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BASEWIDE REMEDIAL INVESTIGATION FOR SITE SS009 FIRE VALVE AREA KANSAS CITY MO

12/1/2000

CH2M HILL

Richards-Gebaur AFB

Basewide Remedial Investigation

SS 009 (Fire Valve Area)

RI Report

December 2000

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1 SS 009 - RI Background

1.1 Site Description

SS 009, Fire Valve Area, is located in the southeastern portion of Richards-Gebaur Air Force Base (AFB), directly on the southwest side of Building 605, southeast of the intersection of Westover and Corkill Roads. The location of SS 009 is shown in Figure 1.

The site is located on the far side of a paved parking lot next to a fire valve and adjacent to a small grass drainage swale. It occupies approximately 400 square feet in area and is generally flat. The site is not located in a floodplain.

1.2 Site History

Building 605 was part of the Civil Engineering Complex and was in use by the Air Force from 1955 until 1994. The building is currently used by the United States Marine Corps (USMC). During the Air Force's occupancy, the building was used for various purposes, including a Carpenter Shop, Interior and Exterior Heat Shop, Roads and Grounds Shop, and Sanitation Shop (Tetra Tech, 1995). Reportedly, no activities at the complex involved the storage or handling of bulk hazardous waste materials (USAF, 1993).

The site was initially identified in 1992 when petroleum product was reported by an Air Force contractor who was digging a ditch to repair an underground water main valve (USAF, 1993). As a consequence, approximately ten cubic yards of petroleum-contaminated soil were excavated from the water line trench to a depth of approximately five feet below ground surface in 1993. The limit of soil excavation is depicted in Figure 2.

In 1994, a total of 70 soil samples were collected from the site for possible laboratory analyses during a Preliminary Assessment / Site Inspection (PA/SI) (Tetra Tech, 1995). A groundwater assessment was conducted at the site to evaluate the potential adverse impacts to local shallow groundwater (Versar, 1996).

1.2.1 Soil

Reportedly, petroleum product was noticed during an excavation to repair a water main valve. In response, ten cubic yards of soil were removed from the Fire Valve Area, to a depth of approximately five feet below ground surface. The excavated soil was tested for benzene, toluene, ethylbenzene, and xylene (BTEX) constituents and total petroleum hydrocarbons (TPH). The results indicated that xylenes (28 parts per million (ppm)) and TPH (24,870 ppm) exceeded applicable state action levels for these chemicals of 10 ppm and 50 ppm, respectively (Tetra Tech, 1995). Post-excavation samples were not collected.

To assess if the affected soil had been removed from the Fire Valve Area, a PA/SI was conducted in 1994. Twenty-two soil borings were drilled and 70 soil samples were collected at depths up to 15 feet below ground surface. The samples were field screened for volatile organic compounds (VOCs) using a field gas chromatograph (GC). Seventeen soil samples were submitted for laboratory analysis. The samples were tested for TPH-gasoline range organics (GRO), TPH-diesel range organics (DRO), VOCs, and semi-volatile organic

compounds (SVOCs) (Tetra Tech, 1995). The DRO constituents of TPH were detected above the state action level for TPH of 50 ppm in one of 17 samples, at a concentration of 370 ppm. However, GRO constituents were not detected in any samples. Furthermore, VOCs and SVOCs were not detected above currently applicable Cleanup Levels for Missouri (CALM) Soil Target Concentration (STARC) C_{tDI} and C_{leach} values in any samples.

1.2.2 Groundwater

A preliminary groundwater assessment was conducted at the site in 1996 (Versar, 1996). Three temporary wells were installed to depths from 14 feet to 18 feet below ground surface. One temporary well, PZ-03, could not be sampled because of insufficient groundwater volume for the required analyses. Groundwater samples were collected from the remaining two wells and analyzed for TPH constituents, VOCs, SVOCs, metals, and polychlorinated biphenyls (PCBs).

No TPH constituents were detected in the samples. No SVOCs were detected above applicable maximum contaminant levels (MCLs). Four VOCs were detected with concentrations that exceeded their respective MCLs. The VOCs detected were 1,1-dichloroethene (17 parts per billion (ppb), 16 ppb), tetrachloroethene (12 ppb, 33 ppb), trichloroethene (8.8 ppb, 11 ppb), and vinyl chloride (4.6 ppb, 21 ppb).

Several metals were also detected in the total metals analysis at concentrations above their respective MCLs. The metals detected included arsenic (63.1 ppb), barium (5,240 ppb), cadmium (5.3 ppb), chromium (157 ppb, 227 ppb), and lead (56.4 ppb, 184 ppb). The dissolved metals analytical results, however, were all below the applicable MCLs. PCB results fell below method detection limits. However, PCB data were considered inconclusive because the method detection limit of 1.1 ppb was higher than the corresponding MCL of 0.5 ppb.

1.3 Current Site Status

The petroleum-contaminated soil has been removed from the site in accordance with Missouri Department of Natural Resources (MDNR) *Underground Storage Tank Closure Guidance Document* (MDNR, 1996). The site has been backfilled with clean material and returned to grade.

1.4 RI Objectives

The primary objective of the RI at SS 009 was to obtain sufficient site-specific data to fill data gaps identified in the 1999 Evaluation and Consolidation Study (ECS) report to support a risk-based site management decision.

The objectives of the site investigation at SS 009 were to:

- Evaluate groundwater flow rate, groundwater flow direction, and hydraulic gradient
- Identify depth and lithology of uppermost bedrock unit
- Identify uppermost water-bearing zone and associated groundwater elevation
- Evaluate presence and concentration of chemical of potential concern (COPCs) in onsite soils

- Evaluate presence and concentration of COPCs in groundwater
- Evaluate potential for natural attenuation (NA) at the site

1.5 RI Scope

To meet the objectives listed above, the following field activities were conducted at SS 009 during the Basewide RI in 1999:

- Installing two monitoring wells, MW-002 and MW-003
- Attempting to install one monitoring well, MW-001, but later abandoning the borehole due to lack of groundwater yield
- Collecting groundwater samples from the two new wells
- Collecting three soil samples from the monitoring well borings
- Analyzing soil and groundwater samples for VOCs, SVOCs, TPH, metals, and PCBs
- Analyzing groundwater samples for NA parameters

Groundwater analytical results from the 1999 Basewide RI indicated that VOCs were not completely delineated by the existing monitoring well network at SS 009. For this reason, additional investigative measures were conducted at the site during an RI Addendum between June and August 2000. The following field activities were conducted during the RI Addendum:

- Installing deep monitoring wells next to two wells installed in November 1999
- Installing three additional shallow / deep monitoring well pairs
- Analyzing groundwater samples from new and existing wells for VOCs

Soil borings and monitoring well borings were drilled by Layne-Western Inc. of Kansas City, Missouri. The borings were continuously sampled and logged at two-foot depth intervals to evaluate subsurface geology.

Soil boring logs and monitoring well construction logs for SS 006 are provided in Appendices E and F, respectively. Monitoring well construction data are summarized in Table 1.

1.5.1 1999 Basewide RI

In October 1999, three monitoring well boreholes, MW-001 through MW-003, were completed between Building 605 and Corkill Road at locations shown in Figure 3. Each of these boreholes was advanced using a hollow-stem auger (HSA) drill rig, and each was terminated at the top of limestone bedrock that underlies the site. One soil sample was retained for laboratory analyses from each borehole. Samples were retained from depth intervals that exhibited the greatest evidence of contamination (e.g., staining, odor, elevated photoionization detector readings). If evidence of contamination was not observed, then samples were collected from depth intervals where contaminants would most likely be present, such as immediately above bedrock. Soil samples were analyzed for VOCs, SVOCs, TPH, metals, and PCBs.

Of the three monitoring well boreholes, MW-001 did not yield groundwater within 48 hours of drilling. For this reason, the borehole was abandoned in accordance with Missouri Well Construction Rules. This decision was made per the 1999 *Richards-Gebaur Air Force Base Basewide Remedial Investigation / Feasibility Study (RI/FS) Work Plan* (CH2M HILL, 1999). Monitoring wells were installed in the MW-002 and MW-003 boreholes.

Following well development, an attempt was made to collect groundwater samples from MW-002 and MW-003 for laboratory analyses of VOCs, SVOCs, TPH, metals (total and dissolved), and PCBs. Groundwater yield constraints prohibited collection of the full analytical suite at each well. Samples collected from MW-002 were analyzed for VOCs, SVOCs, TPH (GRO and DRO) and metals (total and dissolved). Groundwater samples from MW-003 were analyzed for VOCs, dissolved metals, and TPH-GRO.

