STREAMLINED REMEDIATION SYSTEM EVALUATION (RSE-LITE) FOR A GROUND WATER PUMP AND TREAT SYSTEM

EATON CORPORATION FACILITY
KEARNEY, NEBRASKA

SUBMITTED:

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NOTICE

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EXECUTIVE SUMMARY

A Streamlined Remediation System Evaluation (RSE-Lite) involves a team of expert hydrogeologists and engineers, independent of the site, conducting a third-party evaluation of a ground water pump and treat system or other remedy of environmental contamination. It is a broad evaluation that considers the goals of the remedy, site conceptual model, above-ground and subsurface performance, and site exit strategy. The evaluation includes reviewing site documents, communicating with the site team, and compiling a report that includes recommendations to improve the efficiency and effectiveness of the remedy. Recommendations with cost and cost savings are provided in the following four categories:

- Improvements in remedy effectiveness
- Reductions in operation and maintenance costs
- Technical improvements
- Gaining site closeout

The recommendations are intended to help the site team identify opportunities for improvements. In many cases, further analysis of a recommendation, beyond that provided in this report, may be needed prior to implementation of the recommendation. Note that the recommendations are based on an independent evaluation by the RSE-lite team, and represent the opinions of the RSE team. These recommendations do not constitute requirements for future action, but rather are provided for the consideration of all site stakeholders.

The Eaton Corporation facility ("Eaton") is located on East Highway 30 in Kearney, Nebraska. The facility covers an area of 365,000 square feet and began operations in 1969 with engine valve manufacturing. Onsite remediation began in 1986 after trichloroethene (TCE) was found in production wells. On April 20, 1993, Eaton Corporation entered into an agreement with the U.S. Environmental Protection Agency (EPA) Region 7 to delineate and remediate TCE contamination downgradient of the facility. An interim system began operation in 1996, was reconfigured in 1998 to improve plume capture, and reconfigured again in 2003 to adapt to a change in the direction of plume migration.

The current approach to remediation includes an onsite pump and treat (P&T) system to contain the onsite TCE contamination and an offsite P&T system to intercept the downgradient plume. This RSE-lite applies primarily to the offsite P&T system.

The RSE-lite team provides the following recommendations for improving remedy effectiveness, reducing cost, improving technical operations, and gaining site closure:

- Due to a change in the direction of plume migration, the site team should consider removing the point-of-entry treatment (POET) systems at the properties along Pool Avenue, but should consider routinely (e.g., on an annual basis) sampling the residential wells at the two properties along 56th Road south EW-4.

- EPA and Nebraska Department of Environmental Quality (NDEQ) have expressed concern regarding historical changes in the direction that the plume is migrating and have suggested numerical modeling in the past. The RSE-lite team suggests using water level measurements (currently collected as part of the monitoring program) to develop potentiometric surface maps. These maps should improve the site team's understanding of ground water flow patterns and plume migration. The RSE-Lite team believes that a numerical model will be difficult to calibrate given the transience of the system in the past. Accurately determining and representing historical irrigation pumping/infiltration rates will be difficult, as will be selecting appropriate water level targets for calibration. Furthermore, since future irrigation conditions will be variable and hard to predict, the results of scenario-based simulations will likely cover such a large range of possibilities that such simulations will be of little use from a management perspective. The site team may learn about the system through development of a numerical model, but the RSE-lite team believes that this benefit is likely not worth the cost at this time.

- Because permanent monitoring wells cannot be installed downgradient of the plume due to access constraints, the RSE-lite team suggests that the site team use direct-push sampling to gather samples in specifically recommended locations. The results of these samples can help the site team confirm that plume capture is adequate.

- The RSE-lite team recommends using the information from the potentiometric surface maps, direct-push samples, and other previous studies to evaluate plume capture. This effort might involve simple modeling comparable to what the site team has done in the past, but it would not involve the development of a more complex numerical ground water flow model.

- To reduce annual costs while maintaining effectiveness, the RSE-lite team suggests reducing the ground water monitoring frequency from quarterly (and in some cases monthly) to semi-annually. Implementing this recommendation could result in savings of approximately $20,000 to $25,000 per year.

- The onsite remediation system reportedly consists of two air strippers operating in series. The RSE-lite team did not specifically review this system, but given the relatively low influent concentrations, it is likely that a single air stripper would be sufficient to meet discharge standards. The site team should evaluate if operation of one of the air strippers could be discontinued.

- Suggestions are made for improving the remedy progress reports. These suggestions include providing updated plume maps and potentiometric surface maps along with current and historical ground water sampling results.

Finally, the RSE-lite team suggests that the site team consider possible exit strategy alternatives for the current offsite P&T System. TCE concentrations have decreased to less than an order of magnitude above the cleanup standard of 5 ug/L. The RSE team believes that there is a potential for conditions to exist where the offsite plume is stable (i.e., will not expand beyond its current extent) with or without continued pumping at the offsite extraction wells, even though MCLs might be exceeded at some locations. The RSE-lite team recommends that site stakeholders consider that a set of conditions may occur where it may be appropriate to discontinue pumping at offsite extraction wells even if MCLs are exceeded at some monitoring locations. The appropriateness of discontinuing pumping would likely require field data and transport modeling (analytical or numerical) that substantiate the stability of the plume extent due to dispersion, dilution, and any other factors.

