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REPLY TO ATTENTION OF:

February 10, 2014

Environmental Division

Ms. Elisabeth Green
Federal Facilities Division
Maryland Department of the Environment
1800 Washington Boulevard, Suite 625
Baltimore, Maryland 21230

Dear Ms. Green:

Enclosed please find the February 2014 *Draft Remedial Design, Phoenix Military Reservation* for your review and comment. Copies of the document have been furnished to John Burchette (U.S. Environmental Protection Agency), Mick Butler (Fort George G. Meade), Francis Coulters (U.S. Army Environmental Command), and Kevin Koepenick (Baltimore County).

Please provide comments or questions on the Remedial Design within 60 calendar days of receipt. Written comments should be addressed to Fort. George. G. Meade, Attention: IMNE-MEA-PWE (Paul Fluck), 4215 Roberts Ave., Room 320, Fort Meade, Maryland 20755-7068 or paul.v.fluck.civ@mail.mil.

If you have any questions, please feel free to contact Ms. Denise Tegtmeyer at (301) 677-9559 or me at (301) 677-9365.

Sincerely,

Paul V. Fluck, PG, REP
Program Manager, Installation Restoration Program
Directorate of Public Works-Environmental Division

Enclosure

ARCADIS

Imagine the result

Draft Remedial Design

Phoenix Military Reservation, Jacksonville, Maryland

February 2014

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Draft Remedial Design
Phoenix Military Reservation

Jacksonville, Maryland

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List of Acronyms and Abbreviations

µg/L	micrograms per liter
ARARs	Applicable or Relevant and Appropriate Requirements
ARCADIS	ARCADIS U.S. Inc.
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cis-1,2-DCE	cis-1,2-dichloroethene
COCs	Constituents of Concern
COMAR	Code of Maryland Regulations
DD	Decision Document
DGR	Directed Groundwater Recirculation
ECs	Engineering Controls
EQ	Equalization
ESE	Environmental Science and Engineering, Inc.
FCA	Fire Control Area
FFS	Focused Feasibility Study
FGGM	Fort George G. Meade
ft	feet/foot
gpm	gallon per minute
HASP	Health and Safety Plan
ICs	Institutional Controls
LCA	Launch Control Area
LUC	Land Use Controls
MCL	Maximum Contaminant Level
MDARNG	Maryland Army National Guard

List of Acronyms and Abbreviations continued

MDE	Maryland Department of the Environment
MNA	Monitored Natural Attenuation
O&M	Operation and Maintenance
PID	Piping and Instrumentation Diagram
PLC	Programmable Logic Controller
PMR	Phoenix Military Reservation
RAOs	Remedial Action Objectives
RD	Remedial Design
RI	Remedial Investigation
TCE	trichloroethene
TOC	Total Organic Carbon
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound

Executive Summary

This Remedial Design (RD) for the Phoenix Military Reservation (PMR; hereinafter referred to as "the Site") Fire Control Area (FCA) was prepared by ARCADIS U.S., Inc. (ARCADIS) for Fort George G. Meade (FGGM) under contract number W91ZLK-05-D-0015, Task Order 0005, awarded to ARCADIS in August 2009.

The Installation Restoration Program activities at FGGM/PMR operate principally under the Comprehensive Environmental Response, Compensation, and Liability Act as amended by the Superfund Amendments and Reauthorization Act of 1986 and National Oil and Hazardous Substances Pollution Contingency Plan [40 Code of Federal Regulations 300]. Work is overseen by the Federal Facilities Division of the Maryland Department of the Environment (the lead agency).

PMR is a sub-installation of FGGM. The PMR FCA is located approximately one-half mile west of Jacksonville, Maryland, in northeastern Baltimore County (**Figure 1-1**). The PMR formerly consisted of two parcels of land: the FCA and the Launch Control Area (LCA). The FCA and LCA each occupy approximately 17 acres of land and are approximately one-half mile apart. They occupy two adjacent hilltops separated by a valley through which the Greene Branch flows (Environmental Science and Engineering, Inc. [ESE], 1983). The area surrounding these facilities is rural and residential. The LCA was divested by the Army prior to this investigation and is no longer considered to be part of the PMR.

The PMR was originally developed in 1954 as a Nike Ajax missile site. In 1958, the Site was modified to use the Nike Hercules missiles. Active-duty Army personnel under the command of the Army Air Defense Command manned the Site until 1962, when the Maryland Army National Guard (MDARNG) assumed command. In 1966, the Nike missile program was terminated, and the Site remained relatively inactive until 1974 (ESE, 1983). In 1974, the Army granted the MDARNG a five-year lease of the FCA and its improvements. The MDARNG used the facility as a year-round training ground for its Military Police Company. In 1979, the MDARNG requested and was granted a five-year extension. The MDARNG ceased active operations in 1982, with the buildings being demolished shortly thereafter; the Site has been unoccupied since that time. Historical photographs indicate that the area was farmed prior to the installation of the FCA and more recently maintained as lawn to facilitate site access and visibility. Since the cessation of Army activities on the Site, lawn maintenance has been suspended over most of the Site. Adjacent landowners maintain their properties as extensive lawn areas and pastureland for horses. The area is no longer

being commercially farmed (ARCADIS, 2013). The PMR is currently vacant and surrounded by a fence.

This RD has been prepared to specify the methods and materials for the implementation of the selected remedy at the Site as specified in the approved Decision Document (DD) (U.S. Army, 2013). The remedial action objectives (RAOs), as stated in the DD (U.S. Army, 2013), are based on human health and environmental factors, and provided the basis for the formulation and development of the selected remedy. The RAOs for the selected remedy at the Site are as follows:

- Prevent human exposure to groundwater that would cause unacceptable risk over the duration of the response action.
- Achieve Maximum Contaminant Levels for the identified constituents of concern in groundwater in a reasonable timeframe thereby restoring groundwater to its beneficial use.

This remedy will attain the above mentioned RAOs by reducing future potential risk to human health through implementation of a Directed Groundwater Recirculation (DGR) treatment system and Monitored Natural Attenuation program. Furthermore, existing land use controls (LUCs) will be enhanced and maintained to control future groundwater use at the Site.

A remedial action will be conducted to perform environmental remediation of groundwater that is contaminated with trichloroethene, cis-1,2 dichloroethene, and vinyl chloride above Site Cleanup Levels. Groundwater will be pumped from FCA-01, treated and re-injected into injections wells to the southwest, south, and northeast following treatment. The DGR system is assumed to operate for five years and would operate through any potential change in the future use of the property. Following system shutdown, natural attenuation would reduce remaining concentrations to achieve cleanup goals for the Site within a total time of 10 to 15 years from initiation of the remedial action.

The final component of this design will include the enhancement and maintenance of existing LUCs.

1. Introduction

This Remedial Design (RD) for the Phoenix Military Reservation (PMR) Fire Control Area (FCA) was prepared by ARCADIS U.S., Inc. (ARCADIS) for Fort George G. Meade (FGGM) under contract number W91ZLK-05-D-0015, Task Order 0005, awarded to ARCADIS in August 2009. This work is being conducted under a Performance Based Contract associated with the environmental restoration program at FGGM. The full scope of services for this contract is defined in Contract W91ZLK-05-D-0015: Task 0005.

The Installation Restoration Program activities at FGGM/PMR operate principally under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 and National Oil and Hazardous Substances Pollution Contingency Plan (40 Code of Federal Regulations (CFR) 300]). Oversight is by the Federal Facilities Division of the Maryland Department of the Environment (MDE) (the lead agency).

This RD has been prepared to specify the methods and materials for the implementation of the selected remedy at PMR (hereinafter referred to as “the Site”) as specified in the approved final Decision Document (DD) (U.S. Army, 2013). The selected remedy addresses unacceptable risk for potential future use scenarios due to exposure to contaminants in groundwater and consists of the following components:

- Installation of a Directed Groundwater Recirculation (DGR) system;
- Monitored Natural Attenuation (MNA); and
- Land use controls (LUCs).

All field activities associated with the PMR remedial implementation initiated by ARCADIS will be conducted in accordance with procedures established in the site-wide plans developed for work under the FGGM Performance Based Acquisition:

- Quality Assurance Project Plan for the Performance Based Acquisition at Fort Meade (ARCADIS, 2011a).
- Sample and Analysis Plan for the Performance Based Acquisition at Fort Meade (ARCADIS, 2011b)

- Waste Management Plan for the Performance Based Acquisition at Fort Meade (ARCADIS, 2011c)

- Site-wide Health and Safety Plan for the Performance Based Acquisition at Fort Meade (ARCADIS, 2010)

1.1 Background and Existing Conditions

PMR is a sub-installation of FGGM. The PMR FCA is located approximately one-half mile west of Jacksonville, Maryland, in northeastern Baltimore County (**Figure 1-1**). The PMR formerly consisted of two parcels of land: the FCA and the Launch Control Area (LCA). The FCA and LCA each occupy approximately 17 acres of land and are approximately one-half mile apart. They occupy two adjacent hilltops separated by a valley through which the Greene Branch flows (Environmental Science and Engineering, Inc. [ESE], 1983). The area surrounding these facilities is rural and residential. The LCA was divested by the Army prior to this investigation and is no longer considered to be part of the PMR.

The PMR was originally developed in 1954 as a Nike Ajax missile site. In 1958, the Site was modified to use the Nike Hercules missiles. Active-duty Army personnel under the command of the Army Air Defense Command manned the Site until 1962, when the Maryland Army National Guard (MDARNG) assumed command. In 1966, the Nike missile program was terminated, and the Site remained relatively inactive until 1974 (ESE, 1983). In 1974, the Army granted the MDARNG a five-year lease of the FCA and its improvements. The MDARNG used the facility as a year-round training ground for its Military Police Company. In 1979, the MDARNG requested and was granted a five-year extension. The MDARNG ceased active operations in 1982, with the buildings being demolished shortly thereafter; the Site has been unoccupied since that time. Historical photographs indicate that the area was farmed prior to the installation of the FCA and more recently maintained as lawn to facilitate site access and visibility. Since the cessation of Army activities on the Site, lawn maintenance has been suspended over most of the Site. Adjacent landowners maintain their properties as extensive lawn areas and pastureland for horses. The area is no longer being commercially farmed (ARCADIS, 2013). The PMR is currently vacant and surrounded by a fence.

A summary of the historical investigations and remedial actions conducted at the Site and a summary of past activities, including the implementation of the 1999 groundwater sampling and analysis, are presented in the Remedial Investigation (RI)/ Focused Feasibility Study (FFS) Report (Malcolm Pirnie/Berger, 1999). To

address data gaps identified within the RI/FFS, five additional phases of investigations were conducted between 2003 and 2012. These investigations include the following:

- Phase I – Investigated on-site source areas to determine constituent concentrations in the groundwater between the Site and the Greene Branch.

- Phase II – Delineated the identified dissolved phase trichloroethene (TCE) plume and total petroleum hydrocarbon groundwater plume and assessed impacts to discharge points (surface water or springs).