1.5.2 2000 RI Addendum

To delineate VOCs that were detected in SS 009 groundwater samples, additional monitoring wells were installed at the site during the 2000 RI Addendum. The additional wells (MW-004 through MW-011) were installed in May 2000. Well locations are shown in Figure 3. In June 2000, groundwater samples were collected from the entire SS 009 monitoring well network (MW-002, MW-003 through MW-011) and analyzed for VOCs. Monitoring wells MW-005 and MW-011 were dry and therefore could not be sampled. Selected samples were also analyzed for NA parameters, consisting of sulfates / nitrates / chlorides, methane / ethane / ethene, ferrous iron, total dissolved solids (TDS), and alkalinity.

Monitoring wells completed during the 2000 RI Addendum were installed using air-rotary drilling techniques. Both shallow and deep monitoring wells were installed in 2000. Shallow monitoring wells were installed similarly to wells completed in 1999—these wells were screened through silty clay overburden and seated in underlying limestone. Deep monitoring wells terminated in shale underlying the limestone layer. The screened interval for deep wells encompassed the limestone / shale interface. Shallow and deep wells are designated on the map provided in Figure 3.

1.5.3 Laboratory Analyses

The following laboratories provided analytical services for the soil and groundwater samples collected from SS 009:

- Columbia Analytical Services, Redding, California
- CH2M HILL Applied Sciences, Corvallis, Oregon

2 SS 009 - RI Results

2.1 Hydrogeology

Subsurface materials encountered at SS 009 during drilling and sampling generally consisted of 10 to 13 feet of low to medium-plastic silty clays and weathered shale underlain by six to eight feet of Raytown Limestone of the Iola Formation. Chanute Shale was observed beneath the Raytown Limestone. Evidence of groundwater was observed in several boreholes during drilling, generally at the interface between silty clay / weathered shale and the underlying limestone.

A geologic cross-section was constructed using boring log information gathered during the 1999 Basewide RI and 2000 RI Addendum. The location of the cross-section is displayed in Figure 4. Cross-section details are presented in Figure 5. The groundwater table shown in the cross-section was derived from groundwater level measurements taken in October 2000.

Groundwater levels have been measured monthly at SS 009. Seasonal groundwater levels are shown in Table 2. Using groundwater levels measured in October 2000, a potentiometric surface map was constructed for shallow monitoring wells screened through soil overburden and seated in underlying limestone. The potentiometric surface map is displayed in Figure 6. As shown in the figure, groundwater at SS 009 flows to the south-southeast toward Scope Creek.

Groundwater appears to flow through both silty clay and limestone at SS 009. Based on Figure 6, the hydraulic gradient at of the silty clay was estimated to be 0.021. The hydraulic gradient in the limestone at SS 009 was estimated to be 0.052.

It should be noted that, at SS 009, the potentiometric surface in the limestone is higher than that of the water table over most of the site. This situation could be caused by such factors as the hydraulic conductivity of the silty clay being higher than that of the limestone, thus contributing to more rapid lateral movement of groundwater from this unit, or to the two units having slightly different recharge and/or discharge relationships. The overall trend of groundwater flow does not change, however, and flow in the limestone at SS 009 is still toward Scope Creek.

Because of the presence of chemical constituents in groundwater at SS 009, aquifer tests were conducted at the site. Flow velocities in the silty clay appear to be on the order of 0.00015 feet per day (ft/day) and appear to range from 0.00023 ft/day to 0.0027 ft/day in the limestone. Aquifer tests are described in detail in Section 8 of the RI Report and in Appendix D.

The geology and hydrogeology of the Base is described in detail in Section 4 of the RI Report. The occurrence and distribution of groundwater at the Base is discussed further in Section 9 of the RI Report.

2.2 Surface Water

There is no surface water at SS 009, therefore surface water samples were not collected during the RI.

2.3 Sediment

There is no sediment at SS 009, therefore sediment samples were not collected during the RI.

2.4 Soil

In October 1999, one subsurface soil sample was retained from each of three monitoring well boreholes at SS 009. Soil samples were collected from MW-001, MW-002, and MW-003 and respective depth intervals of 13 to 14 feet, 13 to 14 feet, and 9 to 10 feet. Samples were analyzed for VOCs, SVOCs, TPH, metals, and PCBs. Soil sampling locations are provided in Figure 3.

Analytical results from the soil samples were compared against corresponding Tier 1 Screening Levels for each chemical.

- **TPH**

Total concentrations of petroleum hydrocarbons were not detected above reporting limits in any soil samples collected from SS 009. Therefore, TPH did not exceed screening levels in any of the samples.

- **VOCs**

VOCs were not detected above reporting limits in SS 009 soil samples. Therefore, VOCs did not exceed screening levels in these samples.

- **SVOCs**

SVOCs were not detected above reporting limits and therefore did not exceed soil screening levels.

- **Metals**

Metals did not exceed screening levels in any soil samples collected from SS 009.

- **PCBs**

PCBs were not detected above reporting limits and therefore did not exceed soil screening levels.

2.5 Groundwater

Groundwater samples were collected from SS 009 in November 1999 and June 2000. In November 1999, groundwater samples were collected from MW-002 (VOCs, SVOCs, TPH-GRO/DRO, total and dissolved metals) and from MW-003 (VOCs, TPH-GRO). Groundwater samples from MW-002 were also analyzed for NA parameters.

In June 2000, groundwater samples were collected from MW-002 through MW-004 and MW-005 through MW-010. Monitoring wells MW-005 and MW-011 were dry and therefore could not be sampled. Groundwater samples were analyzed for VOCs. Groundwater samples from MW-003 and MW-006 were also analyzed for NA parameters.

Analytical results from groundwater samples were compared against corresponding screening levels. Exceedences of screening levels are listed individually in Appendix J. Results of the screening exercise are summarized in Table 3. As shown in the table, several chemicals were retained as Chemicals of Concern (COCs), described in the Human Health Risk Assessment (Section 3).

- **TPH**

TPH-GRO/DRO and TPH-GRO analyses were performed on groundwater samples collected from MW-002 and MW-003, respectively, in November 1999. Petroleum hydrocarbons did not exceed TPH screening levels in these samples.

- **VOCs**

VOC analyses were performed on groundwater samples collected in November 1999 and May 2000. Several chlorinated VOCs, 1,1-dichloroethene (DCE), cis-1,2-DCE, trichloroethene (TCE), tetrachloroethene (PCE), and vinyl chloride, exceeded groundwater screening levels. As shown in Figure 7, these exceedences were limited to one monitoring well, MW-003, with one exception: a vinyl chloride concentration of 5.1 J ppb was measured in MW-009 (screening level = 2.0 ppb). The 'J' qualifier indicates that the result is an estimated value.

The distribution of VOC exceedences shown in Figure 7 indicates that VOCs are isolated in occurrence and do not pose a widespread problem at SS 009. Furthermore, the absence of screening level exceedences in MW-006, the deep-well counterpart of MW-003, suggests that VOCs are not migrating through the Raytown limestone into the underlying shale.

- **SVOCs**

SVOCs were analyzed in groundwater samples collected from MW-002 in November 1999. SVOCs were not measured above reporting limits and therefore did not exceed screening levels in any of the samples collected from SS 009.

- **Metals**

Metals analyses were performed on groundwater samples collected from MW-002 (total and dissolved) and MW-003 (dissolved) in November 1999. Total concentrations of iron, lead and manganese exceeded screening levels in MW-002. Dissolved manganese exceeded screening levels in both monitoring wells.

- **PCBs**

Due to insufficient volume, PCBs were not analyzed on groundwater samples collected from SS 009. Because PCBs were not measured above reporting limits in soil samples, it is unlikely that PCBs concentrations in groundwater would exceed Tier 1 Screening Levels.

- **NA Parameters** spill Out

During the 1999 Basewide RI and 2000 RI Addendum, select groundwater samples were collected for NA parameters to perform a preliminary assessment of NA processes at SS

009. Natural attenuation samples were collected in June 2000 from the nested pair MW-003 (shallow) and MW-006 (deep), because this location has historically had some of the highest concentrations of chlorinated VOCs at SS 009. MW-002, a shallow well, was sampled for NA parameters in November 1999. This location is considered to represent background conditions that can be compared to MW-003 (shallow well). NA analytical results are summarized in Table 4.

In 1999, NA parameters were analyzed on samples collected from MW-002. This well did not yield any chlorinated VOCs above reporting limits in 1999.

