

**ENVIRONMENTAL COMPLIANCE  
AND  
AREA COMPLETION PROJECTS**



**2011 ACCOMPLISHMENTS REPORT**

**A SUPPLEMENT TO THE ENVIRONMENTAL REPORT**

# EC&ACP OVERVIEW

The Savannah River Site's (SRS) Environmental Compliance and Area Completion Projects (EC&ACP) is the organization responsible for SRS environmental compliance, environmental monitoring, remediation of contaminated soils, surface water, groundwater, and deactivation and decommissioning (D&D) of inactive facilities. This report covers the Area Completion Projects activities during 2011.

## Area Completion Projects (ACP)

ACP's focus is reducing the footprint of legacy waste at SRS contaminated waste sites and obsolete facilities, and its mission is the cleanup of 515 waste sites and the deactivation and decommissioning of 1,101 facilities across SRS. The approach for soil and groundwater cleanup is to treat or immobilize the source of the contamination and clean up or flow the movement of contamination that has already migrated from the source. The approach for deactivating facilities is to safely remove hazards such as hazardous and radioactive waste, nuclear materials, contaminated equipment and debris and ultimately bring facilities to a cold and dark condition. This includes the decommissioning of industrial, radiological, and nuclear facilities.



**420-D Demolition**

## ACP Tasks:

- Remediate contaminated soils, surface water and groundwater, and inactive waste sites
- D&D surplus facilities
- Meet enforceable Federal Facility Agreement (FFA) milestones and Resource Conservation and Recovery Act (RCRA) Permit commitments
- Operate soil and groundwater remediation systems
- Monitor contaminated surface water and groundwater to ensure control of contaminant migration and effectiveness of remedial systems
- Perform surveillance and maintenance of closed waste units, closed RCRA units, and numerous other facilities
- Develop and deploy innovative remedial technologies