- Phase III – Conducted additional surface water sampling to document contaminant concentrations at plume discharge points.

- Supplemental RI – Initiated to further characterize volatile organic compound (VOC) contamination at PMR and address concerns that PMR constituents have migrated off-site and affected residential wells located southwest (Mollie Court) and east (Sunnybrook Road) of the Site.

- Groundwater Sampling – Completed in December 2012 to further evaluate attenuation mechanisms for constituents in on-site groundwater.

A summary of each of these investigations, as well as associated findings, are provided in the Final RI Report (ARCADIS, 2012) and FFS (ARCADIS, 2013).

The following conclusions are based upon the previous investigations:

- Soil borings and samples advanced at PMR did not show any evidence of soil contamination. As outlined in the 1999 RI/FFS Report (Malcolm Pirnie/Berger, 1999), it appears likely that the TCE source contaminants dissolved and migrated directly down to the water table from the septic system.

- Upon review of the groundwater data collected during the 2011 and 2012 sampling events, contaminants in the shallow portions of the aquifer are at levels below regulatory criteria. Based on this finding and the sampling results of other nearby shallow monitoring wells, the shallow dissolved phase TCE plume is considered to be delineated.

- For the deep portion of the aquifer, three of 11 wells sampled in 2011 exhibited concentrations of TCE above its Maximum Contaminant Level (MCL). TCE was detected at monitoring wells FCA-1, FCA-3, and FCA-7 at concentrations of 250 micrograms per liter (µg/L), 25 µg/L, and 7.4 µg/L, respectively. The deep dissolved phase TCE plume has been delineated. No chlorinated compounds were detected above MCLs in samples from the Mollie Court off-site residential wells sampled in May 2011.

1.2 Organization of Report

Including this introduction, the report is divided into the following nine sections:

- Section 2 – Design Criteria: This section presents criteria that characterize the design, specifically the Remedial Action Objectives (RAOs), State and Federal Regulatory Requirements, and Site Considerations.

- Section 3 – Remedial Action – DGR: This section discusses the manner in which the DGR system will be implemented.

- Section 4 – MNA: This section discussed the manner in which MNA will be implemented at the Site.

- Section 5 – LUCs: This section discusses the existing and proposed LUCs at the Site.

- Section 6 – Long Term Monitoring and Maintenance: This section presents the proposed post construction groundwater monitoring schedule to document the success of the remedy implementation.

- Section 7 – Implementation Schedule: This section provides the anticipated construction schedule to include start dates and durations for the various phases of construction.

- Section 8 – Health and Safety: This section describes the health and safety procedures developed for the Site. In general the existing approved site-wide Health and Safety Plan (HASP) will be used.

- Section 9 – References: Lists the documents referenced within the RD.

2. Design Criteria

Various objectives, criteria, and standards, including Applicable or Relevant and Appropriate Requirements (ARARs) as defined by CERCLA, were identified during preparation of the DD (U.S. Army 2013). These objectives, criteria, and standards guided the design of the remedial action.

2.1 Remedial Action Objectives

The RAOs, as stated in the DD (U.S. Army, 2013), are based on human health and environmental factors, and provided the basis for the formulation and development of the selected remedy. The RAOs for the selected remedy at the Site are as follows:

- Prevent human exposure to groundwater that would cause unacceptable risk over the duration of the response action.
- Achieve MCLs for the identified constituents of concern (COCs) in groundwater in a reasonable timeframe thereby restoring groundwater to its beneficial use.

2.2 Achieving the RAOs and Associated Requirements

The selected remedy will attain the above mentioned RAOs by reducing potential risk to human health through active groundwater treatment and MNA. Furthermore, existing LUCs will be enhanced and maintained to control future groundwater use at the Site. The CERCLA five-year review process, coupled with the annual land use certifications/inspections will be in place as long as contaminants on the site are above levels that would allow for unlimited use and unrestricted exposure in order to document that the remedy remains protective, and assess whether the remedy is functioning as intended with respect to meeting cleanup objectives.

2.3 State and Federal Regulatory Requirements

A comprehensive list of ARARs and To Be Considered criteria for implementation of the RD are in the DD (U.S. Army, 2013). The key regulatory programs considered during the design of the remedial action include the following:

- Local construction permits: The FGGM Dig Permit must be obtained 30 days prior to initiation of intrusive activities. It should be noted that the remediation shed installed for the DGR system is 100 square feet which does not require a Baltimore

County Building Permit. However, compliance with Baltimore County permitting requirements for all other applicable work activities will be adhered to.

- Health and Safety [29 CFR]: The Occupation Safety and Health Administration promulgate standards that regulate work to protect worker health and safety. In particular, the following regulations are applicable to Site work: (1) 29 CFR 1903 (Reporting and Recording Injuries and Illnesses), (2) 29 CFR 1910 (General Industry Standards), and (3) 29 CFR 1926 (Construction Industry Standards).

- Well Construction, Maintenance, and Abandonment [Code of Maryland Regulations (COMAR) 26.04.04]: Establishes requirements for well construction (design, construction materials, and construction procedures), proper maintenance to protect groundwater supplies, and standards for proper abandonment of wells.

- Control of Noise Pollution [COMAR 26.02.03] Applies to activities that produce regular or continuous sound that exceeds or may exceed established limits. It restricts noise to a level that protects the health, general welfare, and property of the people of the state.

- Underground Injection Control Program: A United States Environmental Protection Agency (USEPA) program that regulates the construction, operation, permitting, and closure of injection wells.

- Groundwater Appropriation of Use [COMAR 26.17.06] Regulates the appropriation and use of surface water or groundwater in order to conserve and protect water resources.

2.4 Site Considerations

In addition to the preceding regulatory considerations, the following Site-specific conditions are considered during the design of the remedial action:

- Local Residential Dwellings Located Adjacent to PMR: The Site is located adjacent to numerous residential dwellings. The close proximity of residential housing to the Site will be considered through the implementation of the remedial action. Site activities and final design will be conducted in a manner that minimizes interference and disturbances experienced by local residents.

- Underground Utilities: Underground utilities will be considered during all phases of the remedial action. During the utility locate process, it will be determined if there are any existing utilities present from the previous infrastructure that was removed from the Site.

3. Remedial Action – Directed Groundwater Recirculation

3.1 Directed Groundwater Recirculation System Design

3.1.1 Conceptual System Design

The purpose of the DGR system is to reduce the toxicity, mobility, and volume of COCs through treatment and provide hydraulic control to the core of the plume to further reduce mobility of the COCs. Contaminants in the extracted groundwater will be removed by ex-situ treatment using carbon adsorption; effectively reducing dissolved contaminant concentrations in groundwater in a relatively short timeframe by enhancing the existing natural attenuation processes and removing the highest contaminant concentrations.

3.1.2 System Description

FCA-01 will be utilized as the extraction well. Three wells will be used to inject the extracted water back into the subsurface following treatment as follows:

- One new injection well will be installed approximately 200 feet (ft) to the southwest of FCA-01 (identified as IW-3).
- A second new injection well will be installed approximately 155 ft to the southeast of FCA-01 (identified as IW-2).
- A third new injection well will be installed approximately 40 ft to the northeast of FCA-03 (identified as IW-1).
- One new monitoring well will be installed approximately 25 ft to the south of FCA-01 (identified as FCA-26).

The conceptual DGR system layout is displayed on **Figure 3-1**. The three new injection wells will be installed to a depth of approximately 75 ft below ground surface (bgs) and screened in the fractured schist bedrock from approximately 60 to 75 ft bgs. The new monitoring well will be installed to a depth of 72 ft bgs and screened in the fractures schist bedrock from approximately 62 to 72 ft bgs. The extraction well (FCA-01) is expected to yield between 1 to 3 gallon per minute (gpm); the treatment system can accommodate flows of up to 10 gpm based on availability of treatment equipment, however, that flow is not expected. Extracted groundwater will be directed to a165-

gallon polyethylene equalization (EQ) tank for storage to facilitate batch treatment, as needed, based on observed groundwater extraction rates. Extracted groundwater from the EQ tank will be pumped through a bag filter followed by two granular activated carbon units placed in series for treatment. The effluent will flow out through the discharge piping to the three injection wells.

The treatment equipment and controls will be housed in a structurally sound 10 ft by 10 ft wooden or metal storage enclosure, painted in a neutral color to best fit into the surrounding environment. The enclosure will be secured with a reinforced locking door and will not have windows for added security to the system components. An approximately 14-inch by 9-inch by 24-inch deep sump will be installed in the floor of the enclosure. In order to contain any potential leak in the treatment equipment, a high density polyethylene or equivalent liner will be installed across the surface of the floor and extend approximately 4-inches up the side walls of the building. The liner will also be sealed to the perimeter of the sump. A level switch will be installed in the sump and will disable the DGR system and engage an auto dialer when enabled to provide notification to operational staff. The walls and ceiling of the system building will be insulated and a 5-kilowatt electric heater will be installed to facilitate winter operation.

System flows will be monitored via flow meters installed on the influent piping within the system building and on each of the discharge lines leading to the three injection wells. Extracted groundwater and treated water force mains will be installed subgrade and enter the system enclosure through the floor to prevent freezing. Pressure gauges will be installed within the system building on the inlet and outlet of the bag filter, on each carbon drum, and on each injection line. Gate valves will be installed on each injection line to balance effluent flow to each injection well as necessary. System drawings, including a mechanical equipment layout, M-1, and a piping and instrumentation diagram, PID-1, are included in **Appendix A**.

3.1.3 System Startup Criteria

The following system checks will be performed to confirm the integrated operation of all equipment, instrumentation, and controls prior to system startup;

- Mechanical Check – Used to verify that all mechanical elements as presented on Drawing M-1 in **Appendix A** are installed and operating in accordance with the design and manufacturer's recommendations. This includes checking flow arrows on check valves and strainers, operating all manual valves through their entire

stroke, checking anchor bolts and clamps, and checking vertical and horizontal alignments.

- System Loop Checks – Used to verify electrical continuity and instrumentation and control response/interlocks as presented on Drawing PID-1 in **Appendix A**. This includes bumping all system motors to ensure proper rotation.

- Clean Water Test – Used to verify proper operation of all equipment and instrumentation in the system enclosure using clean water. System piping will be monitored for leaks. Operation of the extraction pump will be tested separately by enabling the extraction pump and filling the EQ tank.

- Integrated System Check – Following completion of the loop checks and clean water test, the integrated system check will be performed to ensure full system operation in an integrated manner, including proper alarm and interlock responses for alarm conditions that are generated.

These tests can be performed either at the system fabricator's facility, or on site depending on the system fabrication method. Testing observations and results will be documented. Any deficiencies identified during the testing will be corrected prior to system startup. Following successful completion of the above tests, system startup can be initiated.

During system startup, system flows and pressures will be monitored to ensure operation in accordance with design and equipment/instrumentation specifications and requirements.