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1.0 INTRODUCTION

1.1 PURPOSE

In 2003 and 2004, the EPA Corrective Action program and the EPA Office of Superfund Remediation and Technology Innovation (OSRTI) sponsored independent optimization evaluations called Remediation System Evaluations (RSEs) at five RCRA sites with pump and treat (P&T) systems. These RSEs involved an independent team of experts reviewing site documents, interviewing site stakeholders, and providing recommendations for improving remedy effectiveness, reducing costs, and gaining site closure.

An RSE involves a team of expert hydrogeologists and engineers, independent of the site, conducting a third-party evaluation of site operations. It is a broad evaluation that considers the goals of the remedy, site conceptual model, above-ground and subsurface performance, and site exit strategy. The evaluation includes reviewing site documents, visiting the site for 1 to 1.5 days, and compiling a report that includes recommendations to improve the system.

Based on the positive results of these RSEs, EPA Technology Innovation Field Services Division and the Office of Solid Waste (OSW) have commissioned a new pilot study that involves developing and piloting a streamlined RSE process that reduces the cost of resources relative to a full-scale RSE, based on the consideration that many sites do not require a full-scale RSE and a streamlined RSE will provide same level of beneficial results at a reduced cost. This streamlined RSE or "RSE-lite" evaluation includes reviewing site documents, conducting conference calls with the site team, and compiling a report of recommendations.

For this new pilot study, up to five RCRA Corrective Action facilities with operating remedies have been selected to receive streamlined RSEs or "RSE-lites". The site managers have been asked to provide site documents for review by the RSE-lite team. After reviewing the documents, the RSE-lite team has communicated with the site managers to learn more about the sites and fill in information gaps not covered by the site documents. As part of this streamlined effort, no site visit has been conducted.

This RSE-lite report for the Eaton Corporation facility ("Eaton") in Kearney, Nebraska is one of the RSE-lite reports from this new pilot study. The facility was nominated by EPA OSW based on a nomination from EPA Region 7. The report consists of the following elements:

- A brief summary on site history, site conceptual model, ground water remedial system, remedy goals, and costs
- Recommendations to improve remedy effectiveness and efficiency of the operating pump and treat system

1.2 RSE-LITE PROCESS

Once a site is selected, a representative of the RSE-lite team contacts the site project manager to obtain site documents for review. The documents typically include information pertaining to site investigations, remedy design, and remedy operations and maintenance (O&M). Upon reviewing this information, the RSE-lite team conducts a conference call with the remedy project manager to address questions that may have arisen as part of the document review or other information gaps. Based on the site documents and the information from communications with the site project manager, the RSE-lite team prepares a short report documenting recommendations for improving efficiency and effectiveness. The text of the RSE-lite report includes a brief background of the site, and a recent site progress report is included as an attachment for more detailed site information.

1.3 PARTICIPANTS ON RSE-LITE CONFERENCE CALL

The following individuals participated the conference call as part of RSE-lite:

- Dan Saathoff, Eaton Corporation
- Jeff Allen, Eaton Corporation
- Jeff Williamson, URS
- Jeff Johnson, RPM & Hydrogeologist, EPA Region 7
- Robert Tobin, Nebraska Environmental State Quality
- Mike Fitzpatrick, EPA HQ
- Peter Rich, GeoTrans, Inc.
- Doug Sutton, GeoTrans, Inc.
- Yan Zhang, GeoTrans, Inc.

1.4 DOCUMENTS REVIEWED

The following documents were reviewed as part of this RSE-lite:

- Slide presentation describing the history of the site

- Cross-sections of the stratigraphy immediately underlying the site

- Selected correspondence between the facility and EPA regarding extraction system

- A proposal from the USGS to develop a site-specific MODFLOW simulation for the site

- Groundwater Quality Survey (Phase 8) Report, July 1998

- Groundwater Quality Survey (Phase 9) Report, February 2003

- A figure showing the current projected plume configuration and the location of the four active off-site extraction wells

- Documentation of the monthly extraction rates

- Quarterly Progress Report – Removal Action Detailed Site Assessment, Fourth Quarter 2004 October 2004 Through December 2004, January 2005

- Table of ground water monitoring well analytical results, January 2005

- Table of direct push ground water sample analytical results, February 2005

- Figure of direct push sampling locations and TCE plume, March 2005

2.0 BACKGROUND

2.1 SITE HISTORY

The Eaton Corporation facility ("Eaton") is located on East Highway 30 in Kearney, Nebraska. The facility covers an area of 365,000 ft^2. The facility production began operation in 1969 with engine valve manufacturing.

The on-site remediation system began operation in 1986 after trichloroethene (TCE) was found in production wells. TCE underground storage tanks were emptied and removed. NDEQ Stipulation and Agreement (SAA) dated January 1989 required further investigation including a soil gas survey and installation of additional monitoring wells. The investigation results indicated that the on-site contamination was contained and the deep aquifer was not significantly impacted by the contamination in the shallow aquifer.

On April 20, 1993, Eaton Corporation entered into an agreement with the EPA Region 7. The Administrative Order on Consent for Removal Activities applied to the presence of TCE and associated degradation products in ground water monitoring wells located east and downgradient of Eaton Corporation's engine work production facility. The Order generally required the delineation of TCE in ground water in the vicinity of monitoring well S-7, located within the Kearney Municipal Airport property, and the subsequent remediation of ground water which poses a threat to human health, safety, or the environment.