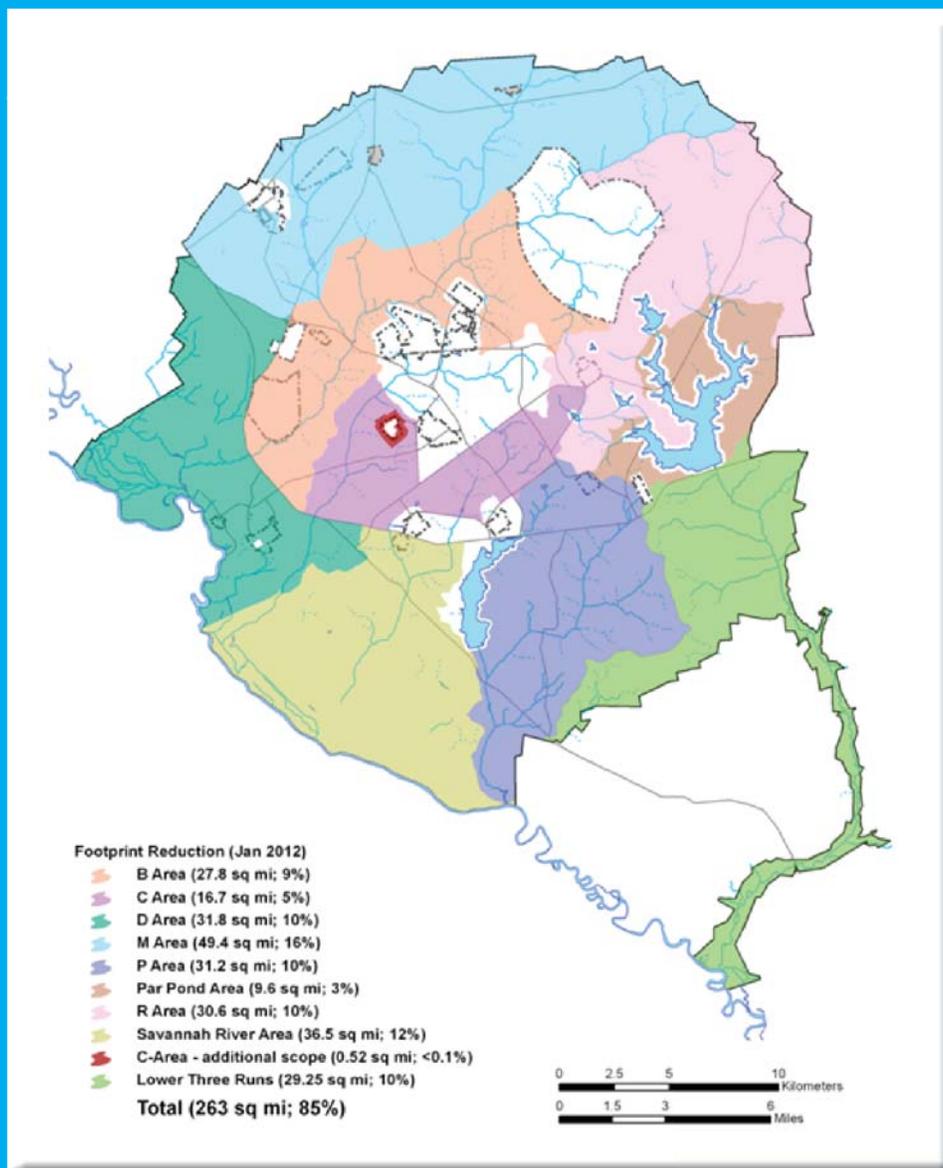
**ACP P&R Closure Celebration**

# EC&ACP OVERVIEW - CONTINUED

## Footprint Reduction

The introduction of the American Resource and Recovery Act (ARRA) and associated funding in 2009 provided an additional opportunity to accelerate the SRS cleanup program. SRS has made significant progress with ARRA initiatives to reduce the Environmental Management (EM) footprint. Through strategic planning, cost-effective technology deployment, the Removal Action process, and disciplined project management, environmental remediation and facility D&D has been successfully accelerated.

In 2011, the site footprint was reduced by 114.7 square miles through the remediation of soil units and the D&D of facilities. By the end of 2012, 263 square miles, or 85% of the site will be released for potential re-use or re-development, reducing the EC&ACP schedule by 10 years over earlier projections.



Projected 2012 Footprint  
Reduction at 85%

# EC&ACP SAFETY PROGRAM



EC&ACP Safety and Health has as its foundation the SRNS Integrated Management elements of Defining the Scope of Work, Analyzing Hazards, Developing the Implementing Controls, Performing Work Safety, and Providing Feedback. We supplement this with Human Performance Improvement tools.

The EC&ACP Safety and Health Program provides a number of tools for employees to actively participate in the SRNS Safety Program. The centerpiece of our program is employee involvement. Employees are encouraged to become active Behavior Based Safety (BBS) Observers and to regularly conduct BBS observations while in the field or office work environments. We have an active, management-sponsored, employee-driven Local Safety Improvement Team (LSIT) that meets monthly and is well attended by a good cross section of our employees. A weekly safety topic containing both on and off-the-job safety topics is developed by our Safety staff and distributed to all of our employees.

We have a dedicated staff of Safety and Industrial Hygiene professionals who provide support and oversight to project teams and functional departments. These individuals participate in Assisted Hazard Analysis (AHA) review and approval, work planning and work package review and approval, self-assessments as well as the facility work area walkdowns, Emergency Preparedness drills and exercises, Fact Finding meetings, accident/incident investigations, BBS iTROTs (Integrated "The Rest of the Story"), Management Field Observations, Subcontractor Focused Observations, LSIT meetings, BBS observations, and Lessons Learned development. They also monitor the conduct of work for compliance with controls specified in work planning documents and/or procedures.

Industrial Hygienists also provide occupational assessment of workplace exposures, recommend control practices to ensure compliance with DOE Order 10CFR 81 and OSHA regulations related to the control of worker exposure to hazardous substances or conditions, and conduct sampling or monitoring for various chemicals and/or contaminants in accordance with the Exposure Assessment Program.

All of the above contributes towards helping EC&ACP safely plan and execute work.

**See something unsafe,  
say something for safety.**

# PROJECTS

## H-4 BASIN CONCRETE DITCH UPGRADES



**H-4 Basin drainage ditch  
concrete placement**

This project was initiated to prevent rainwater intrusion at the H Area Seepage Basin (H-4 Basin), the Site's largest closed basin. Prior to its closure in 1988, the basin received wastewater containing low-level radioactive and hazardous constituents that originated from the Site's Separations Area. A large percentage of the radiological releases to the basin also included relatively high concentrations of tritium. The basin was designed to allow the wastewater to percolate through the underlying soil, filter-

ing and containing a majority of the contamination. Once the basin was closed, a multi-layer clay cap was installed and maintained in accordance with a RCRA Permit. In 2011, a total of 3,858 feet of concrete was poured for the drainage ditch surrounding the basin, and rip rap and fencing were installed for the drainage enhancements.



