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Annual Groundwater Treatment Systems Operation Data Summary Report January through December 2005 Sites 2/12 Groundwater Remedy Former Fort Ord, California Volume II

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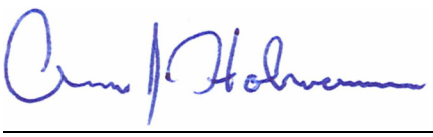

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Annual Groundwater Treatment Systems

Operation Data Summary Report

January through December 2005

Sites 2/12 Groundwater Remedy

Former Fort Ord, California Volume II

Contract # DAC05-01-D003 Task Order 0022

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TABLE OF CONTENTS

TABLE OF CONTENTS
(continued)

TABLES

PLATES

APPENDICES

EXECUTIVE SUMMARY

On behalf of the U.S. Army Corps of Engineers (USACE) Sacramento District, Ahtna Government Services Corporation (AGSC) operated the former Fort Ord Sites 2 and 12 (Sites 2/12) groundwater remedy for the period of January through December 2005.

This report presents Sites 2/12 system operations data, treatment system chemistry data, groundwater extraction/recharge data, a summary of chemicals of concern (COC), chemical mass removal data, and an assessment of the capture of the 2/12 groundwater remedy for the 2005 reporting period.

The granular activated carbon (GAC) treatment system was 100% effective in removing all COCs below the allowable treated-water discharge limits in samples obtained from the discharge compliance point for the entire period. The vinyl chloride (VC) discharge limit was temporarily revised from 0.1 to 0.3 micrograms per liter (µg/L). The system treated 147.6 million gallons (Table 2) and removed 30.3 lbs. of COCs (Table A3) during the 2005 annual period. As of December 30, 2005, a total of 884.58 million gallons have been treated by the Sites 2/12 system (Table 2), with a cumulative mass removal of 334 lbs. since 1999 (Table A3).

System operations, as measured at the GWTP flow meter during the 2005 annual period, consisted of intermittent extraction from each of the eight extraction wells for a total annual average extraction rate of 282 gallons per minute (gpm) and a maximum of 345 gpm (Table 2). Treatment system operational extraction wells and rates are specifically selected to maintain VC concentrations within treatable limits and maximize the total extraction rate. The addition and mixing of Operable Unit 2 (OU2) treated water at an average total rate of 348 gpm created an average aquifer recharge rate of 595 gpm (Table 2).

The extraction wells designated EW-12-01-180M and EW-12-02-180M (Table A4) are consistently showing the highest VC concentrations.

Results from extraction wells at Sites 2/12 indicate that, in general, COC concentrations are significantly decreasing.

These results are consistent with those from previous evaluations and indicate that the current Sites 2/12 remedial program is reducing the mass of COCs in groundwater.

At this site, the decreasing concentrations of some “parent” COCs, specifically, tetrachloroethene (PCE) and trichloroethene (TCE), concurrent with increasing concentrations of “daughter” chemicals (e.g. VC), could be indicative of a reductive dechlorination or other natural attenuation processes/biodegradation.

Streamlines for Sites 2/12 (see Appendix B for modeling) predict capture of the plume within noted portion of the site under the current extraction/injection configuration.

1.0 INTRODUCTION

This annual evaluation report presents a discussion of system performance and an evaluation of monitoring data including treatment plant operations data and a hydraulic capture analysis for the 2005 annual period.

1.1 GROUNDWATER REMEDY BACKGROUND

The Sites 2/12 groundwater contamination was first recognized in 1989 following the installation and sampling of monitoring wells (*JMM, 1990; EA, 1990*). Additional investigation reports (*Basewide RIFS* [*HLA, 1995*]; *Site Analytical Report* [*HLA, 1995*]; *Remedial Action Work Plan Technical Memorandum Number 1* [*IT, 1997*]; and *Remedial Action Work Plan Technical Memorandum Number 2* [*IT, 1997*]) served as the basis for the Sites 2/12 system design (as outlined in *Conceptual Design Analysis* [*HLA, 1995*]; *Performance Specifications* [*HLA, 1995*]; and *Draft Final Remedial Action Work Plan*, [*IT, 1999*]).

