M85000 11 South Plants Contamination Survey & Remedial Action Assessment

1.0 INTRODUCTION Final Tech Plan Task #2

1.1 Description of the RMA Problem

The Rocky Mountain Arsenal (RMA) is located in western Adams County, northeast of Denver, Colorado. RMA was established in 1942 as a manufacturing facility for the production of mustard gas. Subsequent military uses included the production, handling, or demilitarization of GB nerve agent, Lewisite, arsenous chloride, chlorine, cyanogen chloride (CK), phosgene (CG), and incendiary bombs. In 1946, excess facilities at the South Plants area were leased by the Julius Hyman Co. for the production of insecticides. The chemical division of the Colorado Fuel and Iron Company leased several facilities in the South Plants area in the early 1950's. Products manufactured by CF&I included chlorobenzene, DDT, naphthalene, chlorine, and fuzed caustic. In the early 1950's, the Shell Chemical Company (SCC) began insecticide production in leased facilities within the South Plants area, generally as successor to the Julius Hyman Co. This activity continued until recent years, and SCC still leases facilities at the South Plants area. SCC has also reportedly constructed 66 buildings and 108 tanks in the South Plants area.

The industrial wastes from all operations of the government and its lessees were initially discharged just north of the South Plants area into Basin A, an unlined basin in Section 36. Subsequently, wastes were discharged into four other unlined basins, as well as Basin F which was constructed with an asphalt liner. Some of the basins, pits, burn sites, sewers, and structures (buildings, pipes and tanks) became sources of ground-water contamination.

In 1954, farmers near RMA claimed that their crops had been damaged by ground water used for irrigation. In May of 1974, diisopropylmethylphosphonate (DIMP) and dicyclopentadiene (DCPD) were detected in surface water at the northern boundary of the arsenal. Later that year the Colorado Department of Health (CDH) detected DIMP in a well north of the arsenal. As a result, the CDH issued cease and desist orders in April, 1975, directing SCC and RMA to immediately stop the off-post discharge of DIMP and DCPD in surface and subsurface water.

As a result of the CDH cease and desist orders, a contamination control program at RMA was established to insure compliance with Federal and State environmental laws. As a result of this program, sources of contamination have been identified, pathways by which contaminants migrate into the environment have been delineated, and three ground-water treatment systems have been installed at the northern and northwestern boundaries of RMA to intercept, treat, and replace contaminated ground water.

Two law suits have been filed as a result of the contamination at RMA. The first suit was filed by the Department of Justice on behalf of the Department of the Army against Shell Chemical Company for reimbursement of environment response costs and for damage to the natural resouces at RMA. The second suit was filed by the State of Colorado on behalf of the Colorado Department of Health against the Shell Chemical Company and the U.S. Department of the Army for environmental damages both on and off RMA.

1.2 South Plants Area

1.2.1 Building Usage

More than 300 buildings, tanks, and foundations have been identified in the South Plants area. The Army used the South Plants for the production, filling and storage of mustard, lewisite, phosgene, white phosphorus, chlorine, incendiary mixtures, hydrazine, and explosive button bombs. Since 1946, parts of the South Plants have been leased to private companies for the manufacture of chlordane, DDT, dieldrin, aldrin, and other pesticides. Shell Chemical Company, which has leased several of the South Plants buildings for almost 40 years, has also constructed over 150 buildings and tanks in the South Plants area. Additional details regarding the usage and nature of buildings and other structures in the South Plants area are given in Appendix A of this Technical Plan.

1.2.2 Waste Disposal

Most of the waste products generated at the South Plants area were disposed of in Section 36. Liquid wastes were conveyed by ditches and pipelines to

Basin A, and later to Basin F. Potentially contaminated surface water runoff was channeled through drainage ditches toward the Sand Creek lateral and Upper and Lower Derby Lakes. Solid wastes were generally buried in pits or trenches in Section 36, although some disposal pits and trenches were occasionally dug in the South Plants area. A salt storage area and two sanitary landfills were also located in the South Plants area. Further details regarding waste-disposal practices in the area are given in Section 3.3.

1.2.3 Groundwater Conditions

The ground-water conditions in the South Plants area are quite complicated. The movement of contaminants is affected by the existing ground-water mound, interaquifer flow between the alluvium and the Denver Formation, ground-water and lake interactions, and surface-water ground-water interaction.

The major water bearing geologic formations in the South Plants area consist of the alluvium and the Denver Formation. The alluvium consists of clay, silt, sand and gravel. The underlying formation is the Denver Formation, which consists of carbonaceous shale and claystone with sandstone and siltstone lenses.