**H Area Seepage Basin Upgrades  
were completed in 2011**

## F AREA BARRIER WALL EXTENSION



**F Area Barrier Wall drilling  
in progress**

In 2004, SRS successfully constructed subsurface barrier systems at F and H Seepage Basins to control the release of tritium into Fourmile Branch from the water table aquifer. The barrier systems were constructed using a deep soil mixing technology to further control and contain tritium. Approximately 1,140 linear feet of low permeability underground barrier, consisting of indigenous soils blended with grout, was installed to a depth of 70 feet.



# PROJECTS

## ADVANCED TACTICAL TRAINING ACADEMY (ATTA)

ATTA was constructed in 1984 for advanced weapons and tactical training of the Site's security force. This project was to relocate and establish several functions that were located at the Small Arms Training Academy (SATA) and ATTA for the SRS Site Security Contractor. The project was completed in May and included:

- Building an approximately 8,400 square foot Administration Training Building
- Repairing and maintaining the access road to ATTA Range
- Providing a fiber optic cable or wireless communications circuit
- Building a weapons cleaning facility
- Installing a weapons storage facility
- Installing a maintenance storage facility
- Installing two ammunition magazine storage vaults at ATTA
- Relocating the BEAR target system



Administration Building and Fire Tower in progress



Aerial of the completed ATTA Range

## SMALL ARMS TRAINING ACADEMY (SATA)



Above: SATA before remediation  
Below: SATA after remediation



SATA had operated since 1951 as a firing range facility for small arms weapon training of SRS security personnel. The SATA facility included three small arms ranges, storage buildings for supplies, a weapon cleaning building and a control building. A 370-foot earthen berm at the facility had been used as a backstop for bullets. The berm had accumulated a large amount of spent lead bullets, and had lead soil concentrations that exceeded EPA residential and industrial worker regional screening levels. Approximately 11,000 cubic yards of contaminated soil needed to be removed. For the SATA Project, contaminated



Last load of contaminated soil from SATA being loaded onto railcar

soil was excavated, loaded into rail cars, and transported to a hazardous waste landfill in Oklahoma for disposal. Non-hazardous material was hauled to a nearby landfill. Final grading and site restoration was completed in May.

# PROJECTS

## HEAVY WATER COMPONENT TEST REACTOR (HWCTR)

HWCTR was built to test the concept of heavy water moderated reactors for the civilian power industry. It was retired in place in 1965. Preparations for the dome removal and reactor D&D began in October 2009. The 175,000 pound dome was safely removed in February 2011. Its removal facilitated successful critical lifts of the reactor vessel, two steam generators, and polar crane trolley / bridge from the facility. The steam generators and reactor vessel were shipped to Solid Waste for burial; the transfer coffin was moved to the reactor vessel void. The below-grade structure was then grouted. The dome and shell were later cut into smaller pieces and placed in the E Area Low-Level Waste Facility. Additional work included

demolishment of the interior structure, loading waste into containers, and shipment for disposal. Lastly, a concrete cover was placed over the reactor's footprint, officially marking the end of HWCTR's decommissioning.

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**Aerial of HWCTR  
before decommissioning**



**HWCTR Dome Removal**



**Top Left: Aerial of HWCTR without dome  
Center Left: Reactor vessel being removed from HWCTR  
Bottom Left: Demolition in progress  
Bottom Right: HWCTR was completely demolished, grout was placed in the underground opening, and a permanent concrete cap was installed.**



# PROJECTS

## P AREA REACTOR AND DISASSEMBLY BASIN CLOSURE



**P Reactor Complex before remediation**

P Area includes P Reactor, the first SRS reactor to be decommissioned .