Monitoring and reporting of chemicals of concern (COCs) in groundwater and water level elevations from up to 45 monitoring wells at Sites 2/12 has occurred quarterly since 1992 as part of the basewide monitoring activities. The approximately fourteen years of groundwater monitoring data supports the original interpretations of groundwater flow and COC plume distribution used for remediation system design. The original source of the COC plume is assumed to be historical use and improper disposal of solvents in the Site 12 area. The Upper 180-foot Aquifer COC plume appears to have originated in the Site 12 area and to have been transported by groundwater flow about 3,000 feet to the southwest, passing beneath Highway 1 and into the Site 2 area.

1.2 GROUNDWATER REMEDY DESCRIPTION

The Sites 2/12 groundwater remedy is defined by the *Basewide Remedial Investigation Sites Record of Decision* (RI Sites ROD; *Army, 1997*) and consists of a groundwater pump and treatment system designed to remediate groundwater containing COCs above aquifer cleanup levels (ACLs). The Sites 2/12 COCs in the Upper 180-foot Aquifer are: chloroform, 1,2-dichloroethane (1,2-DCA), 1,1-dichloroethene (1,1-DCE), cis-1,2-dichloroethene (cis-1,2-DCE), total 1,3-dichloropropene (1,3-DCP), tetrachloroethene (PCE), TCE, and VC. Table 1 presents the ACLs and treated-water discharge levels for the COCs that were in effect during the 2005 annual operational period.

The Lower 180-foot Aquifer occurs below the Upper 180-foot Aquifer and is hydraulically separated from the overlying aquifer by the Intermediate 180-foot Aquitard. Historically, low concentrations of COCs have occasionally been detected below ACLs in samples from Lower 180-foot Aquifer monitoring wells.

The Lower 180-foot Aquifer groundwater continues to be monitored on a quarterly basis as part of the basewide groundwater monitoring activities.

Construction of the Sites 2/12 groundwater remedy was performed by IT and documented in the *Construction Completion Report* (*IT, 1999*). Groundwater extraction and treatment first

occurred at Sites 2/12 on April 13, 1999. Continuous groundwater extraction and treatment began on May 3, 1999 (*IT, 2000*). Diversion of treated effluent water from the OU2 GWTP to the Site 2/12 aquifer recharge structures began on June 23, 1999.

During the first five months of system operation, VC concentrations observed in extracted groundwater from individual wells and in the combined influent flow to the Granular Activated Carbon (GAC) vessels were greater than originally anticipated during treatment system design. The elevated VC concentrations were not efficiently treated by the GAC treatment system and exceeded the discharge compliance limit of 0.1 µg/L at the treatment system's effluent sampling point. Operational changes consisted of turning off extraction wells with elevated VC concentrations, and moving the discharge compliance sampling location to a location that incorporates treated OU2 water (sent to the Site 2 aquifer recharge structures) to maintain system operations and discharge compliance.

Following five months of initial system operation by IT, Harding ESE assumed responsibility for treatment system operations beginning October 4, 1999. On March 1, 2002, AGSC assumed responsibility for treatment system operations.

The Sites 2/12 groundwater remedy consists of eight extraction wells located at Site 12, the 2/12 GWTP, and five Upper 180-foot Aquifer recharge structures (two injection wells and three infiltration galleries – see Plate 1). System operations consist of Upper 180-foot Aquifer groundwater extraction from wells at Site 12. Extracted groundwater is piped to the 2/12 GWTP where, prior to treatment, the water undergoes pH adjustment by sulfuric acid addition (Plate 2). COCs are then removed by adsorption to GAC. Treated water from the OU2 groundwater remedy is piped to the 2/12 GWTP and added to the Sites 2/12 treated water in the effluent tank before the combined stream is transferred to the Site 2 aquifer recharge structures.

