AR1429

TRAINING CLASS
FOR THE
MEMPHIS DEFENSE DEPOT
RESTORATION ADVISORY BOARD

PREPARED BY:
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MEMPHIS, TENNESSEE

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MAY 30, 2002

THE MEMPHIS DEPOT
TRAINING FOR RESTORATION ADVISORY BOARD

1.0 INTRODUCTION

Hess Environmental Services, Inc. (HES) was retained by the Defense Distribution Center to provide technical assistance to the Memphis Depot Restoration Advisory Board (RAB). This assistance includes training for Interpretation of the "Memphis Depot, Dunn Field, Remedial Investigation Report (RIR), Sections 1 through 18, April 2002. – Rev. 1." The text, which follows, constitutes HES' written training for the April 2002 RIR document.

1.1 Areas to be Covered

- Site Area Geology (soil conditions beneath subject site),
- Site Area Ground Water (condition and direction of flow),
- Contaminants found at the subject site, and
- Storm Water Migration/Pathways of Contaminants Migration during Storm Water Events.

2.0 SITE AREA GEOLOGY

2.1 Soil Classifications

- Clay – an extremely fine-grained sediment of mineral particles of any composition having a diameter less than 1/256 millimeters (mm) or approximately 4 microns.
- Silt – particles finer than fine sand and coarser than clay, commonly, in the range of 1/16 to 1/256 mm.
- Sand – particles smaller than a granule and larger than a silt grain, having a diameter in the range of 1/16 to 2 mm.
- Gravel – an unconsolidated natural accumulation of rounded rock fragments, mostly of particles larger than sand (>2 mm).
- Lignite – a brownish-black coal that is intermediate in coalification between peat and sub bituminous coal.

2.2 Geologic Terms

- Alluvial – pertaining to or composed of alluvium, particles deposited by a stream or running water body.
- Aquifer – a body of rock/sediment that is sufficiently permeable ("porous") to conduct ground water and to yield economically significant quantities of water to wells and springs.
- Fluvial – of or pertaining to rivers; growing or living in a stream or river; physical products by the action of a stream or river;
- Glacial Melt Water – a turbid stream of whitish water containing rock flour in suspension with other aggregates (rock particles).

- Loam – a rich, permeable soil composed of a mixture of clay, silt, sand, and organic matter.
- Loess – a blanket deposit of buff-colored silt, it is considered to be windblown dust.
- Marine – of, or belonging to, or caused by the sea.
- Outwash – sand and gravel deposited by melt water streams in front of the end moraine or the margin of an active glacier.

2.3 Soils of Dunn Field

- Falaya Silt Loam (Fm) – This soil unit may have originally developed as a narrow strip of alluviam occupying a platform above a stream channel. The Falaya Silt Loam is generally described as a silt loam, with poor-to-moderate drainage, and possessing a shallow water table and typically low-to-moderate permeabilities.
- Graded Land (CG) – This soil unit has been artificially developed from silty native upland material as a result of numerous land use charges throughout the installation's operational history. The unit generally consists of silty sandy clay or clayey sandy silt, and permeability is reported to be highly variable.
- Memphis Sand Loam (MeB) – This unit has developed in silty native upland materials on low hilltops, benches, and adjacent slopes. This unit consists of silt loam or silty clay loam. It is well drained and possesses low-to-moderate permeabilities.
- Memphis Silt Loam (McD2) – This unit has developed in silty native upland material or intermediate slope and benches and is described as a silt loam or a silty clay loam. It is deep and well drained, and possesses low-to-moderate permeabilities.

2.4 Geologic Units under Dunn Field

This section focuses on the statigraphy (soil layers) and geology at Dunn Field, based on lithologic (soil typing) logs from soil borings drilled within and adjacent to Dunn Field.

The stratigraphic definitions used in the site investigation reports are based on local interpretations of statigraphy and may not exactly correspond to definitions published in previous reports for the Memphis area.

