PRO-ACT
A Base-level Pollution Prevention Resource sponsored by HQ Air Force Center for Environmental Excellence

SUCCESS STORY

SPOTLIGHT ON: **HILL AFB - JANUARY 1999**

Pollution Prevention in the Air Force

The United States Air Force recognizes the importance of pollution prevention (P2) in protecting the environment, achieving compliance objectives, and reducing waste disposal costs. Successful P2 programs including recycling, waste minimization, product substitution, and process changes, among other strategies, are planned or underway at Air Force installations worldwide. The Air Force's environmental programs must do more today than ever before, and with increased cost-effectiveness.

The Air Force is a leader in fostering environmental awareness and education within its workforce and communities, thereby extending environmental stewardship from a management concept to an individual responsibility. In response to executive orders, regulations, and policies, successful P2 strategies and technologies are continuously being developed, applied, and improved at Air Force bases around the world. As new ways emerge to eliminate compliance burdens, save money, and minimize chemical exposures, the Air Force is committed to collecting these P2 success stories and making them available to Air Force activities everywhere.

SPOTLIGHT ON: Hill Air Force Base

The Ogden Air Depot or "Hill Field" was established in 1940 and named in honor of Major Ployer P. Hill who lost his life in 1935 while piloting the first B-17 Flying Fortress. During World War II, battle weary B-17, B-24, B-29, P-40, P-47, P-61, and A-20 aircraft relied on Hill Field and its workforce of 22,000 for repairs, engines, and parts. In 1947, Hill Field became Hill Air Force Base when the Army Air Corps became the United States Air Force. Today, Ogden Air Logistics Center (OO-ALC) is the host unit and largest organization at Hill AFB. The base overhauls and repairs landing gear, wheels and brakes, rocket motors, air munitions and guided bombs, photonics equipment, training devices, avionics, instruments, hydraulics, software and other aerospace related components. OO-ALC provides worldwide engineering and logistics management for the F-16 Fighting Falcon jet aircraft, and is the depot-level maintenance center for F-16 and C-130 Hercules aircraft. Logistical management for the nation's fleet of strategic ICBMs is also conducted by highly trained personnel at Hill AFB. The base occupies 6,698 acres and ranks as one of Utah's largest employers with approximately 20,000 military, civilian, and contract personnel working on site.

Hill AFB Success Stories

The Environmental Management Directorate

To better execute the environmental program at Hill AFB, the Environmental Management (EM) Directorate was established in October 1988. The mission of the EM Directorate is to support industrial processes and manage environmental resources at Hill AFB and its properties by using effective, proactive management practices that focus integrated stewardship, new technology and individual responsibility on past, present, and future environmental needs. The EM Directorate focuses its resources in three key areas: 1) Restoration (EMR); 2) Compliance (EMC); and 3) Pollution Prevention and Planning (EMP). The EM Directorate established environmental representatives in each of OO-ALC's product directorates. This added an important link to a program that would eventually become one of the most respected in the DoD.

Headquarters Air Force Materiel Command (HQ AFMC) announced in October 1998 that Hill AFB was the recipient of three Command Level Gen Thomas D. White Awards for: 1) Recycling (Industrial); 2) Recycling (Team/Individual: Mr. David A. Friese); and 3) Environmental Restoration, for fiscal year 1998. In December 1998, Headquarters United States Air Force (HQ USAF) announced that Hill AFB was the winner of the Air Force Gen Thomas D. White Award for Recycling (Industrial) and would be nominated for the Secretary of Defense Environmental Security Award. For more information about the EM Directorate at Hill AFB, visit their World Wide Web (WWW) site at **http://esoh-www.hill.af.mil** or contact Mr. Charles A. Freeman, Chief of Environmental Public Affairs, OO-ALC/EM, DSN 775-6951, (801) 775-6951, or *freemach@hillwpos.hill.af.mil*.

P2 Success Stories Implemented at Hill AFB

Range Residue Recycling

Process Description:
Several hundred practice bombs are dropped each month by Air Force, Army, and Navy aviators at the Utah Test and Training Range (UTTR), located in western Utah. All bombs and munitions dropped at the UTTR must be demilitarized, or "rendered non-recognizable as a bomb," before they can be disposed of or put to any other use. The current demilitarization (demil) process, performed by Hill AFB Explosive Ordnance Disposal (EOD) personnel, includes certifying that the bomb has been "fired" before placing it in large storage piles at the UTTR.