In 2000, samples from the nested well pair MW-003 / MW-006 were collected for NA parameter analyses. In 2000, shallow well MW-003 was found to contain various chlorinated VOCs (PCE = 43 ppb; TCE = 34.6 ppb; cis-1,2-DCE = 282.3 ppb; 1,1-dichloroethane = 109 J ppb; 1,1-DCE = 106.2 ppb; vinyl chloride = 14.68 ppb). Chlorinated VOCs were found at lower concentrations in the deep-well counterpart, MW-006 (cis-1,2-DCE = 4.75 ppb; vinyl chloride = 1.63 ppb).

Common degradation products of 1,1,1-trichloroethane were also observed at MW-003 and include 1,1-dichloroethane, 1,1-dichloroethene, and vinyl chloride. The detection of degradation products of PCE, TCE, and 1,1,1-trichloroethane suggests natural attenuation processes, via anaerobic biodegradation (Wiedemeier et al., 1998), have occurred or are occurring in the vicinity of MW-003 and MW-006. However, NA parameters, with the exception of nitrate, are generally not at optimal values for anaerobic biodegradation (Wiedemeier et al., 1998) at SS 009. Dissolved oxygen concentrations may not accurately represent groundwater conditions due to sample measurement at ground surface, exposing the sample to oxygen in the atmosphere. A flow-through cell, which would isolate the sample from the atmosphere, could not be used to measure dissolved oxygen at MW-003 and MW-006 due to the low yields

Although the natural attenuation parameters generally suggest that conditions may not be optimal for anaerobic biodegradation, the presence of the several degradation products does indicate that degradation has occurred or is occurring.

3 SS 009 - Human Health Risk Assessment

A tiered risk assessment was performed for SS 009 using results obtained during the 1999 Basewide RI. The Tier 1 risk assessment was conducted by evaluating the list of compounds with concentrations exceeding chemical-specific Tier 1 Screening Levels. As described in Section 5 of the RI Report, screening levels were derived from United States Environmental Protection Agency (USEPA) Region IX Preliminary Remediation Goals (PRGs), MCLs, and in the case of some metals, RI-specific background concentrations in soil. Samples with concentrations higher than screening levels were compiled from 1999 Basewide RI analytical results and are presented in Appendix J. Total site risks were evaluated for the complete exposure pathways identified in Section 4.7 of the RI Report. Methods for evaluating these exposure pathways are described in Section 5 of the RI Report and in Attachment 1.

3.1 COPCs

COPCs are those chemicals found at concentrations higher than action levels in at least one sample from a site. The following paragraphs discuss COPCs and provide justification for whether or not each compound was retained as a COC for further evaluation in the risk assessment. Additional screening of the chemicals was conducted in accordance with applicable USEPA risk assessment guidance, as described in Section 5 of the RI Report, and is described below.

3.1.1 Groundwater

Cis-1,2-DCE, 1,1-DCE, PCE, TCE, and vinyl chloride were detected in groundwater at concentrations higher than screening levels. Therefore, these VOCs were evaluated in the risk assessment. Analytical results for these COCs are presented in Table 5. Metals were detected in groundwater at concentrations above screening levels. However, as discussed in Section 4.5.3 of the RI Report, metals detected in groundwater are likely to reflect naturally-occurring levels rather than releases from sites. Therefore, the metals detected in groundwater were not included as COCs.

3.2 COCs

COCs carried into the risk assessment are cis-1,2-DCE, 1,1-DCE, PCE, TCE and vinyl chloride in groundwater. Human health risks associated with the COCs are estimated in Section 3.5.

3.3 Potential Exposure Pathways

Potential exposure pathways from soil and groundwater, under residential and industrial land uses at this site, are presented in Table 5-1 of the RI Report. The pathways and receptors presented in Table 5-1 of the RI Report were evaluated in the site-specific risk evaluation. Further discussion of potential exposure pathways and receptor populations is presented in Section 4.7 of the RI Report.

3.4 Estimation of Chemical Intake

This step involved estimating exposure concentrations in soil or water at the site. The exposure concentration was then combined with equations described in Section 5.7.1 of the RI Report the to characterize potential risks The exposure concentration in groundwater was estimated using the assumption that a well supplying drinking water could be placed at the location where the highest VOC concentrations were found.

3.5 Risk Characterization

The excess lifetime cancer risks and non-cancer hazard quotients for the potential exposure of residents to chemicals in groundwater are given in Table 6.

Potential exposures from residential ingestion and inhalation of volatiles from groundwater were estimated using standard default exposure factors for a residential exposure scenarios. The excess lifetime cancer risks for the residential exposure scenario was 5×10^{-3}, associated with 1,1-DCE, TCE, PCE and vinyl chloride. The non-cancer hazard quotient for potential residential exposure to groundwater was above one, principally from cis-1,2-DCE (the hazard quotient for cis-1,2-DCE was five).

Exposure pathways from groundwater to workers (specifically VOCs in groundwater-to-indoor air, and direct contact with water ponded in deep excavations) are potentially complete, as described in Section 4.7 of the RI Report. While quantitative risks were not calculated for these exposure pathways, it is reasonable to assume that risks to workers from VOCs in groundwater are lower than with the risks calculated for residential ingestion and inhalation of volatiles from groundwater. See Section 5.8.1 of the RI Report for further discussion of exposure pathways from groundwater to workers.

3.5.1 Uncertainties

The assumptions used to characterize health risks may either understate or overstate the potential risks associated with VOCs in groundwater. As described in Section 4.7 of the RI Report, dermal contact with groundwater may be a complete exposure pathway for residents. Potential exposure from this pathway was not included as in the calculation of total site risks (because dermal exposure is not included as a pathway in development of the tap water PRGs used to calculate total site risks). Excluding dermal exposure to VOCs in groundwater potentially understates residential risks associated with VOCs in groundwater. The use of the maximum detected concentration of VOCs in groundwater as the exposure concentration assumes that an individual is exposed to this concentration on a daily basis. Use of the maximum concentration to represent lifetime average concentrations in groundwater (since it is known that concentrations are lower at other locations) greatly overstates potential exposures and health risks.

3.6 Conclusions

Calculated risks in groundwater were higher than established risk thresholds of 1×10^{-5} (carcinogenic) and of a hazard index of one (non-carcinogenic). Assuming groundwater consumption from a water supply well placed at the highest concentration identified for this site, the estimated carcinogenic risk in groundwater is 5×10^{-3} ; the estimated non-cancer hazard index is higher than one (the hazard quotient for cis-1,2-DCE is five). Available information (see Section 4.6 of the RI Report) strongly suggests that there is little likelihood

of future use of this shallow groundwater as a drinking water supply. Therefore, it is very unlikely that future residents would be exposed to this groundwater. There is a potential for complete exposure pathways to workers for VOCs in groundwater-to-indoor air, and for direct contact with water ponded in deep excavations. Considering minimal exposure times and possible use of protective equipment, it is reasonable to suggest that risks from these pathways are lower than risks associated with residential ingestion and inhalation of volatiles from groundwater. For these reasons, further action for groundwater at this site may not be required.

4 SS 009 - Ecological Risk Assessment

A Tier 1 qualitative ecological exposure assessment was conducted for SS 009 according to guidance provided in the CALM (MDNR, 1998). The purpose of the Tier 1 ecological exposure assessment was to determine whether the site is likely to pose a risk to ecological receptors and, in turn, determine whether a quantitative ecological risk assessment is warranted for the site.

The following ecological exposure assessment was performed in accordance with the Ecological Risk Assessment Approach described in Section 5.9 of the RI Report.

4.1 Phase I Screening

To screen for potential ecological receptors and habitat, the physical and biological site characteristics need to be considered. The site was evaluated based on the following factors, and the characteristics of the site were identified where appropriate.

- Considerations for Evaluating Known or Suspected Wetland Habitats (Table 7)
- Considerations for Evaluating Aquatic Habitats (Table 8)
- Considerations for Evaluating Terrestrial Habitats (Table 9)

SS 009, the Fire Valve Area, is a small mowed grass site where petroleum-contaminated soil was removed in 1993. The site was backfilled with clean material and returned to grade. The site is currently paved or covered with grass, and no aquatic or terrestrial habitats or ecological receptors were observed directly adjacent to the site (Table 10). Therefore a pathway evaluation was not necessary and no further ecological assessment is required for the site.

5 SS 009 – Summary and Conclusions

SS 009, Fire Valve Area, was investigated during the 1999 Basewide RI and 2000 RI Addendum to support a risk-based site management decision. Previous investigations at the site included a remedial action that was performed in 1993. The remedial action consisted of excavating 10 cubic yards of contaminated soil from the site.

