

## TVNI ANNOUNCEMENT GRAND PRIZE

The American Academy of Environmental Engineers awarded Leggette, Brashears and Graham Inc the 2012 Grand Prize for Small Projects for "Innovative Phytoremediation Process Utilizes Landfill Leachate as a Resource in Lieu of Traditional Disposal As a Waste" see:

<http://www.aeee.net/E32012GPSmallProjects.php>

This project relates to a landfill in Mississippi. Brad Granley and Paul Truong were very involved in the design of the project. Our congratulations!!!



*Excellence in  
Environmental Engineering®*

### 2012 Grand Prize - Small Projects

Innovative Phytoremediation Process Utilizes Landfill Leachate as a Resource in Lieu of Traditional Disposal As a Waste

**Location:** Biloxi, Mississippi

**Entrant:** Leggette, Brashears & Graham, Inc.

**Person in Charge:** Brad Granley

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*Click images to enlarge in separate window.*



Landfill Operations. The solid waste industry provides an essential service for our society.



GCLF Aerial Photo. When precipitation falls on a landfill, some infiltrates through refuse and becomes leachate. Leachate is often contaminated and must be properly processed; usually at a great expense.

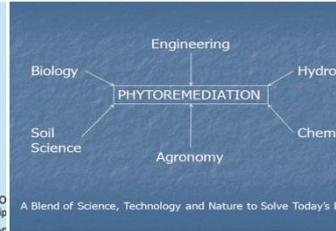
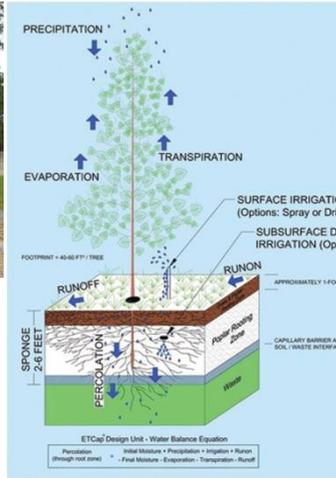


The Old Way. Traditionally, landfill leachate is hauled away in tanker trucks for disposal at WWTPs. Leachate from GCAL was hauled 150 miles one way to a facility that was capable and willing to accept.





Aboveground Storage Tanks. When leachate production spiked to 3.5 million gallons per year at GCAL, the cost to transport and dispose over such a great distance was far too costly, and a better solution was essential.



Multi-disciplined Approach. To be successful, a phytoremediation project requires expertise from a wide range of specialists and must overcome technical, regulatory, logistical, budgetary, and site restraints.

Phytoremediation Tree Diagram. Phytoremediation is a new technology that can treat landfill leachate on site in an environmentally friendly way, and at a much lower cost than traditional methods.

## Entrant Profile

Leggette, Brashears & Graham, Inc. (LBG) has successfully implemented a first-of-its kind project in the western hemisphere that is likely to change sustainability practices in the \$50 billion US solid waste industry. Through the innovative application of sustainable phytoremediation technology, landfill leachate can actually be utilized on-site as a resource in lieu of disposal as a waste. The approach provides an excellent option to address one of the most persistent and expensive long-term problems associated with landfills. LBG was retained by Republic Services, Inc. (the second largest solid waste company in the US) to implement this cutting-edge technology at one of their Gulf Coast Area landfills (GCAL), located near Biloxi, Mississippi.

The role of LBG in this innovative environmental project was to develop and implement the entire phytoremediation concept from start to finish, including: designing the leachate pre-treatment and main distribution system, designing the specialty subsurface-drip irrigation system, developing the PLC control program, assisting in obtaining regulatory approval, procuring all equipment and specialty subcontractor services, overseeing system installation, and operating and maintaining the system upon startup.

LBG is a professional ground-water and environmental engineering services company dedicated to serving our Client's needs by approaching complex environmental challenges with innovation. Established in 1944, LBG is the oldest groundwater consulting firm in the nation and is a consistent leader in innovation as shown by a rich history of not only developing industry-changing ideas, but applying them with success in the field to solve real problems for our clients.

## Project Description

In 2010, the US produced 250 million tons (over ½-trillion pounds) of solid waste. Within landfill operations, leachate disposal represents one of the most persistent and expensive long-term challenges and, if not handled properly, can lead to serious environmental problems.