The majority of the munitions dropped at the UTTR are 500 pound practice bombs filled with a mixture of concrete and vermiculite. Completion of the demil process requires cutting the inert bomb into pieces so it is no longer recognizable as a bomb. The completion of the demil process on inert bombs at the UTTR has not occurred due to the high costs associated with the cutting of the bomb and the disposal of the remaining metal and filler debris. Of particular concern is the fact that cutting the bombs with a torch could heat the concrete filler and cause it to explode.

The "fired" bombs at the UTTR, made of 1/2" thick steel, were estimated to represent approximately $1.2 million worth of recyclable, high-quality scrap metal if a safe, cost-effective way could be found to separate the metal bomb casings from the filler. In 1997, Hill AFB Environmental Management personnel decided to find a demil method that would turn this range residue from a liability into an asset.

Process Change/Improvements:
Any new demil method had to produce "clean" scrap metal at a rate of at least one ton per hour in order to be profitable. It was thought that the concrete filler should also be collected and recycled. After considering a variety of proposals and technologies, OO-ALC/EM staff built a portable machine that successfully cuts the bomb and separates the casing from the filler. The machine is able to produce clean scrap metal at more than the desired rate of one ton per hour.

The machine works by holding and rotating the bomb while a rotary saw blade cuts through only the thickness of the casing. Once the cut is completed, the bomb breaks in half and the filler can be easily removed from the casing by the same machine.

Practice bombs stockpiled at the Utah Test and Training Range.

Benefits:
Although the new demil and recycling process is still in the developmental stage, Hill AFB anticipates that the sale of the scrap metal will be profitable. A ton of clean scrap metal will sell for $55 to $120. The inert bombs will be properly demilitarized and recycled rather than transported to a landfill. The machine/process developed by Hill AFB is inexpensive ($9,000), has low maintenance requirements, and is safe to use. Hill AFB continues to refine the equipment to improve its efficiency. For more information, contact Mr. Brent W. Butler, Environmental Protection Specialist, OO-ALC/EMP, DSN: 777-3124, *butlerb@hillwpos.hill.af.mil*.

Composting and Wood Recycling

The Hill AFB Recycling Program was established with a mission to reduce solid waste discarded in landfills, prevent pollution, conserve natural resources, and generate revenue for the Services Division. Hill AFB pays $75-$140 per ton to dispose of solid waste at the Davis County Energy Recovery Facility where it is burned and/or landfilled. The base set a goal to reduce waste 40% by the end of CY 1997 from a 1992 baseline. A variety of waste reduction and recycling efforts have been implemented at Hill AFB in an effort to divert paper products, metal, glass, plastics and other wastes from the solid waste stream. A recent analysis of the base's total waste stream determined that garden trimmings and wood make up almost 21.5% of the total solid waste produced. Thus, efforts to collect and recycle garden trimmings and wood became a high priority for the EM Directorate.

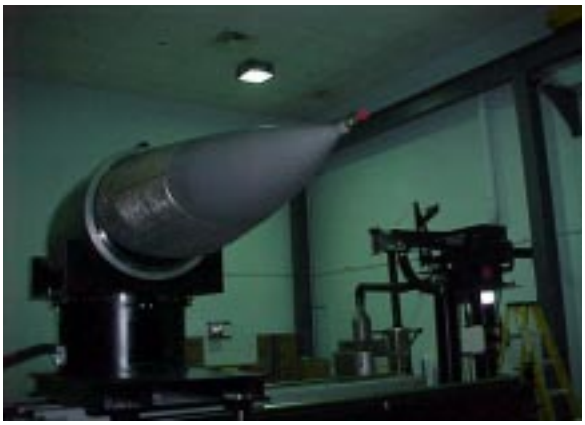
Under a new plan developed by the Solid Waste Program Office, all waste wood (e.g., branches and

pallets) generated at the base is collected and shredded in a large tub grinder. The wood chips are then used for composting and as cover material for the base's Class IV (construction debris) landfill. The landfill is no longer used; however, precipitation continues to leach through it causing potential groundwater contamination. The wood chip cover will decompose and allow a natural vegetative mat to become established on the landfill. This vegetative cover, once established, will absorb and divert precipitation, thereby reducing infiltration and leaching through the landfill. In addition, the appearance of the landfill, which is large and highly visible, will be greatly improved with the natural cover.