3.1.4 Performance Monitoring Criteria

Data collected from the extraction, injection, and monitoring wells on site will be used to evaluate hydraulic influence and contaminant trends. Performance and operational data will be collected to satisfy the following criteria:

- Water levels on the property will be gauged quarterly during operation and maintenance (O&M) field work and gradients assessed to evaluate effectiveness of the recirculation system, confirm flow directions, and evaluate potential impact on plume geometry. In addition, groundwater samples will be collected quarterly at FCA-01, FCA-03, FCA-05, FCA-07, FCA-09, FCA-25, and FCA-26 and analyzed for VOCs during the first two years of operation of the DGR system.;

- Treatment effectiveness of the DGR system will be based upon determination of COC trends in monitoring and extraction wells described under the MNA program. Decreasing COC concentration trends were identified in the RI (ARCADIS, 2012) and are expected to continue during operation of the DGR. Specifically, linear regression will be performed after eight rounds of data are collected to identify decreasing trends with 95% confidence.; and,

- Confirm that Site COCs in groundwater are not migrating off-site towards residential dwellings.

3.1.5 Shutoff Criteria

Based upon design assumptions, operating the DGR system as presented on **Figure 3-1** is expected to decrease the TCE concentrations by an order of magnitude within five years by increasing the number of clean water pore flushes in the aquifer. Operation of the DGR is therefore planned to occur for five years. The duration of operation may be modified based upon TCE concentrations observed in FCA-01 and/or monitoring wells during MNA sampling. Linear regression analysis will be performed after eight rounds of data have been collected and decreasing trends for TCE will be calculated with 95% confidence. The attenuation rates calculated during operation of the DGR will be compared with the rates calculated prior to operation of the DGR (pre-DGR rate) calculated in ARCADIS (2012) to determine the relative impact of DGR system operation. Disabling and decommissioning the DGR system will occur when TCE concentrations have sufficiently decreased to allow MNA to address the remaining contaminant mass within a timeframe of approximately 10 years or less. This determination is anticipated to be made using concentrations achieved during operation of the DGR and projecting forward pre-DGR natural attenuation rates; it will be concluded that the site cleanup level for TCE of 5 ug/L will be achieved if the 95% upper confidence limit of the line falls below 5 ug/L at 10 years or less

Potential rebound of contaminant concentrations at FCA-01 will be monitored through MNA sampling detailed in Section 4 prior to decommissioning the DGR system. Further if rebound is observed after system shut-down, the DGR system will be restarted. Disabling and decommissioning the DGR system will occur when concentrations have sufficiently decreased based on periodic review of the groundwater concentration data to allow monitored natural attenuation to address the remaining contaminant mass. Based on the linear regressions completed for the Site, it is expected to take an additional 5 to 10 years (for a total remedial timeframe of 10 to 15 years) to achieve the cleanup goal of 5 parts per billion for TCE (ARCADIS, 2013).

3.2 Directed Groundwater Recirculation System Implementation

3.2.1 Permitting

The remedial actions taken at the Site will be implemented in accordance with permit requirements of MDE and Baltimore County. For PMR, these include the following:

- Well Permits – Baltimore County well permits will be obtained for each of the wells installed as part of this remedial action.

- Underground Injection Control – Regulates the subsurface emplacement of liquids through any of five classes of injection wells in order to prevent contamination of underground sources of drinking water. This regulation is applicable because the injection wells are considered to be Class V wells through which fluids will be injected into the ground.

- Groundwater Appropriation or Use - Regulates the appropriation and use of surface water or groundwater in order to conserve and protect water resources.

- Electrical Permits – Baltimore County electrical permits will be obtained for all electrical work conducted for the DGR system.

3.2.2 Utility Clearance

In accordance with Army and ARCADIS Utility Locate Procedures, utility clearance will be conducted prior to installing new wells or permanent infrastructure requiring sub-surface digging/trenching. Prior to drilling activities, a private utility locating company will be contracted to survey the site for underground utilities. ARCADIS employs a three-lines of evidence approach, using utility mark outs, review of available utility maps, visual inspection for utilities, and hand clearing. The area will be surveyed with ground penetrating radar and magnetic locating equipment to identify utilities not included under the public locating service. The proposed locations for the additional injection wells shown on **Figure 3-1** will be marked following utility locating. Necessary permits for the installation of the wells would be obtained prior to initiation.

3.2.3 Pre-Construction Testing

A hydrogeological understanding of the site and previous pumping activities indicate that low flow volumes will be achieved during extraction and injection activities. The

extraction rate from FCA-01 was estimated at 1 to 3 gpm based on pump rate and drawdown observations made during low flow sampling events. To verify the estimated extraction rate, sampling data from 5/26/2011 and 12/31/2012 were analyzed using the Theis Equation. The analysis showed that the calculated extraction flow rate required to dewater the well (1.5 gpm) is within the predicted range for full-scale pumping from FCA-01 (1 to 3 gpm) and represents a conservative extraction rate; the actual pumping rate will be less since full dewatering of the well is not desired.

ARCADIS is confident that the estimated extraction flow rate of 1 to 3 gpm will be consistent with and likely overestimate, the extraction flow rates that will be observed during full-scale extraction activities. This will be verified in the field during remedial construction and prove out of the system.

3.2.4 Access Clearing and Trenching

The extraction and injection pipe network will be below grade. The pipes will be installed using open trenching methods. Any area where installation disturbs the current condition of the Site will be restored to original condition following installation of the system pipe and electrical conduit.

The treatment system will be installed in a cleared area located adjacent to FCA-01. Minimal grading may be required to install the foundation for the treatment building. The proposed location of the equipment compound is in an area that will require minimal clearing of grass and shrubs, and likely no tree clearing will be necessary. A natural vegetation barrier will be preserved between the building and the property line. Trench configuration from the equipment compound to the injection wells will be installed along the tree line in an effort to minimize tree clearing at the Site. The conceptual DGR system layout is displayed on **Figure 3-1**. Best management practices will be implemented for erosion and sediment control during the construction phase.

3.2.5 Well Construction

The wells installed for the DGR system will be drilled via air rotary. Soil and bedrock samples will be collected via wire-line coring from the borings continuously from ground surface to the completion depth of each boring, estimated at approximately 75 ft bgs but is subject to change based on Site conditions. For the injection wells, each borehole shall be reamed using a 10-5/8 inch tri-cone bit or larger. For the monitoring

well, the borehole shall be reamed using a 8 inch tri-cone bit or larger. As previously mentioned, FCA-01 will be utilized as the extraction well. Well construction specifications for all the PMR wells are provided in **Table 3-1.** Review of the boring logs at FCA-01 indicate this well is suitable for groundwater extraction.

3.2.5.1 Injection Wells

The three additional injection wells will be constructed of four-inch diameter, Schedule 40 black carbon steel casing and stainless steel screen. The screens shall be constructed of "v"-shaped trapezoidal wire continuously wrapped around an array of equally spaced support rods of the same material. Each junction of wire/rod shall be resistance welded. The screens and end fittings shall be made of Type 316 stainless steel. The screens shall be 15 ft long (or constructed of flush threaded segments), with a screen slot size of 0.020-inch. Screens will be Johnson Small Diameter Free-Flow™ W60 construction and size 4P or equivalent. Following placement of the well, the borehole annulus will be backfilled with a Southern Products and Silica Company #2, or equivalent, primary sand pack with a uniformity coefficient of 2 or less to an elevation of 2 feet over the top of the screened interval. Two feet of a choker sand, Southern Products and Silica Company #1A sand pack pellets, or equivalent, will be set above the primary filter pack sand and topped with neat-cement-grout to within 2 ft bgs. A locking expansion cap will be installed to secure the top of each well riser and the wells will be completed in a well vault (Section 3.2.5.2). The injection well construction diagram is presented as Drawing M-2 in **Appendix A**. Well construction specifications for the remediation wells utilized for the DGR system are provided in **Table 3-2.**

3.2.5.2 Monitoring Well

The one additional monitoring well will be constructed of two-inch diameter, Schedule 40 polyvinyl chloride (PVC) casing. The screen shall be constructed of PVC. The screen shall be 10 ft long, with a screen slot size of 0.020-inch. Following placement of the well, the borehole annulus will be backfilled with a Southern Products and Silica Company #2, or equivalent, primary sand pack with a uniformity coefficient of 2 or less to an elevation of 2 feet over the top of the screened interval. Two feet of a bentonite seal will be set above the primary filter pack sand and topped with cement/bentonite grout to within 2 ft bgs. A locking expansion cap shall be installed to secure the top of the well riser and completed with a 3 ft x 3 ft concrete pad and a stick-up casing with protective bollards. Well construction specifications for the monitoring wells at PMR are provided in **Table 3-1.**

3.2.5.3 Well Vaults

The extraction and injection well vaults will be 30-inch diameter, 12-inch deep vaults to facilitate installation of valves and instrumentation necessary for control and monitoring of the system. Well vaults will be constructed of concrete or metal with protective cover.

3.2.6 Directed Groundwater Recirculation System Extraction, Distribution and Treatment Infrastructure

Riser piping connected to the submersible well pump will be 1/2 inch and will be routed from the extraction well to the treatment system enclosure. Conveyance piping will penetrate the floor of the treatment system enclosure and tie into the treatment system piping upstream of the influent EQ Tank. Extracted groundwater will flow through the system in accordance with drawing PID-1 and discharge to the injection wells. Conveyance piping to the injection wells will be 1-1/2 inch and exit the system enclosure through the floor and will be installed below frost depth which is approximately 3 ft bgs.

Power will be installed from nearest power drop to the treatment system power distribution panel installed on an exterior wall of the system enclosure. Solar power options will also be considered.

3.3 Directed Groundwater Recirculation System Startup, Operation and Shutdown

3.3.1 Startup/Shakedown

As previously discussed, level and pressure switches will be tested for proper operation and triggering of interlocks to enable and disable the system and engage the auto dialer. Pressure at each gauge will be recorded and compared to expected values. Switch and gauge locations are shown on the System Drawings in **Appendix A**.

Extracted groundwater flow to each injection well will be measured, recorded, and compared to expected values. Injection line flow will be balanced, as necessary, using the gate valves on each injection line. Flow meter locations are shown on the System Drawings in **Appendix A**.

Water table drawdown in the extraction well, mounding in the injection wells, and the influent flow rate will be measured and recorded. During initial operations, extracted groundwater will be directed to the EQ tank.

3.3.2 Operation

The system is designed to operate continuously. If continuous groundwater extraction cannot be sustained, or low extraction flow rates are observed, the system will operate in batches from the EQ tank to ensure optimum treatment through the filter and carbon vessels.