In 1999, two groundwater monitoring wells were installed, and two groundwater and three soil samples were analyzed for TPH, VOCs, SVOCs, and metals. One additional monitoring well borehole was abandoned according to Missouri Well Construction Rules due to lack of groundwater yield. Preliminary results of the 1999 investigation revealed the presence of chlorinated VOCs in groundwater. To delineate groundwater impacts, ten additional monitoring wells were installed. Each well in the monitoring well network was sampled for VOC analyses in June 2000. Select groundwater samples were also analyzed for NA parameters. Based on available data, it appears that chemical constituents were sufficiently delineated at SS 009. This will be verified through future quarterly groundwater monitoring at the site.

Subsurface materials encountered at SS 009 during drilling and sampling generally consisted of 10 to 13 feet of low to medium-plastic silty clays and weathered shale underlain by six to eight feet of Raytown Limestone of the Iola formation. Chanute Shale was observed beneath the Raytown Limestone. Groundwater appears to flow through both silty clay and limestone at SS 009. The hydraulic gradient at of the silty clay was estimated to be 0.021. The hydraulic gradient in the limestone was estimated to be 0.052.

Aquifer tests were conducted at SS 009 in July 2000. Based on aquifer test data, flow velocities in the silty clay appear to be on the order of 0.00015 feet per day (ft/day) and appear to range from 0.00023 ft/day to 0.0027 ft/day in the limestone.

Natural attenuation parameters suggest that conditions at SS 009 may not be optimal for anaerobic biodegradation. However, the presence of the several degradation products does indicate that degradation has occurred or is occurring.

Analytical results were evaluated in a tiered Human Health Risk Assessment (HHRA). COCs at the site were identified as chlorinated VOCs in groundwater. COCs were not identified in soil. Calculated risks in groundwater were higher than established risk thresholds of 1×10^{-5} (carcinogenic) and of a hazard index of 1 (non-carcinogenic).

A Tier 1 qualitative ecological exposure assessment was conducted for SS 009 according to CALM guidance. The assessment consisted of Phase I screening. Ecological risks were not found because there are no ecological receptors or habitats at SS 009.

Because of human health risk associated with chlorinated VOCs in groundwater at SS 009, it is recommended that a Feasibility Study be performed to evaluate remedial options for this site.

6 SS 009 – References

CH2M HILL, 1999, 1999 *Richards-Gebaur Air Force Base Basewide Remedial Investigation/Feasibility Study (RI/FS) Work Plan.*

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Versar, 1996, *Groundwater Assessment, SS003, SS004, SS006, and SS009* (draft).

TABLE 1
Monitoring Well Construction Data at SS 009

Monitoring Well ID	Screened Depth Interval (feet)	Installation Contractor and Date	Screened Formation
SS009-MW002	8 5 – 13.5	CH2M HILL (1999)	Silty Clay Overburden and Weathered Shale
SS009-MW003	8 5 – 13.5	CH2M HILL (1999)	Silty Clay Overburden and Weathered Shale
SS009-MW004	18 7 – 23 7	CH2M HILL (2000)	Limestone
SS009-MW005	9.2 – 14.2	CH2M HILL (2000)	Silty Clay Overburden and Weathered Shale
SS009-MW006	18.7 – 23 7	CH2M HILL (2000)	Limestone
SS009-MW007	19.2 – 24.2	CH2M HILL (2000)	Limestone
SS009-MW008	18.7 – 23.7	CH2M HILL (2000)	Limestone
SS009-MW009	11 2 – 16 2	CH2M HILL (2000)	Silty Clay Overburden and Weathered Shale
SS009-MW010	18.0 – 23.0	CH2M HILL (2000)	Limestone
SS009-MW011	9.7 – 14.7	CH2M HILL (2000)	Silty Clay Overburden and Weathered Shale

TABLE 2
Groundwater Elevations at SS 009

Monitoring Well ID	Top of Casing Elevation (ft msl)	Groundwater Elevations (ft msl)			
		January 2000	April 2000	July 2000	October 2000
MW-002 (S)	1009 16	1002 34	1003 26	1002.94	1002 20
MW-003 (S)	1010.10	1000 26	1001.62	1003 15	1001.82
MW-004 (D)	1012 85	NM	NM	1003 89	1002 59
MW-005 (S)	1012.86	NM	NM	998 91	999.93
MW-006 (D)	1012.83	NM	NM	1005 33	1004 35
MW-007 (D)	1012.16	NM	NM	1003.75	1006.17
MW-008 (D)	1012.71	NM	NM	1004 63	1006 57
MW-009 (S)	1012.39	NM	NM	1003 19	1002 05
MW-010 (D)	1013.17	NM	NM	1006 04	1000 81
MW-011 (S)	1013 12	NM	NM	1001 25	1000 30

Water level measurements performed by Booz-Allen & Hamilton under contract to AFCEE

NM = Not measured because well had not yet been installed

TABLE 3
Selection of Chemicals of Concern in Groundwater at SS 009

Chemical Group or Compound	Tier 1 Screening Level (ppb)	Number of Tier 1 Exceedences	Number of Sampling Locations	Maximum Concentration (ppb)	Retained as COC?	Rationale for Exclusion
VOCs						
1,1-Dichloroethene	7	1	8	106 2	Yes	
cis-1,2-Dichloroethene	70	1	8	282.3	Yes	
Tetrachloroethene	5	1	8	58.9	Yes	
Trichloroethene	5	1	8	34.9	Yes	
Vinyl Chloride	2	2	8	50.3	Yes	
METALS						
Iron	300	1	1	25,500	No	Naturally-occurring constituent[1]
Lead	15	1	1	21.2	No	Naturally-occurring constituent[1]
Manganese	50	1	1	1,120	No	Naturally-occurring constituent[1]
Manganese, Dissolved	50	2	2	677	No	Naturally-occurring constituent[1]

Notes
[1]As discussed in Section 4 5 3 of the RI Report, concentrations of metals detected in groundwater are more likely to represent naturally-occurring levels rather than releases from sites at the Base

TABLE 4
Natural Attenuation Parameters in Groundwater at SS 009

Well ID	Chloride (ppm)	Nitrate (ppm)	Alkalinity (ppm)	TDS (ppm)	Sulfate (ppm)	Iron, ferrous (ppm)	Methane (ppb)	Ethane (ppb)	Ethene (ppb)	Dissolved Oxygen (mg/L)	pH	Conductivity (umhos/cm)
November 1999												
MW-002	189.1	0 08	NM	NM	35 8	0 16	NM	NM	NM	0 16	6.84	1.410
June 2000												
MW-003	128 7	0.01 U	660	979	55 8	0.02 U	29 2	0 29 F	0 24 U	3.28	7.63	1.65
MW-006	103	0.01 U	418	664	48.7	0.02 U	3.4	0.23 U	0 24 U	3.88	8.09	1 2

Lab Qualifiers
F = analyte positively detected, but concentration is below the reporting limit (RL)
U = analyte not detected above the method detection limit (MDL)

TDS = Total Dissolved Solids
NM = Not measured

TABLE 5
SS 009 - Concentrations of Chemicals of Concern in Groundwater

Location	Units	cis-1,2-DCE	1,1-DCE	PCE	TCE	Vinyl Chloride
MW-002	ug/L	0 12U	0 1U	0 1U	0 09U	0.12U
MW-003	ug/L	241 9	57 3	58 9	34.9	50 3
MW-003	ug/L	282 3	106 2	43	34 6	14 68
MW-006	ug/L	4 75	1 97M	0 25F	0 96F	1 63
MW-009	ug/L	15 8J	2 8	2.1J	2 7J	5 1

Notes

cis-1,2-DCE = cis-1,2-Dichloroethene
1,1-DCE = 1,1-Dichloroethene
PCE=Tetrachloroethene
TCE = Trichloroethene

Qualifiers (Flags) are as follows

F - Analyte positively identified, but concentration is below the analytical reporting limit (RL)
U - Analyte not detected, value presented in the minimum detected level (MDL)
J - Analyte positively detected, quantitation is an estimate
M - Matrix effect was present

TABLE 6
Estimated Health Risks for Chemicals in Groundwater at SS 009

		Residential Exposure Scenario	
Chemical	**Concentration in Groundwater (ppb)**	**Excess Lifetime Cancer Risk**	**Non-cancer Hazard Quotient**
cis-1,2-Dichloroethylene	282 3		5
1,1-Dichloroethylene	106.2	2E-03	2
Tetrachloroethylene	58.9	5E-05	0 2
Trichloroethylene	34.9	2E-05	1
Vinyl chloride	50.3	3E-03	
	Total Risk or HI	**5E-03**	

Notes.

Exposure point concentrations for cis-1,2-dichloroethene, 1,1-dichloroethene, tetrachloroethene, trichloroethene, and vinyl chloride are the maximum concentrations which occur at MW-003.