The eight extraction wells are arranged in four groups of two extraction wells per group. Extraction wells in a group are either screened in the upper part of the Upper 180-foot Aquifer or screened in the lower part of the Upper 180-foot Aquifer. Extraction wells designated with a *U* at the end of the well name extract groundwater from the upper portion of the aquifer. Wells designated with an *M* at the end of the well name extract groundwater from the lower portion of the aquifer.

The five Upper 180-foot Aquifer recharge structures consist of three infiltration galleries and two injection wells. Treated water from Site 2 extraction and OU2 extraction is combined at the 2/12 GWTP and piped to five aquifer recharge structures for the purpose of treated-water discharge to the Upper 180-foot Aquifer.

The groundwater remedy was designed to extract groundwater from Site 12 at a system rate of about 300 gallons per minute (gpm) and recharge the Upper 180-foot Aquifer at a total system rate of about 600 gpm. The additional 300 gpm of aquifer recharge water is provided by the OU2 system. The aquifer extraction/recharge system is designed to reverse the natural westerly groundwater flow gradient, redirect the flow toward the east, and facilitate groundwater flow from Site 2 to the Site 12 extraction wells. The extraction capacity of the eight extraction wells was designed to allow for maximum system operation flexibility in the event that extraction at a

well would need to be reduced or discontinued. The loss of extraction capacity could be compensated for by turning up the extraction rate at another well. The performance goal of the groundwater remedy is to facilitate groundwater extraction and hydraulic capture of the COC plume while maintaining a groundwater mound to minimize saltwater intrusion at Site 2.

2.0 TREATMENT PLANT OPERATIONS

This section of the report describes treatment plant operations and interprets monitoring data and system performance for the period of January through December 2005. Treatment plant operations were conducted following the *Operations and Maintenance Manual, Sites 2 and 12 Groundwater Remedy, Fort Ord, California* (*AGSC, 2004*). Treatment plant sampling and analysis was conducted in accordance with the site specific *Sampling and Analysis Plan* (SAP) (AGSC*, 2004*). Issues discussed below are: treatment system configuration, operating performance, system monitoring data summary, treatment operations, extraction well and aquifer recharge well performance, and recommendations for future actions.

2.1 TREATMENT SYSTEM CONFIGURATION

The 2/12 GWTP plant consists of two GAC vessels operated in series. Treated water flows to an effluent storage tank prior to aquifer recharge. Capacity of the 2/12 GWTP with the carbon beds in series is approximately 300 gallons per minute (gpm). The capacity is the practical maximum flow rate at which the inlet pressure to the carbon vessels does not exceed the allowable operating limit. Schematic diagrams of the equipment arrangements and sampling locations for the 2005 annual reporting period are shown on Plate 2. Chemical concentrations are monitored at up to five sampling locations. The sample station designations are listed in the table below:

Sites 2/12 GWTP Sample Station Designations

Station Designation	Description
TS-212-INF	Composite of untreated influent water for monitoring treatment effectiveness and for calculating total contaminant removal.
TS-212-GAC-A TS-212-GAC-B	Effluent from carbon beds GAC-A and GAC-B for monitoring contaminant breakthrough. Beds alternate between lead and lag positions.
TS-212-EFF	Point for monitoring water after treatment.
TS-212-INJ	Point for monitoring discharge compliance prior to aquifer recharge.

2.2 OPERATING PERFORMANCE

Operating performance is discussed in terms of extraction and treatment flow rates and totals, aquifer recharge flow rates and totals, online effectiveness, non-routine operations, and indirect waste stream production. Weekly data are presented in Tables 2, 3, and 4.