P Reactor started up in 1954 and was placed in shutdown in 1991. Its purpose was to produce special nuclear materials for national defense. Facilities in the area included the reactor building, maintenance buildings, administration building, cooling water basin, pump house, and a coal fired power house. P Reactor decommissioning included placing 116,000 cubic yards of grout and then

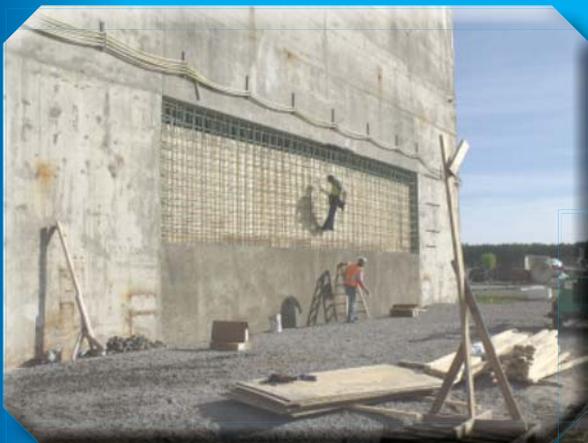
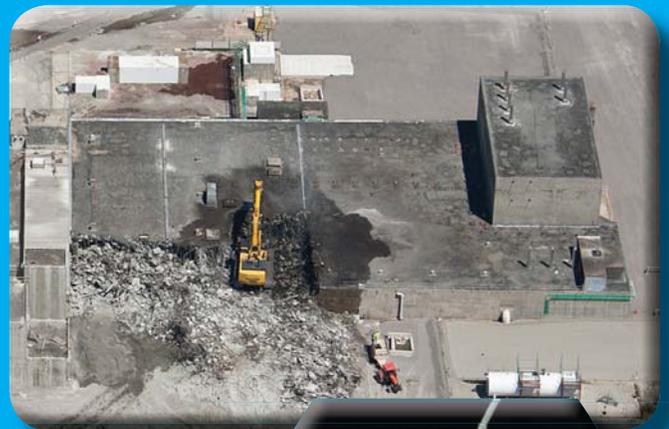
sealing the building, Gantry Crane removal, stack removal, and disassembly basin water evaporation and subsequent demolition. An environmental cap was then installed over the basin area.

**Top Right: Disassembly Basin demolition is progress**

**Center Right: Environmental Cap installation in progress**

**Below Left: Openings being sealed in the reactor building**

**Below Right: Aerial of P Reactor Complex after remediation**



# PROJECTS

## P ASH BASIN / P-007 OUTFALL

At the P Area Ash Basin, Recovery Act workers removed about 35 acres of vegetation on and around the 14-acre man-made earthen basin to prepare for remediation. Next, they consolidated ash inside the basin that had spread in the area from former P Area Powerhouse operations, which ended in 1991. Approximately 232,000 cubic yards of ash and fill material were placed in P Ash Basin. In addition, 8,000 cubic yards of cesium-contaminated soil from the P-007 Outfall was disposed. Old piping support structures and miscellaneous concrete and metal items were collected and also placed in the basin. Workers then installed a sod cover. The vegetative layer prevents precipitation from infiltrating the basin's ash residues and entering the groundwater.



**Aerial of P Ash Basin before remediation**



**Top Left: Ash being consolidated inside the basin**



**Center Left: Clean soil being added to the basin**



**Bottom Left: Sod cover being placed**



**Bottom Right: Aerial of P Ash Basin after remediation**

# PROJECTS

## P AREA PROCESS SEWER LINES

The P Area Process Sewer Lines Project remediated about three miles of process sewer lines and isolated radiological contamination within the P Area piping system in an effort to prevent mobilization of contaminants into the environment. The system consisted of carbon steel pipes and interconnected reinforced concrete storm water lines of various sizes, depths and configurations that received contaminated process water discharges from the Reactor Building. The P Area process sewer lines were active when P Reactor was operational from the 1950s until it was shut down in 1988. Since then, the lines have been abandoned. The project remediated 2.9 miles of sewer lines and isolated 51 structures (diversion boxes, manholes, and catch basins) to prevent water flow through the system, which could cause contaminate migration. The lines were isolated and plugged, and the structures were filled with grout and concrete.



