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REPRINT - 2019 Remediation & PFAS

Environmental Business International Inc.

GZA BRINGS TECHNICAL, TOXICOLOGICAL, INNOVATION AND RISK MANAGEMENT EXPERTISE TO PFAS MARKETS

Don Goldberg and Bill Zoino founded GZA GeoEnvironmental Inc. (Norwood, MA) in 1964 as a soils and foundations specialty consultant. Since then, the company has grown from a small consulting partnership to a major multi-disciplinary, employee-owned firm that focuses on environmental, geotechnical, ecological, water, and construction management services. With a staff of more than 700 people in 31 offices, GZA has completed over 100,000 projects for a wide array of public and private clients over the past 55 years. GZA is an employee-owned firm with gross revenues exceeding \$100 million annually.

Richard Desrosiers, Associate Principal and hydrogeologist. Mr. Desrosiers has 34-years of environmental experience and has focused on understanding complex geologic, hydrogeologic and geochemistry associated with soil and groundwater contamination. He leads GZA's PFAS initiative and is currently involved with two current Interstate Technology & Regulatory Council (ITRC) teams "Optimization of In-Situ Remediation and Injection Strategies" and "Per- and Polyfluoroalkyl Substances (PFAS)."

EBJ: Besides the attention that has been brought to emerging contaminants, what are some of the biggest changes you have seen in the remediation segment over the last couple of years?

Desrosiers: A greater focus, particularly at the federal level, on schedule and "making progress." From my perspective, this has been spurred, at least in part, by the

list of priority sites and the greater level of senior EPA focus placed on those sites.

EBJ: How would a national elimination of production of PFAS would look like? Can we compare it to the one of CFCs or asbestos or DDT?

Desrosiers: The federal government spearheaded the bans on CFCs, asbestos, and DDT. At this time, the states, as a

group, are way ahead of the federal government in addressing PFAS. That said, we believe PFAS restrictions may be more similar to asbestos, which was banned in phases, the first ban being on friable asbestos-containing materials. Because there are numerous types of PFAS compounds with varying degrees of toxicity, we anticipate that significantly restricted uses will remain as more widespread uses are curtailed.

EBJ: Is it a matter of concentration or is it a matter of a different variety of compounds that will make the remediation more complex?

We see a greater focus at the federal level on schedule and "making progress."

Desrosiers: We believe that the wide variety of PFAS, in particular, their varying (carbon) chain lengths and functional groups (heads) pose more complications for treatment technologies than varying concentrations. Chemical differences in the PFAS family create varying physical/chemical properties which cause treatment techniques to be more efficient for some PFAS than for others. This is already well-documented; for instance, short-chained PFAS are not as sorbed to activated carbon as longer-chain PFAS.

EBJ: What types of PFAS are getting the most attention in your region and for what type of Client or responsible party?

Desrosiers: The issues surrounding PFAS contamination are not limited to one

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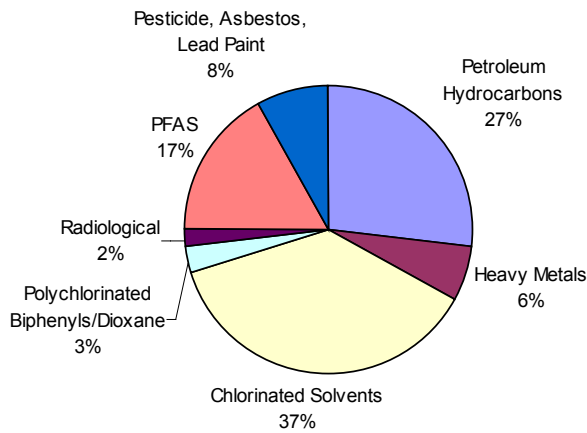
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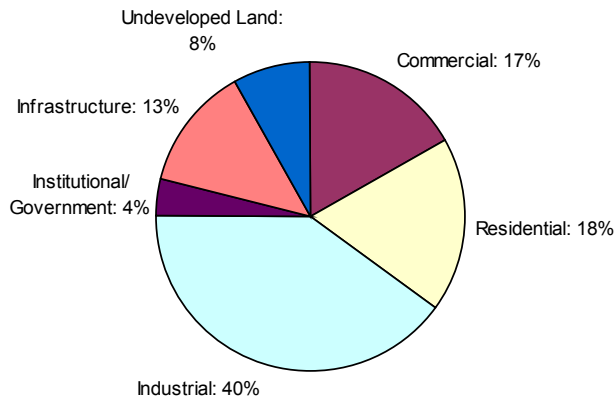
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GZA Remediation Revenues By Contaminant in FY 2019