2.2.1 Groundwater Extraction and Treatment System Performance/Mass Removal

An increase in the VC discharge limit from 0.1 µg/L to 0.3 µg/L was approved and Field Work Variances were issued on February 7, 2002 (*IT Corporation, 2002*), January 24, 2003 (*AGSC, 2003*), June 26, 2004, and June 1, 2006. This allowed for increased flow rates at selected extraction wells, since there was previously limited flow capacity due to non-effective VC treatment by the existing GAC system. The extraction wells that were placed online varied based on GAC loading and GAC change-out schedules, as summarized in Section 2.2.4.

The weekly averages for total treated-water flow rates at the GWTP (2005 annual period) are presented in Table 2. The reported average weekly flow rate is the total volume pumped averaged over the period of time between measurements, usually seven days. The reported average weekly flow rate varies depending on flow rates for individual wells and any downtime experienced at the plant or the extraction wells. The total volume of treated groundwater in 2005 was 147.6 million gallons (Table 2). The average annual extraction and treatment system flow rate, as measured at the GWTP meter, was 282 gpm and the maximum average weekly flow was 345 gpm. Cumulative treated water since startup on April 13, 1999 through December 30, 2005 was 884.58 million gallons. Total system flow rates are shown graphically on Plate 3.

The total mass of COCs removed during the 2005 annual period by the remediation system is approximately 30 lbs.. The cumulative COC mass removed through December 2005 was 300.6 lbs.. The aforementioned data is summarized in Appendix A, Table A3. The compounds TCE, cis-1,2-DCE, and PCE represent approximately 98% of the total COCs in the untreated influent, integrated over the entire operational period (Plate 5). The remaining 2% is a combination of 1,1-DCA, 1,1-DCE, chloroform, and VC.

2.2.2 Groundwater Recharge System Performance

Treated water is discharged into five separate Upper 180-foot Aquifer recharge structures consisting of two injection wells and three infiltration galleries. The two injection wells are IW-02-01-180 and IW-02-02-180. The three infiltration galleries are INF-02-01-180, INF-02-02-180, and INF-02-03-180. The Sites 2/12 system discharged treated water from both Sites 2/12 and OU2 to the five aquifer recharge structures at a calculated average rate of 595 gpm (Table 2) based on system flow meters. The weekly average aquifer recharge rates, measured from flow meters at the five aquifer recharge structures during the 2005 annual reporting period, are presented in Table 4.

2.2.3 Operability and Planned and Non-Routine Operations Interruptions

The 2005 annual 2/12 GWTP weekly operability rates are summarized in Table 5. For the annual 2005 period the average weekly operability rate was 99.3%. The GWTP's cumulative operability rate (as of December 30, 2005) was 95.6%. Plant downtime included all scheduled and unscheduled operational outages.

The system operated during this annual period for a total of 8,667.75 hours with 92.25 hours of downtime. The system downtime resulted from:

- One hour of downtime on January 6, 2005 due to the installation of a new effluent tank level transducer.
- Ten hours of downtime on January 15, 2005 due to a power outage and the failure of the dial-out alarm.
- Six hours of downtime on February 9, 2005 due to a carbon change out of the GAC-A vessel and repairs to the PLC.
- Four hours of downtime on February 11, 2005 due to a carbon change-out at the OU2 GWTP.
- Two hours of downtime on May 11, 2005 due to a regional power outage.
- Twenty-four hours of downtime on June 28, 2005 due to repairs on a deteriorated valve on the pipeline leading to the infiltration galleries at Site 2.
- Two hours of downtime on June 30, 2005 due to the installation and programming of a new effluent tank level transducer.
- Twenty-four hours of downtime on June 28, 2005 due to a break in the vault valve south of the Site 2 PLC.
- Eight hours of downtime on June 30, 2005 for scheduled repairs.
- Two hours of downtime on July 6, 2005 due to a carbon change out of the GAC-B vessel.
- One quarter of an hour of downtime on July 29, 2005 due to an unscheduled power outage.
- Six hours of downtime on September 12, 2005 due to a carbon change out at the OU2 GWTP.
- Three hours of downtime on November 2, 2005 due to a carbon change out of the GAC-A vessel.