TABLE 7
Considerations For Evaluating Known or Suspected Wetland Habitats at SS 009

Consideration	Observation
• Obvious or designated wetlands present	No
• Wetlands suspected (e g , site adjacent to water body, in floodplain, standing water present, dark, wet soils, mud cracks, debris line, water marks, etc)	No
• Vegetation present at suspected wetlands (e g , submerged, emergent, scrub/shrub, wooded, prairie or grassland)	NA
• Size and depth of suspected wetlands	NA
• Source water at suspected wetlands (e g , river, stream, creek, lake, pond, groundwater, industrial discharge, surface water runoff)	NA
• Known/suspected contaminant inputs to suspected wetlands	NA
• Discharge of water from wetland to river, stream, creek, estuary, groundwater, impoundment	NA
• Natural community classification [1] of any obvious wetlands present	NA
• Observed biota (e.g , waterfowl, deer, rodents, etc.)	NA

TABLE 8
Considerations for Evaluating Aquatic Habitats at SS 009

Consideration	Observation
NON-FLOWING (LENTIC)	
• Type of water body (e g., pond, lake)	None
• Natural or man-made (e.g., lagoon, reservoir, canal, impoundment)	NA
• Size, depth, trophic status of water body	NA
• Nature of bottom (e.g., muddy, rocky, sand, concrete)	NA
• Uses of water body (e g , recreation, flood control, drinking water, habitat)	NA
• Source water (e.g , river, stream, groundwater, industrial discharge, surface water runoff)	NA
• Known/suspected contaminant inputs to water body	NA
• Discharge of water to river, stream, creek, groundwater, wetlands impoundment	NA
• Nature of bottom (e.g , muddy, rocky, sand, concrete, etc)	NA
• Vegetation present (e g., submerged, emergent, floating)	NA
• Evidence/observations of benthic macroinvertebrates, fish, reptiles, amphibians, birds, mammals	NA
FLOWING (LOTIC)	
• Type of water body (e.g , river, stream, brook, creek, intermittent stream, dry wash)	None
• Natural or man-made (e g., ditch or other channeled waterway).	NA
• Size, depth, flow rate, and order (e g primary, secondary, etc.) of water body	NA
• Bank environment (e.g., vegetated or bare, steep or gradual grade, height, etc)	NA
• Natural community classification [1] of any obvious wetlands present	NA
• Uses of water body (e g., recreation, flood control, drinking water, habitat)	NA
• Source water (e.g , river, stream, groundwater, industrial discharge, surface water runoff)	NA
• Known/suspected contaminant inputs to water body	NA
• Discharge of water to river, stream, creek, groundwater, wetlands impoundment	NA
• Nature of bottom (e g , muddy, rocky, sand, concrete)	NA
• Vegetation present (e g., submerged, emergent, floating)	NA
• Evidence/observations of benthic macroinvertebrates, fish, herptiles, birds, mammals	NA

TABLE 9
Considerations for Evaluating Terrestrial Habitats at SS 009

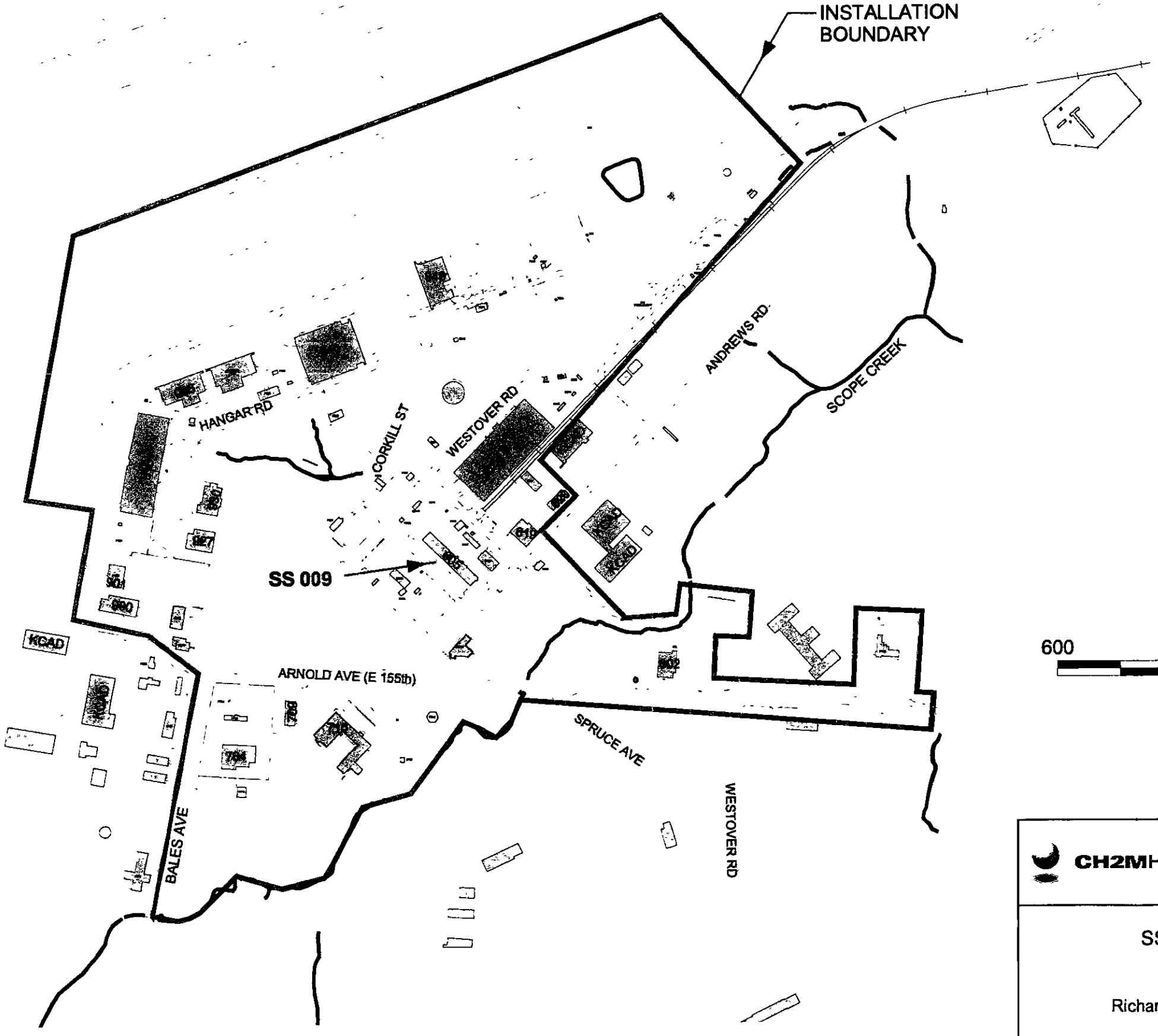
Consideration	Observation
WOODED	
• Percentage of site that is wooded	0%
• Dominant vegetation (e.g , evergreen, deciduous, mixed)	NA
• Predominant tree size at breast height (e.g., <6 inches, 6-12 inches, >12 inches)	NA
• Evidence/observations of macroinvertebrates, reptiles or amphibians, birds, mammals	NA
• Natural community classification [1]	NA
SCRUB/SHRUB	
• Percentage of site that is scrub/shrub	0%
• Dominant vegetation	NA
• Predominant height of vegetation (e g., <2 feet, 2-5 feet, >5 feet).	NA
• Characterize density of vegetation (e g , dense, patchy or sparse).	NA
• Evidence/observations of macroinvertebrates, reptiles, amphibians, birds, mammals	NA
• Natural community classification [1]	NA
GRASSLAND AND AGRICULTURAL AREAS	
• Percentage of site that is open (grassed or cropped - no shrubs or trees)	Grassed 100%
• Dominant vegetation (e g , grasses, agricultural crops, other forbs)	Grasses
• Predominant height of vegetation (e g , <2 feet, 2-5 feet, >5 feet).	<2 feet
• Characterize density of vegetation (e g., dense, patchy or sparse).	Sparse pavement
• Evidence/observations of macroinvertebrates, reptiles, amphibians, birds, mammals	None
• Natural community classification [1]	Mesic Prairie

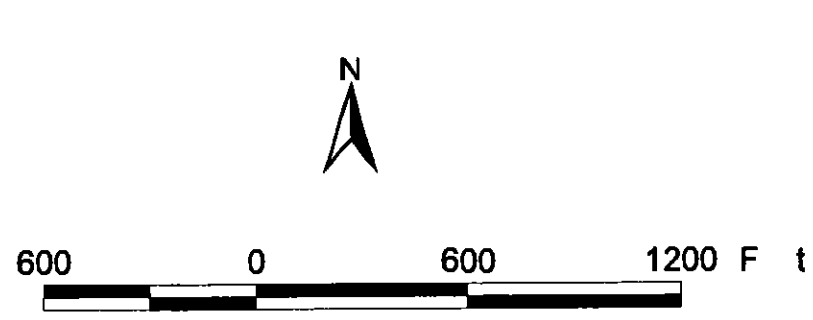
[1] From *Natural Communities of Missoun*, Nelson, Paul, Missoun Natural Areas Committee, Rev. 1987.