Hill AFB also operates a large-scale composting operation that serves the landscaping and gardening needs of the entire base. The compost is made up primarily of grass clippings and garden trimmings. A tub grinder and soil-screening unit are used to process the compost. It is estimated that over 250 tons of high-quality compost is used throughout the base's 6,698 acres. For more information about Hill AFB's composting and wood recycling initiatives, contact Mr. Dave Friese, Solid Waste Program Manager, DSN 775-2325, *friesed@hillwpos.hill.af.mil*.

Laser Automated Decoating System (LADS)

Process Description:
One of the most fragile components of the F-16 fighter jet is the radome. A radome is a dome-like protective housing for radar equipment used in most aircraft, usually located in the aircraft's "nose." F-16 radomes are made of non-metallic fiberglass and/or composite materials, so that the enclosed radar equipment can function without interference. Typically, an F-16 radome will be repainted and recalibrated several times during its lifetime. Conventional abrasive and chemical stripping depainting processes can damage surfaces and shorten the life of the radome. Within the nation's fleet of several hundred F-16s, approximately 48 out of 150 radomes depainted must be replaced each year due to the damaging effects of manual paint stripping processes. A radome costs approximately $41,000 to replace. This loss amounts to an annual cost of nearly $1.9 million. The manual stripping of a radome consumes 8-16 labor-hours, 7-31 days, and generates over 300 gallons of hazardous waste. In addition, there are many safety and occupational health hazards associated with this process. The cost associated with radome depainting, painting, and recalibration can easily approach the replacement cost.



F-16 Radome undergoes depainting in the LADS facility.

Process Change/Improvements:
One of the most recent paint removal processes implemented at Hill AFB is the Laser Automated Decoating System (LADS). This process uses a carbon dioxide pulse laser to remove paint from the surface of F-16 radomes. The new laser depainting equipment is housed within its own soundproof structure inside the main building. An adjacent control room, with a window for viewing the laser depainting operation, houses the electronic control and guidance devices. The laser is controlled by a specially designed software package loaded onto a desktop computer. The computer has the capability to perform a geometric analysis of the radome before it is depainted. This allows the LADS to "memorize" the three-dimensional contour of the radome before the depainting process begins, thus ensuring complete removal of all paint.

The radome is affixed to a device that rotates as the laser beam burns the paint from the surface. The CO_2 laser generates a 1/2" to 2" wide, 2300 degrees Fahrenheit (F°) pulse beam (130 pulses per second) that is guided by the previously recorded geometric analysis data. The only machine of its type in the world today, the LADS can "burn" the paint from a radome in just a few hours without damaging the composite surface despite the laser's extreme temperature. The surface temperature of the radome never exceeds 170 F°.

The paint residue is immediately vacuumed from the radome as it is burned off and passed through a filtration system. The resulting air emissions do not require a federal permit. One laser depainted radome (32 ft^2) generates only about one cup of non-hazardous paint ash residue. The LADS equipment incurred a total capital cost of $6.5 million and has been in use at Hill AFB for 3 years.

Benefits:
The LADS can be configured to depaint a variety of aircraft and AGE components. The depainting cost

with the LADS method is only $4,000 per radome. In the three years it has been in operation, the LADS has saved the Air Force over $500,000 per year in radome replacement costs, and another $125,000 per year in hazardous waste disposal costs. Hill AFB plans to have LADS depaint more F-16 radomes as well as C-130 radomes and wing components, which is expected to generate significant additional cost savings. For more information, contact Mr. Dallis N. Massey, Laser Technician, OO-ALC, DSN 777-6253.

Reduction of Hazardous Sludge

Process Description:
The industrial wastewater treatment plant (IWTP) at Hill AFB collects and treats wastewater from metal finishing and electroplating, aircraft washing, and painting operations. These waste streams can contain significant amounts of cyanide, cadmium, and chromium. The sludge generated by the IWTP typically contained cadmium and chromium at levels high enough for it to be considered a toxic characteristic hazardous waste. The sludge also contained significant concentrations of cyanide, oil & grease, suspended solids, and other metals. The Hazardous Waste Management Program at Hill AFB set a goal to reduce the initial introduction of cadmium and chromium to the IWTP so that the resulting sludge would no longer require management as a hazardous waste. A significant portion of the total cadmium and chromium inflow came from the electroplating and surface preparation processes in the landing gear maintenance operations of the Commodities Directorate. These concentrated waste solutions were delivered in carboys to the batch pretreatment process at the IWTP. Other waste streams entered the main part of the IWTP via the continuous flow stream (equalization/feed tanks).