System Shutdown Evaluation

The evaluation summarizes system shutdowns affecting system performance. The following table summarizes the events resulting in 2/12 GWTP downtime during this reporting period. The Sites 2/12 system generally requires the addition of OU2 treated water to maintain VC discharge compliance. This relationship leads to Sites 2/12 system shutdowns during OU2 system shutdowns, thus the OU2 shutdowns are also listed below.

- Four hours of downtime on February 11, 2005 due to a change-out of GAC vessels TK-600-A and TK-600-D.
- Two hours of downtime at OU2 GWTP on May 11, 2005 due to a regional power outage.
- One quarter of an hour of downtime on August 1, 2005 due to a power outage at the OU2 GWTP.
- Thirty hours downtime on August 29-30, 2005 due to electrical problems at the OU2 GWTP related to a problem with EW-OU2-01-180.
- Six hours of downtime on September 12, 2005 due to a change-out of GAC vessels TK-600-B and TK-600-C at OU2 GWTP.
- Three and a quarter hours of downtime on December 26, 2005 due to a power outage at the OU2 GWTP.

The system downtime associated with the power outages and electronic component failure is judged to be acceptable and not to warrant corrective actions, such as an independent power supply or redundant electronic components.

2.2.4 INDIRECT WASTE STREAMS

Chemical breakthrough is monitored to determine when activated carbon needs to be changed out alternately in one of the two vessels, designated GAC-A and GAC-B. Following the change-out, the lag bed is routed to become the lead bed and the vessel with the new carbon becomes the lag bed.

Three carbon change-outs occurred in the 2005 annual reporting period; February 9, 2005 carbon change-out of the GAC-A vessel, July 6, 2005 carbon change-out of the GAC-B vessel, and November 2, 2005 carbon change-out of the GAC-A vessel.

In all three change-outs, the 8 x 30 mesh carbon and change-out services were supplied by U.S. Filter/Westates. Spent carbon from Sites 2/12 is returned to the carbon vendor as non-Resource Conservation and Recovery Act (RCRA) hazardous waste on the basis of a self-determination test (i.e. a test performed at the direction of the generator to demonstrate the characteristics of the waste as non-hazardous). The spent carbon from the change-outs was transported by U.S. Filter/Westates to their facility in Red Bluff, California, for regeneration.

2.3 MONITORING DATA SUMMARY

This section presents an evaluation of treatment system monitoring data from the 2005 annual reporting period and is divided into influent, effluent, and GAC performance monitoring. Treatment plant system monitoring and extraction well COC analytical data are presented in Tables 6 and 7, respectively. Extraction well inorganic analytical data is presented in Table 8. All analytical data generated during this review period was subject to data validation, as described in the CDQMP and project SAP, and were considered to be acceptable and suitable for use. The quality control summary report (QCSR) for these data can be found in the Appendices to the Quarterly Groundwater Treatment Systems Operation Data Summary Reports.

2.3.1 Influent Monitoring

Influent monitoring includes monitoring of COCs for the combined treatment plant influent flow from the eight extraction wells. Monitoring data for the individual extraction wells is discussed in Section 3.

The combined treatment plant influent from the eight extraction wells is sampled at TS-212-INF, prior to entering the carbon adsorption units (Table 6). A historical summary of influent COC concentration is presented in Appendix A (Table A2) and is shown graphically on Plate 4. The highest concentration of any COC was TCE, which averaged 14.56 µg/L for the 2005 annual period. The second highest concentration of any COC was cis-1,2-DCE, which averaged 8 µg/L for the 2005 annual period. VC results recorded for the eight extraction wells during December 2005 monitoring period ranged from non-detect (below the reporting limit of 0.1 µg/L) to 0.15 µg/L.

Treatment System Effluent Monitoring

The treatment plant effluent is sampled at TS-212-EFF after treatment through the carbon adsorption units (Table 6). System effluent is usually monitored weekly and analyzed within 72 hours to evaluate the GAC performance and carbon change-out schedule.

