampling strategy to fill in data gaps as well as interpreted specialty analysis to assess allocation. Jointly retained by two potentially responsible parties to act as intermediary and develop an opinion on potential source.

Government Inquiry and Investigation of Odours (VOCs) from Cold Heavy Oil Production (CHOPs)

Baytex Energy Corporation, Alberta

2013-2014

Retained for the development of sampling strategy and development of response to land owners claims of odour issues near Baytex facilities. Established sampling procedures, selected contaminants of concern, conducted intensive field program and reporting. Used fingerprinting techniques on volatile organic compounds (VOCs) and polycyclic aromatic compounds (PAHs) to determine contaminant sources. Project involved public communication of scientific data to regulatory agencies, government officials (ministers) and local residents at a public inquiry.

Sampling and Chemistry Expert Witness Support for Petroleum Refinery Case

BP, Texas

2012-2013

Providing expert witness support in reports and review of plaintiff documents on potential air contaminants allegedly associated with the BP refinery operation. Examined PAH fingerprinting and diagnostic ratios as part of source determination of contaminants.

Patent Lawsuit Involving Removal of Contaminants from Pharmaceutical Grade Fish Oil

Pronova, California

2011

Provided expert opinion on persistent organic pollutant (POPs) measurements in a pharmaceutical grade fish oil product. Patent involved the process of removal of POPs from the pharmaceutical product and potential patent infringement of that process.

Class Action Lawsuit Involving Alleged Exposure to Dioxins at a Wood Treatment Facility

Koppers Inc, Mississippi

2009-2010

Investigated alleged exposure to polychlorinated dibenzo-*p*-dioxins and polychlorinated dibenzofurans (PCDD/Fs) from a former wood treatment facility. Services were retained to analyze chemistry data and biomonitoring data from human blood samples and comparing to the National Health and Nutritional Examination Survey (NHANES) and other human biomonitoring scientific literature.

Class Action Lawsuit Involving Alleged Exposure to PCBs at a Former Transformer Manufacturing Facility

Kuhlman Electric Corporation, Mississippi

2009-2010

Investigated alleged exposure to polychlorinated biphenyls from a former transformer manufacturing facility. Services were retained to develop testing procedures and to analyze environmental chemistry data and human biomonitoring data from blood samples and conducted statistical comparisons to the National Health and Nutritional Examination Survey (NHANES) and other scientific literature.

Class Action Lawsuit Involving Alleged Exposure to Dioxins at a Wood Treatment Facility

Roy O Martin, Mississippi

2009-2010

Investigated alleged exposure to polychlorinated dibenzo-*p*-dioxins and dibenzofurans (PCDD/Fs) from a wood treatment facility. Services were retained to analyze environmental chemistry data and biomonitoring data from human blood samples and compared to the National Health and Nutritional Examination Survey (NHANES) and other scientific literature.

Class Action Lawsuit Involving Alleged Exposure to Dioxins, PAHs and Metals at a Wood Treatment Facility

Burlington Northern Santa Fe Railway Company, Texas

2007-2010

Investigated alleged exposure to chlorinated dioxins, PAHs and metals from a local railroad tie plant. Exposure pathways include inhalation of ambient air and incidental ingestion of soil. Services were retained to analyze chemistry data, and the corresponding risk assessment, and to render an expert opinion on residential exposures.

Toxicology Review and Chemical Composition of Coal Fly Ash and Comparisons to Soil from Local Residential Properties

Confidential Client, Nova Scotia

2006-2009

Retained as a plaintiff expert and investigated the chemical composition of fly ash (coal) and compared to soil samples collected from the surrounding community and plaintiff properties. The potential human health effects linked with ambient exposures to fly ash and its associated elements were also studied as part of the investigation. Sixty-five metals were analyzed, including a number of heavy metals and rare earth metals.

Risk Assessment and Toxicology Review for Perchlorate

City of Colton, California

2006-2007

Retained as a plaintiff expert. Investigated exposures to perchlorate in the environment and the potential human health effects associated with those exposures. Additionally, reference doses and drinking water standards (e.g., maximum contaminant level; MCL) that have been derived for perchlorate were critically reviewed. Other project-related chemicals of concern include trichloroethylene, dichloroethylene and vinyl chloride.

