GW - 114

Work Plan
(GW Remediation)

Date:
August 15, 2013

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August 15, 2013

Mr. Edward Hansen
Environmental Bureau
New Mexico Oil Conservation Division
1220 South St. Francis Drive
Santa Fe, New Mexico 87505

RE: Work Plan Amendment
Groundwater Remediation Program Modifications
Former Dowell Schlumberger Facility, Artesia, New Mexico (GW-114)

Dear Mr. Hansen:

On behalf of the Schlumberger Technology Corporation (Schlumberger) and The Dow Chemical Company (Dow), CH2M HILL has prepared this work plan amendment under existing Discharge Plan GW-114 to perform modifications to the current groundwater remediation program at the Former Dowell Schlumberger Facility in Artesia, New Mexico. The following sections present background on the existing remediation system, current conceptual site model, and the proposed modifications.

Background and Conceptual Site Model

Chlorinated and petroleum hydrocarbon-related volatile organic compounds (VOCs) are present in site groundwater. Groundwater flows to the northeast at the site. Figure 1 shows the locations of the monitoring wells at the site. Table 1 shows the monitoring wells with exceedances of the New Mexico Water Quality Control Commission (WQCC) standards from New Mexico Administrative Code 20.6.2. The wells with exceedances of the WQCC standards are located in two general areas, the former wash bay (MW-12 for benzene), and the downgradient portion of the plume (remainder of the wells shown in Table 1 for 1,1-dichloroethene [DCE] and/or tetrachloroethene [PCE]).

No active treatment of the groundwater is being performed in the former wash bay area; however, a soil vapor extraction (SVE) system has been operating in that area to recover vapor-phase VOCs. Based on the results of quarterly monitoring of the SVE system offgas, the vapor-phase VOCs near the SVE system have been removed and the SVE system is no longer recovering VOCs from the vadose zone. The VOC concentrations in groundwater in the area appear to have reached a point of diminishing concentration reductions. Details regarding closure of the environmental concern associated with soils at the site are discussed in a separate work plan amendment (see *Artesia Soil Investigation and Soil Vapor Extraction System Closure Work Plan Amendment*, Schlumberger, August 2013).

Currently, a groundwater extraction, treatment, and gravity re-injection system is operating at the facility in the downgradient portion of the plume (Figure 1). To help accelerate removal of

VOC mass and to limit downgradient migration of the plume, treatment of extracted groundwater was added to the existing extraction system in the fall of 2012. Groundwater is treated by pumping extracted water through granular activated carbon (GAC) canisters and discharging it to the infiltration trench located upgradient of the central portion of the downgradient plume. The post-treatment groundwater was sampled and found to be nondetect for VOCs. The data indicate the groundwater extraction and treatment system is both removing contaminant mass from the downgradient plume and diluting the upgradient portion of the plume by re-injecting clean water. Well MW-31, adjacent to the infiltration trench, has had PCE concentrations decrease from 0.036 milligram per liter (mg/L) in April 2012 to nondetect (less than 0.001 mg/L) in April 2013. The 1,1-DCE concentration decreased from 0.022 mg/L to nondetect over the same period.

The highest downgradient concentrations of VOCs are observed in wells MW-25 and MW-30. However, both wells have shown decreasing concentrations for the last 2 to 3 years. During the second quarter of 2013, VOC concentrations in MW-25 were similar to those observed in the previous sampling event. VOC concentrations in MW-30 were slightly lower than those observed in the previous sampling event.

Schlumberger and Dow plan to implement additional active groundwater remediation activities to expedite site cleanup activities. The remediation activities will be conducted to pursue a reduction of VOC concentrations to below WQCC standards within several years and obtain clean closure of the site groundwater.

Schlumberger and Dow are evaluating in situ chemical oxidation (ISCO) injections at the site to facilitate decreases in VOC concentrations that are currently in excess of WQCC standards. An ISCO substrate, such as persulfate or permanganate, will be injected into the aquifer at targeted locations. However, prior to undertaking ISCO injections, site-specific soil and groundwater data are needed to finalize the ISCO design. Once the design parameters are determined, a single round of ISCO injections will be performed in the areas shown in Figure 1.

Preliminary Activities

Soil Investigation

Ten soil borings will be completed as described in the *Artesia Soil Investigation and Soil Vapor Extraction System Closure Work Plan Amendment*. To support the ISCO predesign objectives, soil cores will be collected within the aquifer matrix at 3 of the 10 locations shown in Figure 1. Two of the three soil borings for aquifer matrix testing are located in historical source areas, one at the former acid plant and one at the former wash bay. The third soil boring is located adjacent to MW-28 in the downgradient portion of the plume. The soil cores will be analyzed for soil oxidant demand (SOD) and soil pH buffering capacity to support selection of a suitable injectable ISCO amendment, verify parameters for final ISCO dosing calculations, and evaluate the ISCO treatment efficiency expected within the target treatment zones.