2.3.3 Discharge Compliance Monitoring

Discharge compliance monitoring occurs at the discharge compliance point TS-212-INJ during normal operation and is conducted to document compliance with treated-water discharge requirements prior to aquifer recharge. The TS-212-INJ data are reported in Table 6. System effluent is usually monitored weekly and analyzed within 72 hours to evaluate discharge compliance and the effects of OU2 water addition. All sample results were within discharge limit criteria.

2.3.4 GAC Performance Monitoring

GAC treatment system performance monitoring consists of sampling the stream between the two activated carbon beds (lead bed effluent sample point TS-212-GAC-A or TS-212-GAC-B) to monitor for contaminant breakthrough. GAC performance monitoring takes place twice a month and the results are analyzed within 72 hours to evaluate lead GAC performance.

From December 25, 2005 to February 9, 2005, the GAC vessels operated with the GAC-A vessel in the lead position and the GAC-B unit in the lag position. From February 9, 2005 through July 6, 2005, the GAC-B vessel was in the lead position and the GAC-A unit was in the lag position. From July 6, 2005 to November 2, 2005, the GAC-A vessel was in the lead position and the GAC-B unit was in the lag position. From November 2, 2005 to December 30, 2005, the GAC-B vessel was in the lead position and the GAC-A unit was in the lag position.

Only one carbon bed is changed at a time. After a change-out, the sequence of the beds is reversed (i.e. the previous lead bed filled with activated carbon becomes the lag bed and the bed previously used in lag position becomes the lead bed). Thus, residual chemicals from the loading of the new carbon are immediately detected as lead bed breakthrough after a carbon change-out. The Sites 2/12 breakthrough chemicals detected from the lead bed after a carbon change-out are usually 1,1-DCA, chloroform, cis-1,2-DCE, and 1,2-DCA. Either cis-1,2-DCE or 1,2-DCA is typically the chemical that first approaches the discharge limits and initiates scheduling a carbon change-out.

3.0 GROUNDWATER MONITORING AND HYDRAULIC CAPTURE EVALUATION

Sites 2/12 groundwater hydraulic capture performance (for the 2005 annual period) was evaluated through:

- Inspection of maps showing the distribution of COCs above ACLs in the Upper 180-foot Aquifer.
- Inspection of maps showing the distribution of TCE in the Upper 180-foot Aquifer groundwater.
- Statistically evaluating the concentration trends of COCs in the extracted groundwater over time.
- Conducting groundwater flow computer model simulations with MODFLOW using average:
    1) 2005 annual extraction well pumping rates, and
    2) Fully operational extraction wells flow rates.
- Using the flow model results to estimate the aquifer areas hydraulically captured as a result of system operation (Section 3.3 and Appendix B).

Groundwater plume monitoring data collected during Sites 2/12 operations activities and basewide groundwater monitoring activities are presented in Section 3.1. Statistical evaluation of the extracted groundwater COC concentration trends is presented in Section 3.2. An evaluation of the hydraulic capture of the Sites 2/12 Upper 180-foot Aquifer COC groundwater plume is presented in Appendix B.

3.1 GROUNDWATER PLUME MONITORING

Organic chemical data generated are reported in the quarterly monitoring reports and presented on Table 6. Table 6 displays all COCs detected above ACLs for the 2005 annual period. Plates showing the TCE concentrations have been presented in the quarterly reports prepared by MACTEC.

Table 7 summarizes the COC concentrations from extraction wells at or above ACLs for the 2005 annual period. TCE is the most frequently detected COC, detected at the highest concentration at Sites 2/12, and is generally present at the highest concentration when detected with other compounds. Because of the distribution of TCE, TCE isoconcentration plots (see MACTEC's 2005 quarterly reports) have been used to approximate the Sites 2/12 Upper 180-foot Aquifer groundwater plume.