TABLE 10
Checklist for Potential Receptors and Habitats at SS 009

Item	Yes	No	Observation
Are wetlands such as marshes, swamps, or fens directly adjacent to the site?		X	
Are aquatic habitats such as rivers, lakes, or streams directly adjacent to the site?		X	
Are forested habitats directly adjacent to the site?		X	
Are grassland habitats directly adjacent to the site?		X	
Are there federal or state rare, threatened, or endangered species adjacent to or near		X	
Are there one or more environmentally sensitive areas (such as those listed in the text box on pg F6) at, near, or adjacent to the site?		X	
Are commercially or recreationally important species on, adjacent to or near the site?		X	

INTERPRETING RESULTS: If the answer to any one question is yes, then go to pathway evaluation If the answer to all questions is no, then no further ecological assessment is required.





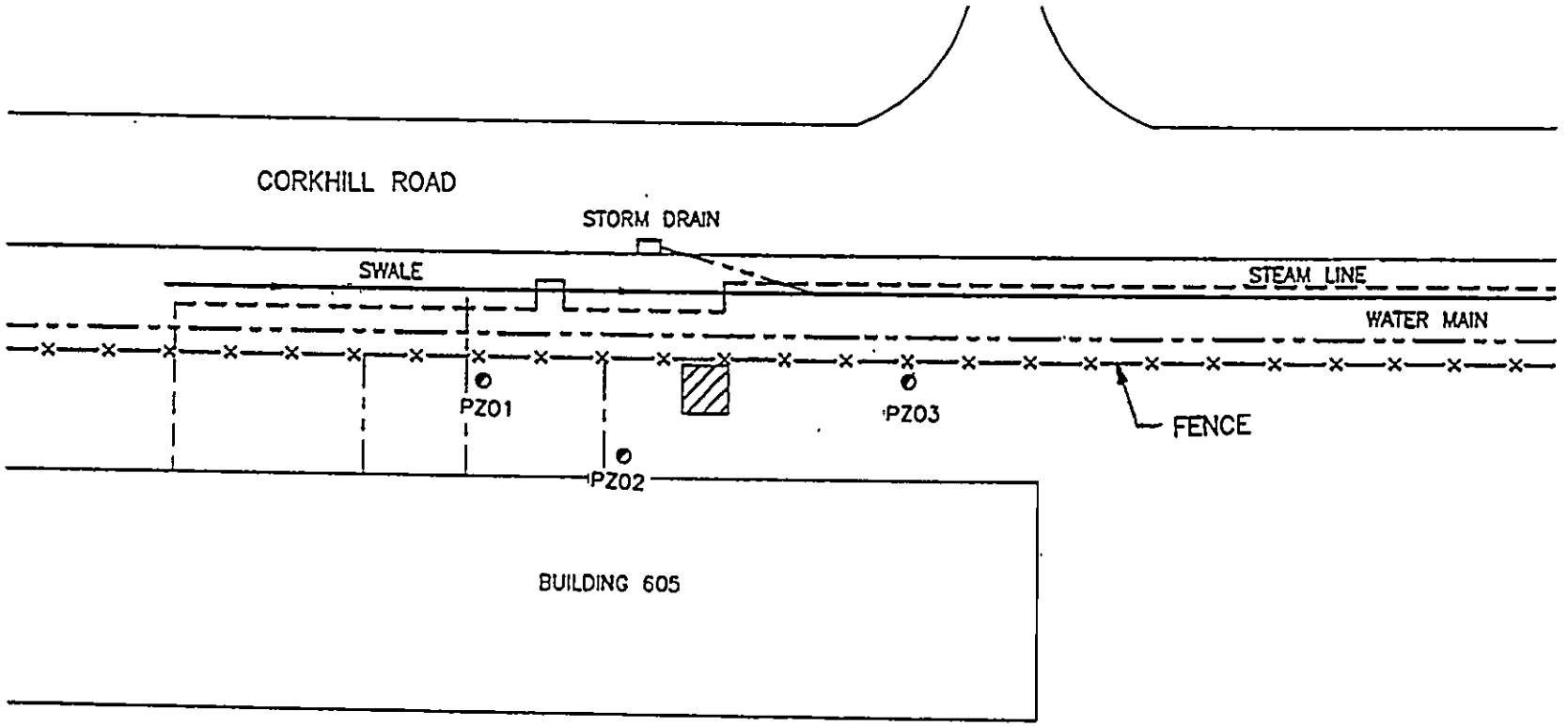
CH2MHILL FIGURE 1

SS 009 - FIRE VALVE AREA

SITE LOCATION MAP

Richards - Gebaur AFB, Kansas City, MO

I:\144012\SS009B.DWG PLOT DATE: 10-26-98



0 15' 30' 60'

SCALE IN FEET

LEGEND

LIMITS OF EXCAVATION

TEMPORARY WELL

Figure 2

SITE LAYOUT &
LIMITS OF EXCAVATING
SS 009
Richards-Gebaur AFB
Kansas City, Missouri

