



THINK THERMAL

In Situ Thermal Remediation Updates & News

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TerraTherm Expands ERH Capabilities with new Acquisition

TerraTherm is pleased to welcome Global Remediation Solutions (GRS) to our family. GRS is specialized in Electrical Resistance Heating (ERH) and has been involved in some of the most complex ERH projects completed to date.

The GRS team has been designing, installing and operating effective remediation solutions targeting the most challenging site conditions and recalcitrant contaminants for decades. In addition to large scale ISTR projects, GRS offers affordable ERH solutions for dry cleaner contaminated sites. GRS also provides a full suite of air movement technologies for both in situ and ex situ remediation applications including soil vapor extraction, dual vapor extraction, multi-phase extraction, air sparging, recirculation wells, vapor intrusion systems, bio-venting and bio-slurping, and hot-air injection. TerraTherm will take on GRS' ongoing projects along with their entire technical team.



"The GRS team brings extensive ERH remediation experience to TerraTherm. The GRS smart ERH technology coupled with our large fleet of treatment systems and process engineering capability is unique among thermal vendors" says John Bierschenk, President and Co-founder of TerraTherm.

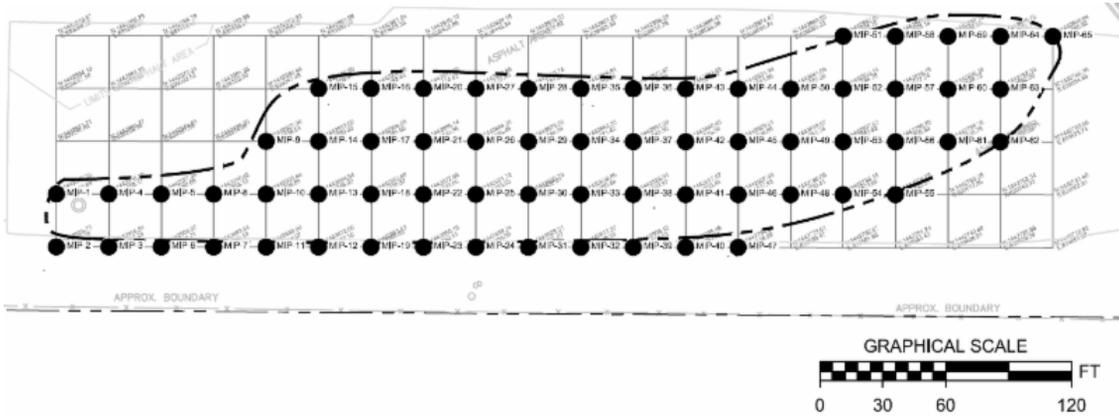
TerraTherm is the only vendor to offer all thermal technologies in-house and is uniquely qualified among thermal contractors to evaluate each site's unique characteristics. We offer our clients customized solutions, tailored to their exact needs, by providing the most cost-effective technology or combinations of technologies to achieve success. The acquisition of GRS will help strengthen TerraTherm's position as the worldwide leader in thermal remediation.

New Frontiers for TerraTherm: Using HRSC to better define the Treatment Zone and Site Conceptual Model

One of the major benefits we are able to offer our clients since becoming a member of Cascade, is a whole new suite of tools that are readily available to us for defining the Target Treatment Zone (TTZ) and conceptual Site Models (CSM) which strengthens our designs. The Cascade Technical Services Vermont office has developed an approach called High Resolution Site Characterization (HRSC) which utilizes soil profiling techniques to define the extent of soil contamination both vertically and horizontally. The HRSC approach can be used in the early stages of site assessment and/or to fill in data gaps. Typically, we are interested in having a thorough understanding of soil properties across a contaminated site such as soil permeability, VOC concentrations, distribution of coal tar, etc. in order to better optimize the thermal remediation design. Each soil parameter under investigation is fitted to an appropriate HRSC technology and some technologies such as Membrane Interface Hydraulic Profiling Tool (MiHPT) and Waterloo Profilers are capable of investigating multiple parameters at once. HRSC is beneficial to our clients because it refines the treatment zone dimensions, often resulting in a smaller treatment volume. Additionally, it better ensures that the entire source area is characterized and that minimal source mass is left outside of the treatment zone, thus guaranteeing a more successful clean-up. Both of these points reduce treatment costs for our clients and allow for a better thermal design and implementation. The remedy becomes more sustainable - less energy is used and it only has to be attempted once, because the probability of success is maximized by having a solid CSM and TTZ definition.

