Solid Waste Management Unit 154
Building 9960 Septic System

Part 1

Site History

- Solid Waste Management Unit (SWMU) 154, Building 9960 Septic Systems is located in the Coyote Test Field on Kirtland Air Force Base and is approximately 1.3 miles east of Technical Area III.
- Building 9930 was constructed in 1965 to machine and prepare high explosive (HE) assemblies for tests in Coyote Test Field. SWMU 154 consists of two separate areas:

  "West System" – consists of two 5-foot diameter HE seepage pits located southwest of Building 9960. Wastewater from explosive cuttings and powders was discharged to the HE seepage pits. In 1991 disposal to the pits was discontinued. In 1992 above ground holding tanks for the HE wastewater were installed.

  "East System" – consists of a septic system with a 900 gallon tank and 5-foot diameter seepage pit located north of Building 9960. Building 9960 contains one bathroom with a shower, sink, toilet, and floor drain. In 1993 the Building 9960 septic system was connected to the TA-III sanitary sewer system.

Depth To Groundwater

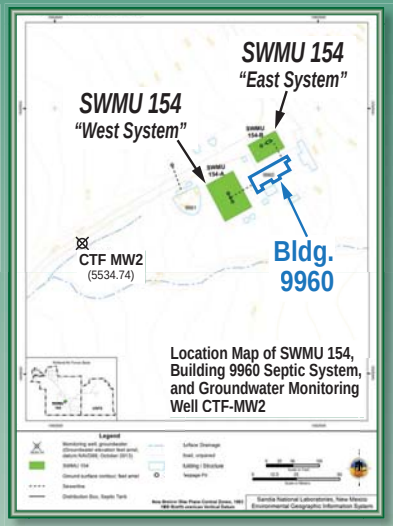
- Depth to the regional aquifer is 44 feet below the ground surface (October 2013).

Constituents of Concern

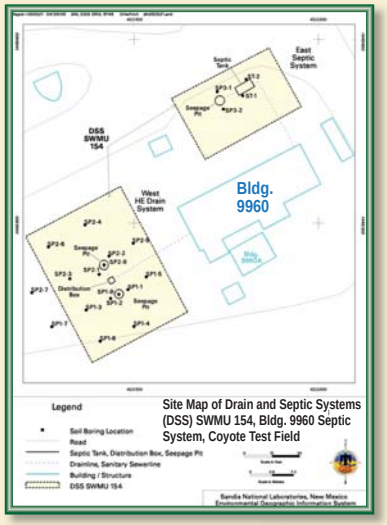
- Volatile Organic Compounds (VOCs)
- Semivolatile Organic Compounds (SVOCs)
- Metals
- Nitrate
- Chromium VI
- HE compounds
- Radionuclides

Geophysical Surveys

- Geonics™ ground conductivity surveys were performed for the SWMU 154 septic system and HE seepage pits in March 1994. The purpose of the surveys was to locate wetted areas around the septic and HE seepage pits. No areas of moist soil in the subsurface were detected.



Location Map of SWMU 154, Building 9960 Septic System, and Groundwater Monitoring Well CTF-MW2



Site Map of Drain and Septic Systems (DSS) SWMU 154, Bldg. 9960 Septic System, Coyote Test Field

Soil Gas Surveys

- A passive soil gas survey was conducted in the septic system and HE pits in May and June 1994 to identify releases of VOCs and SVOCs. 12 soil gas samplers were installed at SWMU 154. Six samplers were placed in a grid pattern that covered the septic seepage pit. Six samplers were placed in a grid around the two HE seepage pits.
- Perchloroethane (PCE) and trichloroethane (TCE) were not detected in any soil gas samplers. BTEX (benzene, toluene, ethylbenzene, and xylene) were detected at three of the six samplers around the septic system. No BTEX was detected at the six HE seepage pit samplers. Aliphatic compounds were detected at two of the six septic system samplers, and one of the six samplers around the HE seepage pits. VOCs were not detected in any of the samplers at SWMU 154. The detection of BTEX and aliphatic compounds may be due to fluid leaking from the vehicles that occasionally park on the areas where the soil gas surveys were conducted.

Confirmatory Soil Samples

- Five rounds of confirmatory soil sampling were performed at SWMU 154.