In 1993, Eaton prepared and implemented a Removal Action Work Plan. In 1995, Eaton finalized an interim action proposal. Construction of the interim action system began in November 1995 and was completed in February 1996. The system was reconfigured in 1998 after the Groundwater Quality Survey (Phase 8) Report in July 1998 proposed changes to the system to provide more effective extraction and treatment. Another system modification was conducted in 2003 which included relocating the existing ground water extraction system to better intercept the area of highest TCE concentrations.

2.2 SITE CONCEPTUAL MODEL

Hydrogeology

Subsurface material at the site consists of fine-grained alluvial sand from 16 to 30 feet below ground surface (bgs) and coarse-grained alluvial sand with gravel from 30 to 70 feet bgs. Site hydrogeology consists of a single unconfined aquifer unit extending to a depth of approximately 70 ft bgs that overlies alluvial clay with fine-grained sand that acts as an aquitard. Monitoring wells have been completed in both the shallow and deep portions of this unconfined aquifer. Concentrations in the unconfined aquifer increase with depth, and concentrations at the base of the aquifer are typically 2 to 10 times those at the water-table.

The depth to water table ranges from 24 to 35 feet bgs, and the saturated thickness is approximately 30 to 40 feet. The hydraulic conductivity averages 1,000 feet/day in the aquifer and 0.002 to 0.3 feet/day in the aquitard. The horizontal hydraulic gradient is approximately 0.001 directed to the east-northeast. The estimated Darcy velocity is therefore approximately 1 foot per day. The porosity is estimated to be 0.27 based on field measurements. Therefore, the estimated seepage velocity is approximately 4 feet per day.

Sources, Contaminants of Concern, and Plume Extent

TCE and associated degradation products are the primary contaminants of concern at the site. The ground water contamination may be related to historical operations of the TCE solvent degreaser and the associated former underground tanks and piping system. There are other potential VOC sources in the area that may have also contributed to the observed ground water contamination. The consent order for the site specifically refers to remediation of ground water contamination downgradient of the Eaton facility.

Sampling results in 1991 indicated that TCE concentrations increased significantly in some offsite monitoring wells screened in the deeper portion of the unconfined aquifer, and by 1994 TCE concentrations above 1,000 ug/L were found approximately 5,000 feet downgradient of the facility. By 1995 TCE was observable 18,000 feet downgradient. The current extraction wells are located approximately 18,000 to 19,000 feet downgradient of the facility.

Potential Receptors

EPA believes that there are no current drinking water receptors within the current plume footprint. There are six private drinking water wells nearby, all of which are outside of the plume boundary, and all of which are screened in the deep aquifer beneath the aquitard. Two of the wells had previously been screened in the unconfined aquifer but were replaced by deep wells completed beneath the aquitard. Three of the wells have point-of-entry treatment (POET) systems that use both Ultraviolet (UV) radiation and granular activated carbon (GAC) for treatment. These treatment systems are maintained once per year. A temporary POET system is also maintained for the Kearney raceway drag strip, which is only used a few days during the summer each year. The RPM indicates that it is unlikely that two shallow wells that were replaced with deeper wells were the only wells in the area screened in the shallow aquifer but exact numbers were not reported to the RSE-lite team. All domestic wells in the immediate vicinity of the plume are now screened in the deeper aquifer, which is believed to be hydraulically separated from the shallow aquifer containing Eaton’s TCE plume. However, two other wells are located within 1.5 miles NE and downgradient of the current downgradient edge of the plume. Where these wells are screened is not currently known. While these wells are located in the historic direction of plume migration, an exact prediction of the future direction of plume migration is difficult due to complicated patterns of irrigation pumping that have resulted in historical changes in flow direction. The site team also reports a high likelihood of high nitrate concentrations throughout the region in the unconfined aquifer due to non-point sources, which might affect the quality of drinking water.

Irrigation pumping is the primary use for ground water in the surrounding area, and the operation of these wells appears to impact ground water flow direction and velocity. Within the plume there are two irrigation wells that are still in use, but the site team has determined that there is an acceptably low risk associated with this use.

2.3 GROUND WATER REMEDIAL SYSTEM

System Description

There are two ground water remediation systems installed:

- An onsite remediation system to contain and remediate the onsite plume
- An offsite interim action system to remediate the off-site plume

The onsite ground water remediation system was installed and began operation in December 1986. The system includes one extraction well referred to as the North Shallow Production (NSP) well, two air stripping towers in series, and discharge of treated water to two on-site ponds. In 1995, the system was modified to allow for effluent discharge to the plant process water system. The system flow rate is currently around 190 gpm with an influent TCE concentration of 25 to 30 ug/L in 2004.

The offsite interim action system is the focus of this RSE-lite. The history of that offsite interim action is summarized as follows:

- The interim action system began operation in February 1996 with single extraction well pumping at 1,000 gpm. The design influent TCE concentration was 660 ug/L. The influent ground water was treated with an air stripper tower to reach the design effluent TCE concentration of 3 ug/L. The treated ground water was then returned to the aquifer through two injection wells. The average extraction well pumping rate was reduced to 650 gpm by November 1997 due to frequent shutdowns resulting from decreased capacity of the injection wells.

