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DRAFT REMEDIAL INVESTIGATION REPORT ADDENDUM LIGHTER AMPHIBIOUS RESUPPLY CARGO (LARC) 60 MAINTENANCE AREA FORT STORY VA

8/1/2007

MALCOLM PIRNIE

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Draft Remedial Investigation Report Addendum

LARC 60 Maintenance Area

Sent by email from Malcolm Pirnie 8-9-07

August 2007

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Remedial Investigation Report Addendum

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Malcolm Pirnie, Inc. was contracted by the U.S. Army Corps of Engineers (USACE), Baltimore District to conduct a Remedial Investigation (RI) at the Lighter Amphibious Resupply Cargo (LARC) 60 Maintenance Area site at Fort Story, Virginia. The Final RI Report was completed in December 2002 and recommended a Feasibility Study to evaluate remedial alternatives for remediation of contaminated groundwater; however, several investigations have been conducted at the site since finalization of the RI Report which have changed the recommended future action for the site. This Addendum summarizes those investigations and subsequent revised conclusions and recommendations.

ES.1 INTRODUCTION

The specific purpose of this RI Addendum is to present the data that has been collected after completion of the Final RI Report and also present any revised conclusions and recommendations for further action at the site. Additional investigations conducted after submittal of the Final RI Report for the site include the following:

- 2003 Groundwater Monitoring Event
- 2003 Groundwater Pilot Scale Study
- 2004 Groundwater Monitoring Event
- 2007 Groundwater Monitoring Event

Site Description and History

A former 10,000-gallon underground storage tank (UST) was located at the north gate of the LARC 60 vehicle motor pool approximately 600 feet south of the wash rack area. This UST was installed in 1983 and used for waste oil and degreaser storage. Although James M. Montgomery, Inc.'s (JMM) April 1990 field visits to this area identified soil-stained zones around the UST, there are no reports of tanks failing or leaking documented. These soil-stained areas may have been caused by overfilling or spillage during use.

Previous Investigations

A summary of previous investigations conducted at this site is provided in the table below.

PREVIOUS INVESTIGATIONS		
Investigation	**Description**	**Results**
U.S. Army Environmental Hygiene Agency (June1987)	Health risk assessment of soil contamination.	No unacceptable human health threat exists to workers at the site.

PREVIOUS INVESTIGATIONS		
Investigation	**Description**	**Results**
James M. Montgomery (January 1992)	PA/SI conducted to determine presence of contamination at site.	Total petroleum hydrocarbons (TPH) and metals detected in soils. TPH and VOCs detected in groundwater.
ERC (September 1992)	UST Initial Abatement Measures Report prepared for UST and soils removal	10,000 gallon UST and associated petroleum-stained soils removed from excavation.
IT Corporation (November 1994)	Removal action conducted to remediate soils.	Treated TPH contaminated soils on site via bioremediation.
Environmental Technology (February 1995)	UST investigation with soil and groundwater samples collected.	Numerous VOCs and TPH were detected in groundwater.
Earth Technology (April 1995)	Collection of additional soils data in the former UST excavation area.	PID results indicated that petroleum contamination was present in the soil zone above the water table but below the former excavation depth.

ES.2 FIELD INVESTIGATION PROGRAM

2003 Groundwater Monitoring Event

To supplement the data gathered during previous investigations and to further refine the plume configuration for the pilot scale study, six additional monitoring wells were installed and developed at the site. Groundwater samples were collected from eight existing and six newly installed wells at the LARC 60 site. Samples were analyzed for TCL VOCs using Method 8260.

Groundwater Pilot Scale Study

A Pilot Study was conducted in 2004 to evaluate the effectiveness of in-situ chemical oxidation using sodium permanganate ($NaMnO_4$) for reducing the concentration of the VOCs in the groundwater in the former underground storage tank (UST) area of the site. The treatment area is located just north of the former UST Area. This area was chosen due to its relatively high concentrations of VOCs, the variety of contaminants detected, and its designation as the probable, former source for site contamination

2004 Groundwater Monitoring Event

A site-wide groundwater monitoring event was conducted in June and July 2004 to assess the

current VOC concentrations across the site after completion of the Groundwater Pilot Scale Study. The monitoring well samples were only analyzed for VOCs during this site-wide event which includes the collection and analysis of samples from 15 monitoring wells.

2007 Groundwater Monitoring Event

Malcolm Pirnie collected groundwater samples from six wells (MW-117, 6MW-5S, 6MW-3S, 6MW-7, 6MW-8, and 6MW-9) in May 2007 to assess the current groundwater quality at the site as it relates to VOC and polynuclear aromatic hydrocarbon (PAH) contamination.

ES.3 GROUNDWATER SAMPLING RESULTS

Numerous VOCs, as well as two PAHs (naphthalene and 2-methylnaphthalene), have been detected in wells at the site over the 12-year monitoring period. However, historically VOCs have only exceeded the MCL (or RBC when an MCL was not available) in four wells (MW-117, 6MW-3S, 6MW-7, and 6MW-9) at the site. The effects of the sodium permanganate injections on groundwater quality in the former source area is evident by the continued decrease in VOC concentrations in MW-117 which is located directly downgradient of the former source area where the injections took place. Historically, the most impacted downgradient well has been 6MW-3S with cis 1,2-DCE, PCE, TCE, and vinyl chloride exceeding the MCLs in the 2004 monitoring data. Although still detected in 2007, none of these compounds exceed their respective MCL. Monitoring well 6MW-9 is located directly downgradient of 6MW-3S but none of these compounds were detected in 2007.

Comment [a1]: They were not detected in the wells mentioned in that sentence or all wells? This is a little unclear.

ES.4 CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Human Health Risk

The potential for future development of the land as commercial, residential, or recreational properties is not expected as the installation will remain open and the area will continue to be identified as industrial usage. It is expected that the land will continue to be used for industrial purposes and that groundwater will continue not to be utilized. If land use conditions change in the future, possible exposure scenarios (e.g., residential exposure to soil and groundwater if residential development was planned) will be re-evaluated. This conclusion is a revision from the text provided in the baseline human health risk assessment presented in the Final RI Report for the site. Based on guidance provided by the USAEC, unless residential development is expected or planned in the future for an installation, the residential land use scenario will not be evaluated for future land use conditions.

Because potential risk was only identified for the future scenario of residential development at the site during the RI, based on this policy change, no human health risk has been identified for the LARC 60 site.

Ecological Risk

As presented in the Final RI Report, ecologically, much of the site provides little value to wildlife for foraging or nesting habitat. Therefore, the risks to wildlife associated with the ongoing activities at the LARC 60 Maintenance Area are considered low.