1. The first round was collected in October 1994. Soil samples were obtained from one boring on either side of the septic tank and seepage pit, and one boring on either side of the each of the two HE seepage pits. Samples were analyzed for VOCs, SVOCs, Target Analyte List (TAL) metals, and hexavalent chrome. Also, two composite samples from the two septic seepage boreholes, and one composite sample from the four HE seepage pit boreholes were analyzed for isotopic uranium and gamma spectroscopy.

   Only low to trace concentrations of three VOCs (acetone, methyl chloride, and toluene) were detected. No SVOCs were detected above Method Detection Limits (MDL). Elevated barium concentrations of 1,460 and 1,230 mg/kg were detected in the north HE pit borehole SP2-2 and south HE pit borehole SP1-1, respectively. Barium concentration of 241 mg/kg from the septic tank borehole ST-1 was slightly above the Sandia National Laboratories/New Mexico (SNL/NM) background of 214 mg/kg. 15.2 mg/kg of chromium was detected in the deep soil sample from the east system seepage pit borehole SP3-1. This quantity was slightly above the 95th percentile concentration of 12.8 for chromium.

2. The second round of sampling was conducted in October 1995. The plan was to collect samples from the four previous borehole locations next to the HE pits, and six step out locations. However, due to drilling and equipment difficulties only one composite sample consisting of equal fractions of soil from the north HE pit boring SP2-2 and south HE pit boring SP1-1 was collected. Analysis of the composite sample detected 1,430 mg/kg of 2,4,6-trinitrotoluene (TNT) in the material.

3. The third round of sampling was completed in June and July, 1996. Samples were collected from two previous boring locations around the north HE pit (SP2-1 and SP2-2) and from three new step-out locations around this unit (SP2-3, SP2-4, and SP2-5). Samples were also collected from two previous boring locations around the south HE pit (SP1-1 and SP1-2) and from three new step-out locations around this unit (SP1-3, SP1-4, and SP1-5). The samples from the boring locations next to the HE pits were analyzed only for explosive compounds. Samples from the six step-out borings were analyzed for explosives compounds, TAL metals, and samples from six of the ten sampling locations were also analyzed for nitrate plus nitrite (NPN).

   Explosives compounds were detected in all four of the third-round samples collected next to the HE pits. Explosives compounds were also detected in two of the six step-out locations (SP1-3 and SP2-3) located on the west side of the units but, at generally lower concentrations than those detected in samples immediately adjacent to the HE pits. Samples from the other four step-out borings SP1-4, SP1-5, SP2-4, and SP2-5, and on the south, east, and north sides of the HE pits did not contain detectable levels of HE compounds. NPN was not identified in the six samples that were analyzed for these compounds. The TAL metals analytical results of samples from the six step-out borings indicated that of the eight TAL metals, only silver was elevated relative to the SNL/NM 95th percentile background concentration <1 mg/kg for silver.

4. The fourth round of soil sampling was completed at the site in March 1997. Samples were collected from two more step-out boring locations west and northwest of the north HE pit (SP2-6 and SP2-7) and from two additional step-out locations (SP1-6 and SP1-7) west and southwest of the south HE pit. The samples were analyzed for TAL metals and explosives compounds. Explosives constituents were not detected in any of these boreholes, and with the exception of a lead concentration of 30 mg/kg in borehole SP2-6, elevated metals concentrations were not identified in any samples.

5. The Fifth and final round of soil sampling was collected from the centers of the two HE seepage pits in January 1998. The samples were analyzed for VOCs, SVOCs, metals, HE, and uranium. The south HE seepage pit (SP1-8) sample detected barium at 1740 mg/kg, RDX at 12.0 mg/kg, and 1,3,5-trinitrobenzene (TBN) at 5.2 mg/kg. The north seepage pit (SP2-8) detected arsenic at 7.25 mg/kg. Only arsenic was detected at a level slightly above the NMED residential limit of 4.25 mg/kg for soil, but the value was below the industrial limit of 17.7 mg/kg. NMED does not set a limit for 1,3,5-TBN, but the amount detected was far below the EPA residential limit of 780 mg/kg.

(SWMU 154 continued)...

Solid Waste Management Unit 154
Building 9960 Septic System

Part 2

Septic Tank Decontamination and Decommissioning

- The SWMU 154 septic tank contents were removed and the tank was thoroughly cleaned and decontaminated in January 1996. The tank was inspected by the New Mexico Environment Department (NMED) to verify the tank content had been removed, and the tank was closed in accordance with applicable State of New Mexico regulations.
- In addition, a sample of the cleaned and decontaminated concrete from immediately beneath the septic tank inlet pipe was collected for waste characterization purposes and verification that radionuclides were not entrained in the material. A tank concrete sample was also collected from the outer part of the tank cover that had never come into contact with sewage, for comparison. Significant levels of radionuclides were not detected in either concrete sample.