Implementing HRSC typically consists of dividing an area under investigation into a grid of points (See figure below) and advancing a probe into the subsurface at each point. The distance between the grid points defines the grid *resolution*. The figure shows an example of a HRSC sampling grid showing 65

points at 20 ft spacing in the horizontal direction. At this site the HRSC tools were used to determine permeability contrasts and to determine screen depths for extraction and venting.



The less space there is between each point the higher the resolution. Most HRSC technologies are able to measure continuously, meaning the entire length of the soil boring is sampled. Additionally, the data can typically be viewed in real-time, meaning the investigation strategy and implementation can be adjusted and adapted to field conditions. When defining the horizontal and vertical extent of contamination it is often unknown how far the sampling grid should extend laterally or how deep probe(s) should be advanced. Therefore, grids often include an interior of primary sampling points bordered by secondary sampling points that are profiled only if contamination is discovered along the edge of the primary sampling grid. To define the vertical extent of contamination, HRSC designers will often choose a depth to advance the probe to at all locations based on prior understanding of the depth of contamination; such as the depth of an impenetrable surface like bedrock or until the probe hits refusal. The ability to view the data in real-time means that operators can immediately see when contamination levels rise and fall as the probe is advanced into the subsurface and make informed decisions regarding how deep to advance the probe.

Upcoming Conferences



Environmental Show of the South

May 17-19, 2017
Chattanooga Convention Center, Tennessee

You can find more information about the conference [here](#)

i2t2
SYMPOSIUM



May 30-31, 2017
Banff, Alberta, Canada

You can learn more about the conference [here](#)



Cascade Technical Services is the first environmental services provider to offer onsite analyses for the class of emerging contaminants of concern known as PFAS (poly and perfluorinated alkyl substances). It is not a screening technique but a full capability laboratory brought to the site. This newest addition to Cascade's MobiLab service line provides fully defensible laboratory analyses for any project location in an accredited onsite laboratory.

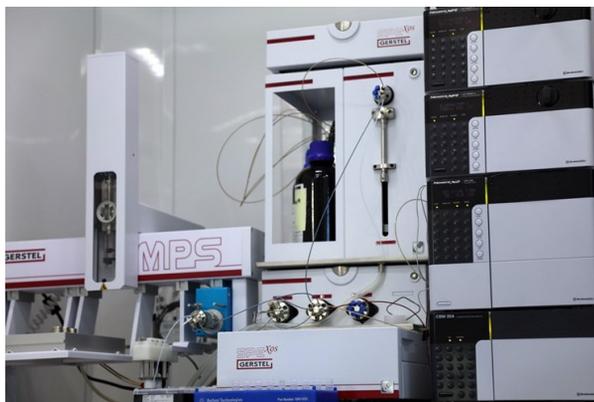
PFAS are extremely stable, man-made chemicals used to make a wide variety of specialty coatings and fire suppression foam (Aqueous Film Forming Foams or AFFF). Due to the strength of the carbon-fluorine bond these chemicals are very stable and persistent in the environment. They are highly soluble and sorb only moderately to organic matter and mineral surfaces, meaning they migrate readily in the subsurface. They have been detected in surface water, sediments, groundwater, soil, and air, as well as in animal and human blood around the globe. They are known to concentrate in the food chain and in the human body. Since these chemicals are persistent, mobile, toxic, and have been the subject of significant litigation, they have attracted considerable attention in the environmental industry.

The US EPA recently established health advisory levels of 0.070 ug/L for perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) in drinking water. Industrial manufacturing sites typically have relatively few PFAS compounds (primarily PFOS and PFOA) while the AFFF sites have very complex chemistry with hundreds of compounds present. Due to the very low detection limits and the potentially complex chemistry, laboratory analyses have only recently been developed to address the problem. In situ remedial technologies are largely untested at the present time.

Our PFAS MobiLab uses state of the art solid phase extraction and liquid chromatography (LC/MS/MS) to confidently identify and quantify PFAS in water and soil/sediment matrices. This allows for the use of dynamic work strategies which keep investigations focused and efficient. It also allows for identification of potential cross contamination due to sampling activities while in the field. The opportunities for cross contamination during PFAS sampling are abundant due to the prevalence of these compounds in our daily lives. This has been a significant challenge on many site characterization and remediation projects. With MobiLab's PFAS analyses, sources of cross contamination can be isolated and eliminated in the field before the field work is completed, increasing confidence in the results of the sampling program.