PCDD/F and PCB Fingerprints and Concentrations in Fish and Sediment

Lone Star Steel, Texas

2006

Lead expert in analytical chemistry for the measurement of polychlorinated biphenyls (PCBs) and polychlorinated dibenzo-*p*-dioxins and dibenzofurans (PCDD/Fs) patterns and levels in fish species and sediment. Provided critical review of analytical and field-sampling methodology, interpretation of data and third party reports, and development of field sampling programs to adequately assess risk. Lead expert witness for the measurement of PCBs and PCDD/Fs fingerprints and levels in fish species and sediment to determine potential sources.

Class Action Lawsuit Involving Alleged Polychlorinated Biphenyl/Dioxin Exposure

Borg Warner Inc, Mississippi

2004-2005

Testifying expert for assessing alleged exposure of local residents to PCBs and polychlorinated dibenzo-*p*-dioxins and dibenzofurans (PCDD/Fs). Provided an opinion on laboratory quality assurance-quality control, significance of blood contaminant levels (biomonitoring) by comparing to the National Health and Nutritional Examination Survey (NHANES), PCB pattern assessment and the proper scientific process.

Expert Witness/Report on H₂S and SO₂ for Sour Gas Oil Well Application to the Alberta Energy and Utility Board

Vaquero Energy Inc, Alberta

2004-2005

Provided an expert report on the potential impact to air quality from a proposed sour gas well application for Alberta EUB approval. Examined the local air shed and air modeling reports for toxicological interpretation and provided opinion on potential health implications from the proposed development. All information was supplied to support public hearing for development.

ENVIRONMENTAL FORENSICS INVESTIGATIONS

Petroleum Hydrocarbon Environmental Data Interpretation

Gibsons Energy Inc, Alberta

2014-2015

Multiple projects interpreting petroleum hydrocarbon (PHC) fingerprinting data to determine the contribution of different sources of contaminant beneath a historical trucking, historical on-site operations, chemical storage yard, and partly decommissioned oil terminal.

Petroleum Hydrocarbon Fingerprinting of Fresh Release on Multiple Source Spill Zone

Plains Midstream LLC, Alberta

2011-2013

Used petroleum hydrocarbon fractions, chromatogram fingerprinting and petroleum biomarkers (terpanes, steranes, sesquiterpanes and isoprenoids) to provide multiple lines of evidence to distinguish between a recent release of sweet crude from historical spills (dating back to the 1950s) in a pipeline area with multiple potential sources. The chemical fingerprinting allowed the client to definitively delineate the recent spill to allow appropriate remediation of their spill without excessive cost to remediate unrelated historical releases.

Petroleum Hydrocarbon Fingerprinting of Residential Fuel Oils

Stantec Consulting Ltd, Ontario

2011-2012

Conducted an environmental forensics data review on contaminated soil results beneath a residential area. The data reviewed involved chromatogram review, biomarker pattern comparison (terpanes and steranes) and total sulfur content to distinguish two aged sources of fuel oil beneath the property under investigation.

Source Determination of Historical Sub-Surface Free Products From Multiple Fuel Sources

Shell Lube Oil Facility, Busan, Korea

2010

Conducted a sampling event of multiple free product sources including on-site source materials under legal chain of custody standards requiring samples to be shipped to North American laboratory for analysis. The use of a tiered environmental forensics investigation examining chromatograms, analyzing comprehensive PAH and alkylated PAH patterns, and multiple petroleum biomarkers (terpanes, steranes, sesquiterpanes and isoprenoids) determined that multiple sources of free product were present beneath the facility all of which were unrelated to current day activities.

Source and Fate of Nitrate and Nitrite with Domestic Groundwater Aquifer

Imperial Oil, Saskatchewan

2009-2011

Services were retained to design two separate forensic investigations to establish the source of nitrate and nitrite within groundwater in two local communities. The work entailed a detailed review and interpretation of historical data to allow the development of a sampling and analysis plan. The investigation included an extensive analytical program aimed specifically at identifying parameters in groundwater associated with water quality and identification of source. A number of advance analytical techniques (including stable isotopes and potential marker compounds) were applied to determine the source and fate of nitrate within local groundwater.