3.2 EXTRACTED GROUNDWATER COC TREND EVALUATION

Extraction well COC data were evaluated by trend analysis to identify whether COC concentrations are likely increasing or decreasing at each well. As chemical mass is removed from the aquifers, COC concentrations are expected to exhibit a decreasing trend, especially for compounds that exceed ACLs. If COC concentrations are consistently increasing at a well, significant chemical mass may be upgradient of the well and additional extraction from the well or other upgradient wells may be warranted. Trend analyses will also be used in the future to identify wells that may be shut off because of VC concentrations or because the COC concentrations are below ACLs and continue to exhibit a decreasing trend.

3.2.1 Statistical Evaluation Method

A statistical analysis was conducted of COC concentration data for the eight Site 12 extraction wells using the Mann Kendall test for trend. The Mann Kendall test for trend is a nonparametric statistical evaluation that uses only the relative magnitudes of the data rather than actual data values to evaluate the probability that a trend exists *(Gilbert*, *1987)*.

The data are ordered by time, and each data point is compared to data points corresponding to earlier sampling dates. The number of earlier data points that are higher or lower than a given test data points are used to calculate the Mann Kendall statistic (S). The statistic is used, in conjunction with the total number of data points (n), to determine the probability that a trend (positive or negative) exists; however, the statistic does not indicate the magnitude (rate of increase or decrease) of the trend. Chemical data are considered to show a significant concentration trend (i.e. that a trend very likely exists) when the Mann Kendall probability exceeds 95%.

The general formula used to calculate the Mann Kendall statistic is:

$$S = \sum_{k=1}^{n-1} \sum_{j=k+1}^{n} \text{sign}(x_j - x_k)$$

Where: sign(x_j-x_k) is dependent on the number of positive and negative sums for each data comparison, and j and k are simply variable names for each data point (and j > k).

3.2.2 Statistical Evaluation Results – Sites 2/12

Table 9 summarizes the applicable Mann Kendall trend probability for COCs in the eight extraction wells. The direction of the concentration trend is described with the Mann Kendall probability as either increasing (+) or decreasing (-). The data used for the Mann Kendall statistical evaluation consisted of 48 sets of monthly data collected from the extraction wells since the system began operation in April 1999 (Appendix A, Table A4).

A significant trend in changing concentration, as determined from the Mann Kendall statistical test for trend, is indicated by probabilities exceeding 95%.

If not enough data points were available for a statistical analysis, no trend could be calculated. Non-significant trends indicate that the area of the plume is in a steady state (or equilibrium) and the mass removal is neither increasing nor decreasing. If an extraction well continues to have non-significant trends, continues to be below ACLs, or does not contribute to plume capture, the extraction well should be considered for shut-down.

The statistical data indicates that operation of the 2/12 groundwater remedy is affecting the plume and generally producing statistically significant decreasing concentration trends. The pattern and consistency of decreasing trends indicate that the system is making progress toward meeting the remedial goals. All eight 2/12 extraction wells showed significant decreasing trends for some COCs.

If increasing trends are observed, the COCs may be moving towards that well, a possible additional COC source may be identified, or may be indicative of an occurrence of reductive dechlorination.

Results from extraction wells at Sites 2/12 indicate that COC concentrations are generally decreasing, and significantly so at extraction wells EW-12-01-180M (PCE and TCE), EW-12-03-180U (cis-1,2-DCE), and EW-12-04-180M (cis-1,2-DCE). Only a slight (i.e. not statistically significant) increase in COCs was calculated at extraction wells EW-12-03-180M (PCE, TCE), EW-12-03-180U (cis-1,2-DCE, PCE, TCE), and EW-12-04-180U (cis-1,2-DCE).

At this site, the decreasing concentrations of some "parent" COCs (specifically PCE and TCE), concurrent with increasing concentrations of "daughter" chemicals (e.g. VC) could be indicative of an occurrence of reductive dechlorination or another natural attenuation processes/biodegradation.