A water-table mound, believed to have been created by leaking water lines, has formed below the South Plants area with flow lines radiating out from the top of the mound in all directions. A ground-water divide (or no-flow boundary) has been created at the confluence of the regional flow system and that of the mound. As a result, underflow entering RMA from the southeast is forced to turn either east or west around the South Plants area. Water flowing south from the mound area is forced to change direction. As the regional underflow moves away from the mound, flow is toward the west to northwest and the northeast.

Vertical flow conditions also occur under the Arsenal. The results of different programs indicate that there is much interchange of ground water between the stringers of Denver Sands and the alluvium.

In addition, many of the analyses of subsurface fluids in the South Plants area indicate high concentrations of hydrocarbon products such as benzene. Petroleum products, such as benzene, are less dense than and are relatively immiscible in water (there are also products, such as carbon tetrachloride, that are more dense than water and sink to the bottom of the aquifer). As a consequence of this, the product itself, oil or its derivative, migrates in the unsaturated zone, above the water table. At the water table, some of the product does go into solution, and then migrates with the ground water.

1.3 Summary of Technical Approach

The objectives of the present task are to conduct contamination surveys and remedial action assessments for the South Plants area. The contamination surveys are designed to assess the degree and types of contamination within the South Plants area, and to support the development and assessment of feasible remedial actions. Although ground water has been determined to be the principal environmental pathway for contamination from RMA and SCC facilities, the current study will focus on the sources of contamination at the South Plants area rather than contaminant pathways. Consequently, the activities to be conducted within the scope of this Technical Plan will primarily consist of the collection of soil samples and various building samples for subsequent chemical analysis. A limited number of new ground water monitoring wells will also be constructed in areas where ground-water contamination is believed to be likely but where previous investigations may have been inadequate to characterize local ground-water contamination. Soil samples will generally be collected from the unsaturated zone extending from land surface down to the local water table. However, where contamination sources may lie below the water table (e.g., trenches or buried pipelines), soil samples will be collected from the saturated zone below the water table. Building samples will be taken from dust, standing water or other liquids, tanks, vats, sumps, sewer lines, and other sources. Ground-water samples will be collected from those new monitoring wells installed in the South Plants area during the course of this activity.

Shell drilled boreholes in 1980 at or near the aldrin sites. One borehole at each of the aldrin areas is planned as well as three at the spent acid spill which may be difficult to locate. The sewer leak will be examined in the sewer borehole program described in Section 3.4.4.2.

C. Building 424A

A 200 gallon BCH spill occurred east of Building 424A in 1960 in the northern portion of what appears to be an equipment yard (70 feet by 30 feet) as seen on a 1982 aerial photograph. Three boreholes have been planned to find the spill.

D. Building 433

Three recorded spills occurred near this building. In 1971, a 100 gallon spill of D-D soil fumigant was reported to have occurred southeast of the building on the south side of the railroad tracks. In 1973, 55 gallons of DCPD were spilled southeast of the building on the railroad grade. A 250 gallon D-D soil fumigant spill occurred southeast of the building near a drainage ditch in 1975. The cleanup effort extended to removal of the contaminated dirt from the ditch. Each of the sites appears well enough defined to locate with a single boring to the water table.

E. Building 451

A 55 gallon Azodrin spill occurred southeast of this building on the railroad grade in 1974. The dirt was removed from this site. This site may be difficult to locate and three borings are estimated.

F. Tanks 462 A, B; 463 A-H

Six reported spills occurred in the tank farm (Site 1-10). They are a 100,000 gallon Benzene spill in 1948; a 1,400 gallon spill of BCH bottoms in 1956; a 1,500 gallon spill of DCPD bottoms/No. 6 fuel oil in 1967; a 1,548 gallons dicyclopentadiene (DCPD) Bottom fuel Oil No. 6 on August 8, 1976; 50,864 gallons BCH Bottom fuel Oil No. 6 in September, 1978. In addition, between 1967 and 1975 an estimated 55 gallons of spent acid was spilled.

These tanks are located within Site 1-10. The sampling scheme is shown in the site discussion and Figure 3.3-4.

G. Building 471

Eight spills are reported by Shell as being in the vicinity of this building. In the southern area of the building, the spills are as follows:

1) Allyl chloride, 100 gallons, February 15, 1972
2) Allyl chloride, 550 gallons, June, 1976
3) Vapona, 200 gallons, 1960-1980

MI8580011

In the northern area, the spills are:

4) Nemagon, 93 gallons, November 10, 1971
5) Nemagon, 1100 gallons, November 13, 1973
6) Allyl chloride, 2138 gallons, January 13, 1975 in a ditch, some recovered
7) Mineral spirits, 300 gallons, April 24, 1975

In the tank farm associated with the building the spills are:

8) BCH leak, 1950-1981
9) Acetone, 10 gallons, tank farm, 1977 or 1978

The spills in each of the three areas appear locatable from the literature and two borings are planned for each area of spills.