In the pretreatment process, the concentrated waste cadmium cyanide solution (avg. 833 gallons per year) was batch pretreated only to neutralize cyanide, resulting in the precipitation of cadmium-containing solids. The waste chromic acid solution (avg. 19,500 gallons per year) was not pretreated at all. After pretreatment, the solutions were bled slowly into the continuous flow stream for treatment in the IWTP.

A hazardous sludge reduction project was organized to evaluate and test the feasibility of separating chromium and cadmium in the pretreatment module of the IWTP, at the point where they are most concentrated, rather than introducing them directly into the main flow. The desired result was to reduce concentrations of these two heavy metals in the main plant flow so that the treatment sludge did not require disposal as a hazardous waste.

Small filter press designed to remove metal-containing sludges.

Process Change/Improvements:
Since the major portion of the total cadmium and a significant portion of the total chromium entering the IWTP was from the concentrated solutions process through batch pretreatment, it was decided to effect changes in this process that would remove the two metals prior to entry into the main flow. The Hill AFB Environmental Management staff and their contractor formed a team that also included representatives of the Commodities Directorate and the IWTP.

Two small filter presses were installed as part of a pilot study inside the plant adjacent to the pretreatment tanks. Each press has 32 square feet of filter area. Initial filtration tests conducted on the cadmium solution over a two-month period resulted in a removal efficiency of 98%. The cadmium content of the pretreated influent was reduced from 13 milligrams per kilogram (or parts per million - ppm) to 0.25 ppm in the effluent. The resulting filter cake (sludge) has no free liquid and is 45% solids. The solids contain 7.4% cadmium oxide, which can be recycled to reclaim the cadmium.

In order to reduce the chromic acid solution from hexavalent chrome to trivalent chrome, it was first treated with sulfur dioxide gas and then with sodium hydroxide (caustic) to precipitate the solid chromium hydroxide. Initial filtration tests were conducted on 4,350 gallons of the chrome solution. The chromium content of the pretreated influent was reduced from over 50,000 ppm to less than 20 ppm in the effluent. The filter cake has no free liquid and is 31% solids. The solids contain 13% chromium oxide (in hydrated form). As in the case of the cadmium sludge, the chromium content of the filter cake is high enough to make it recyclable. The metals are reclaimed from the sludges by a vendor using a high temperature metal recovery process.

Benefits:
The net result for Hill AFB is that high concentrations of cadmium and chromium are removed from the IWTP influent and reclaimed instead of being disposed of as hazardous waste. The cost to purchase, install, and operate the equipment for the project was $100,000 and was paid for with pollution prevention funds. No additional labor costs were incurred. Until further testing is complete, the resulting IWTP sludge is still being disposed of as a hazardous waste at a cost of $0.21 per pound. However, the sludge volume decreased 64% when the new pretreatment process was initiated. An annual disposal cost savings of $91,000 is anticipated. The cost to recycle 30,000 pounds of the metal-containing filter cake for the period July-December 1997 was approximately $15,000. Savings will increase if the final sludge, averaging 10 tons per month, is shown to be non-hazardous. For more information about recovering heavy metals from concentrated waste solutions, contact Mr. Blair Armstrong, P.E., CHMM, Environmental Management Directorate, Hill AFB, DSN 777-2693, *armstrob@hillwpos.hill.af.mil*.

Solvent Vapor Recovery System

Process Description:
Control of volatile organic compounds (VOCs) that result from aircraft painting operations is required under the Clean Air Act Amendments of 1990. These amendments established National Emission Standards for Hazardous Air Pollutants (NESHAPS) for the Aerospace Industry. Hill AFB has depot maintenance, modification, and repair responsibilities for several hundred F-16 and C-130 (Navy and Air Force) aircraft, including the painting of all or part of each aircraft on a periodic basis.