Petrogenic and Phytogetic Hydrocarbon Investigation

Nexen Energy ULC, Alberta

2007-2008

Conducted an investigation to distinguish between natural and petrogenic sources of hydrocarbons. Project involved examining historical site information, field sampling, interpretation of biomarker data, estimation of natural site levels of phytogetic hydrocarbons, and establishing target clean up criteria for remediation.

Chemical Fingerprinting of Polychlorinated Dibenzo-p-dioxins and Polychlorinated Dibenzofurans (PCDDs and PCDFs) for Source Identification

Assorted Clients, Various Locations

2007-2010

Retained on several expert witness cases and other projects related to potential PCDD/PCDF soil contamination. These investigations have involved historical and current wood treatment facilities as well as historical incineration facilities. Soil PCDD/PCDF patterns were used to evaluate sources and to compare to control sites near the facilities in question. In addition to controls, a research project was conducted to determine background soil concentrations in Alberta and distinguish patterns for background dioxins in Alberta. As a result of these projects and research experience, PCDD/PCDF fingerprinting can be completed on environmental matrices to elucidate sources or allocate responsibility when multiple sources are suspected. Results from these studies have been presented at international scientific conferences in San Antonio and Belgium.

Environmental Forensic Investigation for Creosote Source Identification

Confidential, Alberta

2006

Retained to conduct an environmental forensic investigation at a property adjacent to a former wood treatment facility to identify contamination as well as the source of the contamination. Case involved soil and free product sampling for characterization of contaminants using chemical (extended PAH pattern assessment) and isotopic fingerprinting (stable carbon isotopes of PAHs).

Geoforensic Project Experiences

Investigation of Gas Migration and Surface Casing Vent Fluids for Source Identification

Suncor Energy Inc., Calgary, Alberta

2015-present

Retained for multiple projects to develop sampling procedures for gases and liquids for SAGD operations as well as develop field specific geochemical fingerprints from potential zones implicated in vent flows and gas migration. Program involved non-routine field sampling near wellheads, surface casing vent fluid (gas and liquid) sampling (including steam), production gas and fluids, sampling soil gas well and nearby shallow wells to identify all likely potential sources.

Gas Migration and Source Identification*TAQA North Ltd, Calgary, Alberta**2015*

Retained to sample gas from potential gas migration site located in area where potential biodegradation of other contaminants may be present. Program involved non-routine field sampling near historical wellhead, sampling from soil gas well and nearby shallow gas wells to identify sources of gas emitted from historical wellhead. Additionally, sampling from local production casings for production casing gas was completed to aid in source determination. Biodegradation of contaminants was shown to be providing highest concentrations of gases in shallow soil gas well near abandoned wellhead. Results presented to Alberta Energy Regulator.

Gas Migration and Source Identification*Cenovus Energy Inc, Alberta**2013-present*

Multiple projects to sample gas from potential gas migration sites located at various sites around Alberta. Projects generally includes sampling of surface casing vents using proprietary Chemistry Matters Inc. passive samplers and conducting gas migration investigations using soil probes for soil gas sampling. In addition, local gas samples acquired from production wells (production casing gas) and local gas wells to aid in source determination for the well and for the region.

Monitoring and Verification Program Development and Implementation for Carbon Dioxide and Associated Gases Used in Enhanced Oil Recovery Processes*Cenovus Energy Inc, Saskatchewan**2012-2014*

Retained to aid in the development of sampling and analysis plans for the collection and analytical interpretation of samples collected as part of company's long-term monitoring and verification program. Involvement included analysis of historical data, development of new standard operating procedures for collection of samples, and standardization of data interpretation and reporting. These include sampling strategies for soil gas, surface casing vents, high pressure gas sampling, deep and shallow ground water aquifer sampling and include data interpretation techniques for water chemistries and various gas and liquid isotopic analyses.

Review of Shell Quest Project Hydrosphere and Biosphere Monitoring Program*Shell Canada Ltd, Calgary, Alberta**2012*

Reviewed and provided recommendations on the Shell Quest monitoring and verification program. Project involved comprehensive review of planned activities, data gap assessment, documented comments and suggestions for improvement areas and transfer of lessons learned as part of previous soil gas projects involving carbon dioxide injection programs.