Low and high level switches installed in the EQ tank will control operation of the transfer pump which conveys extracted groundwater through the treatment system. Treated groundwater is discharged through the injection well manifold which splits the flow to each of the three injection wells. Flow is balanced between the injection wells using a gate valve and flow meter installed on each branch of the injection manifold. Operation of the extraction well will be controlled by a pressure switch installed on the influent piping. When pressure within the influent line drops below the set point (indicating a leak in the piping or pump cavitation), the extraction well pump will be disabled. A timer will be installed on the extraction well pump to allow for automated re-start after a preset amount of time to facilitate well recharge and reduce the frequency of operator visits to the site to restart the system. If multiple extraction well pumps shutdowns are observed within an operator-specified amount of time, the alarm condition will be communicated via the auto dialer to the system operator to troubleshoot the cause of the frequent shutdown conditions. A high pressure switch, installed on the piping downstream of the transfer pump, will disable the system and communicate the alarm condition via the auto dialer. High pressure on the discharge side of the transfer pump indicates blockage of the conveyance piping or fouling of the injection well and/or injection well piping network. See system controls details on Drawing PID-1 in **Appendix A**.

The DGR system will include a programmable logic controller (PLC) and auto-dialer for control and alarm callout capabilities. However, given the simplicity of the system, full remote parameter read-out and shutdown/restart capabilities were not included in the design. All flow and pressure readings are currently designed to provide local indication only (manual readings) and readings will not be transmitted to the PLC. System control consists of pressure switches installed on the extraction well line and upstream of the bag filters to generate an alarm, disable the system, and provide operator notification of the alarm condition. During startup activities and initial months

of operation, system pressures will be monitored at a higher frequency (i.e., minimum of 2 to 3 times per week) to baseline and understand the system operational parameters (pressure, flows). This will allow the field-adjustable pressure switch set-points to be optimized to detect system upset conditions. Further, routine monitoring will be used to establish the frequency of routine O&M activities, including bag filter change-outs and well maintenance. Equipment and instrumentation maintenance will be performed in accordance with the manufacturer's written instructions.

3.3.3 Performance Monitoring Plan

Monitoring of the system will be conducted monthly, or as indicated below, and will include the following:

- Inspect the system and well network. Correct any leaks or other unusual conditions.

- Record pressure gauge readings and compare to expected values. Make system adjustments as necessary.

- Record flow meter instantaneous and totalizer readings and compare to expected values. Make system adjustments as necessary.

- Collect groundwater samples from the influent, lead carbon effluent, and lag carbon effluent sample valves quarterly. When Site COCs (cis-1,2-dichloroethene [cis-1,2-DCE], TCE, and vinyl chloride) are detected in the lead carbon effluent, remove the lead drum, place the lag drum in the lead position, and place a new drum in the lag position.

- Measure water level in the extraction well. Adjust extraction well pumping rate if necessary. Adjust valves to redirect flow through or away from the equalization tank as necessary.

4. Monitored Natural Attenuation

Based on the review of available data collected during the RI (ARCADIS, 2012), natural attenuation processes are controlling plume migration and steadily reducing COC concentrations in groundwater. The presence of moderately anaerobic conditions in some wells and the detection of cis-1,2-DCE indicate reductive dechlorination of TCE. Groundwater monitoring to support the MNA portion of the remedy will be performed to confirm the effectiveness of natural attenuation. Because of the long period of record for groundwater analytical data at this site, MNA sampling annually is appropriate to continue to assess long term trends. This sampling will be implemented annually at all deep bedrock monitoring wells (FCA-01, FCA-03, FCA-05, FCA-07, FCA-09, FCA-13, FCA-15, FCA-17, FCA-19, FCA-21,FCA-25, and FCA-26) (**Figure 4-1**). Groundwater samples will be collected and analyzed for the following analytes:

- VOCs via USEPA Method 8260B;
- Total organic carbon (TOC) via Method SM 5310C;
- Anions including (SO_4, and NO_3) via Method 300.0; and
- Dissolved iron via USEPA Method 6010C

Biogeochemical results for TOC, nitrate, sulfate, and dissolved iron will be compared with baseline conditions established in ARCADIS (2012) to monitor the status of aquifer redox conditions over the course of the remedial action.

Annual groundwater sampling will continue at all MNA network locations, and performance monitoring of the DGR system at a subset of those wells (near the plume core) quarterly for the first two years for VOCs only. After eight data points have been collected, linear regression will be performed to test for significant increasing or decreasing concentration trends (at a 95% level). The results will be used to update calculations of MNA timeframes, as described previously.

Following shut-down of the system, annual monitoring will continue. Linear regression of COC concentrations will be performed on an annual basis for each monitoring location to confirm that COC concentrations are not increasing. Once concentrations at a monitoring location decrease below the MCL, and the linear regression indicates no significant increasing trend, consideration to discontinue groundwater sampling at that monitoring location will be evaluated with concurrence from the Army and MDE.

The requirements for the cessation of MNA will be evaluated during the CERCLA five year review process.

5. Land Use Controls

In addition to the active component of the remedial action (i.e., DGR system), existing LUCs, including institutional controls (ICs) and engineering controls (ECs), at PMR will be maintained and enhanced. ICs are administrative measures put in place to restrict human activity, in order to control future land use. The LUC boundaries for the Site are shown on **Figure 5-1**. The future use of the property at this point is undetermined. Transfer of the property is not anticipated, however, LUCs will include a groundwater use restriction to prevent uncontrolled exposure to groundwater until it meets the groundwater protection standard and is returned to its beneficial use.

ICs already in use at the PMR, and which provide layers of protection, are listed below:

- **Access Regulations**: Access regulations and controls are in place at PMR, Trespassing and unauthorized activities at PMR are illegal.
- **Army Military Construction Program Development and Execution**: AR 415-15 outlines pre-construction environmental survey procedures. Prior to construction activities, the Army categorizes the proposed construction site based on an environmental survey. Under this regulation, the Army must determine wetland status of the site, historical significance, and endangered species habitat identification.
- **Dig Permit Requirements**: The FGGM Directorate of Public Works requires a dig permit (Form #FGGM-DPW-1001) be submitted 30 days prior to initiation of intrusive activities at the Site (including PMR). The dig permit application specifies the location and the type of intrusive work to be performed. .

ECs, including signage (warning signs) describing restrictions of site use, will be installed. Annual inspections of the Site will be performed to establish that all on-site LUCs (for example, signage) are in good condition, to confirm that the land use of the Site has not changed, and that through visual inspection that groundwater is not in use.

The CERCLA five-year review process, coupled with the annual land use certifications/inspections will be in place as long as contaminants on the site are above levels that would allow for unlimited use and unrestricted exposure in order to document that the remedy remains protective, and assess whether the remedy is functioning as intended with respect to meeting cleanup objectives.

5.1 Land Use Control Implementation

ICs already in place as elements of required procedures at PMR include requirements to obtain excavation permits from the Directorate of Public Works for any intrusive activity at PMR; Master Plan Regulations; and the FGGM Geographical Information System Database. These ICs will be incorporated into CERCLA required procedures at PMR.

Signage will be installed as depicted on **Figure 5-2**. Signage will describe the restrictions of site use will be manufactured and installed in accordance with Technical Manual 5-807-10 – Signage.

Annual visual inspections will be performed to establish that all on-Site LUCs are in good condition and to confirm that the land use of the Site has not changed.

The Army will be responsible for implementation, maintenance, periodic inspection, reporting on, and enforcement of LUCs in accordance with the DD. Although the Army may transfer these responsibilities to another party by contract, property transfer agreement, or through other means, the Army will remain responsible for:

- Conducting five year reviews consistent with CERCLA requirements;
- Notifying MDE, and Baltimore County Department of Environmental Protection and Sustainability of any known LUC deficiencies or violations;
- Obtaining access to the property to conduct periodic inspections and any necessary response; and
- Ensuring that the LUC objectives are met to protect the integrity of the selected remedy.

A land use control annual inspection checklist has been included as **Appendix B**.

6. Long Term Monitoring and Maintenance

This section describes the post construction monitoring, and maintenance plan.

6.1 Site Inspection, Maintenance, and Land Use Controls

Upon approval of this RD by MDE, Site inspections will commence on an annual basis to confirm continued compliance with all LUC objectives. FGGM will maintain the records of these inspections, which will include the following:

- Evaluation of Land Use – The Site will be inspected to ensure that current land use has been maintained and conditions are protective of human health and the environment.

- Well Inspections – All network injection wells and monitoring wells will be inspected for damage. Any necessary repairs will be noted and will be conducted promptly.

Documentation of these annual site inspections will be documented using the Land Use Certification form provided in **Appendix B**.

7. Implementation Schedule

The remedial action will commence in the winter of 2014 pending MDE approval of this RD. It is anticipated that the field components of the remedial action discussed in this report will be conducted over a one-month period.

A proposed schedule is attached as **Figure 7-1**. The schedule illustrates the anticipated timeframes for conducting the individual components of the remedial action as well as the subsequent components of the selected remedy. The estimated timeframes are subject to change based on actual dates.

8. Safety and Health

All work performed at the Site will be in accordance with the approved Site-Wide HASP (ARCADIS, 2010) and with ARCADIS internal health and safety procedures. All Site personnel, contractors, subcontractors, and site visitors shall be in compliance with the health and safety procedures established by the Site-Wide HASP and ARCADIS internal standard operating procedures.

9. References

ARCADIS U.S., Inc. (ARCADIS). 2010. Health and Safety Plan for the Performance Based Acquisition at Fort George G. Meade. Final. October.

ARCADIS. 2011a. Quality Assurance Project Plan for the Performance Based Acquisition at Fort Meade. March 2011.

ARCADIS. 2011b. Sample and Analysis Plan for the Performance Based Acquisition at Fort Meade. March 2011.

ARCADIS. 2011c. Waste Management Plan for the Performance Based Acquisition at Fort Meade. October 2011.

ARCADIS. 2012. Remedial Investigation Report. Phoenix Military Reservation. Jacksonville, Maryland. Final. November.

ARCADIS. 2013. Focused Feasibility Study, Phoenix Military Reservation, Jacksonville, Maryland. Final. June.

Environmental Science and Engineering, Inc (ESE). 1983. Assessment of Contamination - Phoenix Military Reservation.

Malcolm Pirnie / Berger. 1999. Draft Remedial Investigation/Focused Feasibility Study Report. Prepared for the United States Army Corps of Engineers, Baltimore District. Contract Number DACA31-94-D-0017.

U.S. Army, 2013. Decision Document, Phoenix Military Reservation, Jacksonville, Maryland. Final. September.