3.3 GROUNDWATER CAPTURE EVALUATION

Groundwater flow modeling was conducted to evaluate hydraulic capture of the Upper 180-foot Aquifer COC plume by the Sites 2/12 groundwater remedy. Hydraulic capture was estimated using the updated Fort Ord groundwater flow model to simulate aquifer water levels and groundwater flow paths resulting from system operations. Appendix B describes the origin and development of the Fort Ord groundwater flow model and the groundwater modeling process, and contains the results of the groundwater hydraulic capture evaluation, which is also summarized below.

Plates 1, 2, and 3 (Appendix B) illustrate the simulated backward-tracking streamlines under pumping conditions from July 2005-December 2005, for the OU2 plumes in the A-Aquifer and Upper 180-Foot Aquifer, and Sites 2 and 12.

As with the previous capture evaluations, Figure 2 shows that some of the streamlines originating in the Upper 180-Foot Aquifer extraction wells "backtrack" up into the A-Aquifer where the overlying Fort Ord-Salinas Valley Aquitard (FO-SVA) clay pinches out and recharge from the A-Aquifer to the Upper 180-Foot Aquifer occurs. Figure 2 streamlines for the Upper 180-Foot Aquifer predict capture for most of the plume with the exception of the eastern portion of the TCE plume located approximately 1,000 feet downgradient (northeast) of extraction wells EW-OU2-05-180 and EW-OU2-06-180. An additional extraction well (EW-OU2-07-180) has been constructed to remedy this situation; however, it is not yet operational.

4.0 SUMMARY AND RECOMMENDATIONS

4.1 SUMMARY

The Sites 2/12 Groundwater Remedy was operated for the 2005 annual reporting period with a cumulative plant operability rate of 95.5%, as defined by the fraction of elapsed time the 2/12 GWTP was in operation. The treatment system was 100% effective with all COCs below the allowable treated-water discharge limits in samples obtained from the discharge compliance point for the entire period. The system treated 147.6 million gallons of water and removed 30.3 lbs. of COCs during the 2005 annual period. The cumulative COC mass removed since system start-up in 1999 is 334 lbs..

System operations consisted of intermittent extraction from all eight wells for an average 2005 annual extraction rate of 282 gallons per minute (gpm) and a maximum flow rate of 345 gpm. The addition and mixing of OU2 treated water at an average total rate of 348 gpm created an average aquifer recharge rate of 595 gpm.

VC results observed at the eight operating extraction wells in the 2005 monitoring period ranged from non-detect (below the reporting limit of 0.1 µg/L) to 0.72 µg/L. TCE was the predominant COC, and influent concentrations averaged 14.56 µg/L for the 2005 reporting period.

Evaluation and comparison of TCE isoconcentration contours, from the quarterly reports prepared by MACTEC with pre-pumping isoconcentrations, suggest that the Sites 2/12 Upper 180-foot Aquifer TCE plume has decreased in size as a result of Sites 2/12 groundwater remedy operation. The Mann-Kendall test for trend indicates that operation of the 2/12 groundwater remedy is affecting the plume and producing a statistically significant decrease in concentration trends. The pattern and consistency of decreasing trends indicate that the system is making progress toward meeting the remedial goals.

Sites 2/12 trend results indicate that COC concentrations are generally decreasing, and significantly so at three extraction wells. Only a slight, however not significant, increase in COCs was calculated at other three extraction wells. These results are consistent with those from previous evaluations and indicate that the current Sites 2/12 remedial program is reducing the overall concentrations of COCs in groundwater. Streamlines for the Upper 180-Foot Aquifer predict capture of most of the plume.

4.2 RECOMMENDATIONS

Based on the evaluation of the existing GWTS, the GWTS is operating effectively and the Army should continue extraction and injection at the design flow rates while monitoring VC concentrations and evaluate in-situ and ex-situ (i.e. air stripping) methods of VC treatment to allow optimization of the GWTS, while maintaining the effluent discharge limits.

5.0 REFERENCES

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