- Based on recommendations documented in Groundwater Quality Survey (Phase 8) Report in July 1998, the single extraction well was abandoned and two new extraction wells (EW-1 and EW-2) were installed in December 1998 further downgradient to intercept higher TCE concentrations. The two extraction wells were pumped at 600 gpm each. The air stripping tower was modified to increase its hydraulic capacity and was also relocated approximately 1 mile north. The injection well was abandoned and a pipeline was constructed to discharge treated effluent to the Wood River. The modified system began operation in July 1999.

- Due to increased TCE concentrations near monitoring well S-24, more monitoring wells were installed and a direct push investigation was conducted in 2002. The results of the investigation indicated that the plume had shifted to the southeast and had migrated further downgradient. Extraction from EW-1 and EW-2 has largely been discontinued; the wells are only sporadically used. A new extraction well was installed (EW-4), and an existing irrigation well was converted into an extraction well (EW-3). During the irrigation season, the water extracted from EW-3 and EW-4 is used by a local farmer for irrigation. During the non-irrigation season, the extracted water is treated by the air stripper and discharged. The average pumping rates at EW-3 and EW-4, since August 2003, are 745 gpm and 450 gpm, respectively.

System Monitoring

The current monitoring program includes approximately 20 monitoring wells and process monitoring as follows:

- Approximately 20 monitoring wells are sampled on quarterly basis.
- The air stripping towers and extraction wells are sampled on monthly basis.
- Of the monitoring wells sampled quarterly, four are also sampled on a monthly basis to monitor plume change. These four wells are S-24, S-30, S-31, and S-32.
- Three samples (influent, between UV and GAC, and effluent) are collected from each of the POET systems once per year.

2.4 REMEDY GOALS

The interim goal of off-site remediation system is to prevent migration while the ultimate goal is to reduce TCE concentrations to MCLs.

2.5 COSTS

The costs to operate, maintain, and monitor the interim offsite system are approximately $85,690 per year, excluding project management and reporting costs. These costs also do not include capital costs associated with installation of additional monitoring wells or other non-routine costs. The remedy operates relatively consistently and automatically, requiring very little labor.

Cost Category	Approximate Annual Cost
Project management and reporting	Note Reported
Labor – recovery system O&M	$1,000
Labor – ground water sample collection	$5,000
Laboratory analysis	$35,690
Electrical costs	$10,000
Chemicals and materials*	$34,000
Total	**$85,690**

** Assumed to be "other direct costs" associated with the sampling program, such as equipment and materials*

3.0 RSE-LITE FINDINGS

In general, the RSE-lite team observed a conscientious site team that has adapted well to changing site conditions. The findings indicated below are not intended to suggest a deficiency in the remedy design, operation, or other actions of the site team. These findings are also not intended to suggest requirements for the site. Rather, they are the opinions of a third-party evaluation team and are only provided for consideration by the site team.

3.1 FINDINGS PERTAINING TO REMEDY PROTECTIVENESS

- The Phase 9 ground water quality survey, conducted in 2003, consisted of 18 direct-push ground water samples collected in a grid pattern, eight ground water samples from monitoring wells, and three soil gas samples. No TCE was detected in the soil gas samples. Subsequent to the RSE-lite call, the RPM indicated that EPA had informed the facility (in a letter dated January 9, 2003) that soil gas data would not be accepted as a demonstration that vapor intrusion poses no risk because even well designed soil gas studies have reportedly had limited success in accurately documenting such risks. The RPM also indicated that vapor intrusion is not an issue that needs additional evaluation as long as the existing P&T system is in place and no residences are built within the existing footprint of the plume but that additional evaluation of this potential receptor pathway might be required in the future if circumstances change. Under such circumstances, the RPM suggested that the facility might be able to invalidate vapor intrusion as a threat if the facility can show that samples collected from the top of the water table in the downgradient portion of the plume are contaminant-free (based upon the knowledge that contaminant concentrations generally increase with depth, likely in part due to precipitation recharge/dilution in the downgradient part of the plume).

- There are six private drinking wells located in the vicinity. All six private wells are located outside of the plume area. Four of them are screened in the deep aquifer where there is no impact from contamination, and two of them that were originally screened in the shallow aquifer have been replaced with wells in the deep aquifer. None of these residential wells have detectable TCE concentrations.

- EPA and NDEQ have noted that the extraction system has been modified twice to address changes in plume migration. In addition, the recent direct-push investigation conducted in February 2005 indicates the presence of contamination beyond the extraction system and further downgradient than where previous impacts had been detected. There is concern on behalf of EPA and NDEQ that the ground water flow in the region is not sufficiently understood and that additional changes might need to be made to control plume migration. EPA has suggested the use of numerical ground water modeling to assist with the migration control effort.

- The site team reports that access for additional monitoring wells downgradient of the extraction system is limited due to the use of the land for farming. Sampling in this area has therefore been accomplished through direct-push investigations and the use of temporary well points.

- The ground water monitoring event in January 2005 and the direct-push investigation conducted in February 2005 indicated that there is a significant decrease in concentrations since October/December 2002 and April 1998. The maximum TCE concentration during in April 1998 was 600 ug/L. By the October/December 2002 sampling the highest concentration was 110 ug/L, and by early 2005, the maximum concentration was 35.3 ug/L. The attached figure, prepared by the site contractor, compares the TCE plume interpreted based on 2002 and 2005 sampling results. Analytical results of selected monitoring wells and direct-push locations from the 1998, 2002, and 2005 sampling events are listed in the following table for comparison. A general decrease is observed, with order of magnitude decreases observed in multiple locations. In some locations, increases are observed, but this is attributable to plume migration upgradient of the current extraction network.