Tables

Table 3-1
Well Construction Details
Phoenix Military Reservation
Jacksonville, Maryland

Well ID	Installation Date	Drilling Method	Well Driller	Borehole Diameter (inches)	Casing Material	Screen Diameter (inches)	Screen Material	Screen Slot Size	Screen Length (feet)	Depth to Top of Screen (ft bgs)	Depth to Bottom of Screen (ft bgs)	Top of Screen (ft msl)	Bottom of Screen (ft msl)	Ground Elevation (ft msl)	TOC Elevation (ft msl)
BMW-1	Unknown / May-06	Air Rotary	The Louis Berger Group	8	PVC	2	PVC	10 slot	6	15	21	526.54	520.54	541.54	544.07
FCA-2	October-82	Hollow-stem auger/ water rotary	ATEC Associates	8	PVC	2	PVC	10 slot	15	19	34	543.12	528.12	562.12	564.63
FCA-3	October-82 / May-06	Hollow-stem auger/ water rotary	ATEC Associates	8	PVC	2	PVC	10 slot	10	70	80	490.60	480.60	560.60	563.19
FCA-4	October-82	Hollow-stem auger/ water rotary	ATEC Associates	8	PVC	2	PVC	10 slot	15	26	41	533.89	518.89	559.89	560.96
FCA-5	October-82	Hollow-stem auger/ water rotary	ATEC Associates	8	PVC	2	PVC	10 slot	10	65	75	512.13	502.13	577.13	577.85
FCA-6	October-82	Hollow-stem auger/ water rotary	ATEC Associates	8	PVC	2	PVC	10 slot	20	32	52	545.39	525.39	577.39	580.08
FCA-7	October-82 / May-06	Hollow-stem auger/ water rotary	ATEC Associates	8	PVC	2	PVC	10 slot	10	84	94	492.22	482.22	576.22	578.54
FCA-8	October-82 / May-06	Hollow-stem auger/ water rotary	ATEC Associates	8	PVC	2	PVC	10 slot	20	32	52	544.08	524.08	576.08	578.29
FCA-9	November-82	Hollow-stem auger/ water rotary	ATEC Associates	8	PVC	2	PVC	10 slot	10	71	81	480.58	470.58	551.58	554.22
FCA-10	November-82	Hollow-stem auger/ water rotary	ATEC Associates	8	PVC	2	PVC	10 slot	15	22	37	529.78	514.78	551.78	554.21
FCA-12	October-82	Hollow-stem auger/ water rotary	ATEC Associates	8	PVC	2	PVC	10 slot	10	36	46	538.33	528.33	574.33	576.78
FCA-13	May-06	Air Rotary	The Louis Berger Group	8	PVC	2	PVC	10 slot	20	60	80	468.01	448.01	528.01	530.58
FCA-15	May-06	Air Rotary	The Louis Berger Group	8	PVC	2	PVC	10 slot	10	22	32	365.86	355.86	387.86	391.00
FCA-16	May-06	Air Rotary	The Louis Berger Group	8	PVC	2	PVC	10 slot	10	4	14	384.35	374.35	388.35	391.56
FCA-17	May-06	Air Rotary	The Louis Berger Group	8	PVC	2	PVC	10 slot	25	77	102	438.85	413.85	515.85	515.52
FCA-18	May-06	Air Rotary	The Louis Berger Group	8	PVC	2	PVC	10 slot	20	22	42	490.76	470.76	512.76	512.70
FCA-19	May-06	Air Rotary	The Louis Berger Group	8	PVC	2	PVC	10 slot	20	85	105	428.07	408.07	513.07	513.08
FCA-20	May-06	Air Rotary	The Louis Berger Group	8	PVC	2	PVC	10 slot	15	20	35	494.33	479.33	514.33	514.46
FCA-21	May-06	Air Rotary	The Louis Berger Group	8	PVC	2	PVC	10 slot	25	60	85	417.27	392.27	477.27	477.30
FCA-22	May-06	Air Rotary	The Louis Berger Group	8	PVC	2	PVC	10 slot	10	4	14	472.43	462.43	476.43	476.24
FCA-23	May-06	Air Rotary	The Louis Berger Group	8	PVC	2	PVC	10 slot	15	11	26	492.64	477.64	503.64	506.19
FCA-24	May-06	Air Rotary	The Louis Berger Group	8	PVC	2	PVC	10 slot	15	24	39	487.73	472.73	511.73	514.72
FCA-25	May-11	Air Rotary	Parratt-Wolff	8	PVC	2	PVC	20 slot	15	70	85	505.20	490.20	575.20	578.09
FCA-26[1]	--	Air Rotary	DTCI	8	PVC	2	PVC	20 slot	10	62	72	--	--	--	--

Acronyms and Abbreviations:

[1] - FCA-26 will be installed during remedial design implementation

PVC = polyvinyl chloride

ft bgs = feet below ground surface

ft msl = feet mean sea level

TOC = top of casing

Table 3-2
Remediation Well Construction Specifications
Phoenix Military Reservation
Jacksonville, Maryland

Well ID	Installation Date	Drilling Method	Well Driller	Borehole Diameter (inches)	Casing Material	Screen Diameter (inches)	Screen Material	Screen Slot Size	Screen Length (feet)	Top of Screen (ft bgs)	Bottom of Screen (ft bgs)	Top of Screen (ft msl)	Bottom of Screen (ft msl)	Ground Elevation (ft msl)	TOC Elevation (ft msl)
FCA-1	November-82	Hollow-stem auger/ water rotary	ATEC Associates	8	PVC	2	PVC	10 slot	10	62	72	498.39	488.39	560.39	563.02
IW-1[(1)]	January-13	Air rotary	N/A	10-5/8 (min.)	Black steel	4	Stainless steel	20 slot	15	60	75	N/A	N/A	N/A	N/A
IW-2[(1)]	January-13	Air rotary	N/A	10-5/8 (min.)	Black steel	4	Stainless steel	20 slot	15	60	75	N/A	N/A	N/A	N/A
IW-3[(1)]	January-13	Air rotary	N/A	10-5/8 (min.)	Black steel	4	Stainless steel	20 slot	15	60	75	N/A	N/A	N/A	N/A

Notes:
(1) Injection wells IW-1, IW-2 and IW-3 have not been installed. Final well construction details will be provided following well installation and completion.

Acronyms and Abbreviations:
PVC = polyvinyl chloride
ft bgs = feet below ground surface
ft msl = feet mean sea level
TOC = top of casing
N/A = not available

Figures

CITY: MPLS DIV/GROUP: IM DB: MG LD: PIC: PM: TM: TR:
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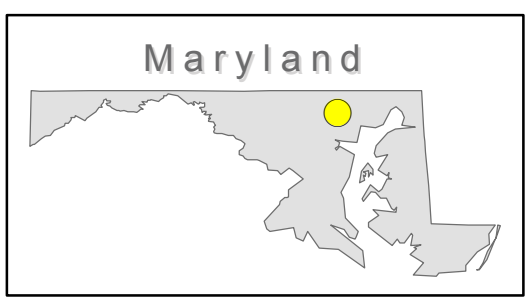

0 0.25 0.5
APPROXIMATE SCALE IN MILES

PHOENIX MILITARY RESERVATION
JACKSONVILLE, MARYLAND

SITE LOCATION

ARCADIS

FIGURE
1-1

CITY: MPLS DIV/GROUP: IM DB: MG LD: KS
PHOENIX MR
Path: G:\GIS\Projects\Fort_Meade\Phoenix MR\SITE_LOCATION\MNA_Meeting\mxd\2014\Conceptual_Layout_20140207.mxd

Legend

May 2011 Trichloroethene Concentration

- 5 µg/L
- 10 µg/L
- 100 µg/L

5 TCE concentration in µg/L

- Deep Monitoring Well Location
- Lineament
- Stream
- Natural Spring
- Extraction Well
- Recirculation Well
- Subsurface Piping
- House
- Approximate Site Boundary

Note:
ND = Non-Detect
J = estimated concentration
µg/L = micrograms per liter

0 200 400
SCALE IN FEET

PHOENIX MILITARY RESERVATION
JACKSONVILLE, MARYLAND

DIRECTED GROUNDWATER RECIRCULATION CONCEPTUAL LAYOUT

ARCADIS

FIGURE
3-1

CITY: MPLS DIV/GROUP: IM DB: MG LD: KS
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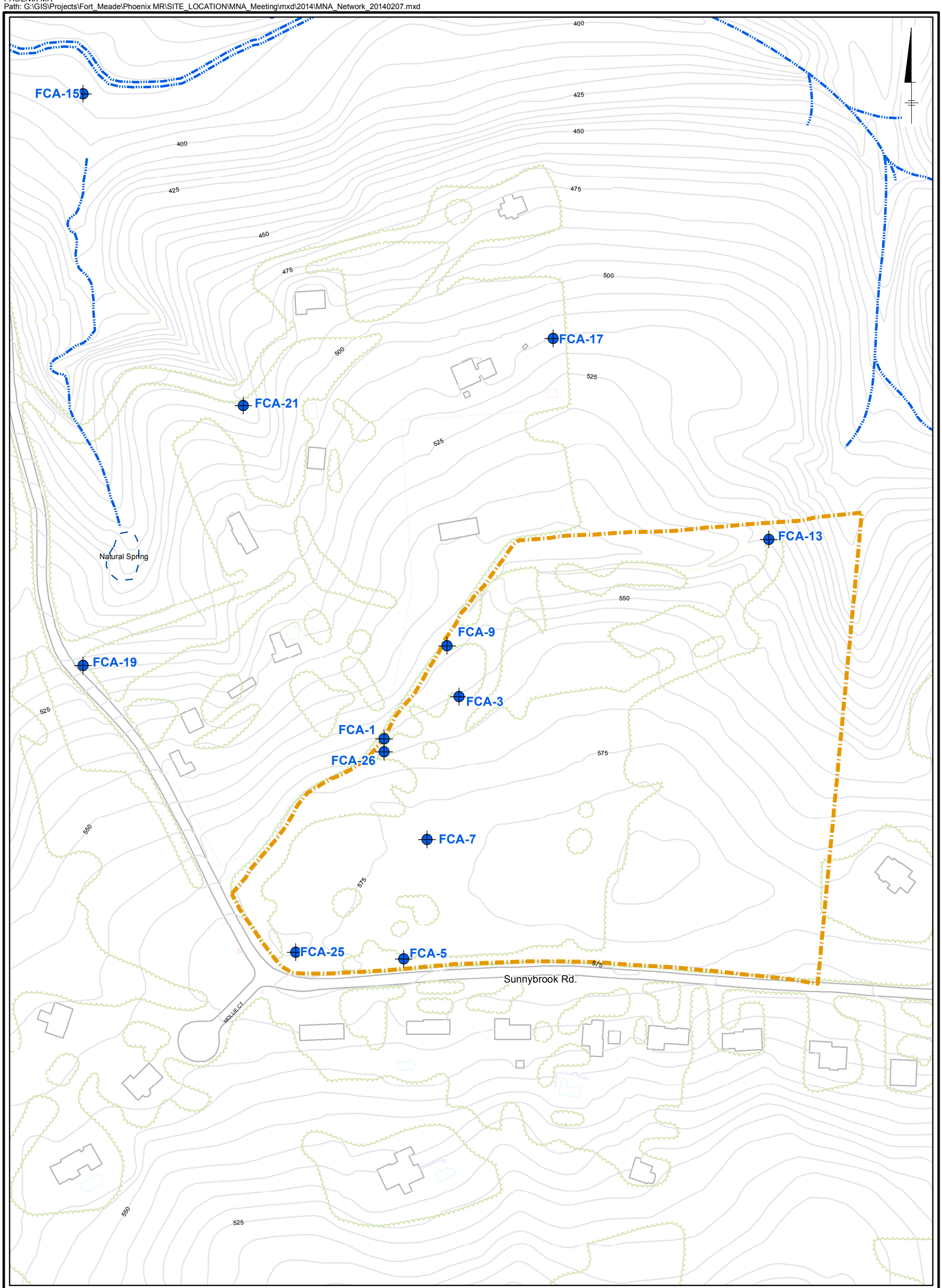