**Top: Concrete placement for process sewer line**

**Left: Concrete finishing in progress**

**Below: Finished cap**



# PROJECTS

## R AREA REACTOR AND DISASSEMBLY BASIN CLOSURE



**Aerial of R Reactor Complex before decommissioning**

R Area includes R Reactor, the second SRS reactor to be decommissioned. R Reactor started in 1953 and was placed in shutdown in 1964. Its purpose was to produce special nuclear materials for national defense. Facilities in R Area included the reactor building, maintenance buildings, administrative building, cooling water basin, pump house, and a coal fired power house. R Reactor decommissioning included placing 124,000 cubic yards of grout, sealing the building, Gantry Crane removal, stack removal, and disassembly basin water evaporation and subsequent demolition. An environmental cap was then installed over the basin area.

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**Above Left: Environmental Cap placement in progress**

**Above Center and Above Right: Openings being sealed in the reactor building**



**Aerial of R Reactor Complex after decommissioning**

# PROJECTS

## D AREA COAL PILE RUNOFF BASIN / WASTE OIL FACILITY

This project was an Early Action performed at the D Area Operable Unit to remediate contamination associated with the 484-D Powerhouse. The remediation project removed contaminated sediment and soil from the D-006 Outfall stream channel and 484-10D Waste Oil Facility and consolidated the material in the Coal Pile Runoff Basin. Lastly, a vegetative cover was installed over the closed portion of the basin.



**Above: D Area Coal Pile Runoff Basin before remediation**

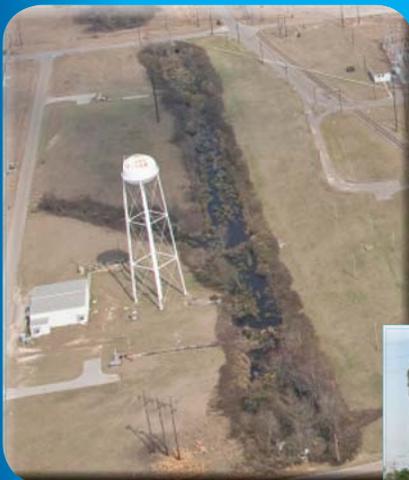
**Below: D Area Coal Pile Runoff Basin after remediation**



**Left: Rip Rap being added for drainage  
Below: Sod being placed for cap**



## D-006 OUTFALL



**Above: D-006 Outfall before remediation**

**Below: D-006 Outfall remediation in progress**



**Left: D-006 Outfall work in progress**

**Below: D-006 Outfall after remediation**



# PROJECTS

## PAR POND FACILITIES DEACTIVATION

Deactivation was performed at several PAR Pond Facilities, including the Boat House, the Environmental Support Facility, the Chlorine Container Building, Pump-house Equipment Building. Also, ten large river water pumps and motors were removed. The Transfer Substation was demolished and several transformers were removed for disposal.



**Aerial of PAR Pond before demolition and deactivation**



**Above Left: Lab Boat Dock, Equipment Building, Chlorine Gas Building and Environmental Support Facility before demolition**

**Above Right: Boat House and Equipment Building demolition in progress**



**Aerial of PAR Pond after demolition and deactivation**

## D AREA DETRITIATION PROJECT

At D Area, four Thermal Detritiation Units were used to treat tritium-contaminated concrete and soil. Thermal detritiation is an innovative technology that uses resistance heaters to drive off tritium from contaminated media. Approximately 1,650 cubic yards of contaminated materials were successfully treated in multiple campaigns. The treated material, along with debris and common fill was returned to the excavated areas.



**Top Right: Inside of a Thermal Detritiation Unit**

**Center Right: Thermal Detritiation in progress**

**Below Right: Aerial of finished Thermal Detritiation Units**



# PROJECTS

## C AREA CASK CAR RAILROAD TRACKS

The C Area Cask Car Railroad Tracks as Abandoned is an area west of the C Reactor. During operation of the reactor, radiological materials was transferred into metal casks and later loaded onto railroad cars. The outside surfaces of the casks would occasionally become contaminated with radiological compounds while being packed. When the cask cars were exposed to rain, radiological materials were washed from the cask cars onto the railroad tracks below. A study estimated that approximately 23 linear feet of railbed gravel and soil were contaminated with Cesium-137. Remaining railroad tracks were also found to be contaminated. The cleanup project involved the removal of the contaminated cask car railroad tracks, ties, gravel and contaminated soil. New tracks were then installed to maintain the historical integrity of the area, as part of an effort to preserve C Area, a protected historical site.