Groundwater Contamination

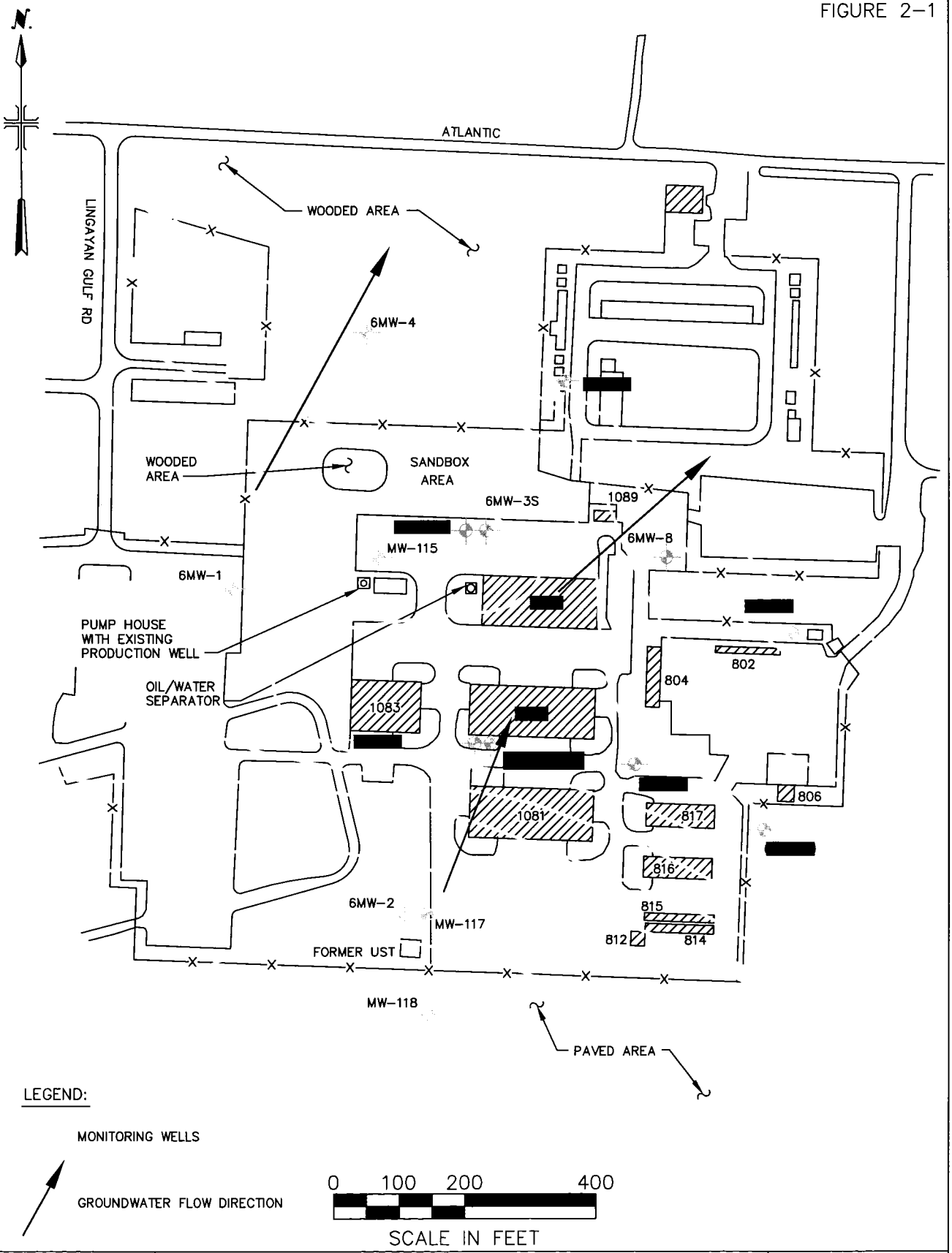
Numerous VOCs, as well as two PAHs (naphthalene and 2-methylnaphthalene), have been detected in wells at the site over the 12-year monitoring period but few exceedences of the MCLs over this period have been noted primarily in two wells: (1) MW-117 which is located downgradient of the former source area and (2) 6MW-3S which is located further downgradient of the former source area.

Sodium permanganate injections impacted groundwater quality in the former source area and is evident by the continued decrease in VOC concentrations in MW-117 which is located directly downgradient where the injections took place. Decreasing trends downgradient of the former source area have also been noted.

Recommendations

Other than preparation of a Decision Document, **no further action** is recommended for the LARC 60 site based on the limited contamination detected in site groundwater and that no human health or ecological risks were identified.

FIGURE 2-1



MALCOLM PIRNIE

FORT STORY, VIRGINIA
RI REPORT ADDENDUM
LARC 60 MAINTENANCE AREA
MONITORING WELL LOCATIONS

MALCOLM PIRNIE, INC.

JULY 2007

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Malcolm Pirnie, Inc. was contracted by the U.S. Army Corps of Engineers (USACE), Baltimore District to conduct a Remedial Investigation (RI) at the Lighter Amphibious Resupply Cargo (LARC) 60 Maintenance Area site at Fort Story, Virginia. The Final RI Report was completed in December 2002 and recommended a Feasibility Study to evaluate remedial alternatives for remediation of groundwater contaminated with chlorinated volatile organic compounds (VOCs) underlying the LARC 60 site; however, several investigations (three groundwater monitoring events and a Groundwater Pilot Scale Study) have been conducted at the site since finalization of the RI Report which have changed the recommended future action for the site. This Addendum summarizes those investigations and subsequent revised conclusions and recommendations.

Benzene, ethylbenzene, toluene, and xylenes (BTEX), methyl isobutyl ketone (MIBK), 2-methylnaphthalene, naphthalene, tetrachloroethene (PCE), trichloroethene (TCE), cis 1,2-dichloroethene (cis 1,2-DCE), and vinyl chloride were detected in groundwater above EPA risk screening criteria (EPA Region III Risk-Based Concentrations [RBCs] and/or EPA Maximum Contaminant Levels [MCLs]) during the RI.

1.1 PURPOSE OF REPORT

The work was conducted under the requirements of the Department of Defense (DOD) Installation Restoration Program (IRP) that are consistent with the U.S. Environmental Protection Agency (EPA) guidelines. The EPA guidelines followed during the RI are set forth in "Guidance on Remedial Investigations and Feasibility Studies under CERCLA" (EPA, 1988). All work was conducted in accordance with the Scopes of Services developed by the USACE.

The activities in the RI and this Addendum are geared towards collecting the information necessary to evaluate the type and magnitude of contamination as well as the transport mechanisms and impacts of contamination on various media such as groundwater and soil. The specific objectives of the RI were:

- Delineation of the nature and extent of contamination
- Evaluation of potential migration of contaminants
- Assessment of risks to human health and the environment
- Development of recommendations for future action based on the findings

The specific purpose of this RI Addendum is to present the data that has been collected after completion of the Final RI Report and also present any revised conclusions and recommendations for further action at the site. Additional investigations conducted after submittal of the Final RI Report for the site include the following:

- 2003 Groundwater Monitoring Event
- 2003 Pilot Scale Study

- 2004 Groundwater Monitoring Event
- 2007 Groundwater Monitoring Event

1.2 BACKGROUND

1.2.1 Site Description and History

The LARC 60 Maintenance Area, which is the maintenance and wash rack area for LARC 60 vehicles, is located in the sand flat area that lies between the coastal dune complex to the north and the central sand ridge to the south. The LARC 60 area includes Buildings 1081, 1082, 1083 and 1084. During the 1950s, the wash rack area was first used as the barge amphibious resupply cargo (BARC) motor pool and maintenance facility. In 1964, the BARC vehicle was phased out and the LARC 60 vehicle was prototyped. Presently, Fort Story is the only base on the East Coast available to the Army Transportation Corps for amphibious training. In 1982, the LARC 60 facility was modified with the construction of a concrete wash rack pad. Approximately 39 catch basins are located through the LARC 60 site, which are used for collection of storm and wash water. Heavy equipment is currently stored awaiting maintenance and operated on the concrete wash rack and Sandbox Area.

A former 10,000-gallon underground storage tank (UST) was located at the north gate of the LARC 60 vehicle motor pool approximately 600 feet south of the wash rack area. This UST was installed in 1983 and used for waste oil and degreaser storage. Although James M. Montgomery, Inc.'s (JMM) April 1990 field visits to this area identified soil-stained zones around the UST, there are no reports of tanks failing or leaking documented. These soil-stained areas may have been caused by overfilling or spillage during use. In 1987, the U.S. Army Environmental Hygiene Agency sampled the UST and found it contained oil, water, 1,1,1-trichloroethane and chromium. In September 1992, the Environmental Restoration Company (ERC) removed the waste oil UST and excavated a large volume of petroleum-stained soils.

1.2.2 Previous Investigations

A summary of previous investigations conducted at this site is provided in the table below.

PREVIOUS INVESTIGATIONS		
Investigation	**Description**	**Results**
U.S. Army Environmental Hygiene Agency (June1987)	Health risk assessment of soil contamination.	No unacceptable human health threat exists to workers at the site.

PREVIOUS INVESTIGATIONS		
Investigation	**Description**	**Results**
James M. Montgomery (January 1992)	PA/SI conducted to determine presence of contamination at site.	Total petroleum hydrocarbons (TPH) and metals detected in soils. TPH and VOCs detected in groundwater.
ERC (September 1992)	UST Initial Abatement Measures Report prepared for UST and soils removal	10,000 gallon UST and associated petroleum-stained soils removed from excavation.
IT Corporation (November 1994)	Removal action conducted to remediate soils.	Treated TPH contaminated soils on site via bioremediation.
Environmental Technology (February 1995)	UST investigation with soil and groundwater samples collected.	Numerous VOCs and TPH were detected in groundwater.
Earth Technology (April 1995)	Collection of additional soils data in the former UST excavation area.	PID results indicated that petroleum contamination was present in the soil zone above the water table but below the former excavation depth.

U.S. Army Environmental Hygiene Agency Risk Assessment

The U.S. Army Environmental Hygiene Agency (USAEHA) conducted a Health Risk Assessment in June 1987 at the LARC 60 Maintenance Area to determine if an unacceptable health threat exists to workers at the site. USAEHA detected grease, oil, lead and chromium in soil north of the wash rack (Sandbox Area). For the contaminants, the excess, upper bound, lifetime cancer risk estimate calculated was within the range considered acceptable to the EPA. In addition, the hazard index derived was less than one, indicating that non-carcinogenic health effects would not be expected. Based on the quantitative risk assessment, USAEHA concluded that an unacceptable human health threat does not exist to workers at the site.