Sample ID	TCE in 1998 (ug/L)	TCE in 2002 (ug/L)	TCE in 2005 (ug/L)
S-9D	120	33	13.0
S-11D	1.4	22	9.2
S-12D	430	25	19.7
S-17D	3.2	20	6.0
S-21D	19	1.5	<0.5
S-24D	1.9	52	26.4
S-26D	600	18	14.0
S-27D	420	30	7.0
S-28D	1.3	95	29.8
S-30D	N/A	10	7.8
S-31D	N/A	ND	<0.5
S-32D	N/A	110	23.9
GS-102 (2002) / GS-216 (2005) [1]		18	0.5
GS-101 (2002) / GS-215 (2005) [1]		20	35.3
GS-104 (2002) / GS-214 (2005) [1]		18	11.4
GS-105 (2002) / GS-213 (2005) [1]		8	8.1
GS-108 (2002) / GS-202 (2005) [1]		7	3.6
GS-107 (2002) / GS-203 (2005) [1]		11	8.2
GS-109 (2002) / GS-204 (2005) [1]		8	0.7

Note:

1. The 2005 direct-push sample was collected near the 2002 direct-push sample.

- The direct-push investigation conducted in February 2005 indicated that TCE contamination is present downgradient of extraction wells EW-3 and EW-4 and downgradient of areas where TCE was previously observed in 2002. However, it is possible that this contamination was present before 2002 and before the installation of EW-3 and EW-4. For example, in December 2002, the furthest downgradient samples were collected from GS-107, GS-108, and GS-109 where TCE concentrations were 11 ug/L, 7 ug/L, and 8 ug/L, respectively. Therefore, the TCE concentrations that were observed downgradient of these locations in 2005 at GS-208 (5.1 ug/L) and GS-209 (7.6 ug/L) could have already been present. For this reason, the RSE-lite team does not believe that this downgradient contamination recently observed in 2005 is an indication of insufficient capture provided by EW-3 and EW-4. Furthermore, the concentrations are so close to the standard of 5 ug/L that additional remedial effort (e.g., additional pumping) in this area would likely provide a negligible improvement in remedy effectiveness.

- The RSE-lite team has reviewed the previous modeling efforts conducted by the site team and agree with the interpreted capture zones for EW-3 and EW-4. The actual capture zones may even be more extensive than those interpreted by the site team. The capture zones also appear to be sufficient to capture the core of the plume (S-28 northeast to GS-215), even if the ground water flow shifts directly to the east. The RSE-lite team also acknowledges that the ground water flow pattern has a history of shifting. However, predicting this shifting would be extremely difficult. Although numerical modeling could be used to simulate ground water flow, the RSE-Lite team believes that a numerical model would be difficult to calibrate given the transience of the system in the past. Accurately determining and representing historical irrigation pumping/infiltration rates will be difficult, as will be selecting appropriate water level targets for calibration. Furthermore, since future irrigation conditions will be variable and hard to predict, the results of scenario-based simulations will likely cover such a large range of possibilities that such simulations will be of little use from a management perspective. The site team may learn about the system through development of a numerical model, but the RSE-lite team believes that this benefit is likely not worth the cost at this time.

- The decreasing TCE concentrations downgradient of the facility suggests that containment and/or mass removal provided by the onsite remediation system has been effective. Continued decreases in the concentrations at S-9 and other wells downgradient of the facility will confirm that onsite pumping is providing sufficient capture/removal of onsite contamination.

3.2 FINDINGS PERTAINING TO COST-EFFECTIVENESS

The remedy appears to be operated cost-effectively. Based on the reported costs, the site team is running the treatment plant efficiently with little operator labor. The highest costs are in two categories: laboratory analysis and chemicals/materials.

- The laboratory analytical costs appear to be relatively high compared to the monitoring scope of work described in Section 2.3 of this report. The RSE-lite team estimates that analytical costs for the above-described monitoring scope of work should cost approximately $25,000 to $30,000. In addition, the monitoring program could likely be modified to reduce the number of samples collected without sacrificing protectiveness as discussed in Section 4.2 of this report.

3.3 FINDINGS PERTAINING TO REMEDY PROGRESS AND SITE CLOSURE

- No institutional control exists for the site. The facility has been tracking if new water supply wells are installed in the area.

- TCE concentrations have decreased by more than an order of magnitude over the past seven years, and the highest TCE concentration is less than one order of magnitude over the cleanup standard of 5 ug/L. The current site exit strategy is to attain MCLs in the downgradient part of the plume. There is no current strategy for potentially terminating ground water extraction at the downgradient extraction wells prior to attaining MCLs at all wells.