Target Treatment Zone Evaluation

Existing hydrogeologic data will be reviewed to evaluate the optimal ISCO target treatment zones, which will be selected to optimize the ISCO treatment efficiency in combination with

continued operation of the groundwater treatment system. An evaluation will also be performed to understand the potential compatibility issues with groundwater system infrastructure relative to the ISCO amendment ultimately selected, since the ISCO amendment may enter the groundwater system over time. The preliminary ISCO injection layout is included as Figure 1. ISCO is proposed in the following areas:

- In the downgradient portion of the plume, on the upgradient side of MW-25, between the infiltration trench and the extraction wells. The proposed ISCO injection location shown in Figure 1 is roughly at the upgradient limit of the PCE exceedance of the WQCC standard. The injection area is used to remediate the highest VOC concentrations and to take advantage of the recirculation aspects of the groundwater system.
- In the downgradient portion of the plume, upgradient of MW-28, but near the north property line. The injection area is used to remediate the VOC concentrations moving to the north.
- In the area of the former wash bay where benzene concentrations in groundwater exceed the WQCC standard.

Existing Groundwater Treatment System Evaluation

CH2M HILL has evaluated the VOC loading rate of the GAC treatment at the groundwater system using the first quarter 2013 VOC concentration data from MW-30, which is located adjacent to the extraction wells. Data from MW-30 and the extraction flow rate indicate that the current GAC usage rate is appropriate for the system. However, the VOC concentrations at MW-30 have shown a decreasing trend and the ISCO process will further decrease the VOC concentrations. Once the ISCO injection criteria and treatment rates are identified, the GAC consumption rate will be re-evaluated. No modifications to the groundwater treatment system are proposed at this time.

ISCO Field Implementation

The oxidant selection, dosage, and injection volume design will be finalized using the data collected during the target treatment zone evaluation. The theoretical mass of oxidant demand will be calculated based on the sum of the contaminant oxidant demand and the SOD of the aquifer solids. The SOD will be determined by the soil analysis described above. It is anticipated that the ISCO injections will be implemented via direct-push drilling methods.

During ISCO injection, the following will be measured and recorded to document the actual oxidant mass loading and injection volumes:

- Volumes of oxidant stock solution used for each injection point
- Liquid flow rate (±5 percent accuracy) of oxidant solution, at least hourly, during injection
- Start and end time of each injection cycle to the nearest minute

At the conclusion of field activities, the soil boring and ISCO injection locations will be surveyed using a hand-held global positioning system with submeter accuracy and the locations will be plotted on the site plans.

ISCO treatment performance will be evaluated based on VOC data collected during subsequent quarterly monitoring events. The groundwater monitoring network and monitoring frequency are also under evaluation and will be addressed in a subsequent amendment to the groundwater monitoring program.

Waste Management

Solid and liquid waste materials will be generated during the field activities. Potential solid waste streams include soil from drilling, empty ISCO totes, and personal protective equipment. Liquid waste will include rinsate from decontamination. The waste materials will be characterized, managed, and disposed of offsite in accordance with applicable local, state, and federal regulations.

Data Evaluation

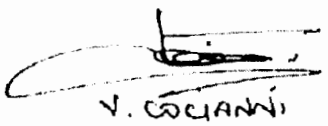
Field data will be compiled from field logs and presented in tables listing the sampling details, field observations, and field parameter measurements. Field data will be used to further refine the understanding of the site conceptual model, as appropriate. The data will be used to make project decisions regarding the ISCO injections, VOC concentration reductions, and potential impacts on the existing groundwater treatment system and potential modifications to the system.

Reporting and Schedule

Following completion of injection activities, an ISCO Injection Summary Report will be prepared to document predesign investigation activities, ISCO injections, and early conclusions following the injections. The initial data collection investigation will be completed during fall 2013, followed by data analysis and field planning during winter 2013, and the ISCO injections will occur during spring 2014.

If you have any questions or comments, please call me at 281-285-4747.