Four (4) stratigraphic units underlying Dunn Field are (from ground surface to depth):

- Surface soils (loess),
- Fluvial deposits,
- Jackson/Upper Claiborne Group Formations, and
- Memphis sands.

2.4.1 Loess

The uppermost geologic unit at or near ground surface at Dunn Field is compressed of loess deposits, containing brown to reddish brown low-plasticity clayey silt (ML) or low-plasticity silty clay (CCL). Portions of the loess may also be described as fine sandy clayey silt. Based on data from the monitoring well installation effort, the loess is continuous throughout the entire Memphis Depot area. The loess deposits are of a thickness range from 10 to 36 feet.

2.4.2 Fluvial Deposits

Fluvial deposits were encountered at all drilling locations on and around Dunn Field and underlie the loess. The fluvial unit is composed of two (2) generalized layers that have been identified throughout the subsurface of Dunn Field.

(1) Reddish brown silty sandy clay to a clayey sand, and
(2) Yellow-brown, orange-brown, and red, poorly to well graded, fine to coarse-grained sand and orange brown gravely sand to sandy gravel.

The upper layer is silty sandy clay deposits that transition to clayey sand deposits. This layer represents a transition zone between silt-dominated loess to the sand and gravel of the fluvial aquifer. The thickness of this layer ranges from three (3) feet to 20 feet within the Dunn Field area.

The second unit is composed of layers of sand, sandy gravel, and gravelly sand. Overall, the sand layers show a coarsening downwards into gravelly sand, with chert (interlocking quartz crystals) being the primary gravel constituent. The second unit ranges from 28 feet to 44 feet in thickness.

2.4.3 Jackson Formation/Upper Claiborne Group

The Jackson Formation/Upper Claiborne Group (JF/UCG) was encountered at most of the monitoring well and soil borings locations of Dunn Field. Within the uppermost part of this group, a clay unit was encountered directly below the fluvial deposits in most boring locations. This clay unit Calso (known as a confining unit) is a distinct stiff, gray, low-to-high-plasticity lignitic layer separating shallow water bearing zones from underlying major aquifers. The clay unit thickness ranges from 0 to 92 feet. The upper clay unit of the JF/UCG is continuous under Dunn Field (based on boring/log data) except for a gap that was found in on-site wells MW56 and MW-34 and off-site wells MW43, and MW40.

2.4.4 Memphis Sands

Memphis sand is composed of a fine to medium grained, gray, sand. The Memphis sand is found under the Jackson Formation/Upper Claiborne Group.

2.5 Seismic Activity

The seismic zone identified in the area is the New Madrid Fault zone. The New Madrid is located at the northern end of the Mississippi Embayment; it is the most seismically active area in the central and eastern United States. There were at least two (2) large earthquakes occurring around 1811 to 1812. Since 1974 there have been 2,500 micro quakes. Johnston and Nava (1985) have estimated a recurrence interval for great earthquakes in the Memphis area to be in the 42.5 to 675 year range, with an interval of 70 years for reoccurrence for moderate earthquakes.

2.6 Glaciation

The cyclic Pleistocene glaciation (ice sheets) has been directly or indirectly responsible for the origin, character, and distribution of virtually all of the deposits and formations in the Mississippi Embayment. Although the ice sheets did not actually extend into the lower Mississippi Valley area, they were responsible for reworking preglacial deposits and drainage to include the southward-trending river and valley, which carried large volumes of glacial melt water and outwash.

3.0 SITE AREA GROUND WATER

3.1 Hydrogeologic

The region's hydrogeologic (ground water) setting consists of a series of thick, generally unconsolidated sedimentary units deposited in the Mississippi Embayment (abroad trough or syncline). Individual sedimentary sequences have been deposited in the Embayment. The most permeable of these units are identified as aquifers (water bearing units) and the least permeable are termed "confining units (aqua tards)."

3.2 Principal l Aquifers

There are several aquifers located within the Memphis area. These aquifers are identified in descending order from ground surface to depth.