Site Investigation to Assess for Fluids and Gases Potentially Emanating from Enhanced Oil Recovery Program on Landowners Property*Cenovus Energy Inc, Saskatchewan**2011-2012*

Conducted a field investigation in response to a local resident's concern regarding alleged leaking carbon dioxide and hydrocarbons on their property from nearby production activities. The investigation involved the development of a sampling and analysis plan, a statistical sampling plan, two field programs to conduct soil gas and groundwater sampling, data interpretation and reporting. Using a tiered approach, injection gases were characterized using chemical analysis and isotopic analysis (stable and radioactive isotopes) as well as noble gas measurements. The injection gas fingerprint was compared to residential soil and dissolved gas compositions on the property and control site. The results unequivocally determined that gases present in the subsurface on the property of concern were not related to the production activities. Results were communicated through reports and in a press conference.

Methane Forensic Geo-Gas Investigation

City of Calgary, Alberta

2007-2010

Fugitive methane emissions were detected at a number of properties controlled by the City of Calgary. Services were retained to develop a methane reference library for use in the identification of possible sources of fugitive methane. Results from this reference library work were published in a peer reviewed journal. Detailed forensic geo-gas investigation and subsequent tiered forensic evaluation of generated data allowed the development of a methane reference library for typical sources and the identification of potential sources at fugitive methane sites, including a former nuisance ground and a community playground.

Scientific Advisory

Emergency Response for Long Lake/Kinosis Emulsion Release

Nexen Energy ULC, Alberta

2015-present

Serving as senior technical expert for Nexen/CNOOC Ltd. for the emergency response and remediation of the emulsion release at Long Lake/Kinosis. Providing program development support, long term planning for regulatory requirements for closure and technical review for Nexen management on-site and at head office in Calgary, and technical contact with AER.

Emergency Response for NuVista Emulsion Release near Chateh

NuVista Energy Ltd., Alberta

2015-present

Serving as senior technical advisory for remediation monitoring and long term monitoring of the emulsion release. Providing program development support, long term planning for regulatory requirements for closure and technical review for NuVista personnel coordinating response and remediation.

Emergency Spill Chemistry Support

Ridgeline Canada Inc., Alberta

2015-present

Providing chemistry support relating to environmental spills for the environmental consultant Ridgeline Canada Inc., including determination of sampling and analytical practices, and evaluation of environmental fate and transport mechanisms for specific environmental spill response.

Scientific Advisor for Long Term Monitoring of Pipeline Oil Release into Red Deer River

Plains Midstream LLC, Calgary

2012-2015

Served as lead scientific advisor for Plains Midstream for designing, coordinating, reporting and regulatory communication. Provided summary reporting as well as in depth scientific analysis, reporting and communication for all long term monitoring related matters as well as additional project support for residential complaints and investigations.

Produced Water Spill Source Allocation and Volume Estimation

Pengrowth Energy Corporation, Alberta

2014

Retained to evaluate site investigation data to assess salt fingerprint to determine source of high salinity soil concentrations near produced water spill and to estimate release volume.

Drilling Waste Management – Toxicity Review and Risk Assessment

Confidential Client, Middle East

2008-2009

Investigated potential human and ecological exposures to drilling wastes and associated leachate. Exposures are primarily anticipated to occur through ingestion of contaminated drinking water (following leaching) and soils, and dermal contact with soils. This project involved the collection of both water (drinking water wells) and soil samples for analyses of PAHs, volatile organics, dioxins/furans, radionuclides, metals, petroleum hydrocarbons, PCBs, alcohols, glycols, and amines. Additionally, toxicity testing using the Microtox® system was conducted with drilling waste samples to assess relative toxicity. A human health and ecological risk assessment was conducted with the data generated through the site assessment activities.

BIOMONITORING STUDIES & DATA INTERPRETATION

Fish Biomonitoring for Potential PAH Exposure Post Oil Spill

Plains Midstream LLC, Calgary

2012-2013

Retained as senior scientific advisor to Plains for review and project management of long term monitoring studies and fish biomonitoring studies involving the Red Deer oil spill in June 2012. Project focused on assessment of PAHs in sediments and measurement of PAHs in fish tissues.