GZA Remediation Revenues By Project Land Use in FY 2019



Source: GZA. Notes: Front-end consulting vs. back-end construction: 56% "front-end"; Remediation revenue as a % of total company revenue: 30%; Private sector vs. government: 92% private sector

specific type of site or client as they have been used in domestic, industrial, military, public safety applications. However, the PFAS compounds attracting the most attention are those identified in contaminated water supplies, especially on or surrounding military facilities where the long-chain fire-fighting foams (AFFF) were used. Until more recently, the research and regulatory focus has been on the legacy long-chain PFAS, such as those used in AFFF, because they have long half-lives which allow for the possibility of bioaccumulation. It is more likely that a threshold concentration can be achieved when chemicals bioaccumulate over several years, thereby increasing potential increased risk of adverse health effects. Additional work will still be required to better understand the impacts from the short-chain and long-chain replacement PFAS compounds.

EBJ: Are there areas that have been overlooked or underestimated in terms of their contaminant impact?

Desrosiers: Currently, EPA has only approved one analytical method, specifically for drinking water, that analyzes for 18 of the more than 1,000 PFAS compounds. Although analytical laboratories have modified this EPA Method for up to about 30 compounds, the majority of the PFAS compounds have no approved method for analysis. Of the compounds that can be analyzed, only about 6 compounds have risk-based regulatory numerical criteria, and no Maximum Contaminant Level has been established by the EPA. Given the number of PFAS compounds, this leads to uncertainties when assessing potential environmental impacts.

We believe that the essentially ubiquitous presence of PFAS in the environment is not currently acknowledged by regulators and the standards they are creating. While more study is needed, existing studies document that PFAS are widespread in the environment at concentrations near or greater than some proposed and promulgated standards. For

instance, various PFAS are routinely found in sanitary sewage at low double-digit parts per trillion range. This is near many drinking water and surface water protection standards recently promulgated or proposed by several states. If septic systems and municipal sewers are sources of environmentally-significant concentrations of PFAS, this must be addressed by the regulatory process.

Similarly, PFAS wind-borne transport of PFAS emissions has been documented to cause widespread PFAS concentrations in soil which result in groundwater and surface water contamination.

EBJ: What trends do you see when it comes to PFAS remediation work? What efforts are you performing to assess, design and remediate sites?

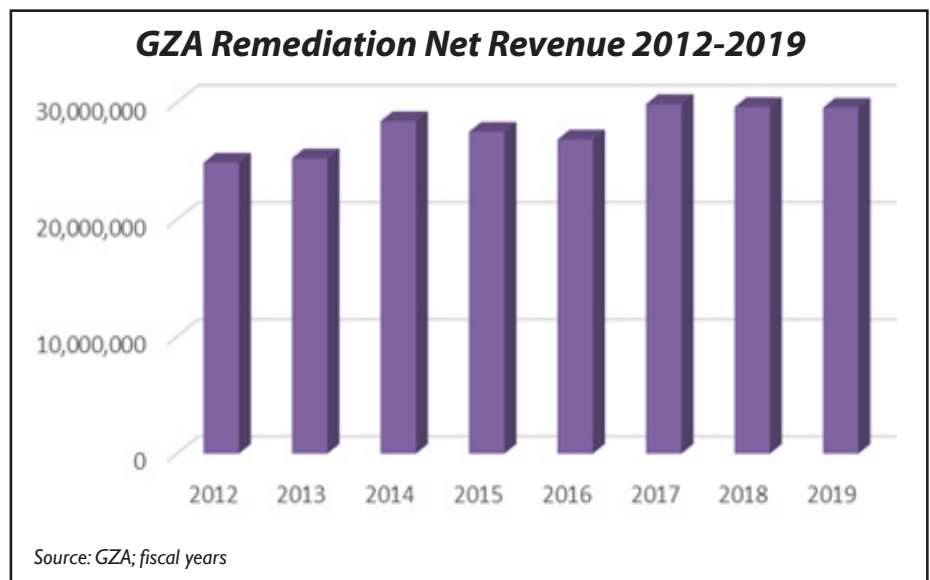
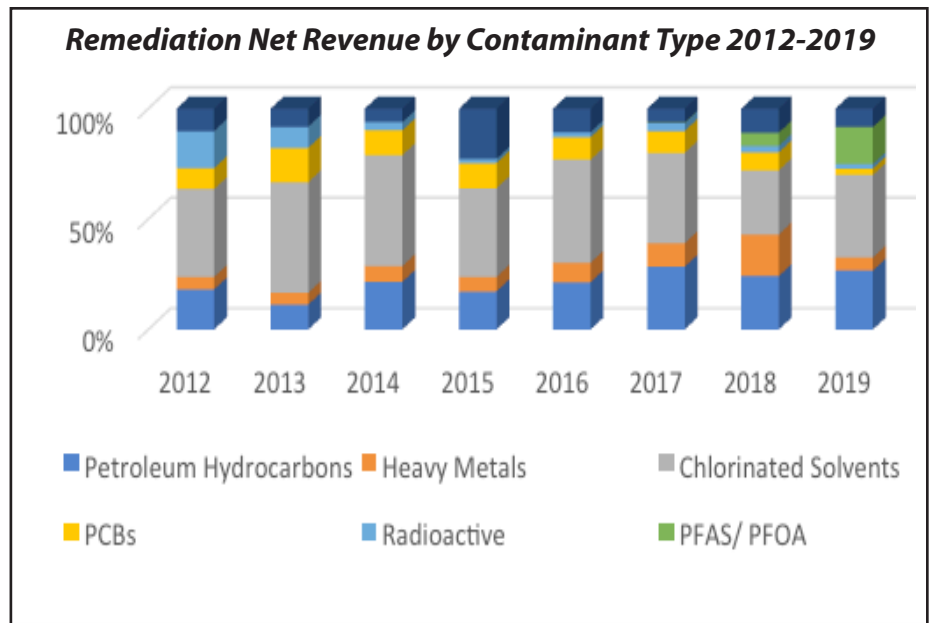
Desrosiers: GZA sees significant changes in the public, government (congressional and state level), federal and state regulatory agencies, and industry as the awareness of PFAS and its emerging science becomes better known and publicized. GZA is actively involved in helping to develop guidance through organizations, including the **National Groundwater Association (NGWA)**, **Interstate Technology & Regulatory Council (ITRC)** and **ASTM International**. However, the state of the science is changing so rapidly that today's understanding will quickly evolve tomorrow and in the years ahead.