(1) Alluvial aquifer
(2) Fluvial aquifer
(3) Intermediate aquifer
(4) Memphis Sand aquifer

3.2.1 Alluvial Aquifer

The Alluvial aquifer's distribution is limited to the channels of primary streams, which are not present at Dunn Field. The Fluvial, Intermediate, and Memphis Sand aquifers are found under Dunn Field.

3.2.2 Fluvial Aquifer

The Fluvial aquifer is an unconfined aquifer consisting of saturated (water bearing) sands and gravelly sands in the lower portion of the fluvial deposits. The Fluvial aquifer is primarily recharged from (supplied by) the infiltration of rainwater (Graham and Parks 1986). The Fluvial aquifer provides water for domestic and farm wells in rural areas, and discharges laterally into adjacent river channels.

3.2.3 Intermediate Aquifer

The Intermediate aquifer is separated from the Fluvial aquifer by a clay-confining unit. There is ground water communication (exchange of ground water) between the Fluvial and the Intermediate aquifers around MW34, 40, and 43 where the clay-confining unit is not present. The water flow direction under Dunn Field is westward, toward the Allen Well Field (drinking water production wells).

3.2.4 Memphis Aquifer

The Memphis Sand aquifer is under the entire Memphis area and is separated from the Fluvial aquifer by the Intermediate aquifer. The Memphis aquifer is under artesian conditions (confined pressure). Locally, due to extensive pumping of ground water for drinking water use, the water table in this aquifer has been lowered considerably. The aquifer is recharged by an outcrop area that has a northeast trending zone that begins at Shelby, Fayette, and Hardeman Counties, extending into much of western Tennessee.

3.3 Aquifer Interaction

Work done by Graham and Parks (1986) suggests that the confining layers of the Jackson Formation/Upper Claiborne Group are not continuous throughout the Memphis area. Because this and the fact that the Memphis aquifer is overlaid by the shallower aquifers (fluvial and intermediate), there is a downward vertical leakage from shallow water-bearing zones into the Memphis sands.

3.4 Groundwater Flow

The Fuvial aquifer appears to be "pinched out" (non-existent) in several areas due to increase in the elevation of the top of the clay "confining unit," which is equal to or exceeds the elevation of the water table.

3.4.1 Intermediate Aquifer

The Intermediate aquifer underlies the Memphis Depot and, based on boring logs, is separated from the Fluvial aquifer by a clay confining unit, except around MW34, 40 and 43, where the confining unit is absent. Water level elevations for the Intermediate aquifer range from 150.71 to 170.32 feet above mean sea level (msL) with a general westward flow toward the Allen Well Field.

3.4.2 Memphis Sand Aquifer

As noted, the Memphis Sand aquifer is under the entire Memphis area and is reportedly separated from the Fluvial and Intermediate aquifers. The top of the Memphis aquifer's potentiometric surface at MW-67 is 139 feet above msL; this is the only well on the Depot that enters the Memphis aquifer. The flow in the aquifer is generally westward, toward the Allen Well Field, the major local pumping zone.

4.0 Contaminants Found at the Subject Site

4.1 Metals "Soil Contamination" (Surface)

- Primary Metal of Concern (Lead)

Lead was detected in concentrations ranging from 14 milligrams per kilogram (mg/kg = parts per million-ppm) to 2,100 ppm with the maximum value recorded in samples from the former Pistol Range.

- Distribution of Metals

Antimony, Cadmium, Silver, and Thallium were detected at concentrations that exceeded background (indigionous) levels. However, the elevated concentrations for these constituents occurred infrequently and are dispersed widely over the area.

- Naturally Occurring Metals

Aluminum, Beryllium, Chromium, Copper, Nickel, and Zinc were detected in surface soil. Few of those detected had concentrations above background levels.

4.2 Metals in Subsurface Soils

Because Impregnite was deposited in the XXCC-3 Burial Ground, samples were collected and analyzed for zinc. Zinc was detected in all of the samples collected, but concentrations were below the background level of 114 ppm that was used in this assessment.