**C Area Cask Car Railroad Tracks before removal and remediation**

**Right and Below:  
C Area Cask Car Railroad remediation in progress**



**Right: Aerial of C Area**

# TECHNOLOGIES

## BASE INJECTION TECHNOLOGY

The F Area and H Area separations facilities discharged acidic effluents into the F and H Area Seepage Basins from the early 1950's until mid-1980's. Releases to the seepage basins formed two large areas of groundwater contamination containing dilute nitric acid, metals, radioactive metals, and non-metallic radionuclides from the basins that eventually discharged into Fourmile Branch. The acidic nature of the groundwater also leached natural metals and radionuclides from the aquifer. The acid keeps the metals in solution in the groundwater and limits the sorption of the metals on to aquifer materials; because of the positive charge within the aquifer due to hydrogen ions from the acid.

As part of the SRS remedial strategy to reduce the migration of contaminants to Fourmile Branch, it was recognized that a remedial approach to manage metal releases was needed. To satisfy this need SRS developed a base injection technology to reduce the acidity of the groundwater in the gates of the funnel and gate system down-gradient of the F Seepage Basin, and up-gradient of Fourmile Branch and down-gradient of the subsurface barrier systems in the F and H Seepage Basins groundwater plumes. The chemical injection neutralizes the acidity in the water table aquifer, and causes metals to complex and sorb on aquifer sediments. The base injection process pumps a weak solution of sodium hydroxide and bicarbonate of soda, and water into the aquifer through a series of injectors.

The current base injection systems inject base solutions into the water table aquifer in the gates of the F Seepage Basin funnel and gate system, and down gradient of the barriers. Down gradient injectors are placed in a fashion to intercept the area known highest acid contamination that supports metal transport to Fourmile Branch. Base injections into the aquifer have been very effective in reducing the migration of metals to the branch. The upper photograph shows the base injection mixing equipment down-gradient of the F Seepage Basins. The lower photograph shows a single injector down-gradient of the F Seepage Basin.



Base injection mixing system down-gradient of the F Seepage Basins; the large tank to the left is the base concentrate storage tank. The system mixes potable water with concentrate, and pumps the solution to injectors.



Base injector down-gradient of the F Seepage Basins.

The base solution developed and deployed at SRS could have application at other sites where acid plumes support the migration of metals.

# TECHNOLOGIES

## LANTHANUM BROMIDE DETECTORS

Utilizing recent advances in radiological detection to aid in environmental cleanup and remediation, ACP has implemented new detectors for field identification of gamma emitting radionuclides. Replacing the old sodium iodide systems with detector crystals made of lanthanum bromide allows for better energy resolution (finer peaks for nuclide identification). While the resolution is not as fine as a high purity germanium detector, the LaBr detector does not require liquid nitrogen cooling, making it a lighter, more portable field tool. The detectors are coupled with a portable operating system (Inspector 1000) that is relatively light weight and rugged, allowing for use in wooded and remote areas.

The Inspector 1000 has four different modes of operation, of which, the gamma locator and the spectroscopy are utilized at this site. The gamma locator mode provides results as real time readings in units of total gammas per minute. The spectroscopy mode captures a spectrum of gamma emissions over a period of time, allowing for isotopic identification of gamma sources. Since the principal isotope of interest is often cesium-137, the Inspector 1000 is an appropriate tool as daily gain adjustment is made with a known cesium source. For quality assurance, a quality check is performed on the equipment with a certified source and multiple performance parameters are compared to historical performance to ensure consistent results.

The equipment has allowed focused sampling by identifying the areas of higher activity thereby reducing the number of samples requiring analysis in a laboratory.



# TECHNOLOGIES

## NON-AQUEOUS PHASE LIQUID



SRS Engineering has developed a software application that will determine the presence of non-aqueous phase liquid (NAPL) in environmental media such as soil, groundwater, or soil vapor samples. The software will determine the mass, volume, and composition of NAPL chemicals in the samples based on the results of analytical soil analysis. The software also computes important environmental engineering measures such as the NAPL residual saturation, NAPL mass in soil, water, and vapor, volume of NAPL, volume of contaminated media, and chemical mass balance and phase distribution of chemical composing the NAPL. Above is a photo of NAPL pumped from a groundwater monitoring well.