4.0 RSE-LITE RECOMMENDATIONS

4.1 RECOMMENDATIONS TO IMPROVE SYSTEM PROTECTIVENESS

4.1.1 Remove POETS from Residential Wells Along Pool Avenue but Sample Residential Wells South of EW-4 along 56th Road

Due to the migration of the plume to the east or southeast, the residential wells to the north no longer appear to be threatened by the plume. These residential wells are also likely deep enough to avoid being affected even if the plume were present in the unconfined aquifer immediately above these residential wells. As with the other residential wells in the area, these two private wells are sufficiently deep that they likely would not be receptors even if the plume were present in the unconfined aquifer immediately above them. The site team should, however, routinely (e.g., on an annual basis) sample the residential wells at the two properties south of EW-4 along 56th Road. This should not have a significant impact on annual costs associated with the remedy.

4.1.2 Develop Potentiometric Surface Maps

Water levels from site monitoring wells are routinely collected and presented in quarterly reports, but potentiometric surface maps are not routinely developed for inclusion in the report to illustrate the data. Given the concern of EPA and NDEQ regarding ground water flow patterns, it is recommended that the potentiometric surface maps be developed for each round of future water level measurements. To gain perspective on past ground water flow patterns, the site team should also consider developing potentiometric surface maps for previous rounds of water level measurements. The maps using historical data should provide the site team with an improved understanding of the potential seasonal changes in the water levels and the potential ground water flow patterns that changed the direction of plume migration. The future maps should help the site team better anticipate future plume movement. When developing these maps, the water levels from operating extraction wells should not be included as they may bias the interpretation.

Developing historic potentiometric surface maps (assuming quarterly data over 7 years), evaluating them for trends in the ground water flow pattern, and potentially discerning a reason for the change in plume direction would cost on the order of $10,000. Developing future potentiometric surface maps should add less than $500 per year to the current reporting costs. The resulting interpretation, however, may help the site team better anticipate and control plume migration for a reasonable cost. As mentioned above, the RSE-lite team does not believe that information gained from developing and using a numerical modeling for the site would be worth the cost at this time.

4.1.3 Conduct Limited Direct-Push Sampling Annually for Three Years

To evaluate plume capture, the site team should consider conducting limited direct-push sampling events on an annual basis for three years. The events should be limited to five locations (i.e., a one-day event) with sampling locations in the vicinity of GS-208, GS-209, and GS-210 plus GS-206 and GS-212. The data from the various events can be compared to determine if there is a consistent trend. A consistent increase in concentrations near GS-208 through GS-210 would suggest that capture is inadequate, and a consistent decrease would suggest that capture is adequate. Similarly, a consistent increase near GS-206 and GS-212 might suggest that the plume is migrating to the southeast. The potentiometric surface maps proposed in Section 4.1.2 of this report would help confirm this potential change in the migration direction.

Because consistent locations will be sampled, there is no need for using a mobile laboratory for field screening. For cost-effectiveness, the samples should just be sent to the laboratory for analysis.

Due to expected variability in sampling data, particularly data obtained from temporary wells, the site team should not make a decision on just one round of results. The RSE-lite team believes this is a cost-effective approach to monitoring plume migration. The estimated cost for each of these events is approximately $10,000, including oversight, drilling, sampling, and analysis; however, the RSE-lite team acknowledges that the site team has conducted direct-push sampling events at the site and would have a better understanding of the associated costs.

4.1.4 Continue to Evaluate Capture

The RSE-lite team believes it is likely that the plume is currently adequately captured, but the site team should continue to evaluate capture. The evaluation should be relatively straight forward and should likely include reviewing the potentiometric surface maps to determine the direction of ground water flow, reviewing concentration data from ground water monitoring and the recommended direct-push events, and use of a simple calculation to estimate width of capture. The site team could use Quickflow™ as they have in the past to evaluate capture, but it would likely be easier and more cost-effective to use the following simple calculation to estimate the approximate width of aquifer that will be captured upgradient of each extraction well.

$$w = \frac{Q}{K \times b \times i \times \ factor}$$

Where
- Q = pumping rate (ft^3 per day)
- K = hydraulic conductivity (ft per day)
- b = saturated aquifer thickness (feet)
- w = plume width (feet)
- i = horizontal hydraulic gradient (feet per foot)
- factor = assumed to be 1.5 for this site (accounts for other potential sources of water to the extraction well)

The approximate width of aquifer that will be captured at the line of the wells (in a direction perpendicular to ground water flow) will be one-half the capture zone width calculated upgradient of the extraction wells.

For example, using the following site-specific input parameters, the width of capture upgradient of EW-3 is approximately 2,400 feet (1,200 feet on each side of the well) and the width of capture upgradient of EW-4 is approximately 1,500 feet (750 feet on each side of the well). The width of capture immediately adjacent to EW-3 is approximately 1,200 feet (600 feet on each side of the well) and the width of capture immediately adjacent to EW-4 is approximately 750 feet (375 feet on each side of the well).

- Q = 143,400 ft^3 per day (745 gpm) for EW-3 and 88,630 ft^3 per day (450 gpm) for EW-4
- K = 1,000 feet per day
- B = 40 feet
- i = 0.001 feet per foot

Note that these types of calculations are simple, and aquifer heterogeneity and uncertainty with respect to input parameter values creates uncertainty in the results. For instance, the use of a "factor" of 1.5 to account for other potential sources of water to the extraction well is subject to significant uncertainty.