MobiLab provides flexibility and a customized sampling program for any remediation site. The sample preparation and injection may incorporate either direct sample injection or an in-line, solid phase extraction/enrichment. Plus, analyses can be augmented with analyses for volatile and semi-volatile organic compounds for complex contaminant mixtures such as those that are often found at firefighting training areas. The detection limits are in the low tens of parts-per-trillion (ppt) to single digit ppt levels. Sample throughput is typically about 30 samples per day, with results available within hours of sampling and the day after sampling for non-critical results.

"This is really a game-changer in terms of the ability of site investigators to apply state of the science dynamic work strategies and high resolution characterization methods to PFAS sites. The value of near-real time data at a price that is competitive with fixed laboratories for much longer turnarounds brings tremendous value to our clients," said Seth Pitkin, Cascade's National Director of Site Characterization Services.





Krüger is starting a new project in Sweden - a country which is ranked as the Most Sustainable Country in the World in 2015 according to the [Country Sustainability Ranking study](#), performed by the investment company RobecoSAM.

As described in the previous newsletters Krüger is already treating a fractured granite site close to Stockholm. Our new site is located in the Municipality of Kristianstad. The area that is left after the old dry cleaners, leaking toxic waste for years, is considered to be one of the most polluted sites in the southern regions of Sweden. The remediation project has a high priority for the municipality, given that the pollution constitutes a threat to a very valuable groundwater resource.

The 15.000 m3 of PCE contaminated soil and groundwater is going to be remediated using the unique Thermal Conductive Heating Technology. The remediation target zone is from the surface till 20 meters below surface with the groundwater table located 4 meter below surface.

A detailed design has been prepared and installations are expected to start by April. Operation is expected between September 2017 and February 2018.

Read more about our other projects [here](#) and follow us for the latest news on [LinkedIn](#).

You are also welcome to meet us at:

- Renare Mark Soil Remediation Conference in Malmö, Sweden on March 29-30
- Remediation Workshop in Brussels, Belgium on May 2nd
- Remediation Workshop in Munich, Germany on May 3rd
- Remediation Workshop in Rome, Italy on May 4nd



TerraTherm Project Updates

Anderson, IN

Construction activities at our Electrical Resistance Heating (ERH) project site in Anderson, IN are progressing. Operations are scheduled to begin in the spring.

Confidential Asia

The design phase of our first full-scale ISTD project in Japan is completed. We have initiated procurement of long lead equipment and are busy preparing for the Implementation phase of this important project. Site work is slated to begin by June 2017. Operations will be conducted at two separate site areas in two separate operational phases.

Confidential Midwest

ISTR operations at an active manufacturing facility in the Midwest began in December 2016. Approximately 2/3 of the thermal treatment zone (TTZ) is located within the footprint of the facility building and several areas of the TTZ are approaching boiling temperatures. The ISTR system will operate into the spring of 2017.

Confidential Northeast

This ERH project heating continues with subsurface temperature ranging from 82°C to over 107°C. The mass recovery of VOC has exceeded the expectations by 3.5 times. The inlet concentration has begun to decline over the past month.

Monmouth, NJ

Mobilization to this Tier-One Thermal Conductive Heating (TCH) project site in Monmouth, NJ is scheduled for March 2017. This project will treat approximately 10,000 cubic yards of PCE impacted soil.

Poughkeepsie, NY

This ERH project with 101 electrodes continues heating operations. Subsurface temperatures range from 65°C to over 125°C. The heated area is approximately 36,000 ft². Operations will continue into the spring.

Get To Know Us - Anthony Caravella



Mr. Caravella joined TerraTherm in 2014 as a Data Manager after graduating from Worcester Polytechnic Institute (WPI) that same year with a degree in Chemical Engineering. Soon after joining TerraTherm, Mr. Caravella took over a leading role in TerraTherm's temperature monitoring systems. He has been involved in the procurement, testing and installation of nearly all temperature monitoring systems for TerraTherm's remediation projects as well as data analysis of the operational data. As part of his data management role, he oversaw the transition of the TerraTherm database to a cloud database to ensure better data flow for all data managers.