NAPL is an especially detrimental type of environmental contaminant. It exists in soil, groundwater, or soil vapor as the same organic chemical(s) originally shipped by the manufacturer. Often NAPL comprises a mixture of different chemicals like trichloroethylene (a cleaning solvent) or petroleum hydrocarbons such as oil and gasoline mixtures. It is extremely difficult to detect the presence of NAPL in the environment and sometimes its presence must be determined by inferential evidence rather than by direct measures or laborious chains of calculations. Failure to recognize the presence of NAPL in a waste site soil will almost certainly result in failure of cleanup efforts. NAPL is persistent in the environment, has low solubility, and is resistant to many conventional remedial technologies such as soil vapor extraction as an example. Most importantly it will provide a reservoir of contamination for both soil and groundwater on a time scale of 10 to 100s of years. Therefore, it is absolutely essential that environmental professionals have a tool they can use to assess the nature and severity of NAPL contamination in order to apply and design the correct cleanup technology.

The NAPL Calculator is an analytical model that requires typical analytical soil/groundwater/soil vapor concentration data and a few simple geotechnical parameters for input. A classic chemistry method is used that is based on the work of Shiu, Feenstra, McKay, and Cherry and is advocated by the US Environmental Protection Agency. The method is known to some academics and researchers in environmental cleanup. Even for those who know the method, the calculation is laborious and must assume some hypothetical data inputs. The NAPL Calculator© is designed to make this calculation method accessible, understandable, and self-explanatory to a variety of environmental disciplines.

NAPL Calculator© simulations have been approved by regulatory agencies and used at dozens of cleanup sites at SRS for over 10 years and other environmental cleanup sites worldwide including Europe and Canada. The software has been sold commercially to a global market of consulting companies, legal firms, environmental remediation companies, and universities.

# TECHNOLOGIES

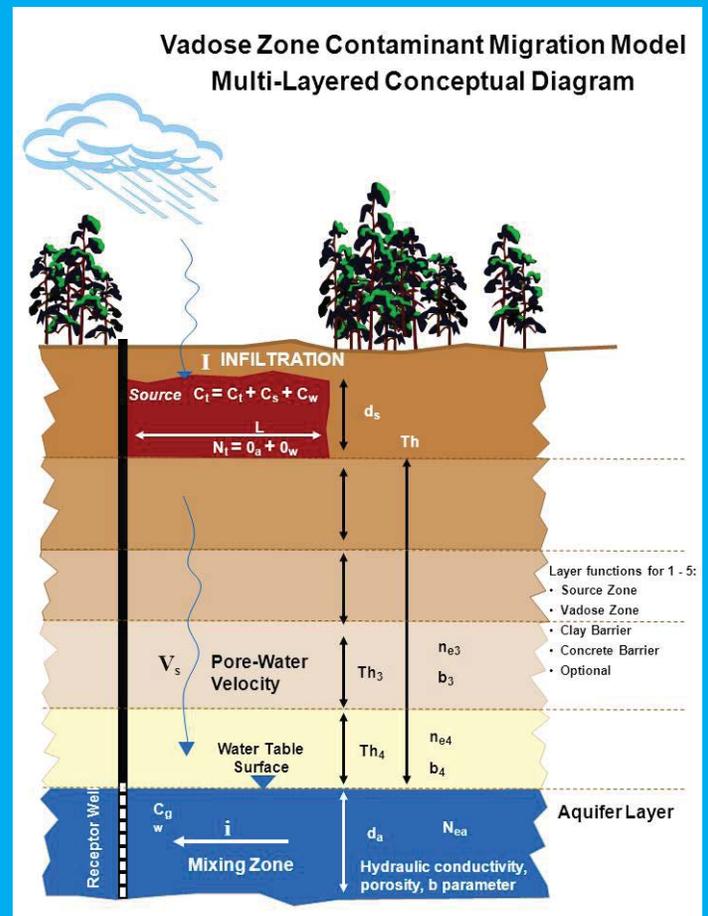
## VZCOMML© VERSION 4.0

SRS Engineering has developed an analytical software application to simulate contaminant fate and transport through the vadose zone to groundwater. VZCOMML© (pronounced Vee-Zee-Com-M-L) is a one dimensional, three-phase equilibrium, analytical contaminant transport model incorporating mass balance and time criteria to calculate key fate transport data. The program automatically uses decision logic to determine the contaminant(s) of concern, the peak groundwater concentration, and the time to reach peak groundwater concentration. The model also performs non-aqueous-phase liquid (NAPL) screening of the analytical soils data.