CH2MHILL

AFTER VERSAR INC., 1996

274 50

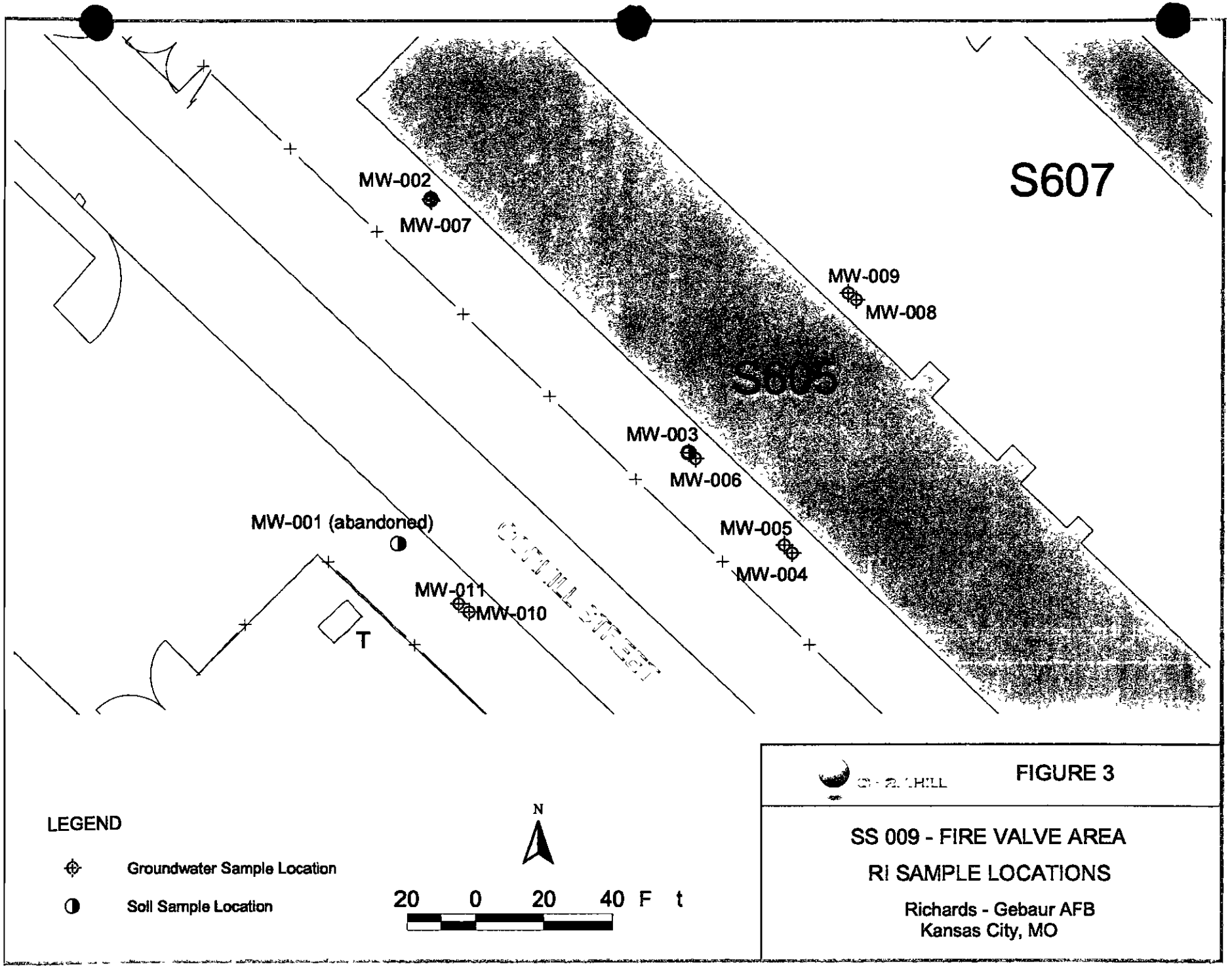
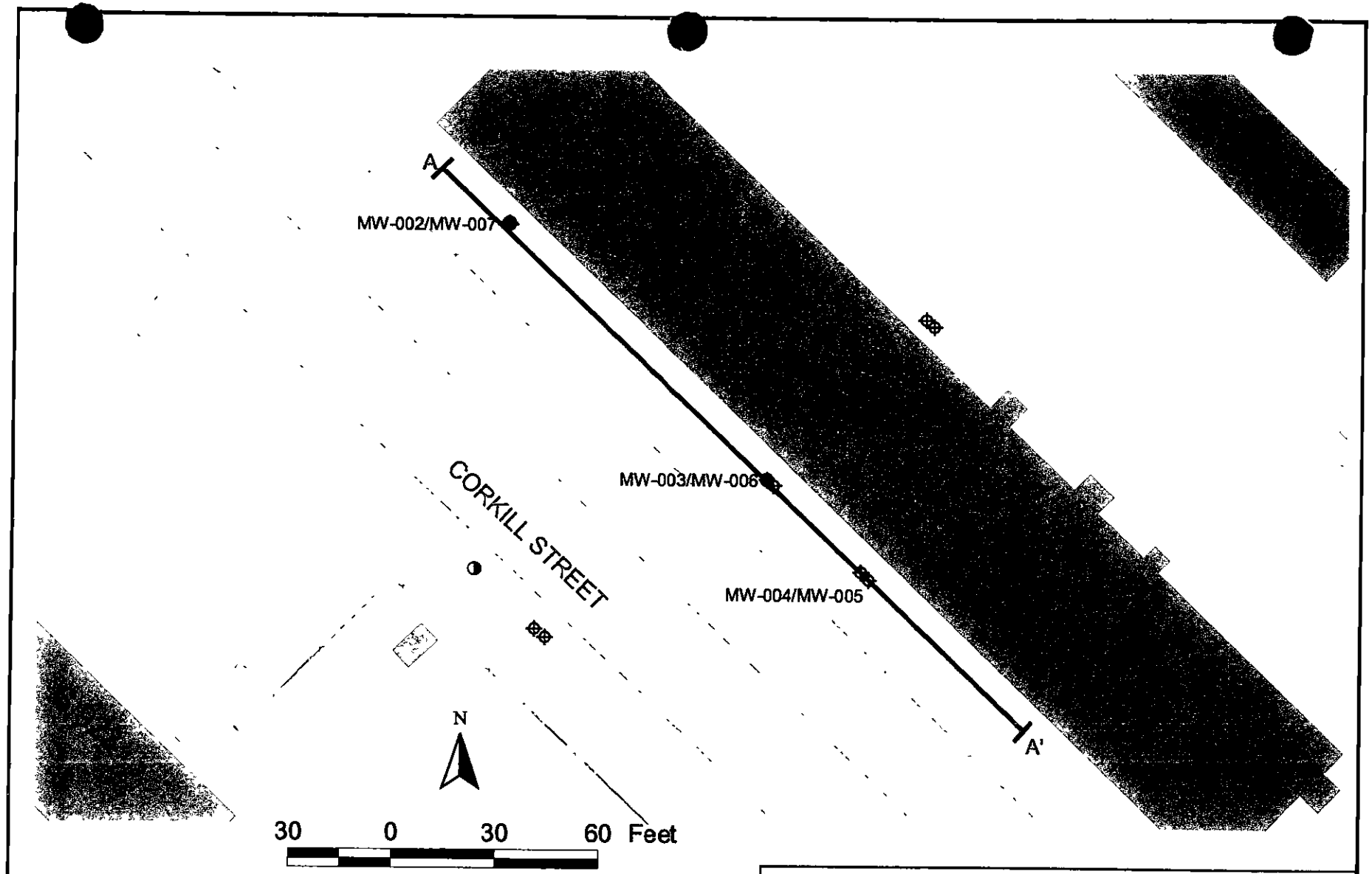


FIGURE 3

SS 009 - FIRE VALVE AREA

RI SAMPLE LOCATIONS

Richards - Gebaur AFB
Kansas City, MO



LEGEND

- Monitoring Well Location
- Soil Boring Location
- Cross Section Line

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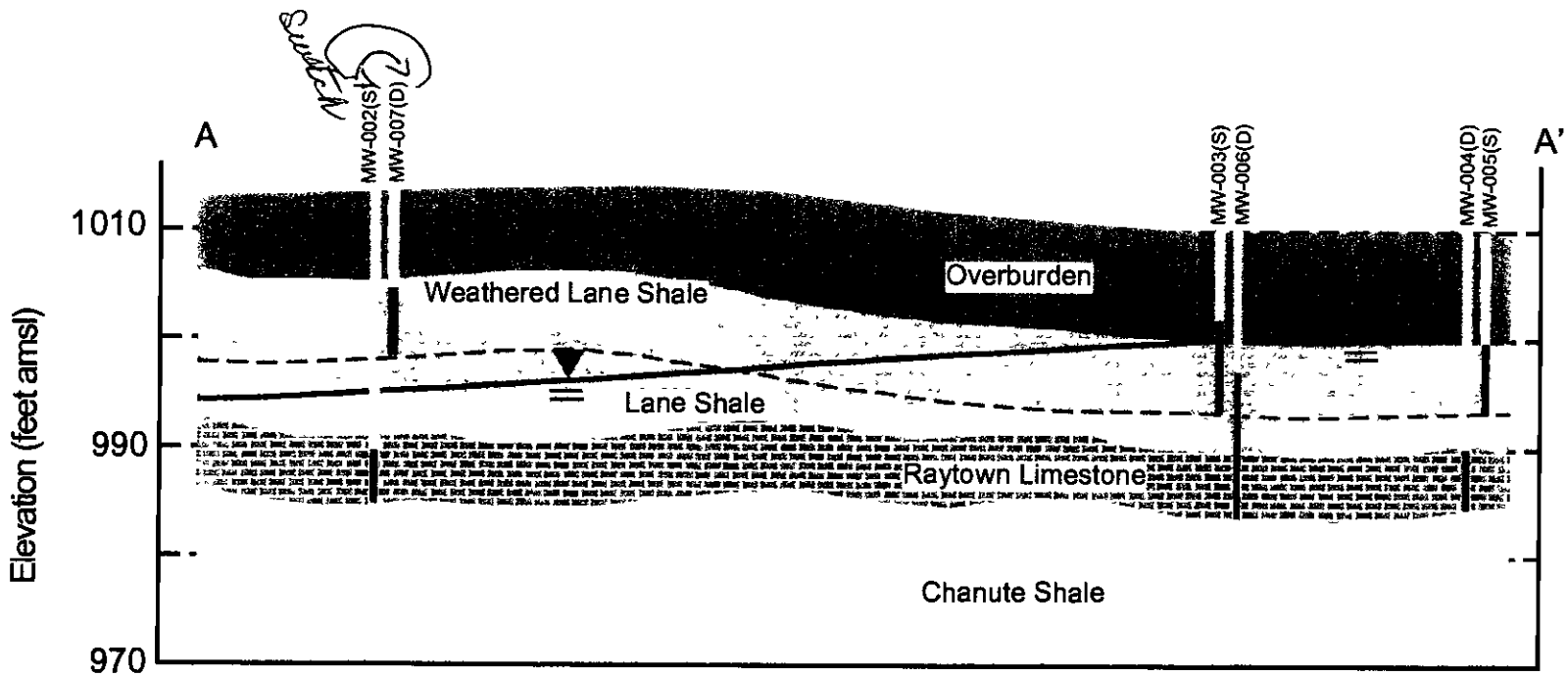
Figure 4

SS 009 - FIRE VALVE AREA

LOCATION MAP OF GEOLOGIC CROSS SECTION: A - A'

Richards - Gebaur AFB, Kansas City, MO



LEGEND

Groundwater Table (October 2000)