Legend

- Deep Monitoring Well Location
- Stream
- Natural Spring
- Approximate Site Boundary

0 200 400
SCALE IN FEET

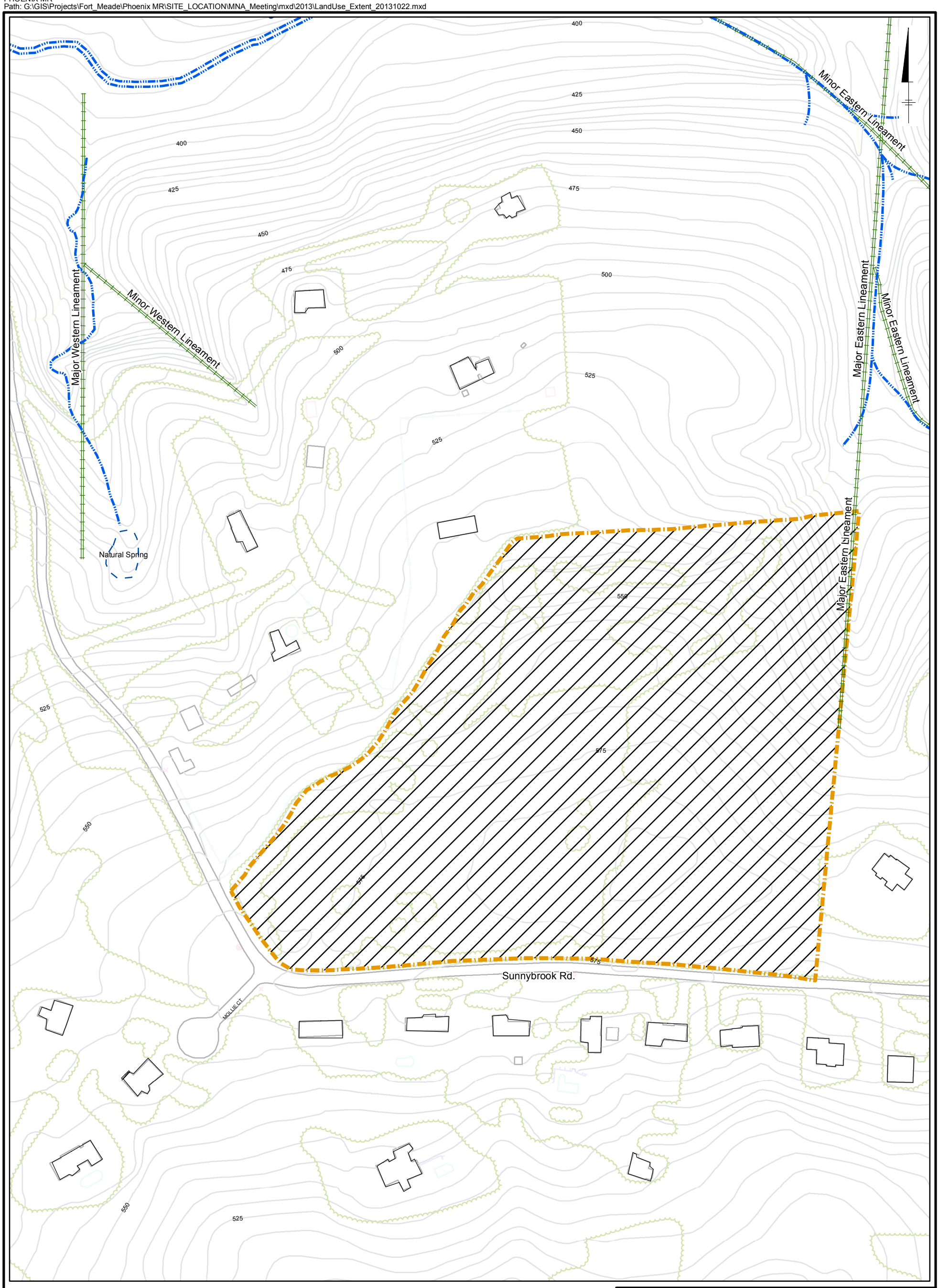
PHOENIX MILITARY RESERVATION
JACKSONVILLE, MARYLAND

MONITORED NATURAL ATTENUATION WELL NETWORK

ARCADIS

FIGURE
4-1

CITY: MPLS DIV/GROUP: IM DB: MG LD: KS
PHOENIX MR
Path: G:\GIS\Projects\Fort_Meade\Phoenix MR\SITE_LOCATION\MNA_Meeting\mxd\2013\LandUse_Extent_20131022.mxd



Legend

- Extent of Land Use Controls
- Approximate Site Boundary
- Lineament
- Stream
- Natural Spring
- House

0 200 400
SCALE IN FEET

PHOENIX MILITARY RESERVATION
JACKSONVILLE, MARYLAND

EXTENT OF LAND USE CONTROLS

ARCADIS

FIGURE
5-1

CITY: MPLS DIV/GROUP: IM DB: MG LD: KS
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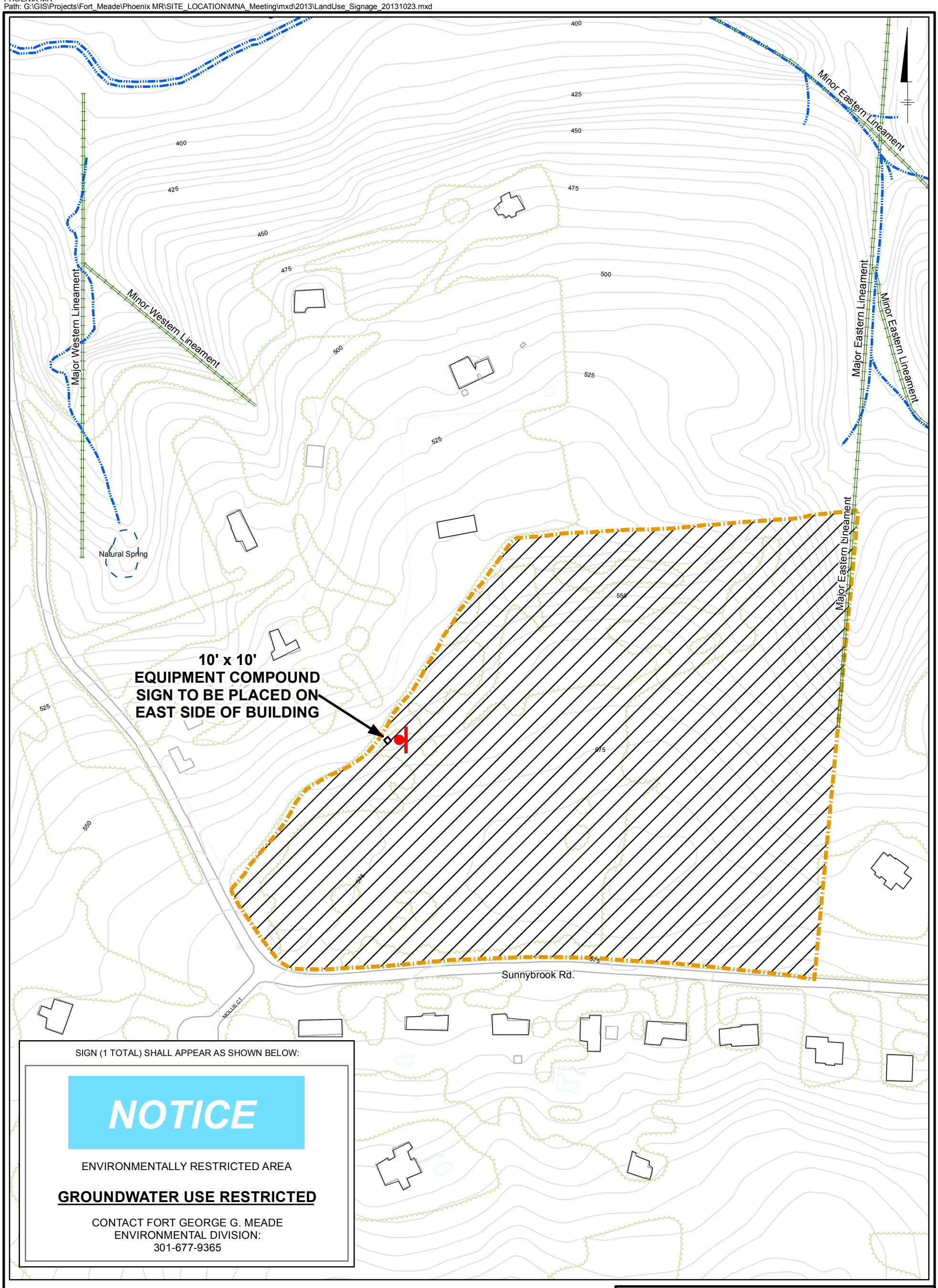


Legend

- Sign Locations
- Extent of Land Use Controls
- Approximate Site Boundary
- Lineament
- Stream
- Natural Spring
- House