4.3 Pesticides and PCB Contamination

Thirteen pesticides were detected across Dunn Field, but they were not associated with discrete releases from a source area. This indicates a widespread surficial pesticide application rather than a release from the temporary storage area, etc. Higher concentrations of Dieldrin were detected at the former Pistol Range and Main Installation but can be attributed to increased applications due to facility activity.

4.4 Volatile Organic Compounds in Soil

Volatile Organic Compounds (VOC) analyses were performed on 155 subsurface soil samples collected from 45 locations in the disposal area. To date, background values for most of the VOCs detected have not been established for soil contamination. Since hazardous waste sites have VOC contaminatents and usually become a ground water contamination source, the identified VOC constituents in the surface and subsurface soil were compared to the EPA ground water protection criteria in a residential scenario (Supplemental Guidance for Developing Soil Screening Guidance Levels for Superfund Sites (source document)).

4.5 Semi-Volatile Organic Compounds

Both surface and subsurface soil samples were collected and analyzed for Semi-Volatile Organic Compounds (SVOC). Over 28 SVOCs were identified in the disposal area surface and subsurface soil samples. Many SVOCs detected in the soil do not have comparable background concentrations (These contaminants concentrations were not found in area background soil). The concentrations may also be associated, with the railroad tracks and railroad spurs located nearby.

5.0 Storm Water Migration/Pathways of Contaminant Migration During Storm Water Events

Contaminants that come in direct contact with storm water have the potential for storm water migration. Surface water runoff provides the potential for soil contaminants at or near the land surface located within Dunn Field to travel by way of overland flow to storm ditches and be discharged off site to streams, creeks, and other water bodies. There are no perennial (year round) flowing water bodies within the boundary of Dunn Field. Surface draining migrates by overland flow via swales, ditches, the concrete-lined channels, and finally into the storm drainage system. Areas that have buildings or have paved roads, parking lots, etc. covering the surface soils are not in contact with storm water runoff. Where undisturbed surface soils are exposed, they are predominantly grass-covered and are conducive to rapid runoff.

Storm water is directed into a series of storm drains that transport storm water in pipes that discharge from various points around the Dunn Field perimeter. Storm water runoff from the neighborhood east of Dunn Field drains to the concrete-lined ditches in the Northeast Open Area of Dunn Field, which then drain into Cane Creek.

Drainage channels in neighboring areas drain either to Cane Creek, northwest of Dunn Field, or to Nonconnah Creek, south of Dunn Field. Cane Creek drains to Nonconnah Creek at a point several miles southwest of Dunn Field. Nonconnah Creek empties into Lake McKellar (CH2M Hill, 1995c).

RAB

HESS ENVIRONMENTAL SERVICES, INC.
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MEMORANDUM

TO: All Memphis Depot Restoration Advisory Board (RAB) Members

FROM: Connie Hess CH

FIRM: Hess Environmental Services, Inc. (HES)

SUBJECT: Presentation of HES' Summary Report Addressing CH2MHill's "Remedial Investigation Report" of April 2002 – Revision 1

DATE: June 3, 2002

PRESENTATION:

Hess Environmental Services, Inc. (HES) will provide a one (1) hour presentation addressing CH2MHill's "Remedial Investigation Report" of April 2002 – Revision 1 (both a verbal and a written report will be provided.)

Date: Thursday, June 20, 2002

Time: RAB Board meeting begins at 6 pm; the HES presentation will begin about 7 pm.

Place: South Memphis Senior Citizens Center
1620 Marjorie Street, Memphis, Tennessee

Presenter: Ms. Kerry Moskal, an Environmental Specialist with a degree in Civil Engineering (with HES) has reviewed this CH2MHill report and will make a summary presentation of report findings. (Mr. David Orton, Geologist and Ms. Connie Hess, Chemist, both with HES, will also be present.)

Subject of Presentation: A Summary of Report Findings

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There was NO RAB Meeting in May, 2002