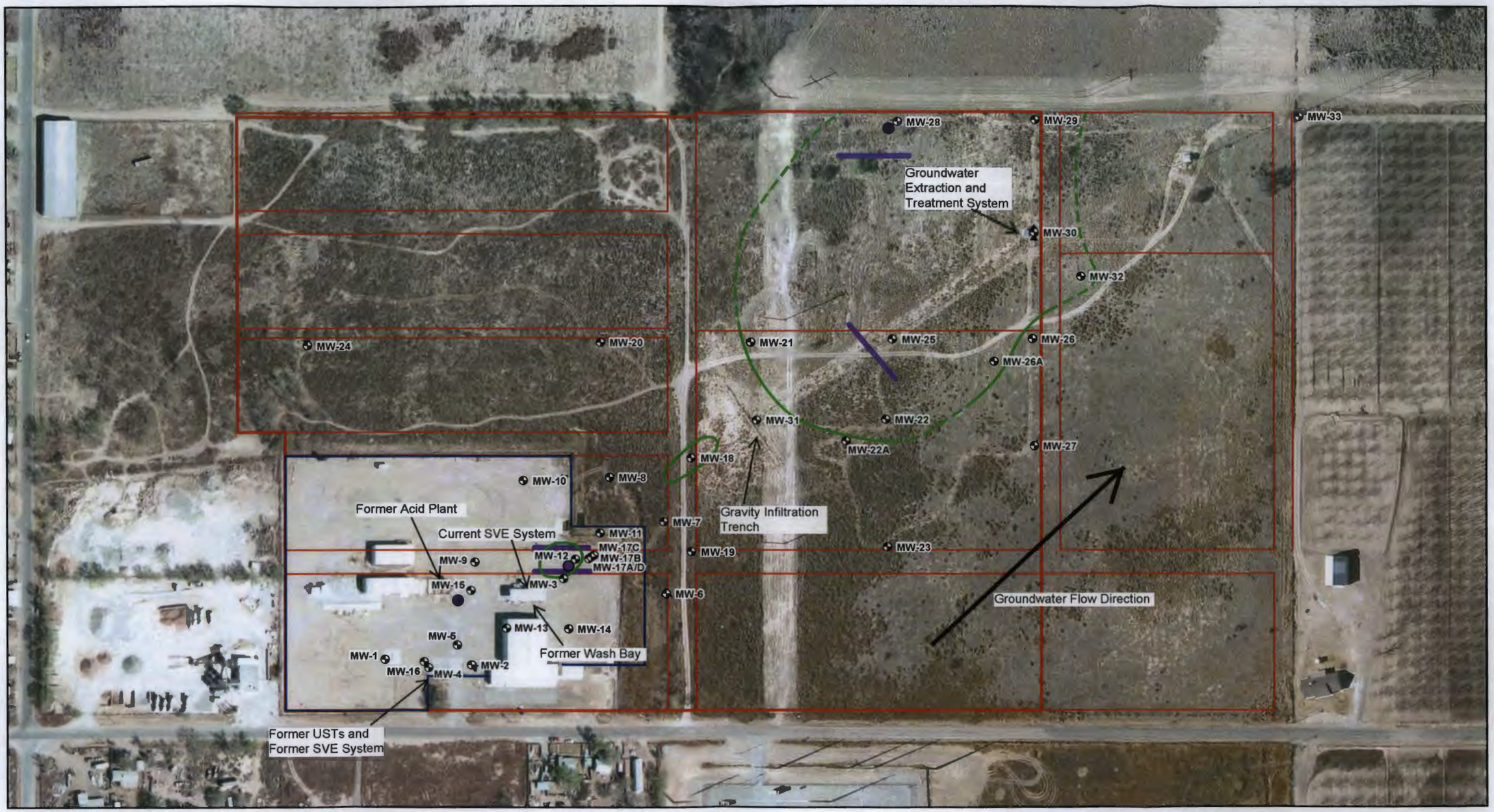
Sincerely,



Virgilio Cocianni
Remediation Manager

c: Jim Strunk, The Dow Chemical Company (1 hard copy)
Cathy Barnett/CH2M HILL (1 electronic copy)
Jennifer Laggan/CH2M HILL (1 electronic copy)
Jeffrey Minchak/CH2M HILL (1 electronic copy)

Figure 1
Potential ISCO Injection Locations



LEGEND

- Monitoring Well
- Groundwater Extraction Well
- Soil Boring with VOC and SOD Analysis
- Fence
- Right of Way Boundary
- Property Line
- Potential ISCO Injection Location
- Area Exceeding NMWQCC Standards (dashed where inferred)

N

0 100 200
Feet

FIGURE 1
Potential ISCO Injection Locations
Former Dowell Schlumberger Facility
Artesia, New Mexico

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CH2MHILL

Table 1
Exceedances of Water Quality Control Commission Standards

Table 1
Exceedances of Water Quality Control Commission Standards
October 2012 & April 2013
Former Dowell Schlumberger Facility, GW-114
Artesia, New Mexico

Analyte	Benzene	1,1-DCE	PCE
WQCC Standard	0.010 mg/L	0.005 mg/L	0.02 mg/L
Well No.			
MW-12	0.015	0.004	ND
MW-18	ND	0.012	ND
MW-21	ND	0.006	ND
MW-22	ND	0.018	ND
MW-25	ND	0.033	0.03
MW-26A	ND	0.013	0.02
MW-28	ND	0.027	0.022
MW-29	ND	0.007	ND
MW-30	ND	0.032	0.032
MW-32	ND	0.009	ND

Note:
WQCC = Standards of the New Mexico Water Quality Control Commission at New Mexico Administrative Code 20.6.2.
1,1-DCE = 1,1-Dichloroethene
PCE = Tetrachloroethene

Shaded cells indicate an exceedance of the corresponding WQCC Standard.

Exceedances shown are from the most recent sampling event. All wells were sampled in October 2012 during the annual sampling event and a subset was sampled in April 2013 during the quarterly sampling event.