The VZCOMML© model uses fundamental fate and transport processes and is easy to use and understand. The increased analytical complexity of the newest version is invisible to the user. The model design minimizes the need for extensive input data. It is preloaded with chemical-specific parameters over 221 compounds including all the analytes on the EPA Target Analyte List/Target Compound List including volatile organic compounds, semi-volatile organic compounds, pesticides, PCBs, and metallic) and for 40 radionuclides. All compounds can be screened simultaneously, eliminating the need for multiple runs.

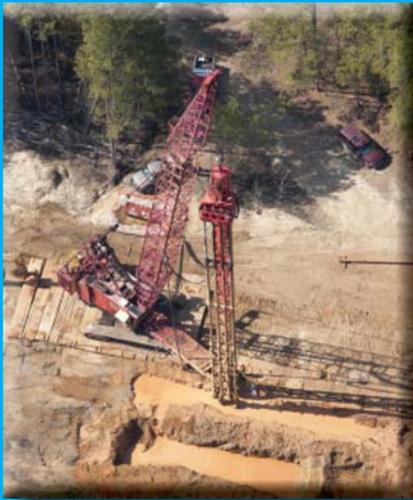
The most important feature of the new software version is the capability to assign any combination of layer hydraulic functions, such as source zone, soil layers, or barrier layers to any layer in the soil column. The model can use up to five separate layers to more accurately simulate unsaturated flow in the vadose zone. Default parameters are easily modified by the user to match site-specific conditions. The new version includes a Custom Analyte Module where any compound, not included on one of the pre-loaded lists, may be evaluated.

VZCOMML© simulations have been approved by regulatory agencies and used at more than 100's of cleanup sites at SRS for over 10 years. The software has been sold commercially to a global market of consulting companies and universities. VZCOMML© was recommended by an independent consultant as the standard model for protection of groundwater resources by the country of New Zealand.



# TECHNOLOGIES

## SUBSURFACE HYDRAULIC BARRIERS DEPLOYED WITH DEEP SOIL MIXING TECHNIQUES



The F Area and H Area separations facilities discharged acidic effluents into the F and H Area Seepage Basins from the early 1950's until mid-1980's. Releases to the seepage basins formed two large areas of groundwater contamination containing dilute nitric acid, metals, radioactive metals, and non-metallic radionuclides that eventually discharged into Four-mile Branch.

The basins were capped in the early 1990's, and by 1997 two large groundwater treatment systems were constructed and operated in a pump and treat mode until late 2003, when it was determined that the units were not able to meet regulatory goals. By 2001 SRS recognized that the pump and treat systems were not effective, and another remedial strategy was needed to reach regulatory goals. In 2003 SRS proposed the construction of subsurface barrier systems at F and H Seepage Basins to control the release of tritium into Fourmile Branch from the water table aquifer.

The F Seepage Basin plume strategy would use a funnel and gate arrangement to limit the migration of contaminants to the Branch from the lower half of the water table aquifer. The H Seepage Basins releases to the Branch would be controlled by installing a barrier up-gradient and down-gradient of the H-4 basin, to reduce the hydraulic gradient to the branch. Construction of the barrier systems began in 2004 and was finished in 9 months.

The barrier systems were constructed using a deep soil mixing technology to a depth of approximately 90 feet below surface. The upper photograph shows a deep soil mixing auger rig during barrier installation down-gradient of the F Seepage Basins. The lower photograph is of the same soil mixing rig from ground level.

The injected grout fills the porosity within the soil, and results in a low permeability soil material. The F and H Seepage Basin barriers used an acid resistant grout. Grouts can be tailored to meet the needs of any remedial or hydraulic scenario. Grouts are composed of relatively non-degradable materials and can perform as designed for a very long time.

The F and H Seepage Basins groundwater remedial goals have been achieved using subsurface barriers to control contaminant flux. SRS is exploring other uses of low permeability subsurface barriers to redirect groundwater flow and alter hydraulic gradients.



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