Given that the two extraction wells are 1,200 feet apart, this calculation suggests that the capture zones of the two wells likely overlap upgradient of the wells to create effective capture for the majority of the plume. However, the capture zones of the two wells may not overlap immediately adjacent to the wells. These results will also vary as extraction rates and ground water flow patterns change. Again, these calculations are simplistic in nature, are subject to significant uncertainty, and only provide one line of evidence that should be used with other lines of evidence in evaluating capture.

Many of the steps in conducting an improved capture zone analysis are already covered in preparing the potentiometric surface maps and conducting the direct push sampling (both recommended above) and preparing typical reports. Therefore, the cost associated with implementing this recommendation should be on the order of $500 per year in addition to current costs and the estimated costs for implementing the other recommendations.

4.2 RECOMMENDATIONS TO REDUCE SYSTEM COST

4.2.1 Reduce the Ground Water Sampling Frequency

The site team should discontinue monthly ground water sampling. The data likely provide little benefit beyond quarterly or even semi-annual sampling. The RSE-lite team suggests that the site team maintain the same monitoring wells in its ground water sampling program but reduce the sampling frequency from quarterly (monthly in some locations) to semi-annually at all locations. Sampling from the extraction wells could continue on quarterly basis. Making this adjustment should reduce both the sampling costs (labor, equipment, and materials) and the analytical costs. Assuming the sampling costs are $39,000 per year ($5,000 for labor and $34,000 for other costs), this recommended reduction should save approximately $10,000 to $15,000 per year in sampling costs. Assuming a cost of $100 for laboratory analysis of each sample, this recommended reduction should save approximately $10,000 in analytical costs. Therefore, by implementing this recommendation, the site team should save approximately $20,000 to $25,000 per year without sacrificing the effectiveness of the remedy or its monitoring program.

4.2.2 Reconsider Need for Two Air Strippers for Onsite Treatment

The onsite treatment system was not a focus of this RSE-lite; however, the RSE-lite team noticed that site documents suggest two air strippers are used in series to treat the water that is extracted onsite. Given the relatively low concentrations in that extracted water, the site team may want to determine if both air strippers are required. The site team might be able to save some electrical costs if the use of one of the onsite air strippers can be discontinued. An estimate of the potential savings associated with this recommendation is not provided because the RSE-lite team does not have the operating parameters for the onsite system.

4.3 RECOMMENDATIONS FOR TECHNICAL IMPROVEMENT

4.3.1 Revise Progress Reports

The site team should consider revising the frequency and format of the progress reports. First, it is recommended that reports be prepared on a semi-annual basis in conjunction with the suggested monitoring frequency. Second, the reports should present recent water level and water quality data in tables and figures. The figures should include potentiometric surface maps (see the above recommendation) and updated plume maps. The tables should include both current and historic water level and water quality data for each sampling location. This would make it easier for the site team and others reviewing the documents to notice trends in concentrations and water levels. Finally, because the data would be presented in tables and figures, the text could be used for interpreting the data rather than simply restating the data. Interpretation should be relatively limited but should focus on plume capture and progress toward restoration. Implementing this recommendation might require an additional $1,000 in capital costs to develop a template for the tables, but it is possible that these changes could be made within the existing project management and reporting budget, which was not reported as part of this process.

4.4 RECOMMENDATIONS TO SPEED SITE CLOSEOUT

4.4.1 Consider Possible Exit Strategy Alternatives for the Current P&T System

The TCE concentrations have decreased by an order of magnitude over the past 7 years and are now within one order of magnitude of the cleanup standard of 5 ug/L. As a result, pumping and treating ground water is having a diminishing effect on mass removal. The current site exit strategy is to attain MCLs in the downgradient part of the plume. There is no current strategy for potentially terminating ground water extraction at the downgradient extraction wells prior to attaining MCLs at all wells.

At this site, mitigating plume migration is a primary remediation objective. However, the RSE team believes that there is a potential for conditions to exist where the offsite plume is stable (i.e., will not expand beyond its current extent) with or without continued pumping at the offsite extraction wells, even though MCLs might be exceeded at some locations. For example, it is possible that, in the future, groundwater concentrations may exceed MCLs at some distance upgradient of the off-site extraction wells, but may be below MCLs at the extraction wells. In that case, some concentrations would remain above MCLs within the current plume footprint, but the extraction wells would not provide any benefit. The plume extent would be stable with or without continued extraction at those extraction wells.

The RSE-lite team recommends that site stakeholders consider that a set of conditions, such as the example presented above, may occur where it may be appropriate to discontinue pumping at offsite extraction wells even if MCLs are exceeded at some monitoring locations. The appropriateness of discontinuing pumping would likely require field data and transport modeling (analytical or numerical) that substantiate the stability of the plume extent due to dispersion, dilution, and any other factors.

The cost for the modeling effort, analysis, and documentation should be approximately $10,000. The appropriate field data might depend on the particular set of conditions and should be determined through discussions between EPA, NDEQ, and the facility. These discussions may require an additional $10,000 in consultant costs. If these efforts ultimately result in discontinuing pump and treat, it would save electrical costs, operator labor, and process sampling costs perhaps totaling $15,000 per year. The costs for ground water monitoring would likely remain for several years. Given the relatively low annual cost savings relative to the evaluation costs, the facility may wait for a set of site conditions where it is relatively easy and low cost to demonstrate plume stability.