Biomonitoring Data Interpretation for Legal Cases

Assorted Clients, Various Locations

2004-2012

Services provided for several litigation cases involved development of sampling strategies of human samples, analysis of selected biomarkers and chemical compounds and interpretation of results as compared to the scientific literature and the National Health and Nutritional Examination Survey (NHANES) database. For NHANES comparison, data is extracted from the historical database and statistically analyzed using accepted procedures developed by CDC. This procedure allows customized reference range concentrations to be developed that match the exposure assessment being conducted as part of the litigation proceedings. This procedure has been conducted on exposure assessments for PAHs, PCBs, persistent organic pollutants (POPs) and polychlorinated dioxins and furans.

Developed Semi-Automated Method for the Measurement of Phthalates and Organophosphate Pesticides in Human Urine

ALS Laboratory Group, Alberta

2011

Retained to aid in the development and validation of a semi-automated method for the analysis of conventional pesticides and phthalates in human urine. Method will be used in the evaluation of general population human exposure and other epidemiology studies.

Developed and Applied Methodology for Measurement of Parabens in Human Urine

ALS Laboratory Group, Alberta

2011

Worked in collaboration with a commercial laboratory in the development and application of paraben analysis in human control samples. Project included method development and troubleshooting as well as the determination of normal paraben concentrations in human urine from the general population.

Evaluation of Sources of Arsenic Within Drinking Water Supply and Optimization of Treatment Processes

Cenovus Energy Inc, Alberta

2009-2010

Retained to evaluate the source of arsenic found within a supply of drinking water and optimize a current water treatment system to remove the arsenic from the water supply. The program involved the development of an investigation program, including the design of a sampling and analytical plan, to evaluate the species and source of arsenic as well as risk associated with water consumption. Interpretation of chemical data will allowed for the modification of the engineering system to ensure the removal of arsenic to below regulatory guidelines.

Blood Dioxin Biomonitoring Data Quality Review

The DOW Chemical Company, New Zealand

2007

The project involved a level four quality assurance and quality control assessment for the polychlorinated dibenzo-*p*-dioxin and polychlorinated dibenzofuran analysis of blood plasma samples from a New Zealand biomonitoring study as well as an interpretation and comparison of levels with similar studies and scientific literature.

CFB Gagetown Fish and Freshwater Mussel Dioxin Assessment

Department of National Defence, New Brunswick

2007

The project involved a quality assurance and quality control assessment for the polychlorinated dibenzo-*p*-dioxin and polychlorinated dibenzofuran analysis of fresh water fish and mussel tissues as well as an interpretation and comparison of levels and patterns with similar studies and scientific literature.

CFB Gagetown Pesticide Assessment

Department of National Defense, New Brunswick

2005-2006

Senior advisor for the analytical program for Gagetown pesticide assessment study. Study involved field program targeting the analysis of historical pesticide usage in various environmental media, including by-products such as hexachlorobenzene and 2,3,7,8-TCDD.

Developed and Applied Methodologies for Measurement and Interpretation of Human Exposure to Environmental Contaminants in Blood and Urine

Centers for Disease Control and Prevention, Georgia

2000-2004

This project is a compilation of the work conducted at the CDC in Atlanta. Managed laboratory responsible for environmental contaminant exposure assessment, which involved writing standard operating protocols, enforcing laboratory safety compliance, passing CLIA (Clinical Laboratory Improvement Amendments) certification, and running a quality assurance and quality control initiative within the laboratory. Worked with epidemiologists and toxicologists in the development of testing strategies and interpretation of human exposure to PAHs, PAH metabolites, diesel fuel biomarkers, biomass/biofuel biomarkers, antibacterial agents, PCBs, PCB metabolites, persistent pesticides, organochlorine compounds (including chlorobenzenes), halogenated phenolic compounds, bromo/chloro-phenols, PBDEs, PBDE metabolites, brominated flame retardants, PCNs, dioxins/furans, toxaphene, incapacitators (including drugs of abuse), and chemical warfare agents. Work also included analyzing and interpreting results for the National Health and Nutritional Examination Survey (NHANES).