To address our clients' (government, industry, municipalities, developers) needs, GZA is bringing to task our technical, toxicological, innovation and risk management experience to solve the complexities associated with PFAS, along with the communication skills necessary to help the public better understand these risks. The issues surrounding PFAS contamination are not limited to one specific type of site as they have been used in domestic, industrial, military, public safety applications. However, by bringing years of experience to the table, we are providing our clients with our knowledge on how to assess these problems and develop practicable and cost-effective solutions. As the science continues to emerge surrounding both the long- and short-chained PFAS compounds, GZA will be informing our clients of the changes and implications concerning health, liability, and cost impacts.

EBJ: Do you anticipate a federal program for innovative technology grants or accelerated efforts and funding to support innovation in PFAS?

Desrosiers: Federal funding has become available through programs such as the American Water Infrastructure Act to address water projects. Many universities are using grant funds to further study PFAS issues, including the development of innovative remedial approaches. As the issues associated with PFAS are ubiquitous in the environment, and because these products have been used since the 1940's, an innovative approach will be required to address contamination at military bases, public and private water supply systems, landfarming application of biosolids on agriculture lands, and in the industrial sector, to name a few. Only through private and federal funding will new technologies be found to address PFAS for future generations. □

We believe that the ubiquitous presence of PFAS in the environment is not currently acknowledged by regulators.



GZA's Recent Acquisitions: 2017/2018

Emery & Garrett Groundwater Investigations: A leading groundwater consulting firm, Emery & Garrett Groundwater Investigations, LLC (EGGI), located in Meredith, New Hampshire, now a division of GZA, provides consulting services to municipal utilities, public water authorities, hospitals, universities, Fortune 500 companies, developers, and municipal, state and federal governments. Serving the State of New Hampshire and the eastern United States for the past 28 years, EGGI has been recognized regionally and nationally by the EPA, the United States Geological Survey (USGS), and the National Association of Groundwater Scientists and Engineers, for providing technical leadership in the field of groundwater exploration, development, and protection.

Civil Dynamics: A regional leader in specialty dam engineering consulting, Civil Dynamics (CD), a division of GZA, operates out of GZA's Fairfield, New Jersey office and provides dam engineering, inspection and maintenance, civil engineering, construction phase services, and other related services for public and private water suppliers, lake communities, and hydropower clients.

Melick-Tully and Associates: Melick-Tully and Associates, P.C. (MTA), based in South Bound Brook, New Jersey, a division of GZA, provides clients with comprehensive geotechnical, environmental, ecological, water, and construction management services. MTA's clients are among the leading builders and developers in the Northeast and their client base represents all sectors of the commercial, industrial, retail and residential markets; schools and universities; utilities; architects, and other design professionals.