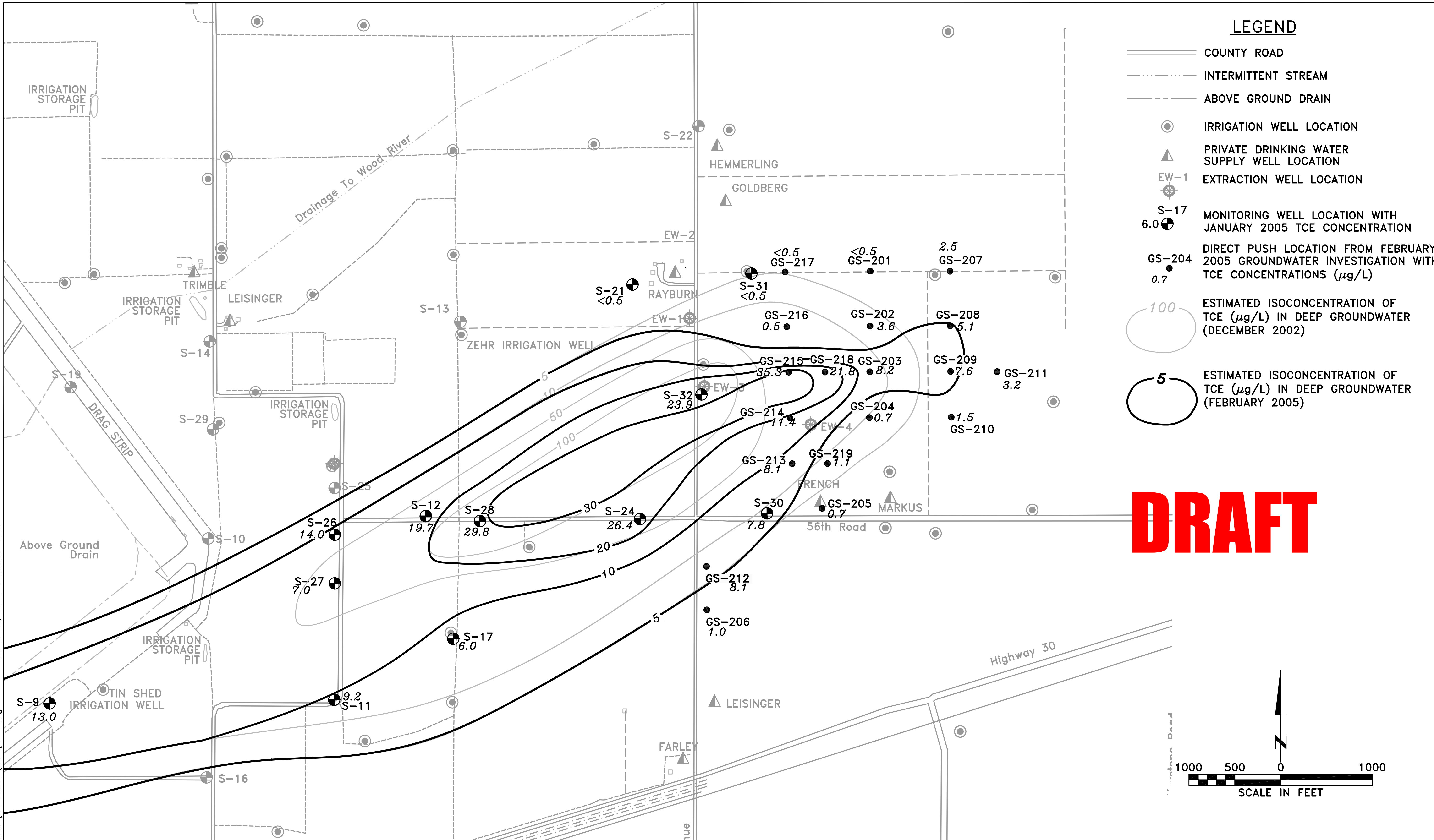
Cost Summary Table

Recommendation	Reason	Estimated Additional Capital Costs ($)	Estimated Change in Annual Costs ($/yr)
4.1.1 Remove POETS from Residential Wells Along Pool Avenue but Sample Residential Wells South of EW-4 along 56th Road	Effectiveness	<$1,000	(<$1,000)
4.1.2 Develop Potentiometric Surface Maps	Effectiveness	$10,000	$500
4.1.3 Conduct Limited Direct-Push Sampling Annually for Three Years	Effectiveness	$30,000	$0
4.1.4 Continue to Evaluate Capture	Effectiveness	$0	$500
4.2.1 Reduce the Ground Water Sampling Frequency	Cost Reduction	$0	($20,000 to $25,000)
4.2.2 Reconsider Need for Two Air Strippers for Onsite Treatment	Cost Reduction	Not quantified	Not quantified
4.3.1 Revise Progress Reports	Technical Improvement	$1,000	$0
4.4.1 Consider Possible Exit Strategy Alternatives for the Current P&T System	Site Closure	> $20,000	(Potentially $15,000 if P&T is Terminated in the future)

Costs in parentheses imply cost reductions.

FIGURES*

** Prepared by the site contractor and included for reference*



Job No. 16169881	URS	DIRECT PUSH SAMPLING LOCATIONS AND TCE PLUME	Figure 2-1
EATON	Direct Push Groundwater Investigation Eaton Corporation Kearney, Nebraska		

Drawing: T:\EATON\16169881\100\2-1.dwg March 25, 2005 11:18:27 a.m.