Data Quality & Data Validation

Data Quality Review and Validation for Legal Cases

Assorted Clients, Various Locations

2004-present

Services provided for most of the litigation cases involved either a critical review of opposing counsel data or data validation of data collected as part of litigation support work. Several levels of data review and validation (Level 1 to Level 4) have been provided for case pertinent data based on EPA terminology for data validation.

Remediation Technology Validation

Multiple Clients, Alberta

2011-present

Retained by oil and gas clients to provide third party validation of water remediation technologies to ensure that instrumentation and technology meets claims of the producer. Projects involve the inspection of the technology, testing of specifications identified by the producer, sampling to confirm compliance, and data validation to provide technology validation for the client.

Laboratory Audit and Third Party Laboratory Testing

Multiple Clients, Various Locations

2006-present

Laboratory inspection and audit conducted as part of review of methodologies for client. Projects involve the inspection of laboratories, method investigations with lead chemists and blind third party continuous laboratory proficiency testing (CLPT) to ensure data quality. In addition, reference materials for a variety of matrices are developed and validated for use in the CLPT or interlaboratory studies as necessary. Third party laboratory testing has been conducted to overturn previous erroneous data, which has caused unnecessary liability to clients.

Water Cut Method Optimization and Validation

Nexen Energy ULC, Yemen

2007

Evaluation of conventional water cut measurement methodology including field sampling, sample handling and analysis. The method was modified to improve reproducibility and precision then subsequently validated for routine use. Upon completion, a database and statistical interpretation of long term trends was conducted to determine and forecast well outputs. Results of the project were published and presented at an international conference in Abu Dhabi.

Arson Investigations

Ignitable Liquid Residue (ILRs) Analysis and Forensic Accelerant Determination

Sustainable Resources and Development (SRD), Edmonton, AB

2015-present

Provide analysis and interpretation of data for samples from all potentially arsonous wildfires collected by SRD within the province of Alberta. Provide a tiered approach to determination of ILR detection and characterization of likely accelerant on a rapid reporting schedule. Provide all litigation support and testimony required as part of any prosecution proceedings.

Ignitable Liquid Residue (ILRs) Analysis and Forensic Accelerant Determination

Office of the Fire Commissioner (OFC), Edmonton, AB

2015-present

Provide analysis and interpretation of data for all samples collected by the OFC for all suspected arson investigations in the province. Provide a tiered approach to determination of ILR detection and characterization of likely accelerant on a rapid reporting schedule. Provide all litigation support and testimony required as part of any prosecution proceedings.

Ignitable Liquid Residue (ILRs) Analysis and Forensic Accelerant Determination

Wildfire Management Branch, Prince George, BC

2015-present

Provide analysis and interpretation of data for samples from all potentially arsonous wildfires collected by SRD within the province of British Columbia. Provide a tiered approach to determination of ILR detection and characterization of likely accelerant on a rapid reporting schedule. Provide all litigation support and testimony required as part of any prosecution proceedings.

Legal Sampling and Forensic Identification of Accelerants from Source Areas of a Forest Fire

Sustainable Resources and Development, Grande Prairie, AB

2011-present

Provided emergency legal sampling of soil and fire debris at two source areas of a forest fire on two separate events. Project involved statistical and judgmental sampling as well as legal sampling protocols to ensure data defensibility for potential use in legal proceedings. Proper control and comparison samples were required to provide both positive and negative controls for comparison in order to positively identify accelerants and provide laboratory check samples.

Publications

Peer Reviewed Journal Publications: 21

R.J. Letcher, Z. Lu, S.R. de Solla, C.D. Sandau, and K.J. Fernie, 2015. Snapping Turtles (*Chelydra serpentina*) from Canadian Areas of Concern across the southern Laurentian Great Lakes: Chlorinated and brominated hydrocarbon contaminants and metabolites in relation to circulating concentrations of thyroxine and vitamin A. *Environmental Research*, Vol 143, p. 266-278.

S.J. Genuis, D. Birkholz, L. Curtis, and C. Sandau. (2013) Paraben Levels in an Urban Community of Western Canada, *ISRN Toxicology*, Vol. 2013, Article ID 507897, pp. 8.