No Further Action Proposal

- A No Further Action (NFA) proposal was submitted to the NMED for SWMU 154 in August 1997. The NMED stated that the NFA proposal would not be approved without groundwater characterization.

Summary of Groundwater Monitoring History - July 2002 to June 2004

- Monitoring well CTF-MW2 was installed in August 2001 and sampled on a quarterly basis from July 2002 to June 2004 to acquire the eight quarters of groundwater data required by the NMED. The groundwater samples were analyzed for VOCs, HE compounds, TAL metals. Although not required by the NMED, additional samples were also collected and analyzed for NPN and anions and cations. These additional samples were collected to further characterize the general ion chemistry of groundwater in this well and for purge water waste characterization purposes. Results for groundwater sampling are as follows:

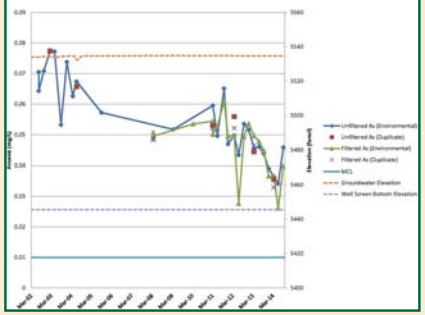
Drilling the borehole for groundwater monitoring well CTF-MW2, SWMU 154.

  - **VOCs:** Acetone was detected only in the first groundwater sample collected in July 2002 as well as in the August 2003 trip blank (TB) and equipment blank (EB) samples. Bromoform was detected only in the December 2003 EB sample and dibromochloromethane was detected in the February and April 2003 EB samples. Methylene chloride and toluene were detected only in TB samples.
  - **HE Compounds:** The compound 1,3,5-trinitrobenzene was detected in the February 2003 groundwater sample. No other HE compounds were detected in the groundwater samples associated with this monitoring well. A trace of methyl 2,4,6 trinitrophenylnitramine (tetryl) and 4 amino-2,6-dinitrotoluene were detected in separate EB samples associated with sampling of this well.
  - **TAL Metals:** Arsenic exceeded the Environmental Protection Agency Maximum Contaminant Level (MCL) in all groundwater samples. SNL/NM personnel identified that the arsenic concentrations were greater than background values and promulgated limits, as well as explained that the source was most likely upwelling deep brines, and not caused by a release at SWMU 154 (Lauffer, September 2002). All other metal concentrations were below regulatory limits.
  - **Total Cyanide, NPN, Anions, and Cations:** Fluoride was detected in all eight primary and two duplicate environmental samples collected, but in all cases, were less than the MCL of 4.0 milligrams per liter (mg/L). The fluoride detected was most likely naturally occurring and derived from Paleozoic and Precambrian bedrock (Skelly, August 2013). None of the known activities conducted at Building 9960 would have produced wastewater containing fluoride.