Well Screen Interval

amsl Above Mean Sea Level

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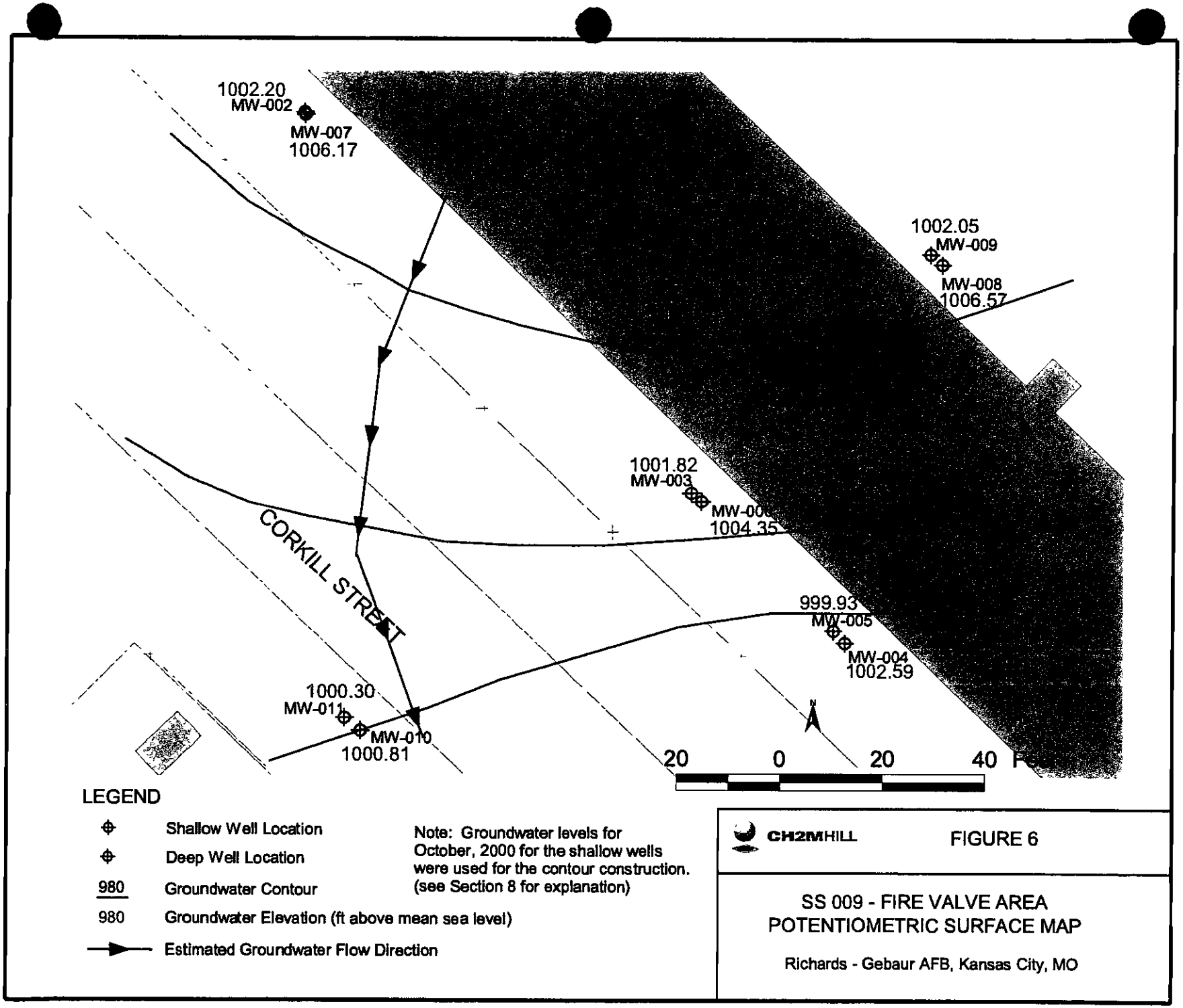
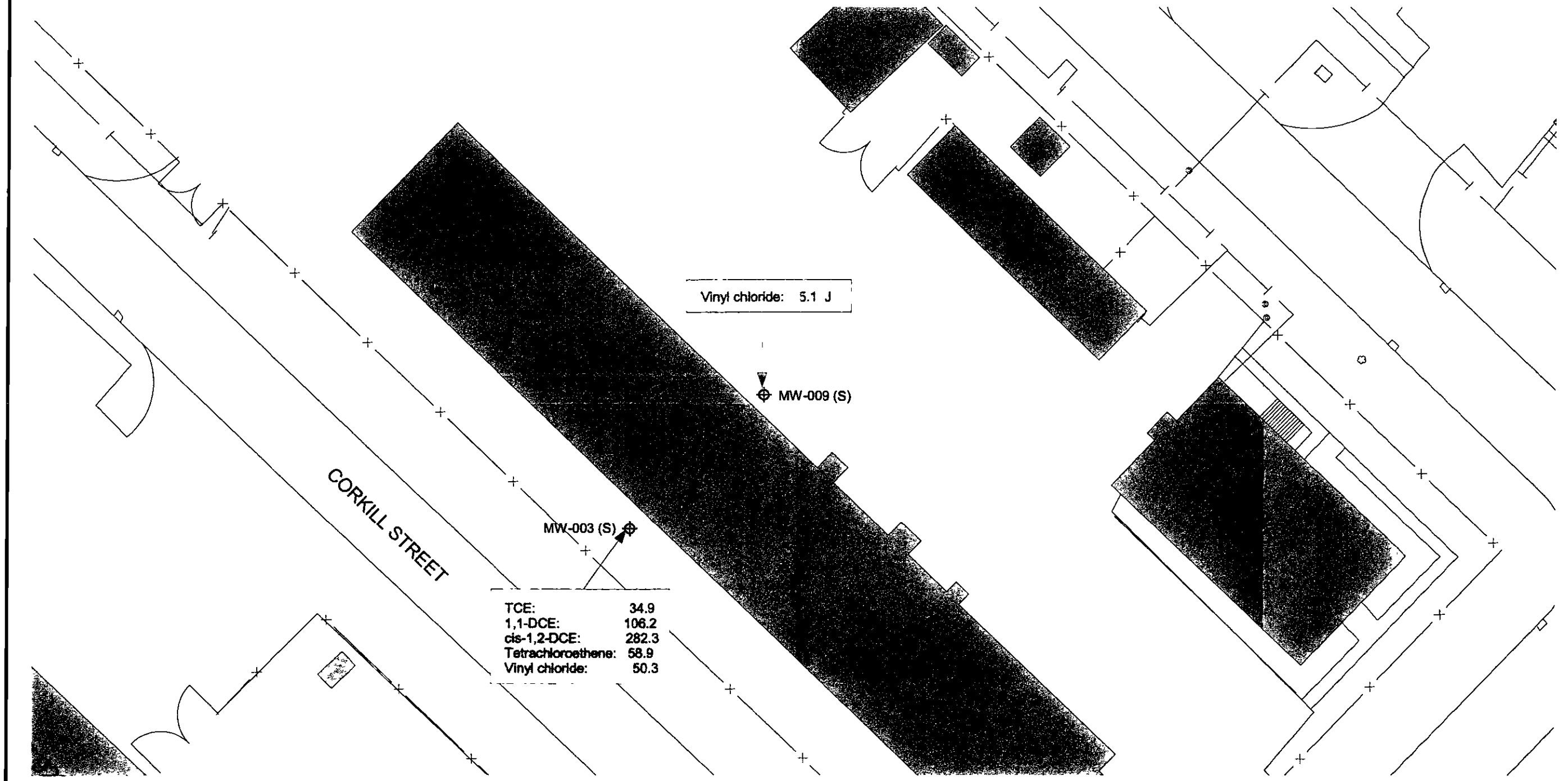
FIGURE 5

SS 009 - Fire Valve Area
Cross-Section A-A'
Richards - Gebaur AFB
Kansas City, MO


1002.20
MW-002
MW-007
1006.17
1002.05
MW-009
MW-008
1006.57
1001.82
MW-003
1004.35
CORKILL STREET
999.93
MW-005
MW-004
1002.59
1000.30
MW-011
MW-010
1000.81
N
20 0 20 40
LEGEND
Shallow Well Location
Deep Well Location
980 Groundwater Contour
980 Groundwater Elevation (ft above mean sea level)
Estimated Groundwater Flow Direction
Note: Groundwater levels for October, 2000 for the shallow wells were used for the contour construction. (see Section 8 for explanation)
CH2MHILL
FIGURE 6
SS 009 - FIRE VALVE AREA
POTENTIOMETRIC SURFACE MAP
Richards - Gebaur AFB, Kansas City, MO



CH2MHILL FIGURE 7

SS 009 - FIRE VALVE AREA - GROUNDWATER
COCs > TIER I SCREENING LEVELS

Richards - Gebaur AFB, Kansas City, MO