James M. Montgomery, Inc. (JMM) Preliminary Assessment/Site Investigation

Preliminary Assessment/Site Investigation (PA/SI) activities were conducted in 1991 and 1992 by James M. Montgomery, Inc. (JMM, 1992). JMM conducted the PA/SI to determine the presence of significant contamination at eight sites including the LARC 60 Maintenance Area.

At the facility, several analytes were detected in the soil at levels above the trigger levels. The site has two main areas of possible environmental concern: the wash rack area, which has an oil/water separator, and the former UST area. Total fuel hydrocarbons, copper, zinc, and lead were detected above trigger levels at the site.

As with soil samples, numerous analytes were detected in groundwater above trigger levels at the wash rack and UST areas. Benzene, vinyl chloride, total fuel hydrocarbons, and 1,1-DCE were detected above trigger levels.

A Remedial Investigation/Feasibility Study (RI/FS) was recommended at the LARC 60 Maintenance Area and three other sites.

ERC Initial Abatement Measures Study

On September 28, 1992, ERC removed one 10,000 gallon UST that contained waste oil from Building 1081. Based on the report, the removal of the UST resulted in an excavation depth of approximately 12.5 feet below land surface (BLS). The initial excavation was reported to be to a depth of 9.5 feet BLS with an additional three feet of petroleum-contaminated soil removed. According to the report, the stained soils were placed back into the excavation.

Three grab samples were collected by ERC personnel from the bottom of the excavation while one composite soil sample was collected from the staged soils. These soil samples were analyzed for total petroleum hydrocarbons (TPH) by EPA Method 418.1. TPH concentrations in the samples from the bottom of the excavation ranged from 36,353 to 62,823 milligrams per kilogram (mg/kg) while the composite samples from the stage soil pile had a TPH concentration of 12,173 mg/kg.

IT Corporation Removal Action

IT Corporation (IT, 1994) conducted several rapid response removal actions at Fort Story in 1994, including the LARC 60 Maintenance Area. IT Corporation reported that the following activities were performed at the site:

- Disposal off-site of two piles of soil believed to contain F-listed solvents.
- Designed and installed an in situ bioremediation system for the treatment of TPH-contaminated soils.
- Excavated and treated soil within the LARC 60 Sandbox to a TPH level of less than 50 parts per million (ppm). The soils were transferred to the bioremediation system for treatment.
- Placed remediated soils back in the excavated area. However, due to the presence of heavy oils and greases in the soils, the 50 ppm treatment goal could not be reached with the bioremediation process. TPH concentrations remaining in treated soils ranged from non-detect to 4,800 ppm with an average concentration of 229 ppm (by Method 8015) and 751 ppm (by USEPA Method 418.1) remaining in soils.

Environmental Technology of North America, Inc., UST Investigation

In February 1995, Environmental Technology of North America, Inc. (ETI) through a USACE, Norfolk District contract, collected soil and groundwater samples by direct push technology (DPT) from the former UST pit at the southern end of the site to determine groundwater quality in that location. TPH, toluene, ethylbenzene and xylene were detected in soils from the pit and from stockpiled soils. Numerous chlorinated organics were detected in the groundwater sample including TPH (180 mg/l), tetrachloroethene (2,700 *ug/l*), trichloroethene (8,800 *ug/l*), and cis 1,2-dichloroethene (5,200 *ug/l*).

Earth Technology Data Collection

Based on continuing issues with the data provided in the ERC Initial Abatement Measures study report, VDEQ requested additional information and clarification. The ERC report indicated that an excavation 9.5 feet BLS was observed after the tank removal followed by an additional three feet of petroleum-stained soils removed from the bottom and the sides of the excavation. According to ERC's report, the excavation was then backfilled with the contaminated soil. Based on this information, VDEQ requested sampling of the backfill soils. Upon mobilization to the site and performance of the field activities, Earth Tech made the following observations:

- The excavated pit had been backfilled with clean sand, lithologically different from the native material.
- The depth of the excavation did not extend beyond 9.5 feet BLS.
- Soil from the original excavation activities were stockpiled adjacent to the excavation and not placed back into the excavation.

Earth Tech collected soil samples from the backfill material and the native soils underlying the backfilled soils. Field observations of the underlying soil material indicated higher photoionization detector (PID) readings than those in the backfill material, but showed no evidence of fuel-saturated soils or free product. Based on the data collection effort, no additional excavation of material was warranted from the former UST excavation area.

1.3 RISK ASSESSMENT SUMMARY

Human Health Risk Assessment Revision

No adverse exposures to chemicals of potential concern are anticipated for Fort Story personnel or trespassers in the current situation. This is the case for cancer and non-cancer risks in all media types.

Based on master planning issues for Fort Story which does not include base closure (most recent BRAC did not include Fort Story as a potential candidate), as well as its unique location and

subsequent training environs, the facility is expected to remain government property. The potential for future development of the land as commercial, residential, or recreational properties is not expected as the installation will remain open and the area will continued to identified as industrial usage; therefore, the future land use will be the same as the current land use. If land use conditions change in the future, possible exposure scenarios (e.g., residential exposure to soils and groundwater if residential development was planned) will be re-evaluated. This conclusion is a revision from the text provided in the baseline human health risk assessment presented in the Final RI Report for the site. Based on guidance provided by the U.S. Army Environmental Command (USAEC), unless residential development is expected or planned in the future for an installation, the residential land use scenario will not be evaluated for future land use conditions.

Because potential risk was only identified for the future scenario of residential development at the site during the RI, based on this policy change, no human health risk has been identified for the LARC 60 site.

Ecological Risk Assessment

It was recommended in the Ecological Risk Assessment (ERA) presented in the Final RI Report that no further investigation of ecological risk be conducted for the site. Ecologically, much of the site provides little value to wildlife for foraging or nesting habitat. Therefore, the risks to wildlife associated with the ongoing activities at the LARC 60 Maintenance Area are considered low.

This section documents specific field investigation programs conducted after finalization of the RI Report in December 2002. Three groundwater monitoring events, as well as a Groundwater Pilot Scale Study, have been conducted since the RI Report was finalized. A summary of each of these investigations is presented below in chronological order.

2.1 2003 GROUNDWATER MONITORING EVENT

Malcolm Pirnie, Inc. was contracted by the USACE Baltimore District to install additional wells and conduct additional groundwater monitoring in support of an upcoming Groundwater Pilot Scale Study at the site under Contract DACA31-00-D-0043.

Benzene, ethylbenzene, toluene, methyl isobutyl ketone (MIBK), 2-methylnaphthalene, naphthalene, tetrachloroethene (PCE), trichloroethene (TCE), cis 1,2-dichloroethene (cis 1,2-DCE), and vinyl chloride were detected in groundwater above EPA risk screening criteria (EPA Region III Risk-Based Concentrations [RBCs] and/or EPA Maximum Contaminant Levels [MCLs]) during the RI. To assist in the planned Groundwater Pilot Scale Studyfor the groundwater at the site and to further refine the plume configuration at the site, the installation and sampling of additional monitoring wells was required.

2.1.1 Investigation Program

Investigation Methodologies

The investigation methodologies for monitoring well installation, decontamination, and site restoration were described in the previously approved Field Investigation Plan, dated December 1994 and were utilized for this investigation. Procedures for monitoring well sampling (all wells have QED well pumps) utilized in this investigation were described in Section 1.4.1 of the *Final Work Plan Addendum, Groundwater Investigations, Treatability/Feasibility Study*, dated December 2002, which was reviewed and approved by VDEQ.

Monitoring Well Installations

To supplement the data gathered during previous investigations and to further refine the plume configuration for the TS, six additional monitoring wells were installed and developed at the site. The wells were installed at the following locations:

- Cluster wells (one shallow and one deep) (6MW-5S and 6MW-5D) were installed approximately 300 feet downgradient of the former UST location.
- One well (6MW-6) was installed approximately 200 feet west of the cluster wells.
- One well (6MW-7) was installed approximately 200 feet east of the cluster wells.
- One well (6MW-8) was installed approximately 300 feet east of the cluster wells 6MW-3S and

6MW-3D.

- One well (6MW-9) was installed approximately 300 feet downgradient (north) of the cluster wells 6MW-3S and 6MW-3D.

The location of each well (new and existing) is presented on **Figure 2-1.**

Each well has a 10-foot screened interval with one foot of the screened interval set above the water table interface. The depth to water across the site was approximately 2.5 to 8 feet below land surface. The deep well (6MW-5D) was screened at a depth of 30 to 40 feet below land surface to assess any vertical migration of contaminants. This is the approximate depth that the other two existing deeper wells (6MW-2 and 6MW-3D) are screened.