Groundwater Monitoring - March 2011 to October 2014

- In March 2006, a Class 3 Permit Modification Request was submitted to the NMED. In April 2010, the NMED responded to the Permit Modification Request with a letter requiring further corrective action at SWMU 154 in the form of an additional eight quarters of groundwater monitoring at monitoring well CTF-MW2. In June 2010, a Sampling and Analysis Plan (SAP) for monitoring at monitoring well CTF- MW2 was submitted and approved by NMED.
- Quarterly groundwater sampling resumed at monitoring well CTF-MW2 in March 2011. The eighth quarter of required groundwater monitoring was conducted in December 2012. In October 2014 DOE and Sandia notified NMED that after 15 quarters, groundwater monitoring at SWMU 154 had been completed, and would be discontinued. Results for the 15 quarters of groundwater sampling are as follows:
  - **VOCs:** No VOCs were detected at concentrations above established MDLs in any CTF-MW2 groundwater samples.
  - **HE Compounds:** No compounds were detected above the MDL, except for 1,3,5 trinitrobenzene (RDX). RDX was detected just above the MDL for the first 14 quarters from March 2011 to June 2014. RDX was not detected in the 15th quarter and last quarter of sampling in September 2014. The concentration of RDX ranged from 0.124 to 0.357 µg/L. The MCL for RDX has not been established, but NMED has a screening level for tap water of 6.11 µg/L. The amount of RDX that was detected is significantly below the NMED screening in level.
  - **NPN:** All values were below the MDL, except for a single sample in June 2012 with a concentration of 0.278 mg/L. This was far below the MCL of 10 mg/L.
  - **Alkalinity and Anions:** No measured values exceeded MCLs. Fluoride was reported at concentrations slightly above background. The likely source of fluoride is the Paleozoic and Precambrian bedrock, and not related to Sandia site activities. None of the activities conducted at Building 9960 would have produced wastewater containing fluoride.
  - **Perchlorate:** Was not detected above the NMED specified screening level/MDL of 4 µg/L.
  - **TAL Metals:** None were detected above established MCLs, except for arsenic. Total arsenic concentrations ranged from 0.0341 mg/L to 0.0651 mg/L, and dissolved arsenic concentrations ranged from 0.0261 mg/L to 0.0610 mg/L. Analysis of trace gases and helium isotope data from groundwater samples collected from CTF-MW2 show that it is a mixture of shallow and upwelling endogenic (deeply derived) groundwater. This indicates that the elevated arsenic values in groundwater samples from CTF-MW2 are naturally occurring because CTF-MW2 taps a mixture of shallow and upwelling ancient deeply derived groundwater (Williams et. al., August 2013).

Arsenic Concentrations, Monitoring Well CTF-MW2 at SWMU 154.



  - **Gross Alpha, Gross Beta, and Isotopic Uranium:** All radiological results were reviewed by a Certified Health Physicist and determined to be nonradioactive.

(SWMU 154 continued)...

Solid Waste Management Unit 154
Building 9960 Septic System

Part 3

Data Used In The Final Risk Assessment

- A total of 20 confirmatory soil analyses were used in the final risk assessment. Two samples were collected adjacent to and beneath the septic tank, and two samples were collected adjacent to and beneath the septic system seepage pit. Eight samples each were collected adjacent to and beneath northern and southern HE seepage pits, for 16 samples total.

Summary of Soil Sampling Performed at SWMU 154

SWMU 154 Sampling Areas	Potential COC Source	Number of Sampling Locations
Soil adjacent to, and beneath the septic tank	Effluent discharged to the environment from the septic tank	2
Soil adjacent to, and beneath the septic system seepage pit	Effluent discharged to the environment from the septic seepage pit	2
Soil adjacent to, and beneath the northern HE seepage pit	Effluent discharged to the environment from the northern HE seepage pit	8
Soil adjacent to, and beneath the southern HE seepage pit	Effluent discharged to the environment from the southern HE seepage pit	8

COC = Constituent of Concern
HE = High explosive(s)

- The types of confirmatory and Quality Assurance/Quality control samples collected from SWMU 154 are summarized as shown:

Number of Confirmatory Soil and Quality Assurance/Quality Control Samples Collected from SWMU 154

Sample Type	VOCs	SVOCs	High Explosive Compounds	TAL Metals	Hexavalent Chrome	Nitrate/ Nitrite	Isotopic Uranium	Tritium	Gamma Spectroscopy Radionuclides
Confirmatory	12	12	17	22	12	6	3	2	4
Duplicate	1	1	3	3	1	0	0	0	0
EBs and TBs[a]	4	2	1	3	0	0	0	0	0
Total Samples	17	15	21	28	13	6	3	2	4

[a] TBs for VOCs only
EB = Equipment blank
SVOC = Semi-volatile organic compound
TAL = Target Analyte List
TB = Trip blank
VOC = Volatile organic compound

Results of Risk Analysis

- Risk assessment results for the residential scenario are calculated per NMED risk assessment guidance in 2003 as presented in the "Supplemental Risk Document Supporting Class 3 Permit Modification Process."
- Because Constitutents of Concern (COCs) were present in concentrations or activities greater than background-screening levels or because constituents were present that did not have background-screening levels, it was necessary to perform a risk assessment for the site. The risk assessment analysis evaluated the potential for adverse health effects for the residential land-use scenario.

Industrial Land-Use Scenario:

The incremental Hazard Index (HI) is 4.72 and the estimated incremental excess cancer risk is 3E-5 for the industrial land-use scenario. NMED guidance states that the cumulative excess lifetime cancer risk must be less than 1E-5; thus the excess cancer risk for SWMU 154 is above the acceptable risk value.