At GCAL, leachate problems compounded rapidly when an unavoidable change in site conditions caused leachate production to increase an order of magnitude from 350,000 to 3.5 million

gallons/year. Reducing leachate production was not an option. The production spike and skyrocketing costs resulted in an immediate 'high-priority' status and LBG was contacted to identify a viable alternate solution.

Traditional leachate handling consists of tanker trucks driving to a landfill, filling up with leachate, and driving through communities to dump leachate as additional loading to municipal WWTPs. This 'old way' works, but at considerable environmental and financial cost; especially at GCAL where the accepting WWTP was located 150 miles away.

LBG evaluated numerous traditional and non-traditional options and recommended that phytoremediation should be implemented as a 'new way' to handle leachate. This cost-cutting approach allows leachate to be handled on site. By definition, phytoremediation is a plant-based system used to remove pollutants from groundwater, surface water, soil, or air. Specifically, LBG recommended phytoremediation using a unique grass called vetiver. Vetiver has been in the US for decades, but has never been used to address leachate problems, making the project a first-of-its kind for the US solid waste industry. Vetiver is ideally suited for leachate utilization due to its tremendous water and nutrient demand, fast growth, and extraordinary tolerance to extreme environmental conditions (contaminants, pH, soil, moisture, insects, and disease). Vetiver is also a USDA non-invasive plant. Coincidentally, leachate's main components are water and contaminants (micro and macro-nutrients to the plants), exactly what vetiver needs.

Republic's commitment to environmental excellence includes seeking out promising innovative technologies. Phytoremediation was approved on the condition that the existing disposal process was not disrupted. LBG designed and installed an automated leachate pre-treatment and distribution system that responds to changes in leachate production, leachate quality, and weather conditions. The system includes 35,000 feet of underground piping, a specially-designed subsurface drip-irrigation system, and PLC with telemetry for desktop monitoring and adjustments.

The success of this project has caused Republic to embrace a new, environmentally friendly approach to leachate treatment. Phytoremediation has replaced the "old way" at GCAL.

### Integrated Approach

The use of phytoremediation at landfills represents an integrated approach having a profound environmental impact.

Groundwater is protected through minimization of surface water infiltration and better control of leachate within the landfill, which can otherwise result in contamination of aquifers, especially at old facilities like GCAL, which has no bottom liner.

Surface water. Vetiver reduces infiltration which helps prevent leachate seeps (leachate that flows out the side of a landfill and to surface water), and can dry up existing seeps. Vetiver also removes sediment and nutrients from surface water runoff.

Soil erosion is reduced. Leachate distribution does not create a problem with soil. The plants effectively utilize leachate compounds as nutrients. Also, a subsurface "biological treatment reactor" develops which effectively breaks down and mineralizes a wide range of compounds.

Adverse impacts to air quality are greatly reduced. Using phytoremediation at GCAL instead of hauling 3.5 million gallons of leachate per year results in the following:

- 1 year: 232,000 miles not driven; 38,000 gallons of diesel not burned (6 mpg); 380,000 kg CO<sub>2</sub> emissions (10 lbs CO<sub>2</sub>/gal diesel burned)

- 30 years: 7 million miles not driven; 1.14 million gallons diesel not burned; 11,400,000 kg CO<sub>2</sub> (25 million pounds CO<sub>2</sub>)

Fast growing vetiver will sequester 113,000 kg CO<sub>2</sub>/year through carbon fixation.

### Quality and User Satisfaction

The GCAL project has exceeded Republic's expectations. The system has performed as designed and nearly 100% of leachate generated has been utilized on site, well ahead of anticipated results. Republic is also thrilled with the cost savings. Phytoremediation system low-cost O&M has cut annual costs by 60%, saving millions over a standard 30-year post-closure care period. Per Republic, "the approach is a game changer for leachate management." The work has also attracted the serious interest of other multi-billion dollar US solid waste companies. Internationally, the first three vetiver system installations in Latin America are underway for the largest solid waste company in Mexico.

### Original and Innovative

The GCAL phytoremediation effort represents the first-ever use of vetiver for landfill leachate utilization not only in the US, but also in the entire western hemisphere. The standard for leachate disposal (load, haul and dump) was essentially an accepted, 'necessary evil' and the concept of utilizing leachate as a resource is changing the industry. The use of an amazing plant like vetiver has greatly expanded the scope of phytoremediation. Further, by incorporating a specialized, sub-surface drip-irrigation system to distribute leachate year-round, the process is further advanced.