Groundwater Sampling

Prior to sampling activities, QED Ferret well pumps were installed for the six new wells. Groundwater samples were collected from eight existing and six newly installed wells at the LARC 60 site. The locations of these monitoring wells are provided on **Figure 2-1**. Samples were analyzed for TCL VOCs using Method 8260.

2.2 GROUNDWATER PILOT SCALE STUDY

2.2.1 Background

To support a planned Feasibility Study, Malcolm Pirnie, Inc. was contracted by the USACE Baltimore District to conduct a Groundwater Pilot Study at the LARC 60 Maintenance Area site at Fort Story, Virginia under Contract DACA31-00-D-0043.

The Pilot Study was conducted to evaluate the effectiveness of in-situ chemical oxidation using sodium permanganate ($NaMnO_4$) for reducing the concentration of the VOCs in the groundwater in the former underground storage tank (UST) area of the site. The treatment area is located just north of the former UST Area. This area was chosen due to its relatively high concentrations of VOCs, the variety of contaminants detected, and its designation as the probable, former source for site contamination.

This Pilot Study was conducted in accordance with the *Work Plan Addendum, Treatability Study, LARC 60 Maintenance Area, Fort Story,* dated May 2003 prepared by Malcolm Pirnie. The goals of the Pilot Study were as follows:

- Gather data to evaluate the effectiveness of chemical oxidation using a permanganate compound (sodium or potassium) as a remedial technology at the site.

- Gather data on contaminant rebound within the study area.
- Gather data to evaluate the effectiveness of chemical oxidant delivery via direct push methods.
- Provide initial steps toward remediating groundwater by reducing levels of VOCs in the test area.
- Quantify (via groundwater sampling) post-injection contaminant concentrations including any rebound effects.
- Quantify oxidant quantity for full-scale implementation of chemical oxidation.

2.2.2 Pilot Study $NaMn0_4$ Injections

The Pilot Study consisted of two phases of $NaMnO_4$ solution application. The methods followed and results obtained for each phase are described in detail in the following sections.

Malcolm Pirnie contracted with In-Situ Oxidative Technologies, Inc. (ISOTEC) to perform the $NaMnO_4$ injections throughout the course of the Pilot Study. $NaMnO_4$ exists as either a fine powder that is dissolved in water prior to injection or liquid concentrate available in higher concentrations. Liquid concentrate was used for both injection events at the site. NaMnO4 was selected over $KMnO_4$ because a slightly higher solubility rate in water and is slightly more stable. ISOTEC used a recirculating mixer assembly to mix the $NaMnO_4$ with potable water obtained from a nearby fire hydrant. Although the Pilot Work Plan Addendum specified using 34 pounds of permanganate, this applied to the amount of potassium permanganate that would have been used. Since $NaMnO_4$ was used instead, an equivalent $NaMnO_4$ dose equal to 110 pounds (lbs) per point was utilized. Therefore, 110 lbs (approximate 1% solution) of $NaMnO_4$ solution per point for both injections events was planned. However, due to the need for a higher dose for the second event (based on groundwater data after the 1st injection), approximately 550 lbs (8% solution) per point was injected during the 2nd event.

Specific information and photographs related to each injection event is presented in the *Groundwater Pilot Study Report*, dated November 2004, provided in **Appendix A**.

2.2.3 Pilot Scale Monitoring

1st Injection Event Monitoring

Groundwater samples were collected from several monitoring wells and injection points prior to the 1st injection event at the site. In addition, a saturated soil sample was collected to assess the extent of sorbed contamination in the treatment area. A summary of these monitoring events is presented below.

Pre-Injection Monitoring Well Sampling

A temporary monitoring well (TW-01) was constructed approximately 60 feet downgradient of the injection points to monitor impacts of the sodium permanganate injections over a period of time after completion of the injections. Prior to the injection events, this well was sampled and analyzed for iron, chlorides, total organic carbon (TOC), diesel and gasoline range petroleum-related organics (TPH DRO and TPH GRO), and VOCs. The other downgradient well (MW-117) was sampled for iron, chlorides, and VOCs. Both wells were sampled on July 25, 2003.

Pre-Injection Saturated Soil Sampling

A saturated soil sample was collected on July 25, 2003 during the installation of TW-01 to assess the extent of any sorbed contamination in the treatment area. The soil sample was analyzed for TOC, TPH DRO, TPH GRO, and VOCs.

Injection Point Monitoring

Prior to the 1st injection event, samples were collected from five injection points and analyzed for chloride, ferrous iron, and field parameters (i.e., temperature, specific conductivity, turbidity, pH, and dissolved oxygen (DO)).

2nd Injection Monitoring

Prior to the 2nd injection event, samples were collected from five injection points and analyzed for chloride, ferrous iron, and field parameters (i.e., temperature, specific conductivity, turbidity, pH, and dissolved oxygen (DO)).

Rebound Monitoring

It was anticipated that after the injections ceased, $NaMnO_4$ concentrations would gradually diminish to below detection and VOC concentrations would gradually rise from below detection to detectable values. This rebound in VOC concentrations is due to reverse diffusion and cross flow that can transport VOCs into the treated zone from any untreated zones. Rebound monitoring was conducted to monitor the rate of $NaMnO_4$ dissipation, iron and chloride concentrations, and subsequent VOC concentration rebound.

A summary of the rebound monitoring data after each injection event is provided below.

Rebound Monitoring – 1st Injection Event

Rebound monitoring was started immediately after the end of the 1st injection event through the

collection of water samples from MW-117 and TW-01 weekly (for 6 weeks) for iron, chloride, $NaMnO_4$ presence observation, and field parameters (i.e., temperature, specific conductivity, turbidity, pH, and DO). On the 6th weekly monitoring event, the wells and the saturated soils were also sampled and analyzed for TPH-DRO, TOC, and VOCs.

Rebound Monitoring – 2nd Injection Event

Rebound monitoring was started immediately after the end of the 2nd injection event through the collection of water samples from MW-117 and TW-01 weekly (for 4 weeks) for iron, chloride, $NaMnO_4$ presence observation, and field parameters (i.e., temperature, specific conductivity, turbidity, pH, and DO). Weekly sampling was discontinued after the 4th week because permanganate was not observed in the well during that event. On the 5th weekly monitoring event, MW-117 was only sampled and analyzed for VOCs and the field parameters. Due to lack of sorbed-phase contamination in the treatment area as indicated in the rebound monitoring conducted after the 1st injection event, no additional saturated soils were collected after the 2nd injection event.

2.3 2004 GROUNDWATER MONITORING EVENT

Malcolm Pirnie, Inc. was contracted by the USACE Baltimore District to conduct additional groundwater monitoring in support of the Groundwater Pilot Scale Study. In addition to the rebound monitoring conducted at MW-117 and TW-01 within the treatment zone of the pilot study, a site-wide groundwater monitoring event was conducted in June and July 2004 to assess the current VOC concentrations across the site after completion of the Groundwater Pilot Scale Study. The monitoring well samples were only analyzed for VOCs during this site-wide event which includes the collection and analysis of samples from 15 monitoring wells. The samples were collected through use of dedicated QED well pumps.

2.4 2007 GROUNDWATER MONITORING EVENT

Malcolm Pirnie collected groundwater samples from six wells (MW-117, 6MW-5S, 6MW-3S, 6MW-7, 6MW-8, and 6MW-9) in 2007 to assess the current groundwater quality at the site as it relates to VOC and polynuclear aromatic hydrocarbon (PAH) contamination. The samples were collected through use of dedicated QED well pumps. The monitoring event was conducted to assess the nature of residual VOC and PAH contamination several years after completion of the Groundwater Pilot Scale Study which remediated contamination within the source area of the site.

The above referenced wells were selected for the following reasons:

- MW-117: This well was located directly downgradient of the former source area and cis 1,2-DCE, PCE, TCE, and vinyl chloride have been detected above MCLs.

- 6MW-3S: This well was located downgradient of the former source area with cis 1,2-DCE, PCE, TCE, and vinyl chloride detects above MCLs.

- 6MW-7: This well was located downgradient of the former source area with one detect of PCE above the MCL.

- 6MW-5S, 6MW-8, and 6MW-9: These wells were located downgradient of the former source area with no detects above the MCLs but migration in these areas may have occurred over the past several years.

Three groundwater monitoring sampling events, as well as a Groundwater Pilot Scale Study, were conducted since the RI Report was finalized. A summary of the groundwater results associated with each of these investigations is presented below in chronological order.

3.1 GROUNDWATER MONITORING DATA

3.1.1 2003 Groundwater Monitoring Data

As part of the investigations to further refine plume configuration, groundwater samples were collected from 14 monitoring wells and analyzed for VOCs. VOC results for the groundwater samples are provided in **Table 3-1**. Numerous VOCs were detected in the samples. A summary of concentration ranges, detection frequencies, and comparison to EPA MCLs is provided in the following table:

VOC	Range	Detection Frequency	Frequency above EPA MCL
Acetone	4.0 to 32.0	4 / 14	---
Benzene	0.1 to 0.6	3 / 14	0 / 14
Chlorobenzene	0.3 to 9.0	2 / 14	0 / 14
Cyclohexane	15.0	1 / 14	---
1,2-Dichlorobenzene	0.2	2 / 14	0 / 14
1,3-Dichlorobenzene	0.5	1 / 14	---
1,4-Dichlorobenzene	0.2 to 1.0	9 / 14	0 / 14
Cis 1,2-DCE	1.0 to 22.0	2 / 14	0 / 14
Ethylbenzene	29.0	1 / 14	0 / 14
Isopropylbenzene	12.0	1 / 14	---
Methylene chloride	0. 2 to 0.3	6 / 14	0 / 14
Methylcyclohexane	26.0	1 / 14	---
PCE	0.4 – 11.0	3 / 14	1 / 14
Toluene	0.4 – 1.0	14 / 14	0 / 14
1,2,4-Trichlorobenzene	0.3	1 / 14	0 / 14
TCE	0.5 to 1.0	3 / 14	0 / 14
Vinyl chloride	1.0	1 / 14	0 / 14
Xylenes	130.0	1 / 14	0 / 14

PCE was the only VOC detected above EPA MCLs and it was detected above the 5 µg/L MCL in only one well (6MW-7). The analytical data sheets for this monitoring event are provided in **Appendix B**.

3.1.2 Groundwater Pilot Scale Study Data

The monitoring associated with the Groundwater Pilot Scale Study was conducted to assess the effectiveness of the sodium permanganate injections at the site near the source area (former UST) rather than to assess VOC contamination on a site-wide basis. A summary of the monitoring associated with the Pilot Scale Study is presented in the *Groundwater Pilot Study Report* provided in **Appendix A**.

3.1.3 2004 Groundwater Monitoring Data

The groundwater monitoring was conducted in 2004 to assess, on a site-wide basis, the extent of VOC contamination fully one year after completion of the Groundwater Pilot Scale Study to see if concentrations were decreasing based on the injection of sodium permanganate into the subsurface at the former source area. As shown in **Table 3-1**, numerous VOCs were detected throughout the site. A summary of the VOC detects is presented in the following table:

VOC	Range	Detection Frequency	Frequency above EPA MCL
Acetone	2.9 to 270	6 / 14	---
Bromodichloromethane	0.83	1 / 14	0 / 14
2-Butanone (MEK)	1.5 to 21	4 / 14	0 / 14
Carbon disulfide	0.22 to 0.83	2 / 14	0 / 14
Chloroform	3.3	1 / 14	0 / 14
Cyclohexane	2.7	1 / 14	---
Dibromochloromethane	0.12	1 / 14	0 / 14
1,2-Dichlorobenzene	0.16	1 / 14	0 / 14
1,1-Dichloroethane	0.34	1 / 14	---
1,1-DCE	1.3	1 / 14	0 / 14
Cis 1,2-DCE	0.15 to 100	6 / 14	1 / 14
Trans 1,2-DCE	0.25 to 0.87	2 / 14	0 / 14
Ethylbenzene	6.8	1 / 14	0 / 14
Isopropylbenzene	6.2	1 / 14	---

VOC	Range	Detection Frequency	Frequency above EPA MCL
Methylene chloride	0. 14 to 3.3	9 / 14	0 / 14
Methylcyclohexane	16.0	1 / 14	---
MIBK	4	1 / 14	---
PCE	0.49 to 62	4 / 14	1 / 14
Styrene	0.12	1 / 14	0 / 14
Toluene	0.10 – 0.42	8 / 14	0 / 14
1,2,4-Trichlorobenzene	0.15	1 / 14	0 / 14
TCE	0.1 to 140	4 / 14	1 / 14
Vinyl chloride	0.2 to 9.7	2 / 14	1 / 14
Xylenes	65.0	1 / 14	0 / 14

VOCs exceeded EPA MCLs in only one well (6MW-3S) with cis 1,2-DCE, PCE, TCE, and vinyl chloride exceeding their respective MCLs. The analytical data sheets for this monitoring event are provided in the Groundwater Pilot Study Report presented in **Appendix A.**

3.1.4 2007 Groundwater Monitoring Data

To continue to evaluate the extent of groundwater contamination at the LARC 60 site, groundwater samples were collected from all wells where previous detects above the EPA MCLs had been noted. The purpose of the monitoring event was a continued assessment of the nature of residual VOC and PAH contamination several years after completion of the Groundwater Pilot Scale Study which remediated contamination within the source area of the site.

As shown in **Table 3-1**, numerous VOCs were detected throughout the site. A summary of the VOC detects is presented in the following table:

VOC	Range	Detection Frequency	Frequency above EPA MCL
Acetone	2.0 to 4.5	6 / 6	---
Benzene	0.12 to 0.24	6 / 6	0 / 6
Carbon disulfide	0.11 to 3.5	4 / 6	0 / 6

VOC	Range	Detection Frequency	Frequency above EPA MCL
Cyclohexane	0.16 to 0.51	6 / 6	---
Cis 1,2-DCE	0.88 to 2	2 / 6	0 / 6
Ethylbenzene	0.11 to 1.4	2 / 6	0 / 6
Methylene chloride	0.16	1 / 6	0 / 6
Methylcyclohexane	8.1	1 / 6	---
PCE	0.33 to 1.3	2 / 6	0 / 6
TCE	1.9	1 / 6	0 / 6
Xylenes	13.0	1 / 6	0 / 6

Although as presented above, VOCs continue to be detected at the site; however, no VOCs exceeded EPA MCLs in any of the six wells sampled in 2007.

Due to the noted presence of naphthalene and 2-methylnaphthalene above the EPA RBCs for tap water during the RI sampling event, PAHs were analyzed as well during this monitoring event. Naphthalene and 2-methylnaphthalene were only detected in one well (MW-117) during this monitoring event at concentrations of 5.1 and 5.3 µg/L, respectively. Although no EPA MCL has been established for these two compounds, their concentrations are below the EPA RBCs for tap water of 24 µg/L for 2-methylnaphthalene and 6.5 µg/L for naphthalene. The naphthalene detect of 5.3 µg/L is also less than the EPA lifetime health advisory of 100 µg/L. No such advisory has been established for 2-methylnaphthalene. The analytical data for this monitoring event are provided in **Appendix B**.

3.2 GROUNDWATER DATA SUMMARY

As shown in **Table 3-1**, numerous VOCs, as well as two PAHs (naphthalene and 2-methylnaphthalene), have been detected in wells at the site over the 12-year monitoring period. However, historically VOCs have only exceeded the MCL (or RBC when an MCL was not available) in four wells (MW-117, 6MW-3S, 6MW-7, and 6MW-9) at the site. It should be noted that the 1 µg/L detect for 1,4-dichlorobenzene appears to be the result of cross-contamination since it also was detected in the associated method blank for that sample.

A summary of the MCL exceedences by sampling event is presented in the following table:

VOC	MCL Exceedences by Sampling Event				
	1995	2000	2003	2004	2007
Cis 1,2-DCE		MW-117: 1,900 µg/L		6MW-3S: 100 µg/L	None
PCE	MW-117: 8.5 µg/L		6MW-7: 11 µg/L	6MW-3S: 62 µg/L	None
TCE	MW-117: 18 µg/L			6MW-3S: 140 µg/L	None
Vinyl chloride		MW-117: 8.8 µg/L 6MW-3S: 3.1 µg/L		6MW-3S: 9.7 µg/L	None

The effects of the sodium permanganate injections on groundwater quality in the former source area is evident by the continued decrease in VOC concentrations in MW-117 which is located directly downgradient of the former source area where the injections took place. It should be noted that there was a downtrend in VOC concentrations in MW-117 prior to the injections as noted in the 2003 groundwater data from MW-117. From the 1995 to 2000 to 2003 monitoring events, concentrations of cis 1,2-DCE, ethylbenzene, PCE, toluene, TCE xylenes and vinyl chloride decreased. The post-injection data for MW-117 (2004 to 2007) suggests a continued downward trend with cis 1,2-DCE concentrations decreasing from 24 to 2 µg/L, PCE from 0.67 µg/L to non-detect, and xylenes from 65 to 13 µg/L.

Historically, the most impacted downgradient well has been 6MW-3S with cis 1,2-DCE, PCE, TCE, and vinyl chloride exceeding the MCLs in the 2004 monitoring data. Although still detected in 2007, none of these compounds exceed their respective MCL. Monitoring well 6MW-9 is located directly downgradient of 6MW-3S but none of these compounds were detected in 2007. There are several reasons for the decreasing trends downgradient including: (1) impact of the sodium permanganate injections upgradient have greatly decreased the concentrations of these VOCs at the source area thereby reducing the mass of VOCs present that can continually leach into groundwater or be transported downgradient, (2) with the reduction of source mass concentrations, infiltration which is high because of the sandy soils and shallow groundwater present reduces concentrations throughout the site, and (3) albeit slow because of the relatively flat groundwater gradient, dispersion of contaminants will have somewhat of an affect on VOC concentrations.

A summary of the conclusions and recommendations associated with post-RI activities conducted at the LARC 60 site are presented below.

4.1 CONCLUSIONS

4.1.1 Risk Assessment

Human Health Risk

The potential for future development of the land as commercial, residential, or recreational properties is not expected as the installation will remain open and the area will continue to be identified as industrial usage; therefore, it is expected that the land will continue to be used for industrial purposes and that groundwater will continue to be utilized. If land use conditions change in the future, possible exposure scenarios (e.g., residential exposure to soil and groundwater if residential development was planned) will be re-evaluated. This conclusion is a revision from the text provided in the baseline human health risk assessment presented in the Final RI Report for the site. Based on guidance provided by the USAEC, unless residential development is expected or planned in the future for an installation, the residential land use scenario will not be evaluated for future land use conditions.

Because potential risk was only identified for the future scenario of residential development at the site during the RI, based on this policy change, no human health risk has been identified for the LARC 60 site.

Ecological Risk

As presented in the Final RI Report, ecologically, much of the site provides little value to wildlife for foraging or nesting habitat. Therefore, the risks to wildlife associated with the ongoing activities at the LARC 60 Maintenance Area are considered low.

4.1.2 Groundwater Contamination

Numerous VOCs, as well as two PAHs (naphthalene and 2-methylnaphthalene), have been detected in wells at the site over the 12-year monitoring period but few exceedences of the MCLs over this period have been noted primarily in two wells: (1) MW-117 which is located downgradient of the former source area and (2) 6MW-3S which is located further downgradient of the former source area.

Sodium permanganate injections impacted groundwater quality in the former source area and is evident by the continued decrease in VOC concentrations in MW-117 which is located directly downgradient where the injections took place.

Decreasing trends downgradient of the former source area have also been noted primarily based on three reasons: (1) impact of the sodium permanganate injections upgradient have greatly decreased the concentrations of these VOCs at the source area thereby reducing the mass of VOCs present that can continually leach into groundwater or be transported downgradient, (2) with the reduction of source mass concentrations, infiltration which is high because of the sandy soils and shallow groundwater present reduces concentrations throughout the site, and (3) albeit slow because of the relatively flat groundwater gradient, dispersion of contaminants will have somewhat of an affect on VOC concentrations.

4.2 RECOMMENDATIONS

Other than preparation of a Decision Document, **no further action** is recommended for the LARC 60 site based on the limited contamination detected in site groundwater and that no human health or ecological risks were identified. The groundwater monitoring programs clearly exhibit a decreasing trend in contaminant concentrations with no exceedences of the MCLs noted during the 2007 groundwater monitoring event which focused on wells that previously had been impacted with VOCs above their respective MCLs.

TABLE 3-1
MONITORING WELL GROUNDWATER RESULTS
LARC 60 MAINTENANCE AREA

	Well ID and Results (concentrations reported in ug/L)																		
	6MW-1				6MW-2				6MW-3S					6MW-3D					
Parameters	**1995**	**2000**	**2003**	**2004**	**1995**	**2000**	**2003**	**2004**	**1995**	**2000**	**2003**	**2004**	**2007**	**1995**	**2000**	**2003**	**2004**	**MCLs (1)**	**RBCs (2)**
Acetone	5 U	5 U	**4**	NT	5 U	NT	**5**	**270 D**	5 U	5 U	5 U	**17 J**	**3.8 B**	5 U	NT	5 U	**3.3**	---	550
Benzene	5 U	5 U	5 U	NT	5 U	NT	**0.1**	0.5 U	5 U	5 U	**0.6 J**	0.5 U	**0.2 JB**	5 U	NT	5 U	0.5 U	5	
Bromodichloromethane	5 U	5 U	5 U	NT	5 U	NT	5 U	0.5 U	5 U	5 U	5 U	0.5 U	0.5 U	5 U	NT	5 U	0.5 U	100 (3)	
2-Butanone (MEK)	5 U	5 U	5 U	NT	5 U	NT	5 U	**21**	5 U	5 U	5 U	0.5 U	0.5 U	5 U	NT	5 U	**2.5**	---	700
Carbon disulfide	5 U	5 U	5 U	NT	5 U	NT	5 U	**0.83**	5 U	5 U	5 U	0.5 U	**0.11 J**	5 U	NT	5 U	0.5 U	---	100
Chlorobenzene	5 U	5 U	5 U	NT	5 U	NT	5 U	0.5 U	5 U	5 U	5 U	0.5 U	0.5 U	5 U	NT	5 U	0.5 U	100	
Chloroform	5 U	5 U	5 U	NT	5 U	NT	5 U	0.5 U	5 U	5 U	5 U	0.5 U	0.5 U	5 U	NT	5 U	0.5 U	100 (3)	
Chloromethane	5 U	5 U	5 U	NT	5 U	NT	5 U	**0.23 JB**	5 U	5 U	5 U	**0.84 J**	0.5 U	5 U	NT	5 U	**0.21 J**	---	19
Cyclohexane	5 U	5 U	5 U	NT	5 U	NT	5 U	0.5 U	5 U	5 U	5 U	0.5 U	**0.21 JB**	5 U	NT	5 U	0.5 U	---	---
Dibromochloromethane	5 U	5 U	5 U	NT	5 U	NT	5 U	0.5 U	5 U	5 U	5 U	0.5 U	0.5 U	5 U	NT	5 U	0.5 U	100 (3)	
1,2-Dichlorobenzene	5 U	5 U	NT	NT	5 U	NT	5 U	0.5 U	5 U	5 U	5 U	0.5 U	0.5 U	5 U	NT	5 U	0.5 U	600	
1,3-Dichlorobenzene	5 U	5 U	5 U	NT	5 U	NT	5 U	0.5 U	5 U	5 U	5 U	0.5 U	0.5 U	5 U	NT	5 U	0.5 U	75	
1,4-Dichlorobenzene	5 U	5 U	**0.3 J**	NT	5 U	NT	5 U	0.5 U	5 U	5 U	5 U	0.5 U	0.5 U	5 U	NT	**0.3 JB**	0.5 U	---	0.47
Dichlorodifluoromethane	5 U	5 U	5 U	NT	5 U	NT	5 U	0.5 U	5 U	5 U	5 U	0.5 U	0.5 U	5 U	NT	5 U	0.5 U	---	35
1,1-DCA	5 U	5 U	5 U	NT	5 U	NT	5 U	0.5 U	5 U	5 U	5 U	0.5 U	0.5 U	5 U	NT	5 U	0.5 U	---	90
1,1-DCE	5 U	5 U	5 U	NT	5 U	NT	5 U	0.5 U	5 U	5 U	5 U	**1.3 J**	0.5 U	5 U	NT	5 U	0.5 U	7	
cis 1,2-DCE	5 U	5 U	5 U	NT	5 U	NT	5 U	0.5 U	5 U	**2 J**	**1 J**	**100**	**0.88**	5 U	NT	5 U	**0.33 J**	70	
trans 1,2-DCE	5 U	5 U	5 U	NT	5 U	NT	5 U	0.5 U	5 U	5 U	5 U	**0.87 J**	0.5 U	5 U	NT	5 U	0.5 U	100	
Ethylbenzene	5 U	5 U	5 U	NT	5 U	NT	5 U	0.5 U	5 U	5 U	5 U	0.5 U	0.5 U	5 U	NT	5 U	0.5 U	700	
Isopropyl benzene	5 U	5 U	5 U	NT	5 U	NT	5 U	0.5 U	5 U	5 U	5 U	0.5 U	0.5 U	5 U	NT	5 U	0.5 U	---	---
Methylcyclohexane	5 U	5 U	5 U	NT	5 U	NT	5 U	0.5 U	5 U	5 U	5 U	0.5 U	0.5 U	5 U	NT	5 U	0.5 U	---	630
Methylene chloride	5 U	5 U	5 U	NT	5 U	NT	5 U	**0.52 B**	5 U	5 U	**0.3 J**	**3.3 JB**	0.5 U	5 U	NT	5 U	**0.47 JB**	5	
MIBK	5 U	**50**	5 U	NT	5 U	NT	5 U	2.5 U	5 U	**44**	13 U	2.5 U	2.5 U	5 U	NT	13 U	2.5 U	---	630
Styrene	5 U	5 U	5 U	NT	5 U	NT	5 U	0.5 U	5 U	5 U	5 U	0.5 U	0.5 U	5 U	NT	5 U	0.5 U	100	
Tetrachloroethene	5 U	5 U	5 U	NT	5 U	NT	5 U	0.5 U	5 U	5 U	**0.4 J**	**62**	**0.33 J**	5 U	NT	5 U	0.5 U	5	
Toluene	5 U	5 U	**0.4 JB**	NT	5 U	NT	5 U	**0.29**	5 U	5 U	**0.8 J**	0.5 U	0.5 U	5 U	NT	**0.9 JB**	**0.42 J**	1,000	
1,2,4-Trichlorbenzene	5 U	5 U	**0.3 JB**	NT	5 U	NT	5 U	0.5 U	5 U	5 U	5 U	0.5 U	0.5 U	5 U	NT	5 U	0.5 U	70	
Trichloroethene	5 U	5 U	5 U	NT	5 U	NT	5 U	0.5 U	5 u	**1.3 J**	**1 J**	**140**	**1.9**	5 U	NT	5 U	0.5 U	5	
Vinyl chloride	5 U	10 U	5 U	NT	10 U	NT	5 U	0.5 U	10 U	**3.1 J**	**1 J**	**9.7**	0.5 U	10 U	NT	5 U	**0.2 J**	2	
Xylenes	5 U	10 U	5 U	NT	5 U	NT	5 U	1 U	5 U	10 U	5 U	1 U	1 U	5 U	NT	5 U	1 U	10,000	

Notes:

(1) USEPA MCLs - EPA Maximum Contaminant Levels for Drinking Water

(2) RBCs - EPA Risk-based Concentrations for Tap Water (April 2007)

(3) MCL is for Total Trihalomethanes

NT - Not tested

Qualifiers:

J - Estimated concentration (result between MDL and PQL for organics)

B - Detected in associated method blank

Organics detected are bolded and italicized.

62 Concentrations above MCLs or EPA Region III RBCs for tap water (if no MCL exists) are bolded and shaded.

TABLE 3-1
MONITORING WELL GROUNDWATER RESULTS
LARC 60 MAINTENANCE AREA

	Well ID and Results (concentrations reported in ug/L)																				
	6MW-4				6MW-5S			6MW-5D		6MW-6		6MW-7			6MW-8		6MW-9				
Parameters	**1995**	**2000**	**2003**	**2004**	**2003**	**2004**	**2007**	**2003**	**2004**	**2003**	**2004**	**2003**	**2004**	**2007**	**2003**	**2004**	**2003**	**2004**	**2007**	**MCLs (1)**	**RBCs (2)**
Acetone	5 U	5 U	5 U	NT	5 U	0.5 U	**4.5 B**	5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	**2 JB**	5 U	0.5 U	**4 J**	0.5 U	**2.4 JB**	---	550
Benzene	5 U	5 U	5 U	NT	5 U	0.5 U	**0.15 JB**	5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	**0.12 JB**	5 U	0.5 U	**0.2 J**	0.5 U	**0.24 JB**	5	
Bromodichloromethane	5 U	5 U	5 U	NT	5 U	0.5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	5 U	**0.83**	0.5 U	5 U	0.5 U	5 U	0.5 U	0.5 U	100 (3)	
2-Butanone (MEK)	5 U	5 U	5 U	NT	5 U	0.5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	5 U	0. 5U	0. 5U	5 U	0. 5U	5 U	0. 5U	0. 5U	---	700
Carbon disulfide	5 U	5 U	5 U	NT	5 U	0.5 U	**0.11 J**	5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	0.5 U	---	100
Chlorobenzene	5 U	5 U	5 U	NT	5 U	0.5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	0.5 U	5 U	0.5 U	**9**	0.5 U	0.5 U	100	
Chloroform	5 U	5 U	5 U	NT	5 U	0.5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	5 U	**3.3**	0.5 U	5 U	0.5 U	5 U	0.5 U	0.5 U	100 (3)	
Chloromethane	5 U	5 U	5 U	NT	5 U	0.5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	0.5 U	5 U	0.5 U	5 U	**0.18 J**	0.5 U	---	19
Cyclohexane	5 U	5 U	5 U	NT	5 U	0.5 U	**0.17 JB**	5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	**0.17 JB**	5 U	0.5 U	5 U	0.5 U	**0.16 JB**	---	---
Dibromochloromethane	5 U	5 U	5 U	NT	5 U	0.5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	5 U	**0.12 J**	0.5 U	5 U	0.5 U	5 U	0.5 U	0.5 U	100 (3)	
1,2-Dichlorobenzene	5 U	5 U	5 U	NT	5 U	0.5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	0.5 U	5 U	0.5 U	**0.2 JB**	0.5 U	0.5 U	600	
1,3-Dichlorobenzene	5 U	5 U	5 U	NT	5 U	0.5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	0.5 U	5 U	0.5 U	**0.5 JB**	0.5 U	0.5 U	75	
1,4-Dichlorobenzene	5 U	5 U	**0.3 J**	NT	5 U	0.5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	0.5 U	5 U	0.5 U	**1 JB**	0.5 U	0.5 U	---	0.47
Dichlorodifluoromethane	5 U	5 U	5 U	NT	**0.3 J**	0.5 U	0.5 U	**0.3 J**	0.5 U	**0.3 J**	0.5 U	5 U	0.5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	0.5 U	---	35
1,1-DCA	5 U	5 U	5 U	NT	5 U	0.5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	0.5 U	---	90
1,1-DCE	5 U	5 U	5 U	NT	5 U	0.5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	0.5 U	7	
cis 1,2-DCE	5 U	5 U	5 U	NT	5 U	**1.1**	0.5 U	5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	0.5 U	5 U	**0.15 J**	5 U	0.5 U	0.5 U	70	
trans 1,2-DCE	5 U	5 U	5 U	NT	5 U	0.5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	0.5 U	100	
Ethylbenzene	5 U	5 U	5 U	NT	5 U	0. 5U	0. 5U	5 U	0.5 U	5 U	0. 5U	5 U	0. 5U	0. 5U	5 U	0. 5U	5 U	0.5 U	**0.11 J**	700	
Isopropyl benzene	5 U	5 U	5 U	NT	5 U	0.5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	0.5 U	---	---
Methylcyclohexane	5 U	5 U	5 U	NT	5 U	0.5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	0.5 U	---	630
Methylene chloride	5 U	5 U	5 U	NT	**0.25 J**	0.5 U	0.5 U	**0.3 J**	0.5 U	5 U	**0.2 J**	5 U	**0.15 J**	0.5 U	**0.3 J**	**0.14 J**	5 U	**0.44 JB**	0.5 U	5	
MIBK	5 U	**19**	13 U	NT	13 U	2.5 U	2.5 U	13 U	2.5 U	13 U	2.5 U	13 U	2.5 U	2.5 U	13 U	2.5 U	13 U	2.5 U	2.5 U	---	630
Styrene	5 U	5 U	5 U	NT	5 U	0.5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	0.5 U	100	
Tetrachloroethene	5 U	5 U	5 U	NT	5 U	**0.84**	0.5 U	5 U	0.5 U	5 U	0.5 U	**11**	**0.49 J**	**1.3**	5 U	0.5 U	5 U	0.5 U	0.5 U	5	
Toluene	5 U	5 U	**0.6 J**	NT	**1 JB**	0.5 U	0.5 U	**1 JB**	0.5 U	**1 JB**	0.5 U	**1 JB**	**0.1 J**	0.5 U	**0.7 J**	0.5 U	**0.5 JB**	**0.15 J**	0.5 U	1,000	
1,2,4-Trichlorbenzene	5 U	5 U	5 U	NT	5 U	0.5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	0.5 U	70	
Trichloroethene	5 U	5 U	5 U	NT	5 U	**1.7**	0.5 U	5 U	**0.10 JB**	5 U	0.5 U	5 U	0.5 U	0.5 U	**0.5 J**	**0.15 J**	5 U	0.5 U	0.5 U	5	
Vinyl chloride	10 U	10 U	5 U	NT	5 U	0.5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	0.5 U	2	
Xylenes	10 U	10 U	5 U	NT	5 U	0.5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	0.5 U	10,000	

Notes:

(1) USEPA MCLs - EPA Maximum Contaminant Levels for Drinking Water

(2) RBCs - EPA Risk-based Concentrations for Tap Water (April 2007)

(3) MCL is for Total Trihalomethanes

NT - Not tested

Qualifiers:

J - Estimated concentration (result between MDL and PQL for organics)

B - Detected in associated method blank

Organics detected are bolded and italicized.