0 200 400
SCALE IN FEET

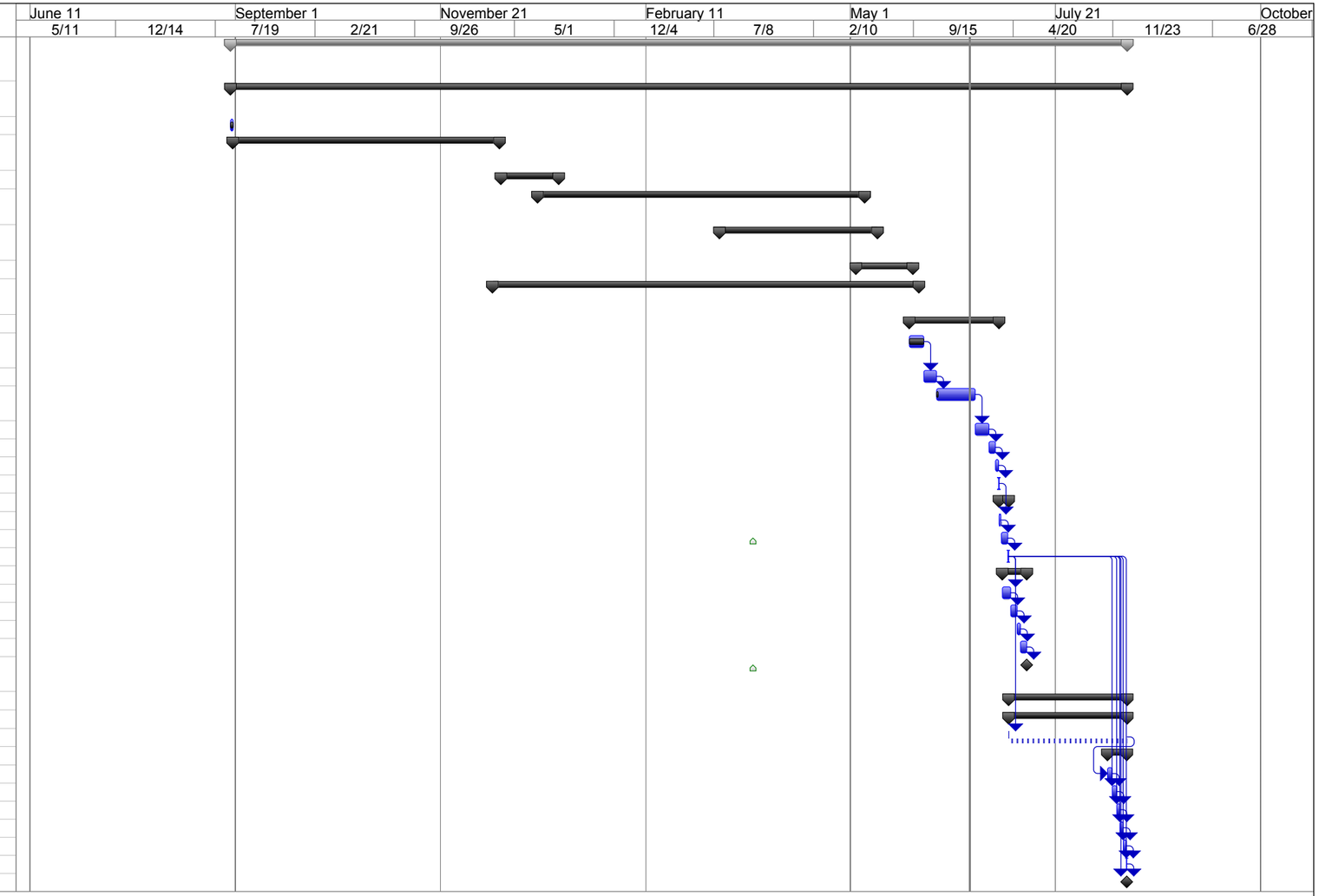
PHOENIX MILITARY RESERVATION
JACKSONVILLE, MARYLAND

LAND USE CONTROL SIGNAGE

ARCADIS

FIGURE
5-2

ID	Task Name	Duration	Start	Finish	Predecessors
0	**GP09MEAD_PHOE-Fort Meade**	**1366.11 days**	**Fri 8/21/09**	**Wed 12/24/14**	
1	**PMR-001 - Phoenix - Former Septic System (MDE Lead)**	**1366.11 days**	**Fri 8/21/09**	**Wed 12/24/14**	
2	Initial Planning	4 days	Fri 8/21/09	Wed 8/26/09	
3	**Remedial Investigation Work Plan**	**407.13 days**	**Wed 8/26/09**	**Tue 3/29/11**	
41	**Field Work**	**88 days**	**Fri 4/1/11**	**Fri 8/5/11**	
47	**Remedial Investigation Report**	**499.88 days**	**Mon 6/20/11**	**Fri 5/31/13**	
55	**Feasibility Study (MDE Lead)**	**241 days**	**Fri 7/20/12**	**Fri 6/28/13**	
66	**Proposed Plan**	**87 days**	**Mon 5/13/13**	**Fri 9/13/13**	
78	**Decision Document (MDE)**	**651 days**	**Mon 3/14/11**	**Thu 9/26/13**	
89	**Remedial Design**	**136.11 days**	**Fri 9/6/13**	**Thu 3/20/14**	
90	Internal Draft Remedial Design	21.24 days	Fri 9/6/13	Mon 10/7/13	82
91	Army Review	20 days	Mon 10/7/13	Mon 11/4/13	90
92	Draft Final Remedial Design	56.88 days	Mon 11/4/13	Mon 1/27/14	91
93	MDE Review	22 days	Mon 1/27/14	Wed 2/26/14	92
94	Comment Resolution	10 days	Wed 2/26/14	Wed 3/12/14	93
95	Final Remedial Design	5 days	Wed 3/12/14	Wed 3/19/14	94
96	Approved RD	1 day	Wed 3/19/14	Thu 3/20/14	95
97	**Remedial Action**	**15 days**	**Thu 3/20/14**	**Thu 4/10/14**	
98	Mobilization	3 days	Thu 3/20/14	Tue 3/25/14	96
99	Implement RA	10 days	Tue 3/25/14	Tue 4/8/14	98
100	Demobilization	2 days	Tue 4/8/14	Thu 4/10/14	99
101	**Remedial Action Report**	**37.88 days**	**Thu 3/27/14**	**Mon 5/19/14**	
102	Draft	12.88 days	Thu 3/27/14	Mon 4/14/14	100FS-10 days
103	Army Review	10 days	Mon 4/14/14	Mon 4/28/14	102
104	Draft Final	5 days	Mon 4/28/14	Mon 5/5/14	103
105	MDE Review	10 days	Mon 5/5/14	Mon 5/19/14	104
106	Approved RAR (GW RIP and SL RIP)	0 days	Mon 5/19/14	Mon 5/19/14	105
107	**LTO/LTM**	**180 days**	**Thu 4/10/14**	**Wed 12/24/14**	
108	**Year 1 (2014)**	**180 days**	**Thu 4/10/14**	**Wed 12/24/14**	
109	LTO/LTM	180 days	Thu 4/10/14	Wed 12/24/14	100
110	**Annual Report**	**29 days**	**Tue 11/11/14**	**Tue 12/23/14**	
111	Draft	8 days	Tue 11/11/14	Fri 11/21/14	109FS-30 days
112	Army Review	5 days	Fri 11/21/14	Mon 12/1/14	100,111
113	Draft Final	5 days	Mon 12/1/14	Mon 12/8/14	112,100
114	MDE Review	5 days	Mon 12/8/14	Mon 12/15/14	113,100
115	EPA Review	5 days	Mon 12/15/14	Mon 12/22/14	100,114
116	Final	1 day	Mon 12/22/14	Tue 12/23/14	100,115
117	Approved	0 days	Tue 12/23/14	Tue 12/23/14	116,100

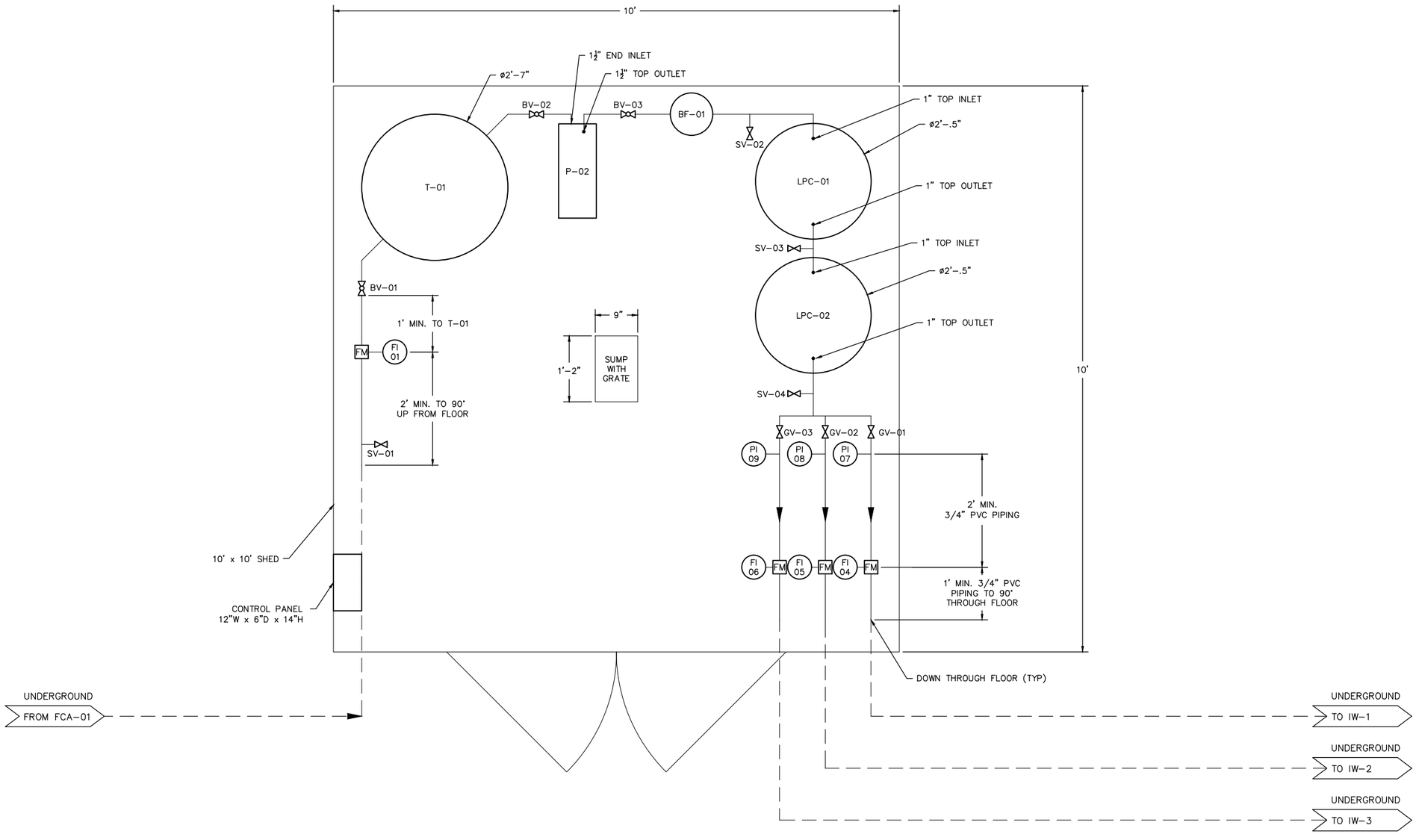


Project: GP09MEAD_PHOE-Fort MEa
Date: Thu 1/16/14

Task		Group By Summary		External Milestone		Duration-only		Deadline	
Split		Rolled Up Task		Inactive Task		Manual Summary Rollup		Progress	
Milestone		Rolled Up Milestone		Inactive Milestone		Manual Summary			
Summary		Rolled Up Progress		Inactive Summary		Start-only			
Project Summary		External Tasks		Manual Task		Finish-only			

Appendix A

System Drawings



NOTES:

1. LOCATE SUMP TO ALLOW 3' WIDE MINIMUM WALKWAY.

CITY: MINNEAPOLIS, MN DIV/GROUP: ENV/CAD DB: R. OBERLANDER LD: PIC: T. TALELE PM: T. LLEWELLYN TM: W. KAHL
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Professional Engineer's Name
Professional Engineer's No.
State | Date Signed | Project Mgr. PP
Designed by | Drawn by | Checked by