### Complexity

After overcoming justifiable skepticism by regulatory authorities, the success at GCAL still required overcoming technical limitations, logistical obstacles, budget restraints, and difficult site conditions all within a compressed timeline. From a technical standpoint, the approach blended numerous disciplines including engineering, hydrology, microbiology, plant physiology/morphology, soil science, agronomy, chemistry, hydrology, and computer science (PLC programming and evapotranspiration modeling). Further, the actual phytoremediation approach includes a number of sub-processes: phytostabilization, rhizofiltration, rhizodegradation, phytodegradation, phytovolatilization, and biodegradation. In addition, the coordination of 15 subcontractors and specialty suppliers from nine states was completed seamlessly. The end result was a highly innovative, successful project completed on time and under budget.

### Contribution to Social or Economic Advancement

The new, vetiver-based phytoremediation approach offers numerous direct and ancillary benefits to the end-user and community at large:

- Leachate treatment costs reduced > 60%, millions of dollars saved
- Initial capital investment offset in only 2 years
- Direct reduction in GHG emissions, additional carbon fixation
- Millions fewer miles driven Carbon footprint reductions Habitat for wildlife
- New technology for engineers to consider
- Advancement of regulatory acceptance
- Protection of groundwater, surface water, and air
- Reduced loading to WWTPs
- Sustainable, GREEN approach
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Click images to enlarge in separate window.



Vetiver Plants - Roots. Vetiver, a unique plant with extraordinary characteristics, was selected for GCAL phytoremediation.



Vetiver Plant - Above Ground. Leachate is composed of water and contaminants (micro and macro-nutrients to the plants) and fast-growing vetiver thrives when 'fed' this nutrient-rich mixture.



Landfill Pre-existing Conditions. GCAL prior to any activities.



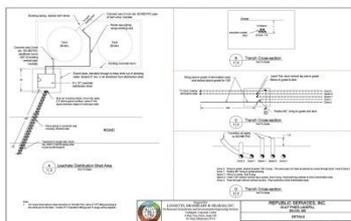
Underground Piping. Force mains are installed to convey leachate to the vetiver planting area.



Subsurface Drip Installation. A specialized subsurface drip irrigation system was chosen for distributing leachate across the vetiver planting area.



Pre-treatment and Distribution System. The engineered pre-treatment and distribution system automatically adjusts to changes in leachate production, leachate quality, and weather conditions to ensure proper operation.



Project Diagrams. Numerous engineering drawings were created to specify system fabrication and to guide field installation crews.



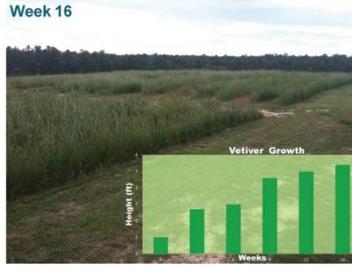
Mechanical Planting. Vetiver is non-invasive and produces no fertile seed. A mechanical planter is used to increase efficiency.



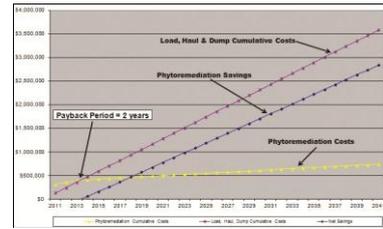
Initial Planting of Site with Vetiver Grass. GCAL had to be planted using tens of thousands of individual 'slips' which stand about 12-inches tall.



Vetiver Growth. Vetiver growth after 7 weeks.



Vetiver Growth Graph. Vetiver growth after 16 weeks. Vetiver has a specialized 'C-4 based' metabolic mechanism, which causes rapid growth.



Payback Period and Saving Graph. The approach greatly reduces costs in an environmentally friendly manner.



Old Way - New Way. Industriels change when new technologies become available. GCAL represents the first use of vetiver for phytoremediation of landfill leachate in the western hemisphere.

Republic Services, the second largest waste management company in the U.S. has stated their opinion on the success of phytoremediation in the following way,  
**"We are planning to evaluate this technology for numerous other landfills and expect the industry as a whole to embrace this new leachate utilization tool."**  
 Per Republic,  
**"The approach is a game changer for leachate management."**

Client Quotes. A sustainable technology that is protective of the environment, advances the state of the industry, and saves money results in satisfied customers.