The application of protective primer and paint coatings to aircraft generates a significant amount of VOC emissions. Aircraft coatings typically consist of paint solids suspended in a volatile organic solvent such as methyl ethyl ketone, toluene, or xylene. Releases of these solvent vapors into the atmosphere can cause tropospheric ozone and smog formation. (Ozone formed in the troposphere (ground-level) is a strong oxidizer and harms living organisms. In the stratosphere, ozone protects organisms from harmful ultraviolet radiation.)

The paint and primer solids typically contain heavy metals and other potentially toxic substances. High-volume, low-pressure compressed air paint spraying, common to most painting operations at Hill AFB,

Solvent Vapor Recovery System (SVRS), note VOC condensate collection container in foreground.

reduces emissions through better paint transfer efficiency. In addition, new high-solids, low VOC paints are becoming more common, but still emit considerable VOCs. Painting operations are conducted in paint booths designed to maintain temperature and humidity levels specific to particular painting operations. The overspray from painting operations is drawn from the paint booth through wet or dry filtering systems designed to capture airborne paint solids. Filters are periodically replaced and disposed of as hazardous waste. The filtered air, which still contains VOC vapors, is a source of air pollution, and in many cases, a regulatory violation if discharged untreated. Until recent regulatory changes, including the Aerospace NESHAP, Hill AFB had not been required to treat these emissions. The need to meet federally mandated VOC emission levels would have limited the number of aircraft that could be painted at Hill AFB in a given year.

Process Change/Improvements:
In an effort to capture virtually all of the VOCs emitted from Hill AFB's aircraft painting operations, engineers from the Aircraft Directorate installed a 100,000 cubic feet per minute (cfm) VOC recovery system at the Aircraft Paint Facility, Bldg. 220. This unique solvent vapor recovery system (SVRS) is the only one of its kind in Utah and is able to recover 50-70 gallons of recyclable solvent each week. The SVRS consists of a series of 24 zeolite (aluminum silicate) absorption cells (one ton each) that remove VOCs from the air stream drawn from the paint booths. After 1.4 days of absorption, cells are taken off-line for 90 minutes of desorption. The schedule is staggered so 23 cells are always on-line and only one cell is off-line for desorption at a time. The VOCs are desorbed from the filters through a hot air reverse-flow rinse process. The desorption air is then dried and chilled so the VOC

vapor condenses and can be collected. Paint solids are filtered out first to protect the zeolite from contamination.

Benefits:
This system, installed in November 1996, is able to capture up to 99.5% of the VOCs emitted from aircraft painting operations in Bldg. 220. The recovered solvent is used to clean paint guns, a money saving recycling effort. The base is able to increase its aircraft painting workload due to the virtual elimination of VOC emissions, as well as receiving credit for the significant emission reduction.

For more information about the solvent vapor recovery system in place at Hill AFB, contact Mr. John Vidic, Environmental Engineer, OO-ALC/LAOE, Hill AFB, DSN 777-2050, *vidicj@hillwpos.hill.af.mil*.

Constructed Wetland Wastewater Treatment Unit

Process Description:
Hill AFB maintains a housing and office facility called the "Oasis" at the Utah Test and Training Range (UTTR), located in western Utah. The UTTR is used for testing munitions and propellants, including ICBM motors and is a training ground for operational devices employed worldwide. The source of water for the Oasis is brackish groundwater from a low-yield aquifer. The groundwater is desalinated with a reverse osmosis process to make it potable. Since water of any quality, especially desalinated water, is such a scarce commodity at the UTTR, Hill AFB decided to look into ways to reclaim some of the facility's wastewater. The objectives were to upgrade the wastewater treatment facility to meet anticipated increases in personnel occupancy using cost-effective, low-maintenance technology, protect against contamination of groundwater, provide for future reclamation of water for landscaping, and improve wildlife habitat.

The original wastewater treatment system consisted of two small unlined containment lagoons excavated into the desert. An additional overflow cell had been scraped out nearby. The system was not constructed in compliance with any applicable local health department criteria or federal guidance. Water was lost through seepage into the ground and evaporation.