H. Building 511

A 1200 gallon hexane spill occurred at the railroad tracks north of this building in 1958. In addition, Kuznear and Trautmann (1980) cite that large amounts of Lewisite were lost through leakage of pipes and tanks. This site will not be easily located and three borings are scheduled at this site.

I. Building 512

Four spills are recorded in the vicinity of this building. Northwest of the building, 500 gallons of chlorothiophenol (CTP) were spilled in 1967. The bad odor of this chemical makes it likely to have been cleaned up. East of the building, 100 gallons of HCCPD leaked between 1953 and 1964. Around the building, mapped as northeast, 400 gallons of isopropanol, 1500 gallons of HCCPD and some unknown amount of compound 773 leaked between 1953 and 1964. Some of the HCCPD was removed and some covered with soda ash. Mercury was also spilled in unknown amount behind the building. It is estimated that three borings will be needed to find the northwest site and three borings will be needed to find the eastern and northeastern sites.

J. Building 514

Ten spills are associated, according to the Shell report, with Building 514. The spills, which are in scattered locations, are:

1) Acetone, 500 gallons, 1979, tank farm
2) Azodrin, acetone and chloroform 1963 - 1981, washing of drum facilities on north dock
3) Caustic soda, 20%, 500 gallons, 1978, dirt replaced
4) Caustic soda, 20%, leak around tank, start date unknown, to 1981, dirt replaced
5) Caustic soda, 20%, 7400 gallons, December 29, 1971 north of building

Depth to water at Site 2-14b is approximately 12 feet. A boring density of 1/1,600 ft^2 will be used, resulting in eight Phase I borings.

	Number of Borings	Total Depth (ft)	Number of Samples
	2	15	6
	2	10	4
	4	5	4
Totals:	8		14

No surface samples (0-1.0 feet) will be taken from any of the borings drilled at Sites 2-14a or 1-14b.

Site 2-18 South Plants Area Spill Sites - Section 2

Numerous spills and leaks have occurred in the South Plants area in Section 2, but few have been documented in the literature. The rationale for boring in this site is the same as the rationale for boring in the spill sites areas in Section 1 described in the text on site 1-13. One spill was reported within Section 2 of the South Plants Area. This was located south of Building 347, and consisted of 60 gallons of Nemagon in 1973. Seepage to an adjacent ditch leading to Sand Creek Lateral was also reported. The exact location of this spill is unknown and three borings will be needed to locate this site.

JOINTLY OPERATED SITES

Site 1-5 Lime Pits and Storage Area

Two revetted storage areas, comprising a total of over 96,000 ft^2 have been identified from 1982 aerial photographs, historical records, and the South Plants location map. These pits were filled with both organic and inorganic compounds, including heavy metals, from 1943 through the late 1950s. Waste products of slate, lime, and acetylene were also disposed of

M8500011

missing on a 1955 photo. All of the unassigned sites are considered uncontaminated and the boring spacing was determined using that assumption. Site 1-3a consists of approximately 25,350 ft^2, and a boring density of 1/1300 ft^2 was used. Estimated depth to water is 15 feet.

Site 1-3b is approximately 2,500 ft^2 in areal extent. A boring density of 1/900 ft^2 was used. One Phase I boring will be drilled. Figure 3.3-13 shows the boring locations for these sites. A summary is as follows:

	Number of Borings	Total Depth (ft)	Number of Samples
Site 1-3a	1	15	4
	1	10	3
Site 1-3b	1	15	4
Totals:	3		11

Site 1-4 Borrow Pit

A borrow pit, identified in a 1980 photograph, is located to the southeast of Site 1-5, the lime pits. The borrow pit was presumably used to obtain material for fill or cover, and no documentation of spills or dumping has been located. However, the pit is a topographic depression, and may have received some surface water runoff from the South Plants.

One boring will be drilled at the topographically low area of the pit. It is anticipated that this will be drilled to a depth of 10 feet. Site 1-4 is shown in Figure 3.3-14.

1-11 Sanitary Landfill

A sanitary landfill, located north of Building 732, was located in a 1980 photograph. The approximate size of the disturbed area is 12,500 ft^2. The nature of buried material is unknown, therefore a geophysical reconnaissance survey is recommended prior to drilling. The depth to water is about