However, both the HI and estimated excess cancer risk were calculated using the maximum concentration for TNT (the main contributor to the risk), which was based on a single composite sample collected from two borings next to the north and south HE seepage pits.

Individual confirmatory samples were also collected and provide a more accurate representation of site conditions; the maximum concentration from these confirmatory samples for TNT was 102 mg/kg in sample SP1-1-24-26. Using the maximum TNT concentration from the individual confirmatory samples leads to a HI of 0.40 and an estimated excess cancer risk to 7E-6; both are below NMED guidelines.

For the radiological COCs under the industrial land-use scenario, the incremental total effective dose equivalent (TEDE) is 1.5E-1 mrem/yr, which is significantly lower than the EPA's numerical guideline of 15 mrem/yr.
The estimated incremental excess cancer risk is 2.4E-7.

Residential Land-Use Scenario:

The HI calculated with the TNT concentration from the single composite sample (1,430 mg/kg) for the non-radiological COCs under the residential land use scenario is 47.65, which is above numerical guidance. The estimated excess cancer risk is 1E-4, this is above than the NMED numerical guidance of 1E-5. Thus the excess cancer risk for this site is above the suggested acceptable risk value.

Using the maximum TNT concentration from the individual confirmatory samples, leads to a total HI of 4.15 and an estimated incremental excess cancer risk of 3E-5. Both the HI and the excess cancer risk exceed the NMED guidelines for residential land use.

- Using the SNL ecological risk assessment methodology, the ecological risk for SWMU 154 is predicted to be low.
- In conclusion, human health risk under an industrial land-use scenario and ecological risk are acceptable per NMED guidance. Thus, SWMU 154 is proposed for Corrective Action Complete with controls.

Human Health Risk Assessment Values for SWMU 154 Nonradiological Constituents of Concern

COC	Maximum Concentration (mg/kg)	Industrial Land-Use Scenario[a]		Residential Land-Use Scenario[a]	
		Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Inorganic					
Arsenic	7.25	0.03	5E-6	0.33	2E-5
Barium	1,740	0.03	--	0.33	--
Chromium	15.2	0.00	--	0.00	--
Chromium VI	0.1[b]	0.00	2E-10	0.00	5E-10
Selenium	5.0[b]	0.00	--	0.01	--
Silver	6.2	0.00	--	0.02	--
Organic					
Acetone	0.0073 J	0.00	--	0.00	--
2-Amino-4,6- dinitrotoluene[c]	1.9	0.00	--	0.02	--
4-Amino-2,6-dinitrotoluene[c]	1.2	0.00	--	0.02	--
2,4-Dinitrotoluene	0.75	0.00	--	0.01	--
HMX	81	0.00	--	0.03	--
Methyl Chloride	0.0038 J	0.00	2E-8	0.00	5E-8
3-Nitrotoluene	0.098	0.00	--	0.00	--
4-Nitrotoluene	0.190	0.00	--	0.00	--
RDX	12.0	0.00	8E-7	0.07	3E-6
Toluene	0.0024[b]	0.00	--	0.00	--
1,3,5-Trinitrobenzene	5.2	0.00	--	0.00	--
2,4,6-Trinitrotoluene	1,430 (102)	4.65 (0.33)	3E-5 (2E-5)	46.81 (3.34)	9E-5 (6E-6)
Total		**4.72 (0.40)**	**3E-5 (7E-6)**	**47.65 (4.15)**	**1E-4 (3E-5)**

[a] Environmental Protection Agency 1989
[b] Nondetected concentration (i.e., one-half the maximum detection limit is greater than the maximum detected concentration)
[c] 2,6-Dinitrotoluene was used as a surrogate chemical.
COC = Constituent of concern.
HMX = Octahydro-1 ,3,5,7-tetranitro-1 ,3,5,7-tetrazocine.
J = Estimated concentration.
mg/kg = Milligram(s) per kilogram.
RDX = Hexahydro-1 ,3,5-trinitro-1 ,3,5-triazine.
-- = Information not available.

For More Information, Contact:

U.S. Department of Energy
Sandia Field Office
Environmental Restoration
David Rast
Telephone: (505) 845-6867

Sandia National Laboratories
Environmental Restoration Project
Task Leader: Clinton Lum
Telephone: (505) 284-3602