Concentrations above MCLs or EPA Region III RBCs for tap water (if no MCL exists) are bolded and shaded.

TABLE 3-1
MONITORING WELL GROUNDWATER RESULTS
LARC 60 MAINTENANCE AREA

	Well ID and Results (concentrations reported in ug/L)																	
	6MW-10	6MW-11		MW-115				MW-117					MW-118					
Parameters	2004	2004	2007	1995	2000	2003	2004	1995	2000	2003	2004	2007	1995	2000	2003	2004	MCLs (1)	RBCs (2)
Acetone	**5.5**	0.5 U	**4.3 B**	5 U	5 U	5 U	**2.9**	5 U	5 U	**32**	0.5 U	**3.1 B**	5 U	5 U	5 U	**3**	---	550
Benzene	0.5 U	0.5 U	**0.18 JB**	5 U	5 U	5 U	0.5 U	5 U	5 U	5 U	0.5 U	**0.19 JB**	5 U	5 U	5 U	0.5 U	5	
Bromodichloromethane	0.5 U	0.5 U	0.5 U	5 U	5 U	5 U	0.5 U	5 U	5 U	5 U	0.5 U	0.5 U	5 U	5 U	5 U	0.5 U	100 (3)	
2-Butanone (MEK)	**4**	0.5 U	0.5 U	5 U	5 U	5 U	0.5 U	5 U	5 U	5 U	0.5 U	0.5 U	5 U	5 U	5 U	**1.5 J**	---	700
Carbon disulfide	**0.22 J**	0.5 U	**3.5**	5 U	5 U	5 U	0.5 U	5 U	5 U	5 U	0.5 U	**0.11 J**	5 U	5 U	5 U	0.5 U	---	100
Chlorobenzene	0.5 U	0.5 U	0.5 U	5 U	5 U	5 U	0.5 U	5 U	5 U	5 U	0.5 U	0.5 U	5 U	5 U	5 U	0.5 U	100	
Chloroform	0.5 U	0.5 U	0.5 U	5 U	5 U	5 U	0.5 U	5 U	5 U	5 U	0.5 U	0.5 U	5 U	5 U	5 U	0.5 U	100 (3)	
Chloromethane	**0.31 J**	0.5 U	0.5 U	5 U	5 U	5 U	0.5 U	5 U	5 U	5 U	0.5 U	0.5 U	5 U	5 U	5 U	**0.26 J**	---	19
Cyclohexane	0.5 U	0.5 U	**0.16 JB**	5 U	5 U	5 U	0.5 U	5 U	5 U	**15**	**2.7**	**0.51 B**	5 U	5 U	5 U	0.5 U	---	---
Dibromochloromethane	0.5 U	0.5 U	0.5 U	5 U	5 U	5 U	0.5 U	5 U	5 U	5 U	0.5 U	0.5 U	5 U	5 U	5 U	0.5 U	100 (3)	
1,2-Dichlorobenzene	0.5 U	0.5 U	0.5 U	5 U5	5 U	**0.15 J**	**0.16 J**	5 U	5 U	5 U	0.5 U	0.5 U	5 U	5 U	5 U	0.5 U	600	
1,3-Dichlorobenzene	0.5 U	0.5 U	0.5 U	5 U	5 U	5 U	0.5 U	5 U	5 U	5 U	0.5 U	0.5 U	5 U	5 U	5 U	0.5 U	75	
1,4-Dichlorobenzene	0.5 U	0.5 U	0.5 U	5 U	5 U	**0.3 J**	0.5 U	5 U	5 U	5 U	0.5 U	0.5 U	5 U	5 U	5 U	0.5 U	---	0.47
Dichlorodifluoromethane	0.5 U	0.5 U	0.5 U	5 U	5 U	5 U	0.5 U	5 U	5 U	5 U	0.5 U	0.5 U	5 U	5 U	5 U	0.5 U	---	35
1,1-DCA	0.5 U	0.5 U	0.5 U	5 U	5 U	5 U	**0.34 J**	5 U	5 U	5 U	0.5 U	0.5 U	5 U	5 U	5 U	0.5 U	---	90
1,1-DCE	0.5 U	0.5 U	0.5 U	5 U	5 U	5 U	0.5 U	5 U	5 U	5 U	0.5 U	0.5 U	5 U	5 U	5 U	0.5 U	7	
cis 1,2-DCE	0.5 U	0.5 U	0.5 U	5 U	5 U	5 U	**0.3 J**	**20**	**1,900**	**22**	**24**	**2**	5 U	5 U	5 U	0.5 U	70	
trans 1,2-DCE	0.5 U	0.5 U	0.5 U	5 U	5 U	5 U	0.5 U	5 U	5 U	5 U	**0.25 J**	0.5 U	5 U	5 U	5 U	0.5 U	100	
Ethylbenzene	0.5 U	0.5 U	0.5 U	5 U	5 U	5 U	0.5 U	**66**	**76**	**29**	**6.8**	**1.4**	5 U	5 U	5 U	0.5 U	700	
Isopropyl benzene	0.5 U	0.5 U	0.5 U	5 U	5 U	5 U	0.5 U	5 U	5 U	**12**	**6.2**	0.5 U	5 U	5 U	5 U	0.5 U	---	---
Methylcyclohexane	0.5 U	0.5 U	0.5 U	5 U	5 U	5 U	0.5 U	5 U	5 U	**26**	**16**	**8.1**	5 U	5 U	5 U	0.5 U	---	630
Methylene chloride	**0.45 J**	0.5 U	0.5 U	5 U	5 U	5 U	0.5 U	5 U	5 U	5 U	0.5 U	**0.16 J**	5 U	5 U	5 U	**0.43 JB**	5	
MIBK	2.5 U	0.5 U	0.5 U	5 U	13 U	13 U	2.5 U	5 U	250 U	13 U	**4**	2.5 U	5 U	5 U	13 U	2.5 U	---	630
Styrene	**0.12 J**	0.5 U	0.5 U	5 U	5 U	5 U	0.5 U	5 U	50 U	5 U	0.5 U	0.5 U	5 U	5 U	5 U	0.5 U	100	
Tetrachloroethene	0.5 U	0.5 U	0.5 U	5 U	5 U	5 U	0.5 U	**8.5**	50 U	**2 J**	**0.67 J**	0.5 U	5 U	5 U	5 U	0.5 U	5	
Toluene	**0.36 J**	**0.17 J**	0.5 U	5 U	5 U	**0.7 J**	0.5 U	**68**	**310**	**1 JB**	**0.15 J**	0.5 U	5 U	5 U	**1 JB**	**0.27 J**	1,000	
1,2,4-Trichlorbenzene	**0.15 JB**	0.5 U	0.5 U	5 U	5 U	5 U	0.5 U	5 U	50 U	5 U	0.5 U	0.5 U	5 U	5 U	5 U	0.5 U	70	
Trichloroethene	0.5 U	0.5 U	0.5 U	5 U	5 U	5 U	0.5 U	**18**	50 U	**1 J**	0.5 U	0.5 U	5 U	5 U	5 U	0.5 U	5	
Vinyl chloride	0.5 U	0.5 U	0.5 U	10 U	10 U	5 U	0.5 U	10 U	**8.6 J**	5 U	0.5 U	0.5 U	10 U	10 U	5 U	0.5 U	2	
Xylenes	0.5 U	0.5 U	0.5 U	5 U	10 U	5 U	0.5 U	**290**	**450**	**130**	**65**	**13**	5 U	10 U	5 U	0.5 U	10,000	

Notes:

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(3) MCL is for Total Trihalomethanes

NT - Not tested

Qualifiers:

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Organics detected are bolded and italicized.

62 Concentrations above MCLs or EPA Region III RBCs for tap water (if no MCL exists) are bolded and shaded.