Process Change/Improvements:
The final wastewater treatment design consists of reconfiguring the two existing lagoons to operate in series, installation of two 150' x 55' free surface water wetland "cells" operating in parallel, and a habitat wetland pond. The existing ponds and new ponds will be lined with a polypropylene liner to prevent seepage to the groundwater. The liner was chosen for its mechanical and chemical properties, especially its resistance to ultraviolet light. Wastewater flows into the first two lagoons for solids separation and digestion. Effluent from the lagoons flows to the free surface water wetland cells that are planted with cattails, bulrushes, and reeds for greater filtering and removal of organic compounds. Effluent from the two wetland cells discharges to a wildlife watering trough and then to the habitat wetland pond that is planted with bulrushes. The wetland cells and habitat pond are only about three feet deep with sloped sides to prevent the trapping and drowning of animals that come to drink. A pump station may be located in the future near the free surface water wetland pond discharge to provide an option to irrigate the surrounding landscape.

Benefits:
The new wastewater treatment system is just being completed at the Oasis. The total cost for the new treatment system was under $300,000, and is priced well under several other alternatives considered. A similar system was constructed at Nellis AFB in Nevada in 1995. The wetland habitat in Nevada has attracted a variety of wildlife, migratory birds, nesting waterfowl, and rabbits. An environmental protection specialist at Nellis AFB has estimated more than 100 different species of desert mammals, waterfowl, and reptiles frequent their wetland habitat.

In the long term, Hill AFB expects the wetland habitat treatment system to provide cost-effective treatment of wastewater, increased protection of groundwater, and improved wildlife habitat with the potential for future water reclamation. The environmental impact of any increase in wildlife in the area of the wetland will not impede flight operations or the mission performed at the site.

For more information about treating wastewater and creating wildlife habitat using constructed wetland technology, contact Mr. Jeffrey Watkins, Environmental Engineer, OO-ALC/EMC, DSN 775-6910, *watkinsj@hillwpos.hill.af.mil*. Additional information about the UTTR can be found at **http://www.hill.af.mil/uttr/index.htm**.

Sulfur Lighting Technology Cuts Energy Use

[Adapted in part from an article written by Chief Master Sgt. Tom Kuhn appearing in the April 1998 issue of Airman Magazine.]

Hangar 225, the home of the Hill AFB Aircraft Operations Division, is illuminated with a new high-tech sulfur bulb lighting system. The huge 590,000 square foot hangar is the first industrial application of sulfur lighting technology anywhere. The project is cosponsored by the United States Department of Energy to encourage airlines, major corporations, warehouses, utility companies, and the military to switch to the new energy-efficient sulfur lighting technology.

Workers prefer the new lighting system because it is bright, but not glaring. The bulbs cast full-spectrum light, like the sun, which makes identification of color-coded materials easier. Another attribute of the lights is that they are very quiet and do not emit the humming noise that conventional fluorescent lighting systems can. In the case of Hangar 225, 44 new sulfur light pipe systems (88 1425-watt lamps, or 125,400 watts total) replaced 448 mercury vapor and metal halide 400-watt lamps (179,200 watts total). The new system results in savings of almost 54,000 watts.

The lighting system at Hill AFB consists of specially designed ten-inch diameter polycarbonate plastic tubes containing a special reflective film fabricated in 6.5-foot segment lengths attached together. Two golf-ball sized sulfur "bulbs," one at each end of the tube, utilizes a magnetron, similar to ones used in microwave ovens, to provide the microwave energy source needed to "excite" the sulfur gas. The result is a glowing tube of light that emits as much light as 44 conventional fluorescent tubes with almost no heat. The bulbs

Sulfur light tubes illuminate Hill AFB's Hangar 225.

have a life expectancy of 60,000 hours; therefore, bulb replacement is expected to be infrequent. Additionally, only the small sulfur bulbs require changing, not the entire tube. The lamps use sulfur with no internal filaments rather than the more traditional mercury used in all other high-wattage lighting systems. Thus, disposal of the bulbs is not expected to pose an environmental problem.

The Air Force did not pay the $1.5 million up-front cost of the new lighting system. Instead, it will share the energy savings for 17 years with the contractor who installed and maintains the sulfur bulb system under an energy saving performance contract. The project satisfies federal, Executive, and Air Force mandates to reduce energy use.

For more information about this unique lighting program, contact the Hill AFB Energy Manager, Mr. Kent Nomura, 75 CES/CEOM, DSN 777-5419, *nomurak@hillwpos.hill.af.mil*.

The AFCEE Team - Recognized as a customer-oriented leader and the preferred provider of environmental, planning, design, and construction services.

Pollution Prevention Success Stories **- TI 19028 - JANUARY 1999**

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