D. Megson, G. O'Sullivan, S. Comber, P.J. Worsfold, M.C. Lohan, M.R. Edwards, W.J. Shields, C.D. Sandau, D.J. Patterson Jr. 2013. Elucidating the Structural Properties that Influence the Persistence of PCBs in Humans using the National Health and Nutrition Examination Survey (NHANES) Dataset. *Science of the Total Environment*, Vol 461-462, p. 99-107.

L.S. Cesh, K.H. Elliott, S. Quade, M.A. McKinney, F. Maisonneuve, D.K. Garcelon, C.D. Sandau, R.J. Letcher, T.D. Williams, and J.E. Elliott 2010. Polyhalogenated aromatic hydrocarbons and metabolites: Relation to circulating thyroid hormone and retinol in nestling bald eagles (*Haliaeetus leucocephalus*). *Environmental Toxicology and Chemistry*, Vol. 29, No. 6, p. 1301-1310.

G. O'Sullivan, B.J. Min, J.M. Bilyk, R. Ciezki, R. Calosing, C.D. Sandau. 2010. Forensic Geo-Gas Investigation of Methane: Characterization of Sources within an Urban Setting. *Environmental Forensics* Vol. 11, No. 1, p.108-116.

R. Dallaire, G. Muckle, É. Dewailly, S.W. Jacobson, J.L. Jacobson, T.M. Sandanger, C.D. Sandau, P. Ayotte. 2009. Thyroid Hormone Levels of Pregnant Inuit Women and their Infants Exposed to Environmental Contaminants. *Environmental Health Perspectives* Vol. 117, No. 6, p. 1014-1020.

Z. Li, C.D. Sandau, L.C. Romanoff, S.P. Caudill, A. Sjodin, L.L. Needham, D.G. Patterson Jr. 2008. Concentration and Profile of 22 Urinary Polycyclic Aromatic Hydrocarbon Metabolites in the US Population. *Environmental Research* Vol. 103, No. 3, p. 320-331.

T.M. Sandanger, P. Dumas, M. Marchand, C.D. Sandau, M. Sinotte, J. Brisson, P. Ayotte. 2007. Plasma Concentrations of Selected Organobromine Compounds and Polychlorinated Biphenyls in Postmenopausal Women of Québec, Canada. *Environmental Health Perspectives* Vol. 115, No. 10, p. 1429-1434.

L.C. Romanoff, Z. Li, K.J. Young, N.C. Blakely III, D.G. Patterson Jr., C.D. Sandau. 2006. Automated Solid-Phase Extraction Method for Measuring Urinary Polycyclic Aromatic Hydrocarbon Metabolites in Human Biomonitoring using Isotope-Dilution Gas Chromatography High-Resolution Mass Spectrometry. *Journal of Chromatography B - Analytical Technologies in the Biomedical and Life Sciences* Vol. 835, No. 1-2, p. 47-54.

T.M. Sandanger, M. Brustad, C.D. Sandau, E. Lund. 2006. Levels of persistent organic pollutants (POPs) in a coastal northern Norwegian population with a high fish-liver diet. *Journal of Environmental Monitoring* Vol. 8, Issue 5, p. 552-557.

A.T. Fisk, C.A. de Wit, M. Wayland, Z.Z. Kuzyk, N. Burgess, R. Letcher, B. Braune, R. Norstrom, S.P. Blum, C.D. Sandau, E. Lie, H.J.S. Larsen, J.U. Skaare, D.C.G. Muir. 2005. An assessment of the toxicological significance of anthropogenic contaminants in Canadian arctic wildlife. *The Science of the Total Environment* Vol. 351-352, p. 57-93.

J. Maervoet, A. Covaci, P. Schepens, C.D. Sandau, R.J. Letcher. 2004. A reassessment of the nomenclature of polychlorinated biphenyl (PCB) metabolites. *Environmental Health Perspectives* Vol. 112, No. 3, p. 291-294.

K. Saito, A. Sjödin, C.D. Sandau, M. Davis, H. Nakazawa, Y. Matsuki, D.G. Patterson, Jr. 2004. Development of a accelerated solvent extraction and gel permeation chromatography analytical method for measuring persistent organohalogen compounds in adipose and organ tissue analysis method. *Chemosphere* Vol. 57, No. 5, p.373-81.

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