DRAFT

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OPERABLE UNIT 4 • FORT GEORGE G. MEADE, MARYLAND
REMEDIAL DESIGN PLAN

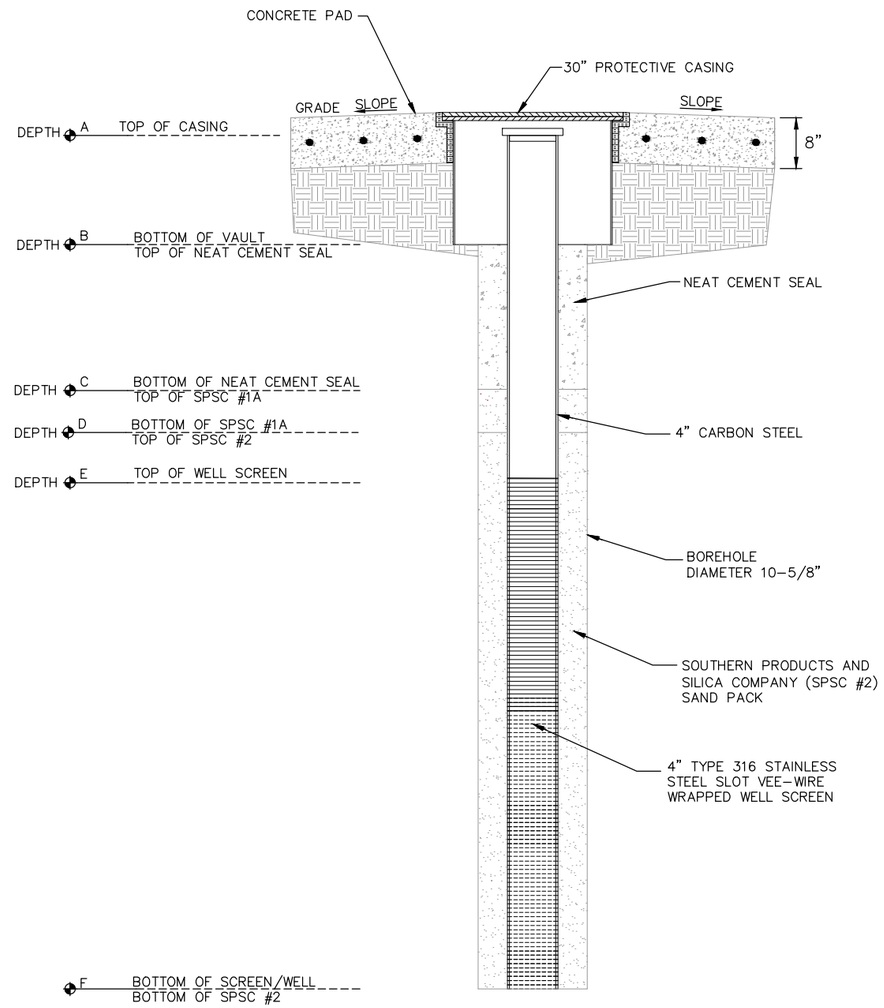
EQUIPMENT LAYOUT

MECHANICAL

ARCADIS Project No. GP09MEAD.PHOE.HG001
Date OCTOBER 2013

ARCADIS
430 FIRST AVE N, SUITE 720
MINNEAPOLIS,MN 55401
TEL:612-339-9434

M-1



INJECTION WELL DETAIL

NOT TO SCALE

WELL CONSTRUCTION SCHEDULE (DEPTHS ARE BELOW GRADE)						
WELL TYPE	A	B	C	D	E	F
DEEP INJECTION	9"	3'	56'	58'	60'	75'

NOTE:

1. ALL DIMENSIONS ARE APPROXIMATE AND ARE SUBJECT TO CHANGE BASED ON ACTUAL CONDITIONS ENCOUNTERED IN FIELD.
2. WELL CONSTRUCTION DEPTHS ARE APPROXIMATE.

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G:\ENVCAD\Minneapolis-MN\ACT\GP09MEAD\PHOE\HG001\DWG\GP09MEAD_M2.DWG LAYOUT: M-2 SAVED: 10/17/2013 2:57 PM ACADVER: 18.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ---- PLOTTED: 10/17/2013 2:58 PM BY: OBERLANDER, ROSEANNE

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Professional Engineer's Name
Professional Engineer's No.
State | Date Signed | Project Mgr. PP
Designed by | Drawn by | Checked by

DRAFT

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OPERABLE UNIT 4 • FORT GEORGE G. MEADE, MARYLAND
REMEDIAL DESIGN PLAN

TREATED GROUNDWATER INJECTION WELL CONSTRUCTION DETAIL

MECHANICAL

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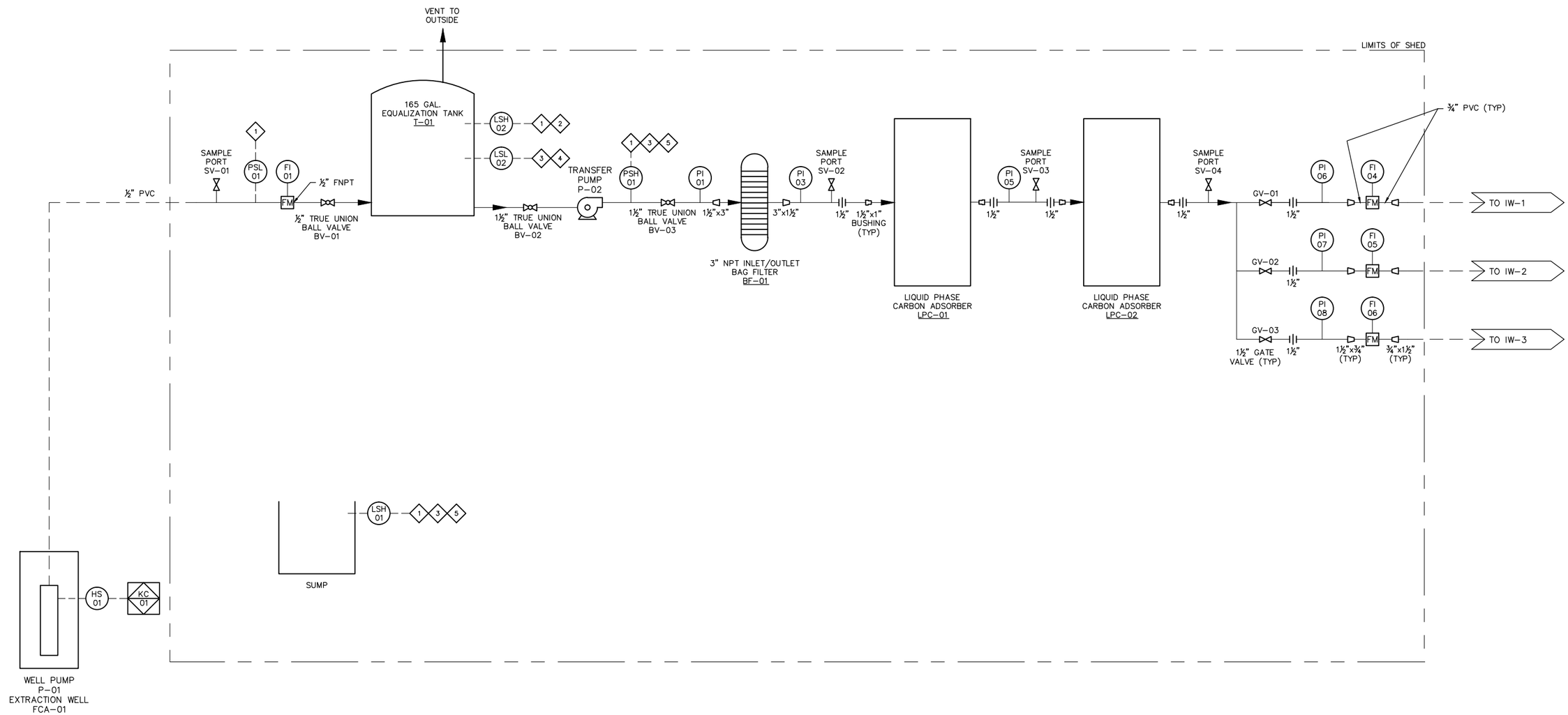

INTERLOCKS

1. STOP P-1
2. START P-2
3. STOP P-2
4. START P-1
5. AUTODIALER CALL OUT

NOTES:

1. SYSTEM PIPING IS 1 ½" SCHEDULE 40 PVC UNLESS OTHER SIZE IS NOTED.
2. TWO FEET OF ½" PIPING WILL BE INSTALLED UPSTREAM OF EACH FLOW METER, AND ONE FOOT OF ½" PIPING WILL BE INSTALLED DOWNSTREAM OF EACH FLOW METER.
3. TIMER WILL BE USED TO RE-START EXTRACTION WELL PUMP (P-01) AFTER PRESET AMOUNT OF TIME (INPUT BY OPERATOR) FOLLOWING ACTIVATION OF LOW PRESSURE SWITCH, PSL-01.

LEGEND

- GATE VALVE
- BALL VALVE
- REDUCER
- UNION
- BUSHING
- PUMP
- FLOW METER
- UNDERGROUND PIPING

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Professional Engineer's Name
Professional Engineer's No.
State | Date Signed | Project Mgr. PP
Designed by | Drawn by | Checked by

DRAFT

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OPERABLE UNIT 4 • FORT GEORGE G. MEADE, MARYLAND
REMEDIAL DESIGN PLAN

PIPING AND INSTRUMENTATION DIAGRAM

ARCADIS Project No. GP09MEAD.PHOE.HG001
Date OCTOBER 2013
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430 FIRST AVE N, SUITE 720
MINNEAPOLIS,MN 55401
TEL:612-339-9434

PID-1

CITY: MINNEAPOLIS, MN DIV/GROUP: ENV/CAD DB: R. OBERLANDER LD: PIC: T. TALELE PM: T. LLEWELLYN TM: W. KAHL
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Appendix B

Annual Land Use Control Inspection Checklist

Annual Inspection Checklist for Land Use Evaluation
Phoenix Military Reservation
Jacksonville, Maryland

Inspector: _____
Date: _____

1. Land Use Evaluation

1. Inspector walked over entire site. ____ Yes ____ No

Reason why not?

2. Check for <u>any</u> signs of the following conditions - note whether corrective action was taken:

Condition	Yes/No	Corrective Action Taken	Designation of Location Shown on Attached Map
Intrusive Activities			
Construction Activities			
Signs of Erosion			
Other			

3. Signs appropriately posted:
4. Condition of the signs:
5. Condition of the perimeter fence surrounding the Site:

Sign noting the following (# of signs installed):	Yes/No/#	Corrective Action Taken
Groundwater Use Restricted		

6. Were any visual signs of disturbance or construction activities noted during inspection? If yes, please describe in detail below: ____ Yes ____ No

7. Photo Log:

Photo Number	Description	Direction Facing

8. Other observations: