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MONITORED NATURAL ATTENUATION PLAN

SOLVENT DOCK AREA

Former Lockheed Martin French Road Facility
Utica, New York

October 2009

Monitored Natural Attenuation Plan
Solvent Dock Area, Former Lockheed Martin
Former French Road Facility, Utica, New York

Prepared for:
Lockheed Martin Corporation

Prepared by:
ARCADIS, Inc.
465 New Karner Road
First Floor
Albany
New York 12205
Tel 518 452 7826
Fax 518 452 7086

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Jeffrey Bonsteel
Project Scientist

Christopher J. Motta, CPG
Project Manager

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Acronyms

AOC	Area of Concern
BBL	Blasland, Bouck, & Lee, Inc.
BDL	below detection limit
bgs	below ground surface
CMS	Corrective Measures Study
COC	contaminants of concern
CVOC	chlorinated volatile organic compound
GCTS	groundwater collection and treatment system
GE	General Electric Company
IRM	interim remedial measure
MMC	Martin Marietta Corporation
MNA	monitored natural attenuation
NYSDEC	New York State Department of Environmental Conservation
OCIDA	Oneida County Industrial Development Agency
OSWER	Office of Solid Waste and Emergency Response
QAPP	*Site-Specific Quality Assurance Project Plan*
RAO	remedial action objective
SMP	*Site Management Plan*
SOP	standard operating procedure
SPDES	State Pollutant Discharge Elimination System
TOGS	*Technical Operational and Guidance Series*
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound

1 Introduction

ARCADIS prepared this Monitored Natural Attenuation Plan (MNA Plan) for Lockheed Martin Corporation (Lockheed Martin) to evaluate the efficacy of the groundwater remedy at the Solvent Dock Area at the former Lockheed Martin French Road facility (the Site) in Utica, New York. This MNA Plan describes the requirements for operation, maintenance, and monitoring of this remedial system (herein the “MNA system”). The Site is occupied by a 500,000-square-foot manufacturing building at 525 French Road in Utica, New York (Oneida County) (see Figure 1). Various Site environmental investigations have identified chlorinated volatile-organic compounds (CVOCs) as the primary contaminants of concern (COC) in groundwater. Site groundwater was defined [in the October 3, 2008 “Order on Consent” (the Order) issued by the New York State Department of Environmental Conservation (NYSDEC) (CO 6-20080321-5)] as one of five “Areas of Concern” (AOC). As part of the Corrective Measures Study Report (CMS Report, ARCADIS 2009), MNA was selected as one of the remedial technologies for the corrective measures alternative to address groundwater contamination at the Site.

1.1 Remedial Action Objectives

The goal of the MNA system is to reduce concentrations of COC in groundwater to NYSDEC groundwater-quality standards, and to protect human health and the environment. The remedial action objectives (RAOs) for MNA-system operation are as follows:

- Demonstrate that concentrations of COC in groundwater at the Site are not a significant risk to human health or the environment;
- Prevent migration of contaminants in groundwater at concentrations above cleanup goals; and
- Prevent off-Site migration of COC in groundwater at concentrations exceeding cleanup goals.

The system achieves these objectives through natural attenuation (described in fuller detail in Section 1.2).

1.2 Description of Treatment Technology

MNA [as defined by the United States Environmental Protection Agency (USEPA) in Office of Solid Waste and Emergency Response (OSWER) "Directive 9200.4-17P" (1999)] refers to the reliance on natural attenuation processes to achieve Site-specific remedial objectives within a reasonable period (as compared to other methods). Under favorable conditions, these natural attenuation processes (biodegradation, dispersion, dilution, sorption, volatilization, chemical or biological stabilization, transformation, or destruction of contaminants) act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in soil and groundwater. The time required for these processes to reduce contaminant concentrations to levels that protect human health and the environment varies widely among different hydrogeologic systems and different chemical contaminants, and depends on the quantity of contaminant released. In general, MNA is an appropriate remediation method only where its use would protect human health and the environment and where can achieve Site-specific remediation objectives within a reasonable period (as compared to other alternatives). When relying on natural attenuation processes for Site remediation, USEPA prefers processes that degrade or destroy contaminants. USEPA recognizes MNA as a complementary process to other remediation technologies (e.g., source control). Also, USEPA generally expects that MNA will only be appropriate for sites with a low potential for contaminant migration (USEPA 1999).

The various natural processes involved in MNA are defined as follows:

- Biodegradation— The change in form of compounds carried out by living creatures such as microorganisms. Under optimal conditions, microorganisms can cause or assist chemical reactions that change the form of the contaminants such that little or no health risk remains.

- Dispersion and dilution— As dissolved contaminants move farther away from the source area, they disperse and are diluted to progressively lower concentrations over time. Contaminant concentrations may eventually be sufficiently reduced so that risk to human and environmental health will be minimal.

- Sorption— Soil and sediment particles (sand, silt, clay, organic matter) through which groundwater and dissolved contaminants move can sorb the contaminant molecules onto the particle surfaces, and hold bulk liquids in the pores in and between the particles, thereby slowing or stopping contaminant migration.

- Chemical reactions— Some contaminants, such as trichloroethane, can undergo significant degradation by chemical reactions without microbial activity. In addition, recent research has shown that enhanced tetrachloroethene and dichloroethene degradation reactions can occur by alternative, abiotic mechanisms that proceed to different products. In particular, a variety of iron- and sulfur-bearing mineral species take part in degradation reactions with chlorinated ethenes at the mineral-water interface. Abiotic-reaction conditions favor transformation of chlorinated ethenes by dichloroelimination rather than by sequential hydrogenolysis (Suthersan 2005).

- Volatilization— Many organic contaminants (e.g., petroleum hydrocarbons and chlorinated solvents) evaporate readily into the atmosphere, where air currents disperse the contaminants, thus reducing concentrations in groundwater.

Groundwater cleanup goals for the Site are the NYSDEC *Technical Operational and Guidance Series (TOGS) 1.1.1 Ambient Water-Quality Standards and Guidance Values*. Remedial criteria for Site groundwater (per the Order) are that groundwater contaminants do not pose a threat to human health or the environment.

Site conditions meet the criteria for MNA because:

- Contaminants in groundwater have the potential to be remedied by natural attenuation processes.

- The contaminant plume appears stable, with low potential that environmental conditions influencing plume stability will change over time.

- Human health, drinking water supplies, other groundwater, surface water, ecosystems, sediments, air, or other resources would not be adversely affected as a consequence of selecting MNA as the remediation option; little or no demand is projected for the affected groundwater over the period during which the remedy would remain in effect.

- The contamination would not exert a long-term detrimental effect on available water supplies or other environmental resources.

- The estimated remediation period is acceptable.
- No continuing source of contamination exists.
- Reliable site-specific mechanisms for implementing institutional controls are available.

As selected in the *CMS Report*, the major components of the selected corrective-measures alternative for groundwater at the Site include MNA, operation and maintenance of the existing groundwater collection and treatment system (GCTS), and institutional controls.

2 Site Background

2.1 Site Location and History

In the early 1950s, General Electric Company (GE) acquired approximately 55 acres of undeveloped land on French Road in Utica, New York and constructed a 500,000-square-foot manufacturing facility. Figure 1 presents a Site location map. GE production operations included manufacturing, assembly, and testing of electrical components for the defense and aerospace industries. GE operations continued until April 1993, when the facility was acquired by Martin Marietta Corporation (MMC). In March 1995, MMC merged with Lockheed Corporation to form Lockheed Martin Corporation. In March 1996, Lockheed Martin sold the property to Pinnacle Park, Inc., which subsequently transferred the property to and leased it back from the Oneida County Industrial Development Agency (OCIDA). ConMed Corporation (ConMed), a medical supplies manufacturer and distributor, now occupies the facility under a lease with OCIDA. Lockheed Martin retains responsibility for environmental cleanup activities related to past releases at the Solvent Dock Area even though they no longer own the property.

Groundwater in the northeast portion of the main manufacturing building (see Figure 2), in an area known as the Solvent Dock and an area along the former northern-perimeter ditch, has been adversely affected by volatile organic compounds (VOCs). The former Solvent Dock and immediate vicinity (referred to as the Solvent Dock Area) included a 275-gallon fiberglass overflow-retention tank. This tank was used to store spent waste solvents, which were periodically sampled, pumped from the tank, and disposed by waste haulers. The tank was removed in June 1990 and was observed to be dented and leaking fluid. The former northern-perimeter ditch (along the northern property boundary) was an open-drainage swale which received stormwater from the area north of the manufacturing building and conveyed the water, along with stormwater from the western portion of the property, to a manhole before eventually discharging to the municipal storm sewer.

Since 1991, GE, MMC, and Lockheed Martin have completed several groundwater investigations in these areas. In November 1994, Blasland, Bouck, & Lee, Inc. (BBL) completed an investigation of the facility storm-sewer in the Solvent Dock Area. The investigation determined that VOCs detected in the storm sewer were attributable to the discharge of VOC-impacted groundwater into the northern perimeter ditch and infiltration of VOC-impacted groundwater from the Solvent Dock Area into the storm sewer beneath the building.

In May 1995, BBL completed a *Storm Sewer Investigation Report*, which recommended that the contaminated portion of the storm-sewer flow be collected, treated, and discharged to meet proposed State Pollutant Discharge Elimination System (SPDES) VOC effluent limitations. BBL evaluated remedial design alternatives to address the source of VOCs entering the storm sewer that would remedy the contaminated groundwater (in accordance with NYSDEC recommendations). The results of this evaluation were presented in the *Storm Sewer Basis of Design Report* (BBL 1995).

Based on this report, BBL completed the final design of the French Road facility ground-water collection and treatment system in October 1995. System construction was completed in June 1996. The system collects groundwater from the Solvent Dock Area and the northern perimeter ditch area, conveys the collected groundwater to a treatment building where VOCs are removed by a low-profile air stripper, and discharges the treated effluent to the municipal stormwater system. A hydraulic and chemical groundwater-monitoring program was developed to evaluate the effectiveness of the GCTS for the Solvent Dock Area. This program, as presented in the *Ground-Water Sampling and Analysis Work Plan* (BBL 1998), has been modified through monthly and quarterly correspondence with the NYSDEC to accommodate changing conditions over the project's life.

In response to groundwater contamination observed at the Site (as described above), Lockheed Martin voluntarily installed and operated the GCTS and initiated an investigation of soil-vapor and indoor-air quality. Beginning in 2007, Lockheed Martin and NYSDEC began developing an Order for the Site, which was finalized on October 3, 2008 (CO 6-20080321-5). The Order identifies five AOC and requires further investigation and identification of corrective actions for each area. These investigations were completed in 2008 and the results are presented in the *CMS Report*. Supplemental investigations to the CMS are ongoing, and updates to this *MNA Plan* will be provided if warranted by those investigations' findings.

2.2 Geology and Hydrogeology

Site geology, as fully described in the *CMS Report*, consists of the following units:

- Fill (approximately 5–10 feet thick) and naturally occurring undifferentiated overburden consisting of silt, sand, and gravel (maximum thickness of 20 feet);
- Till consisting of dense gray-brown silty clay with fine sand and gravel (approximately 20–40 feet thick); and
- The top of bedrock (Utica Shale) was encountered at depths ranging from approximately 30 feet below ground surface (bgs) to 52 feet (ft) bgs. The deepest Site boring was advanced to a total depth of 68.5-ft bgs, where the Utica Shale was still present.

The till surface is observed at higher elevations beneath the building footprint as compared to elevations outside the building footprint. The till surface deepens in a radial pattern away from the building to the north, east, and south. This may be an artifact of excavation and/or removal of the shallow till at locations around the perimeter of the building during construction and utility installation (during the 1950s). The bedrock surface dips gently to the south. A representative Site cross-section is included as Figure 3.

Groundwater occurs in the overburden and bedrock. Groundwater in the fill and undifferentiated overburden is unconfined. Water-elevation data and stratigraphic information indicate that groundwater in the till is also unconfined. Groundwater occurs in bedrock under semi-confined conditions. Dense till overlying bedrock acts as a leaky confining layer.

Groundwater exhibits a downward gradient at the Site (based on water-level measurements collected as part of the CMS investigation). However, measurements collected from bedrock wells continue to indicate a slow yet persistent recharge of water in the wells (i.e., water levels in the wells continue to equilibrate to match the potentiometric surface in the bedrock). This indicates that the till provides strong resistance to vertical flow and that little water is moving through the till into bedrock.

Water-elevation data for the fill, undifferentiated overburden, and till show a complex array of water levels. Overall, the elevation of the water table decreases toward the south. However, water levels measured near the GCTS are depressed in some wells in response to continued system operation.

Groundwater flow within both the overburden and bedrock is southward. Operation of the GCTS has controlled the movement of groundwater and modified the direction of groundwater flow near the former Solvent Dock to a northeasterly direction. The groundwater-elevation and groundwater-quality data suggest the potential for flow along the storm-sewer line (located beneath the facility footprint and headed east toward the catch basins outside the main facility, as shown in Figure 2) is generally eastward, although a permeable backfill-material was not identified during activities associated with GCTS evaluation. However, the potential remains for groundwater infiltration into the storm-sewer line beneath the eastern portion of the building.

2.3 Groundwater Contaminant Distribution

Groundwater in the northeast portion of the main manufacturing building and the area referred to as the northern perimeter ditch has been impacted by VOCs (including tetrachloroethene, trichloroethene, cis-1,2-dichloroethene, and vinyl chloride). Depth to groundwater in these areas is shallow and ranges from 2–7-ft bgs. The source of this groundwater contamination is probably the former 275-gallon overflow-retention tank, which was located immediately north of the loading dock along the northern wall of the manufacturing building. The tank was removed as part of an interim remedial measure (IRM) in 1990. Reports indicate that the overflow retention-tank was in poor condition and leaking upon removal. As part of the tank removal, approximately 5 cubic yards of contaminated soil were removed for off-Site disposal. Analytical soil-data near the tank removal indicate no remaining soil contamination. Residual on-Site dissolved-phase constituents in groundwater are believed to result from isolated releases that affected both soil and groundwater. The inverts of former underground-storage tanks were likely near or below the water table.

The source of groundwater contamination in the northern-perimeter ditch area has not been defined but may be related to the former hazardous-waste storage area at the west end of the present-day maintenance building. Historic soil, groundwater, and surface-water samples collected as part of the initial source investigations did not determine a specific source of observed groundwater contamination. Evaluation of the potential sources for these contaminants is scheduled to be completed as part of supplemental CMS investigations.

Groundwater contamination is found primarily in fill and shallow till. The water table is encountered near the bottom of the fill, typically within one-foot of contact with the underlying till. Groundwater contamination is observed primarily within wells screened either solely within the fill or within the fill and underlying till. Hydropunch data collected from several vertical intervals within the till indicate decreased contamination with depth in the till. Grain-size analysis and hydraulic-conductivity testing show that the fill and till both have a very low capacity to transmit water; that is, the fill and till exhibit very low permeability. This has naturally “contained” the migration of contaminated groundwater within the northeastern portion of the Site. Off-Site migration of contaminated groundwater has not been observed.

3 Monitoring Program

3.1 Performance Objectives

The Site-monitoring program has the following performance objectives:

- Verify that contaminant concentrations are not a significant risk to human health or the environment.
- Ensure that downgradient, lateral, and vertical migration of contaminants at concentrations in excess of standards do not extend beyond the current known area of contamination.
- Monitor hydrologic conditions at the Site over time to identify any changes in groundwater-flow direction that might affect the protectiveness of the selected remedy.

3.2 Monitoring Parameters

The parameters to be monitored at the Site are groundwater VOCs (USEPA Method 8260), pH, dissolved oxygen, redox potential, conductivity, temperature, and water levels. In addition, select monitoring points (as described in Section 3.3) will also be monitored for additional parameters including ferrous iron (via a field kit), nitrate, sulfate, total alkalinity, and methane. These latter parameters will be collected quarterly for one year. After four quarters, only VOCs and field parameters (as described above) will be monitored. These parameters will provide sufficient information to evaluate natural-attenuation mechanisms. Sampling consistency will be emphasized, as routine data collection and analysis will aid in future decision making. All sampling will be completed in accordance with the *Site-Specific Quality Assurance Project Plan* (QAPP). Sampling protocols and standard operating procedures (SOPs) are included as Attachment 2 of the QAPP.

3.3 Monitoring Locations

The well network for MNA monitoring at the Site is presented in Table 1 and in Figure 4. Existing wells were selected as VOC monitoring points based on the current and anticipated extent of contaminants in groundwater (and as presented within the *CMS Report*). Monitoring wells were selected for annual, semi-annual, or quarterly sampling. Monitoring wells selected and corresponding sampling frequencies are as follows:

- MW-1 (quarterly) is within the plume and typically exhibits elevated VOC concentrations.
- MW-2 (annually) is within the plume and typically exhibits elevated VOC concentrations.
- MW-3 (quarterly) is within the plume and typically exhibits elevated VOC concentrations.
- MW-4 (annually) is at the fringe of the plume and hydraulically upgradient.
- MW-5 (semi-annually) is at the fringe of the plume and hydraulically upgradient.
- MW-10 (annually) is at the fringe of the plume and hydraulically sidegradient.
- MW-11 (annual) is in an area not contaminated by VOCs (outside of the plume) and serves as a monitoring point for lateral groundwater-migration.
- MW-13S (quarterly) is at the fringe of the plume, hydraulically upgradient, and monitors the shallow undifferentiated-fill unit.
- MW-14BR (annually) is downgradient of the plume and monitors the bedrock unit.

- PZ-5 (quarterly) is within the plume and typically exhibits elevated VOC concentrations.

- PZ-6 (semi-annually) is within the plume and typically exhibits elevated VOC concentrations.

- PZ-7 (semi-annually) is near the downgradient extent of the plume and typically does not exhibit elevated VOC concentrations.

- PZ-8 (quarterly) is within the plume and typically exhibits measurable VOC concentrations.

- PZ-11 and PZ-12 (quarterly) are at the edge of the plume and typically exhibit elevated VOC concentrations.

In addition to the wells identified in Table 1, groundwater-elevation measurements will be collected quarterly and before groundwater sampling at all accessible Site monitoring-wells. Monitoring-well and piezometer-construction details are provided in Table 2. Well-construction logs for the monitoring-well network are included in Appendix A. Additional wells will be added or removed from the monitoring network as the MNA monitoring program evolves. NYSDEC's April 24, 2009 letter conditionally approving the "Corrective Measures Study" directed the inclusion of permanent monitoring points in the east parking lot to assess GCTS effectiveness and potential off-Site migration of constituents. In response to this requirement, additional piezometers will be installed in the east parking lot as part of a supplemental investigation. Based on results of that investigation, some of the completed piezometers would be included as part of the MNA network for groundwater monitoring.

The monitoring-network wells can:

- Verify that contaminant concentrations are not a significant risk to human health or the environment;

- Ensure that downgradient, vertical, and lateral migration does not significantly extend beyond the current contaminated area;

- Monitor contaminant levels at potential exposure points under current land use conditions; and

- Monitor Site hydrologic conditions over time to identify any changes in groundwater flow that might affect the protectiveness of the selected remedy.

Monitoring wells selected in this remedial design will ensure that the RAOs are being achieved. The following subsections outline the objectives of the MNA-network wells:

Objective 1— verify that contaminant concentrations are decreasing with time such that cleanup goals will be met. This objective will be met by monitoring wells where exceedances have been reported. Long-term trend analysis will confirm downward trends in contaminant concentration and performance will be gauged against this analysis. At no point during the MNA period are contaminant concentrations expected to exceed historical maximums. Objective 1 monitoring locations are included in Table 3.

Objective 2— confirm that contamination is not spreading to uncontaminated areas. Contaminants are expected to continue to disperse within known preferential flow paths throughout remedy duration. This objective will be met by monitoring those wells spanning Site (laterally and vertically) that yield concentrations below cleanup goals. Contamination in these locations is expected to be detectable but below cleanup goals or below detection limits. Objective 2 monitoring locations are included in Table 3.

Objective 3— monitor contaminant levels at potential exposure points under current land use conditions. The monitoring-well network will monitor contaminant levels at the Site to ensure that proper personal protective equipment is used should subsurface work be done in an area with contaminant levels exceeding cleanup goals. Wells selected for this objective are in locations that would cover potential areas of subsurface work, including both interior and exterior areas. Objective 3 monitoring locations are included in Table 3.

Objective 4— monitor Site hydrologic conditions over time to identify any changes in groundwater flow that might compromise human health or the environment. This includes evaluating groundwater elevations in both the overburden and bedrock monitoring wells. Monitoring wells that support this objective span the Site (laterally and vertically) and will detect changes in groundwater flow and contaminant migration. All Site monitoring-well locations will be monitored quarterly for groundwater elevations, and will therefore be included as Objective 4 locations.

The four objectives listed above aim to verify that contaminant concentrations are not a significant risk to human health or the environment, monitor the migration of contaminants at the Site, and monitor the hydrogeologic nature of the Site to detect changes for use in future environmental decision-making. Monitoring locations at the Site have been mapped to primary objectives (identified in table 3); note, however, that monitoring locations will be used for all objectives during data analysis and interpretation (as described in Section 3.5).

3.4 Monitoring Frequencies

Monitoring frequency should be adequate to detect, in a timely manner, potential changes in Site conditions. Flexibility to adjust monitoring frequency over the life of the remedy is also necessary. Decreasing monitoring frequency may be appropriate once it has been determined that natural attenuation is progressing as expected. In contrast, monitoring frequency may need to be increased if unexpected conditions are observed.

The proposed monitoring schedule is presented in Table 1 and consists of quarterly, semi-annual, and annual monitoring. Unless plume conditions dictate a need for more frequent sampling, this sampling frequency will be maintained for one calendar year, at which time sampling frequency will be re-evaluated to determine if a change is appropriate. The sampling frequency has been chosen for each monitoring point to provide a thorough and responsive period to evaluate changes in concentrations while effectively monitoring the stability of the existing plume and confirming that off-Site contaminant migration or migration of groundwater to uncontaminated areas is not occurring. Annual monitoring reports will document the data and any changes in monitoring frequency. Changes in monitoring frequency that require execution before distribution of the annual monitoring report will be annotated in a memo. The memo will also be included as an attachment to the annual monitoring report.

3.5 Data Analysis and Interpretation

The monitoring network is designed to collect data that demonstrate the effectiveness of the remedy or to initiate implementation of other actions if the natural attenuation process is not occurring as predicted (e.g., unexpected expansion of the contaminated area or sustained increases in concentrations within the area of contamination). Data analysis and interpretation will ensure that:

- Monitoring locations indicate that concentrations within the contaminated area are not a significant risk to human health or the environment.

- Monitoring locations indicate when a performance criterion has been exceeded (i.e., no significant expansion of current contamination).

- Monitoring locations are sufficient to determine the necessary personal protective equipment for human receptors (construction or utility workers) should subsurface work be required at the Site.

- Hydrologic conditions continue to support that the selected monitoring-well network protects human health and the environment.

Environmental data are inherently variable. The method of data analysis must account for outliers and values less than the detection limits of the laboratory equipment. In the case of outliers, USEPA's *Guidance for Data Quality Assessment— Practical Methods of Data Analysis* (USEPA/600/R-96-084, July 2000) recommends using the "Extreme Value Test" to identify outliers when the sample size is 25 or fewer. This methodology will be used to evaluate data collected as part of the MNA program. Identified outliers will include possible actions such as a more thorough review of sampling procedures, a more thorough review of laboratory procedures, a re-sampling of monitoring wells, and a change in sampling frequency. For purposes of statistical analysis and calculation, below detection limit (BDL) values will use one-half the detection limits instead of BDL values. For reporting purposes, BDL values will be reported as "< (detection limit value)" (i.e., < 10 µg/L) instead of a notation such as "BDL."

3.5.1 Performance Monitoring

Concentrations of COC are expected to remain stable or decrease over time. This assumes that natural attenuation processes at the Site involve dilution and dispersion with an unquantified and lesser benefit from other attenuation processes (such as adsorption and biodegradation). Performance will be gauged using long-term trends. Ongoing dispersion, analytical variability, or other factors are expected to produce localized and temporary upward trends. All monitoring locations are expected to exhibit statistically significant and meaningful long-term downward trends.

A trend analysis by the nonparametric Mann-Kendall test will be used as the first step in overall statistical evaluation. USEPA's aforementioned *Guidance for Data Quality Assessment* provides more detail on the Mann-Kendall test. The Mann-Kendall test provides a consistent mechanism for evaluating data to determine the extent to which an upward or downward trend is likely. The confidence level for the Mann-Kendall test will be 90%. This method is further discussed in Section 4.3.4 of the USEPA guidance.

This test can be performed as often as needed for each monitoring location after each monitoring round for contaminants exceeding cleanup goals. The test can therefore indicate trend changes (e.g., from no statistically significant trend in either direction to a statistically significant upward or downward trend).

Performance criteria will be set for individual monitoring locations in the event unexpected increased concentrations are found in the contaminated area. These criteria will identify a long-term increasing trend or a sudden increase in contaminant concentrations. The first criterion will be a statistically significant increase in contaminant concentrations for the most recent eight data-points (if available). A concentration exceeding the mean plus three standard-deviations for that location will be considered a data spike, which may indicate an outlying data point or unknown contaminant-contribution. The second criterion is the exceedance of a historical maximum concentration. This concentration will be determined using the combined historical data to statistically compare the highest observed historical concentration.

The comparison that would trigger action will be based on the maximum historical concentration to account for normal fluctuations in the relatively small data sets. Exceedance of a historical maximum will result in an evaluation of the monitoring network, which could result in additional monitoring or installation of additional monitoring wells. Should the exceedance prevent attainment of the performance objectives, additional remediation measures will be evaluated and implemented as necessary to achieve performance objectives. In the event that the data show an increasing trend or a sudden increase in concentrations, the decision tree for monitoring wells will be followed to take appropriate actions (see Appendix B).

The trend analysis described above, in conjunction with the groundwater-monitoring network, sampling plan, and the attached decision tree (Appendix B), satisfy NYSDEC's request in an April 24, 2009 letter that "the *Monitored Natural Attenuation Plan* must include a groundwater monitoring plan that includes contaminant concentrations that will trigger a re-evaluation of remedial measures for groundwater." For the monitoring-well network, four consecutive sampling rounds yielding results below cleanup goals will indicate that cleanup goals have been achieved for a particular location. Removal of that location from the monitoring network will then be assessed and, if appropriate, removal of that location from the MNA monitoring plan will be requested in writing from NYSDEC.

3.5.2 Detection Monitoring

The monitoring-well network will be used to detect and ensure that concentrations of COC greater than cleanup goals do not migrate laterally or vertically. In the event that monitoring data indicate potential migration of contaminated groundwater beyond the current understanding of the extent of contamination, the monitoring network will be reevaluated and modified, as appropriate.

3.5.3 Receptor Protection

Receptor protection will be evaluated to ensure that Site construction or utility workers, or any other potentially affected human receptors, use appropriate personal protective equipment if subsurface work should be required at the Site. The *Health and Safety Plan* (HASP) (ARCADIS 2008) explains mechanisms to ensure worker protection. Before excavating into the water table at the Site, workers will review the most recent annual monitoring report to determine the location of contaminated groundwater relative to the work location. Should the work location be within the boundaries of the monitoring-well network, appropriate personal protective equipment and engineering controls will be used to prevent direct contact with or ingestion of Site groundwater. Periodic assessment of the continued protectiveness of the MNA alternative for all potentially exposed populations will be completed and that review will be included in the annual report.

3.5.4 Hydrologic Conditions

Site hydrologic conditions will be monitored to identify changes in groundwater flow that might affect the protectiveness of the selected remedy. Static groundwater elevation of the wells within the Site’s accessible existing wells will be measured to establish whether groundwater flow is changing significantly, thus potentially changing contaminant-migration patterns. Groundwater-elevation maps will be created and evaluated to verify that the groundwater-flow directions and rates are sufficient to support contaminant attenuation. Continued monitoring of hydrologic conditions will support maintenance of institutional-control boundaries and ensure that the monitoring network is sufficient. Groundwater-elevation maps will be included as part of the annual Site report.

3.5.5 Additional Actions

Though unlikely, the monitoring program recognizes the following potentialities:

- An increasing contaminant-concentration trend in groundwater may indicate an undiscovered source;

- Trends in contaminant concentration indicating that cleanup goals will not be attained; and

- Significant increases in the area or vertical extent of contamination could result in new significant impacts to adjacent uncontaminated groundwater systems.

Responses to changing conditions potentially affecting areas beyond where migration is expected will range from data verification and increased monitoring to verifying that contaminant concentrations are not a significant risk to human health or the environment. A monitoring-program decision-tree outlining these courses of action is included as Appendix B.

4 Reporting

As referenced above, data analysis and interpretation of the MNA system will be completed and submitted to NYSDEC as part of an annual report. The annual report for the MNA system will include a summary of the data collected during the previous year, statistical-trend analysis (as described in Section 3.5.1), an assessment of the continued protectiveness of the MNA alternative for all potentially exposed populations, and any recommendations related to continued system monitoring.

5 Monitoring-Well-Network Maintenance

Monitoring-well-network maintenance is discussed below.

5.1 Monitoring-Well Maintenance

Monitoring wells will be inspected as part of each sampling event. If biofouling or silt accumulation has occurred in the wells, they will be physically agitated/surged and redeveloped. Additionally, monitoring wells will be properly decommissioned and replaced if an event renders them unusable.

5.2 Monitoring-Well Decommissioning Procedures

Wells in the monitoring-well network will be repaired or replaced based on assessments of their structural integrity and overall performance. NYSDEC will receive prior notice of any well decommissionings (for replacement), and these will be discussed in the annual report. Well decommissioning without replacement must receive prior approval by NYSDEC. Wells will be abandoned in accordance with NYSDEC's "Draft Monitoring-Well Decommissioning Policy" (included as Appendix C). Monitoring wells decommissioned because they have been rendered unusable will be reinstalled at the nearest available location, unless otherwise approved by NYSDEC.

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Tables

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Table 1. Summary of Monitoring Well Network, Monitored Natural Attenuation Plan, Solvent Dock Area, Former Lockheed Martin French Road Facility, Utica, New York.

Monitoring Well	Sampling Frequency	Sampling Parameters
MW - 1	Quarterly	VOCs, MNA Parameters, Field Parameters*
MW - 2	Annual	VOCs, Field Parameters
MW - 3	Quarterly	VOCs, MNA Parameters, Field Parameters*
MW - 4	Annual	VOCs, Field Parameters
MW - 5	Semi-Annual	VOCs, Field Parameters
MW - 6	-	-
MW - 7	-	-
MW - 8	-	-
MW - 9	-	-
MW - 10	Annual	VOCs, MNA Parameters, Field Parameters*
MW - 11	Annual	VOCs, Field Parameters
MW - 12	-	-
MW - 13S	Quarterly	VOCs, Field Parameters
MW - 13T	-	-
MW - 13BR	-	-
MW - 14S	-	-
MW - 14BR	Annual	VOCs, Field Parameters
MW - 15S	-	-
MW - 15BR	-	-
PZ - 2	-	-
PZ - 4	-	-
PZ - 5	Quarterly	VOCs, Field Parameters
PZ - 6	Semi-Annual	VOCs, Field Parameters
PZ - 7	Semi-Annual	VOCs, Field Parameters
PZ - 8	Quarterly	VOCs, Field Parameters
PZ - 9	-	-
PZ - 10	-	-
PZ - 11	Quarterly	VOCs, Field Parameters
PZ - 12	Quarterly	VOCs, MNA Parameters, Field Parameters*
PZ - 13	-	-
PZ - 14	-	-
PZ - 15	-	-
PZ - 16	-	-

- = Not Sampled as part of MNA Program
All wells will be measured for groundwater elevations on a quarterly basis.

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Table 2. Monitoring Well and Piezometer Construction Details, Monitored Natural Attenuation Plan, Solvent Dock Area, Former Lockheed Martin French Road Facility, Utica, New York.

Monitoring Well	Diameter/Material	Screen Length	Ground Surface Elevation	Top of PVC Riser Elevation	Well Depth (ft bgs)	Screen Depth (ft bgs)			Screen/Borehole Elevation		Hydrogeologic Unit Monitored	Date Installed	Consultant Name
						From (Top)		To (Bottom)	Top	Bottom			
MW - 1	4" PVC	10	507.53	506.80	17.2	7.0	---	17.0	500.5	490.5	Fill/Till	1991	O'Brien & Gere
MW - 2	4" PVC	15	504.98	504.69	16.5	1.5	---	16.5	503.5	488.5	Fill/Till	1991	O'Brien & Gere
MW - 3	2" PVC	10	506.90	509.30	13.0	3.0	---	13.0	503.9	493.9	Fill/Till	1991	O'Brien & Gere
MW - 4	2" PVC	10	506.98	506.73	14.0	4.0	---	14.0	503.0	493.0	Fill/Till	1991	O'Brien & Gere
MW - 5	2" PVC	10	504.56	504.46	14.0	4.0	---	14.0	500.6	490.6	Fill/Till	1991	O'Brien & Gere
MW - 6	2" PVC	10	505.95	508.58	15.0	5.0	---	15.0	501.0	491.0	Fill/Till	--	O'Brien & Gere
MW - 7	2" PVC	15	507.44	506.94	21.0	6.0	---	21.0	501.4	486.4	Fill/Till	1993	O'Brien & Gere
MW - 8	2" PVC	10	505.76	505.76	14.5	4.5	---	14.5	501.3	491.3	Fill/Till	1993	O'Brien & Gere
MW - 9	2" PVC	10	505.26	505.15	13.5	3.5	---	13.5	501.8	491.8	Fill/Till	1993	O'Brien & Gere
MW - 10	2" PVC	10	504.83	504.48	14.0	4.0	---	14.0	500.8	490.8	Fill/Till	1993	O'Brien & Gere
MW - 11	2" PVC	20	507.26	507.03	25.0	5.0	---	25.0	502.3	482.3	Fill/Till	1993	O'Brien & Gere
MW - 12	2" PVC	10	508.59	508.34	23.4	13.0	---	23.0	495.6	485.6	Fill/Till	--	--
MW - 13S	2" PVC	5	506.27	506.03	7.0	2.0	---	7.0	504.3	499.3	Fill	2008	ARCADIS
MW - 13T	2" PVC	10	506.11	505.68	20.0	10.0	---	20.0	496.1	486.1	Till	2008	ARCADIS
MW - 13BR	2" PVC	10	506.48	506.28	45.0	35.0	---	45.0	471.5	461.5	Bedrock	2008	ARCADIS
MW - 14S	2" PVC	10	508.22	507.85	16.0	6.0	---	16.0	502.2	492.2	Undifferentiated Overburden	2008	ARCADIS
MW - 14BR	2" PVC	10	508.20	507.95	67.2	57.2	---	67.2	451.0	441.0	Bedrock	2008	ARCADIS
MW - 15S	2" PVC	10	507.66	507.46	20.0	10.0	---	20.0	497.7	487.7	Undifferentiated Overburden	2008	ARCADIS
MW - 15BR	2" PVC	10	507.54	507.29	67.6	57.6	---	67.6	449.9	439.9	Bedrock	2008	ARCADIS
PZ - 2	1.5" PVC	5	503.80	503.82	10.3	5.0	---	10.0	498.8	493.8	Fill/Till	--	--
PZ - 4	1.5" PVC	5	505.50	505.51	14.3	9.0	---	14.0	496.5	491.5	Fill/Till	--	--
PZ - 5	1.5" PVC	5	508.44	508.29	10.7	5.7	---	10.7	502.7	497.7	Till	--	--
PZ - 6	1.5" PVC	5	508.52	508.37	10.4	5.4	---	10.4	503.1	498.1	Till	--	--
PZ - 7	1.5" PVC	5	508.51	508.36	10.2	5.0	---	10.0	503.5	498.5	Till	--	--
PZ - 8	1.5" PVC	10	508.43	508.23	16.0	6.0	---	16.0	502.4	492.4	Till	2008	ARCADIS
PZ - 9	1.5" PVC	5	508.55	508.08	10.0	5.0	---	10.0	503.6	498.6	Till	2008	ARCADIS
PZ - 10	1.5" PVC	5	508.44	508.14	12.0	7.0	---	12.0	501.4	496.4	Fill	2008	ARCADIS
PZ - 11	1.5" PVC	2	505.93	505.82	8.5	6.5	---	8.5	499.4	497.4	Fill	2008	ARCADIS
PZ - 12	1.5" PVC	5	505.94	505.84	10.5	5.5	---	10.5	500.4	495.4	Fill	2008	ARCADIS
PZ - 13	1.5" PVC	2	504.08	503.85	8.5	6.5	---	8.5	497.6	495.6	Fill	2008	ARCADIS
PZ - 14	1.5" PVC	5	504.13	504.05	9.0	4.0	---	9.0	500.1	495.1	Fill	2008	ARCADIS
PZ - 15	1.5" PVC	2	504.72	504.43	8.5	6.5	---	8.5	498.2	496.2	Fill	2008	ARCADIS
PZ - 16	1.5" PVC	5	504.70	504.53	9.5	4.5	---	9.5	500.2	495.2	Fill	2008	ARCADIS

All elevations are reported as feet mean sea level (ft msl)
Construction details for MW-1, MW-6, PZ-2, and PZ-4 through PZ-7 estimated based on field measurements
-- = Unknown detail
Survey data is referenced horizontally to the NAD83 and projected on the New York State Plane Coordinate System (Central Zone)
The reference vertical benchmark is the finished floor elevation of the southeasterly corner of the Boiler House Building (Elevation 506.50 feet)

Table 3. Summary of Objectives for Monitoring Well Network, Monitored Natural Attenuation Plan, Solvent Dock Area, Former Lockheed Martin French Road Facility, Utica, New York.

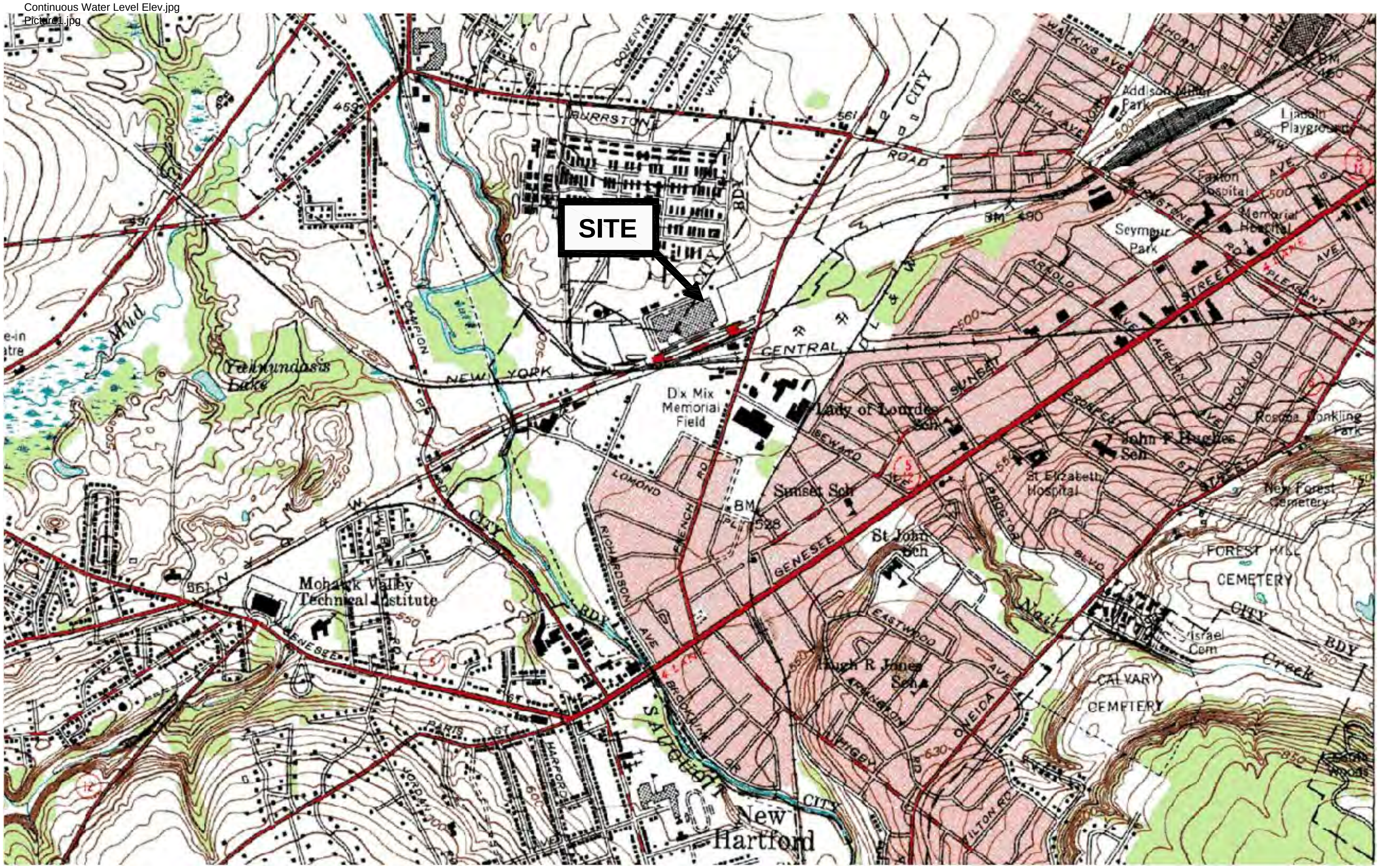
Objective 1 Monitoring Network	Objective 2 Monitoring Network	Objective 3 Monitoring Network
MW-1	MW-5	MW-2
MW-3	MW-13S	MW-4
PZ-5	MW-14BR	MW-10
PZ-6	MW-11	PZ-7
PZ-8		
PZ-11		
PZ-12		

All wells will be measured for groundwater elevations on a quarterly basis

Figures

CITY:(MAHWAH) DIV/GROUP:(ENRI- 1) DB:(JG LD:(Opt) PIC:(Opt) PM:(CM) TM:(BM) LYR:(Opt)ON=*;OFF=*REF*
G:\ENVCAD\Mahwah\ACT\NJ0010000\0001\00001\2009-08\FIG 1A SITE-LOCATION.dwg LAYOUT: 1 SAVED: 8/19/2009 10:24 AM ACADVER: 17.1S (LMS TECH) PAGESETUP: ----PLOTSTYLETABLE: ----PLOTTED: 8/19/2009 10:24 AM BY: GONZALEZ, JAMES

XREFS: IMAGES: PROJECTNAME: ----
Continuous Water Level Elev.jpg
Picture1.jpg



0 12000 24000
SCALE IN FEET

NTS G-14

MONITORED NATURAL ATTENUATION PLAN
FORMER LOCKHEED MARTIN, FRENCH ROAD PROPERTY
UTICA, NEW YORK

SITE LOCATION MAP

ARCADIS

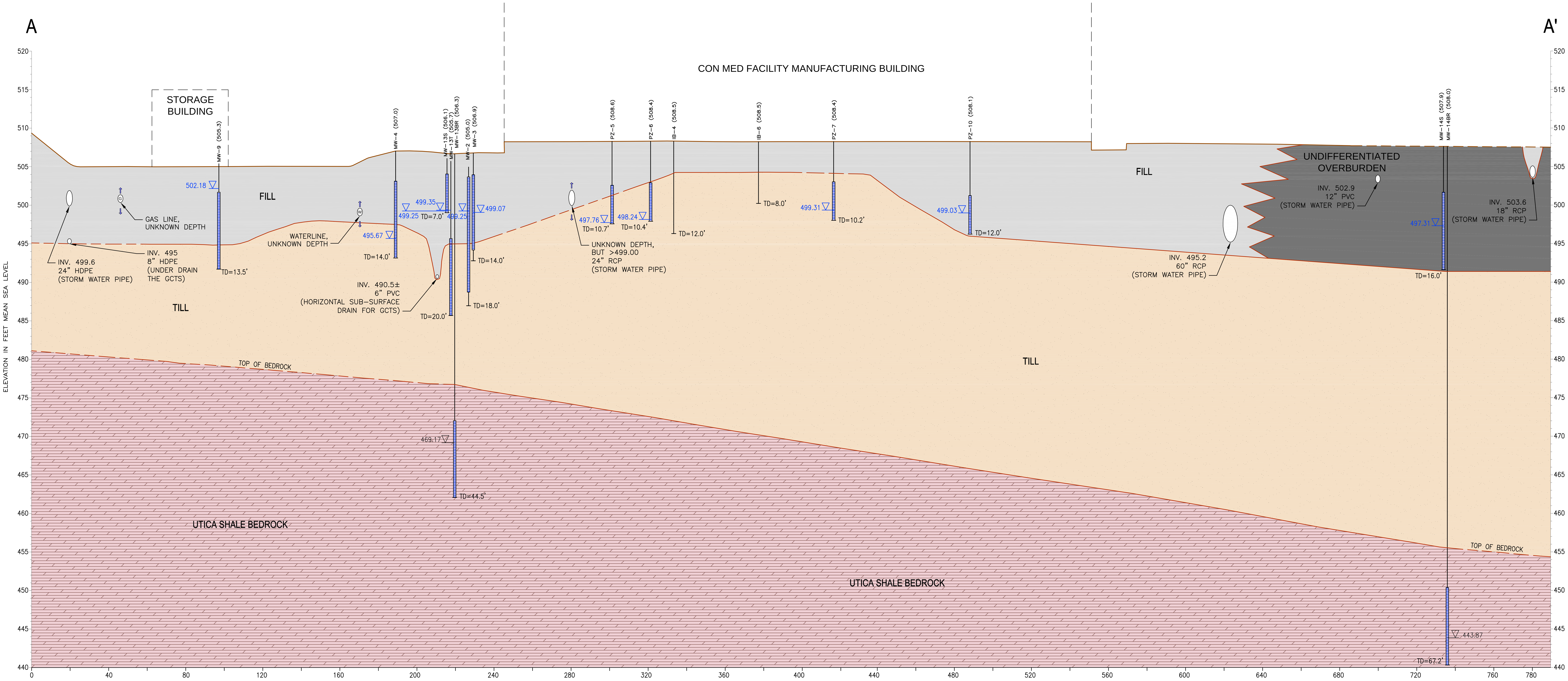
FIGURE
1

MONITORED NATURAL ATTENTUATION PLAN
FORMER LOCKHEED MARTIN
FRENCH ROAD FACILITY
UTICA, NEW YORK

FACILITY MAP

ARCADIS

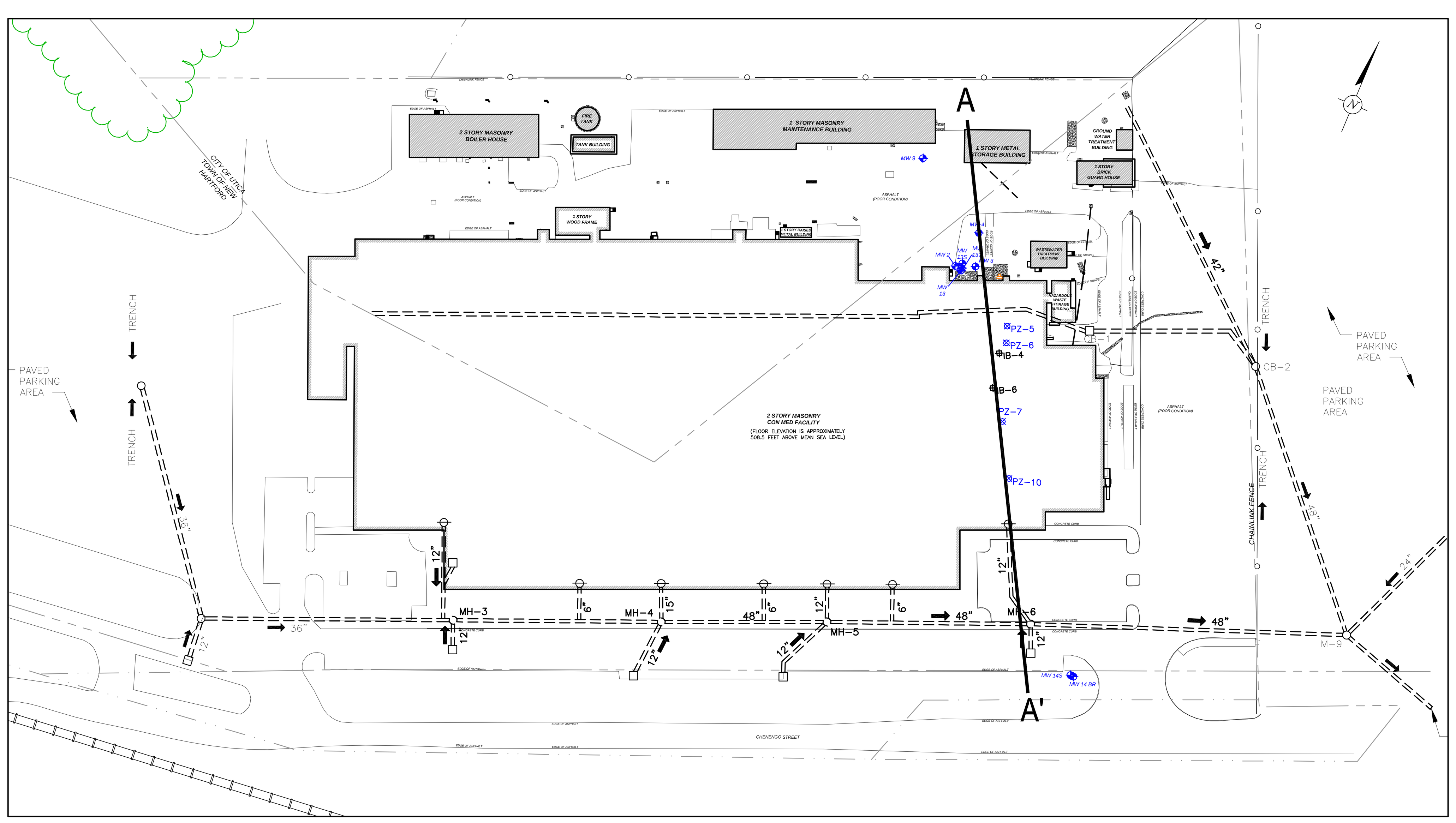
FIGURE
2



CROSS SECTION A-A'

HORIZONTAL SCALE: 1"=20'

VERTICAL SCALE: 1"=5'



KEY PLAN

SCALE: 1"=100'

LEGEND:

- SOIL SAMPLE DESIGNATION
- WELL DESIGNATION
- EXISTING LAND SURFACE
- BOREHOLE/WELL CASING
- GEOLOGIC CONTACT (DASHED WHERE INFERRED)
- SCREENED INTERVAL
- TOTAL DEPTH OF BOREHOLE

TD=12.0 TD=14.0

MW-4	MONITORING WELL (OVERBURDEN)
MW-13BR	MONITORING WELL (BEDROCK)
IB-4	SOIL BORING
PZ-5	PIEZOMETER

- FILL UNIT
- TILL UNIT CONSISTING OF DENSE GRAY-BROWN SILT. FINE SAND, CLAY AND LITTLE GRAVEL
- UNDIFFERENTIATED OVERBURDEN CONSISTING OF SILT, SAND AND GRAVEL
- UTICA SHALE BEDROCK
- GROUNDWATER ELEVATION FOR THE UNCONSOLIDATED UNIT, MEASUREMENT COLLECTED ON AUGUST 12, 2008
- GROUNDWATER ELEVATION FOR THE BEDROCK UNIT, MEASUREMENT COLLECTED ON AUGUST 12, 2008

NOTES:

TILL UNIT NOT OBSERVED AT BORING PZ-10. BORING WAS LOCATED IN THE APPROXIMATE LOCATION OF HISTORIC SOLVENT TANKS THAT WERE REMOVED IN THE 1980'S.

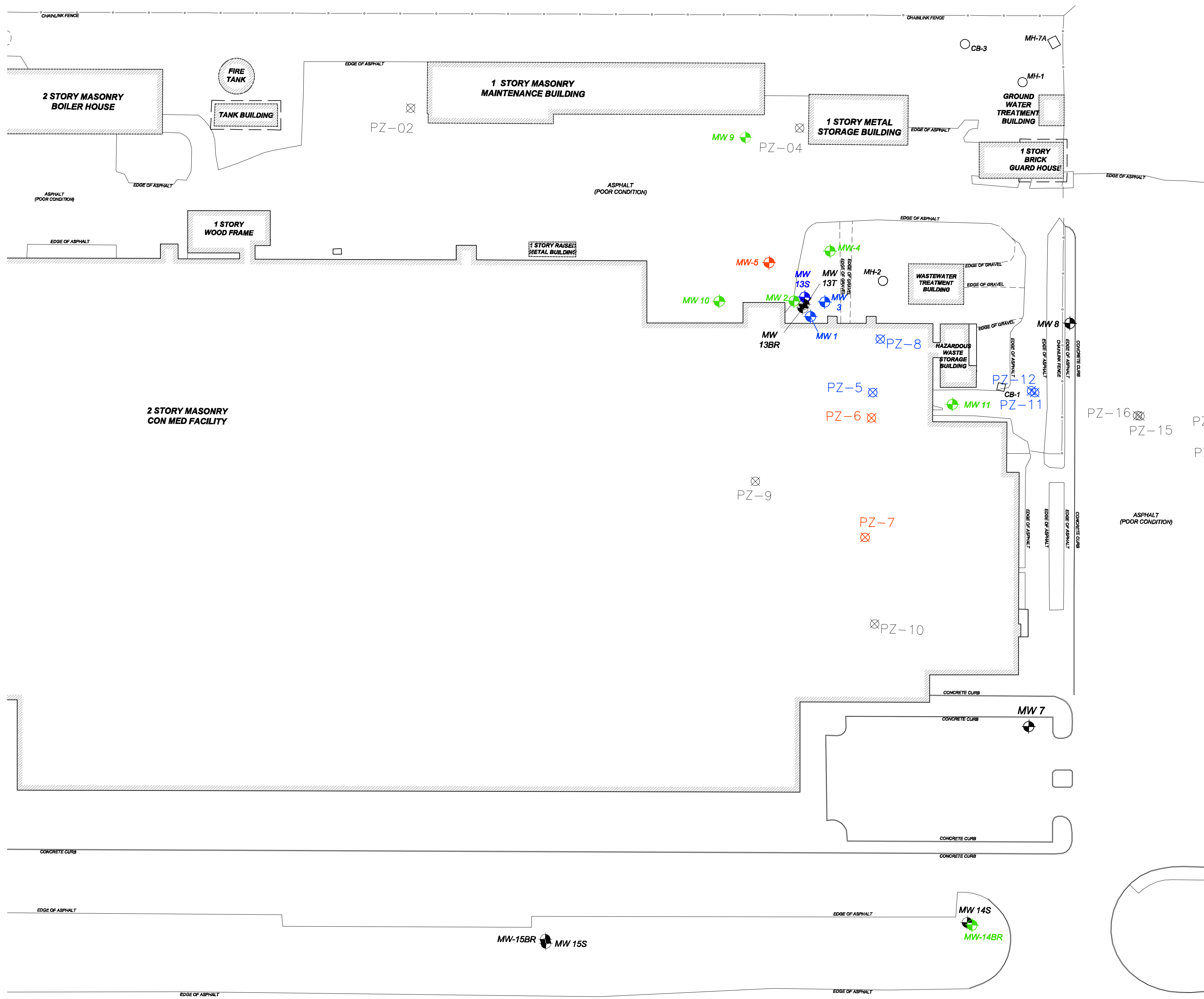
GEOLOGIC LOGS WERE NOT AVAILABLE FOR BORINGS PZ-5, PZ-6 AND PZ-7.

MONITORED NATURAL ATTENUATION PLAN
FORMER LOCKHEED MARTIN
FRENCH ROAD FACILITY
UTICA, NEW YORK

HYDROGEOLOGIC CROSS SECTION A-A'

ARCADIS

FIGURE 3



0 40 80 120
SCALE IN FEET

LEGEND:

MW 10	MONITORING WELL LOCATION
PZ-9	PIEZOMETER LOCATION
(blue)	QUARTERLY MONITORING
(red)	SEMI ANNUAL MONITORING
(green)	ANNUAL MONITORING

NOTES:

1. LABORATORY ANALYSIS TO BE TCL EPA 624/SW846 8260.
2. GROUNDWATER ELEVATIONS TO BE COLLECTED QUARTERLY FROM ALL SITE WELLS.

MONITORED NATURAL ATTENUATION PLAN

FORMER LOCKHEED MARTIN
FRENCH ROAD FACILITY
UTICA, NEW YORK

MONITORING WELL NETWORK

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FIGURE
4

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Appendix A

Well Construction Logs

O'BRIEN & GERE ENGINEERS, INC.

TEST BORING LOG

REPORT OF BORING MW-2
PAGE 1 OF 1

CLIENT: General Electric

PROJECT LOCATION: French Rd., Utica NY

FILE NO.: 3023.024

SAMPLER: Split Spoon 2"
HAMMER: 140 lbs.
FALL: 30"

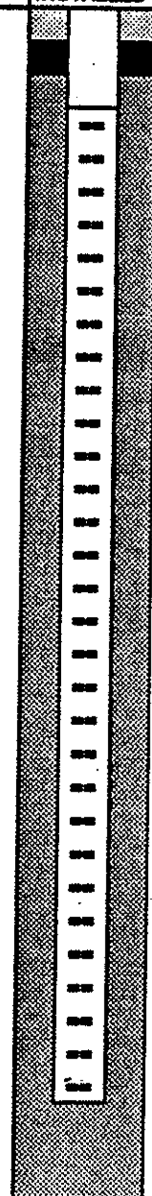
LOCATION:

START DATE: 12/20/91
END DATE: 12/20/91

BORING COMPANY: Parratt-Wolff, Inc.
FOREMAN: Brian Waters
OBG GEOLOGIST: D.E. Broech

GROUND WATER
Depth:
Date:
Elevation:

LEGEND: Grout, Sand Pack, Bentonite, Screen, Riser

DEPTH BELOW GRADE	NO.	DEPTH (FEET)	BLOWS /6"	PENETR/ RECOVERY	"N" VALUE	SAMPLE DESCRIPTION	STRATUM CHANGE GENERAL DESCRIPT	EQUIPMENT INSTALLED	FIELD TESTING HNU (ppm)
0	1	0-2	18-29-34-31	24"/16"	63	CONCRETE to 0.5'. Dry, brown, very dense, fine to coarse SAND, some fine to medium gravel, little silt			0
1									
2	2	2-4	36-17-20-14	24"/16"	37	Dry, brown, dense, fine to coarse SAND, some fine to medium gravel, little silt			0
3									
4	3	4-6	4-4-14-14	24"/16"	18	Wet, brown, medium dense, fine to coarse SAND, some silt, trace fine gravel, samples submitted for analyses	4.0'		0
5									
6	4	6-8	14-12-13-9	24"/16"	25	Wet, brown, medium dense, fine to coarse SAND and fine to medium GRAVEL, little silt, samples submitted for analyses			0
7									
8	5	8-10	17-17-17-19	24"/20"	34	Wet, brown, dense, fine to coarse SAND, trace silt			0
9									
10	6	10-12	10-36-30-100	24"/20"	66	Wet, gray, very dense SILT and fine SAND, some medium to coarse sand, little fine to coarse gravel	10.0'		0
11									
12	7	12-14	18-28-36-41	24"/16"	64	Moist, gray, very dense SILT and fine SAND, some medium to coarse sand, little fine to coarse gravel			0
13									
14	8	14-16	23-42-43-40	24"/16"	85	Moist, gray, very dense SILT and fine SAND, some medium to coarse sand, little fine to coarse gravel			0
15									
16	9	16-18	73-40-36-70/4	24"/10"	76	Moist, gray, very dense SILT and fine SAND, some medium to coarse sand, little fine to coarse gravel, augered to 17', sampled to 18'			0
17									
18						Bottom of boring 18.0' PVC Well Screen 16.5 – 1.5' Sand Pack 18.0 – 1.0' Bentonite 1.0 – 0.5' Cement 0.5 – 0.0'			
19									
20									

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING MW-3 PAGE 1 OF 1
CLIENT: General Electric PROJECT LOCATION: French Rd., Utica NY FILE NO.: 3023.024	SAMPLER Split Spoon 2" HAMMER: 140 lbs. FALL: 30"	LOCATION: Solvent tank area START DATE: 12/19/91 END DATE: 12/19/91
BORING COMPANY: Parratt-Wolff, Inc. FOREMAN: Brian Waters OBG GEOLOGIST: D.E. Broach	GROUND WATER Depth: Date: Elevation:	LEGEND: Grout, Sand Pack, Bentonite, Screen, Riser

DEPTH BELOW GRADE	NO.	DEPTH (FEET)	BLOWS /6"	PENETR/ RECOVERY	"N" VALUE	SAMPLE DESCRIPTION	STRATUM CHANGE GENERAL DESCRIPT	EQUIPMENT INSTALLED	FIELD TESTING HNU (ppm)
0	1	0-2	8-10-10-10	24"/10"	20	Dry, brown, medium dense, fine to medium SAND, some silt, little coarse sand, trace fine to medium gravel			0
1									
2	2	2-4	19-50/2	24"/2"	50+	Dry, brown, very dense, fine GRAVEL, some fine to coarse sand, samples submitted for analyses, hit concrete, moved borehole 3' away from building	2.0'		0
3									
4	3	4-6	6-8-8-11	24"/0"	16	Wet, gray brown, no recovery	4.0'		0
5									
6	4	6-8	11-6-7-13	24"/0"	13	Wet, gray brown, loose, no recovery			0
7									
8	5	8-10	39-33-30-13	24"/16"	63	Wet, gray brown, dense, medium SAND and fine SAND, some coarse sand, little silt, samples submitted for analyses	8.0'		0
9									
10	6	10-12	6-9-13-17	24"/2"	22	Wet, gray brown, medium dense, fine to medium SAND, some coarse sand, little fine to medium gravel, trace silt			0
11									
12	7	12-14	15-42-35-33	24"/16"	77	Dry, very hard SILT and fine SAND, some medium to coarse sand, little fine to medium gravel	12.0'		0
13									
14						Bottom of boring 14.0'			
15									
16									
17									
18									
19						PVC Well Screen 13.0 – 3.0' Sand Pack 14.0 – 2.0'			
20						Bentonite Seal 2.0 – 1.0' Cement 1.0 – 0.0'			

O'BRIEN & GERE ENGINEERS, INC.

TEST BORING LOG

REPORT OF BORING MW-4
PAGE 1 OF 1

CLIENT: General Electric
PROJECT LOCATION: French Rd., Utica NY
FILE NO.: 3023.024

SAMPLER: Split Spoon 2"
HAMMER: 140 lbs.
FALL: 30"

LOCATION: Solvent tank area
START DATE: 12/18/91
END DATE: 12/18/91

BORING COMPANY: Parratt-Wolff, Inc.
FOREMAN: Brian Waters
OBG GEOLOGIST: D.E. Broach

GROUND WATER
Depth:
Date:
Elevation:

LEGEND: Grout; Sand Pack; Bentonite; Screen; Riser

DEPTH BELOW GRADE	NO.	DEPTH (FEET)	BLOWS /6"	PENETR/ RECOVERY	"N" VALUE	SAMPLE DESCRIPTION	STRATUM CHANGE GENERAL DESCRIPT	FIELD TESTING HNU (ppm)
0	1	0-2	5-7-17-45	24"/18"	24	Dry, brown, loose, fine to coarse SAND, some fine to medium gravel		0
1								
2	2	2-4	45-25-23-19	24"/18"	48	Dry, brown, medium dense, fine to coarse SAND, some fine to medium gravel, little silt		0
3								
4	3	4-6	20-14-12-12	24"/2"	26	Moist, brown, medium dense, fine to coarse SAND, some silt, little fine to medium gravel, samples submitted for analyses		0
5								
6	4	6-8	12-14-11-26	24"/20"	25	Wet, brown, medium dense, fine to coarse SAND, some silt, trace fine to medium gravel, samples submitted for analyses	6.0'	0
7								
8	5	8-10	18-15-25-36	24"/20"	40	Wet, gray, dense, fine to coarse SAND and SILT, some fine to medium gravel	8.0'	0
9								
10	6	10-12	19-18-50/2	24"/10"	68+	Wet, gray, very dense, fine to coarse SAND and SILT, some clay laminations, little fine to medium gravel		0
11								
12	7	12-14	12-17-22-24	24"/24"	39	Wet, gray, very dense, fine to medium SAND, some coarse sand, little fine to medium gravel, trace silt	12.0'	0
13								
14						Bottom of boring 14.0'		
15								
16								
17								
18								
19								
20								

EQUIPMENT INSTALLED:

PVC Well Screen 14.0 - 4.0'
Sand Pack 14.0 - 3.0'
Bentonite Seal 3.0 - 2.0'
Cement 2.0 - 0.0'

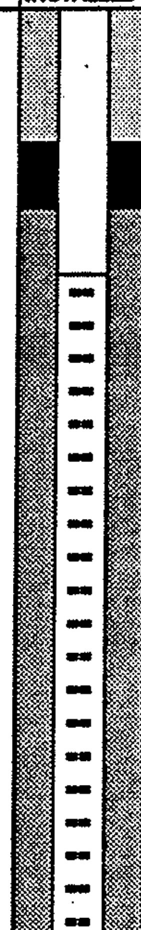
O'BRIEN & GERE ENGINEERS, INC.

TEST BORING LOG

REPORT OF BORING MW-5
PAGE 1 OF 1

CLIENT: General Electric	SAMPLER: Split Spoon 2"	LOCATION: Solvent tank area
PROJECT LOCATION: French Rd., Utica NY	HAMMER: 140 lbs.	START DATE: 12/19/91
FILE NO.: 3023.024	FALL: 30"	END DATE: 12/19/91
BORING COMPANY: Parratt-Wolff, Inc.	GROUND WATER	LEGEND: Grout; Sand Pack; Bentonite; Screen; Riser
FOREMAN: Brian Waters	Depth:	
OBG GEOLOGIST: D.E. Broach	Date:	
	Elevation:	

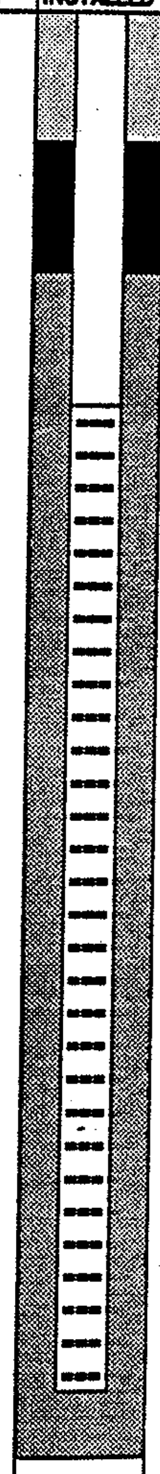
DEPTH BELOW GRADE	NO.	DEPTH (FEET)	BLOWS /6"	PENETR/ RECOVERY	"N" VALUE	SAMPLE DESCRIPTION	STRATUM CHANGE GENERAL DESCRIPT	EQUIPMENT INSTALLED	FIELD TESTING HNU (ppm)
0						CONCRETE to 6"			
	1	0.5-2	29-39-30	16"/16"	---	Dry, brown, dense, fine to coarse SAND and SILT, some fine to coarse gravel, trace clay			0
1									
2	2	2-4	70/0.4	24"/1"	---	Dry, brown, dense, fine to coarse SAND and fine to medium gravel, little silt, samples submitted for analyses			0
3									
4	3	4-6	14-20-28-20	24"/24"	48	Dry, brown, dense, fine to coarse SAND and fine to coarse GRAVEL, little silt, rock stuck in tip of split spoon, samples submitted for analyses			0
5									
6	4	6-8	18-19-24-22	24"/24"	43	Dry, brown, dense, fine to coarse SAND and fine to medium gravel, little silt			0
7									
8	5	8-10	14-31-40-32	24"/24"	71	Dry, brown, dense, fine to coarse SAND and fine to medium GRAVEL, little silt			0
9									
10	6	10-12	23-21-40-31	24"/24"	61	Dry, brown, dense, fine to coarse SAND and fine to medium GRAVEL, little silt, water seen entering borehole			0
11									
12	7	12-12.8	57-50/3	24"/8"	---	Dry, brown, dense, fine to coarse SAND and fine to medium GRAVEL, little silt			0
13						Bottom of boring 12.8'			
14									
15									
16									
17									
18									
19									
20									



PVC Well Screen 14.0 – 4.0'
Sand Pack 14.0 – 3.0'
Bentonite Seal 3.0 – 2.0'
Cement 2.0 – 0.0'

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING MW-7 PAGE 1 OF 1
CLIENT: GE Aerospace	SAMPLER: Split Spoon	LOCATION: South corner of building
PROJECT LOCATION: Solvent Dock Utica, NY	HAMMER: 130 lbs	START DATE: 2/8/93 END DATE: 2/9/93
FILE NO.: 5526.009	FALL: 30"	
BORING COMPANY: Parratt-Wolff, Inc. FOREMAN: Arnold Chapel OBG GEOLOGIST: Susan E. Ferrara		LEGEND: Grout, Sand Pack, Pellets, Screen, Riser

DEPTH BELOW GRADE	NO.	DEPTH (FEET)	BLOWS /6"	PENETR/ RECOVERY	"N" VALUE	SAMPLE DESCRIPTION	STRATUM CHANGE GENERAL DESCRIPT	EQUIPMENT INSTALLED	FIELD TESTING PID	FIELD TESTING HEAD-SPACE
0						ASPHALT				
	1	0.5-2	137-80-21	18"/14"	101	Damp, brown SILT, some fine to medium sand and gravel, trace coarse gravel through-out	0.5'			
1										
2										
3										
4										
5	2	5-7	34-44-38-57	24"/15"	82	Same as above				
6										
7										
						Damp, brown SILT, some fine sand, little fine to coarse gravel, hard	7.5'			
8										
9										
10	3	10-12	49-60-71-34	24"/18"	131					
11										
12										
13										
14										
15	4	15-15.5	100/0.3'	0.3'/0.2'	—	Same as above				
16										
17										
18										
19										
20	5	20-20.8	35-50/0.3'	8"/6"	—	Saturated, brown, fine to coarse SAND, some silt, little fine to medium gravel	20'			
21										
22						Bottom of boring 22 ft.				



O'BRIEN & GERE ENGINEERS, INC.

TEST BORING LOG

REPORT OF BORING MW-8
PAGE 1 OF 1

CLIENT: GE Aerospace
PROJECT LOCATION: Solvent Dock
Utica, NY
FILE NO.: 5526.009

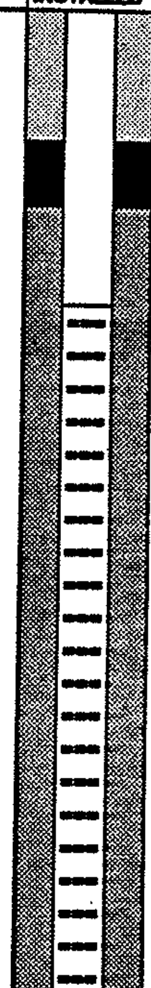
SAMPLER: Split Spoon
HAMMER: 130 lbs
FALL: 30"

LOCATION: On sidewalk
START DATE: 2/9/93
END DATE: 2/9/93

BORING COMPANY: Parratt-Wolff, Inc.
FOREMAN: Arnold Chapel
OBG GEOLOGIST: Susan E. Ferrara

LEGEND: Grout, Sand Pack, Pellets, Screen, Riser

DEPTH BELOW GRADE	NO.	DEPTH (FEET)	BLOWS /6"	PENETR/ RECOVERY	"N" VALUE	SAMPLE DESCRIPTION	STRATUM CHANGE GENERAL DESCRIPT	EQUIPMENT INSTALLED	FIELD TESTING PID	FIELD TESTING HEAD-SPACE
0	1	0-2	15-18-9-9	24"/6"	27	ASPHALT				
						Damp, brown, fine SAND, some silt, little fine to medium gravel, loose	0.5'			
1										
2										
3										
4										
5	2	5-7	3-5-8-27	24"/10"	13	Wet, dark brown SILT, some fine sand, little fine to medium gravel	5'			
6										
7										
8										
9										
10	3	10-11	34-50	12"/6"	—	Dry, brown SILT, some fine sand, little fine gravel				
11										
12										
13										
14	4	14-14.5	50/0.6'	0.6'/0.4'	—	Wet, gray SILT, little fine sand, trace clay, trace fine gravel				
15						Bottom of boring 14.5 ft.				
16										
17										
18										
19										
20										

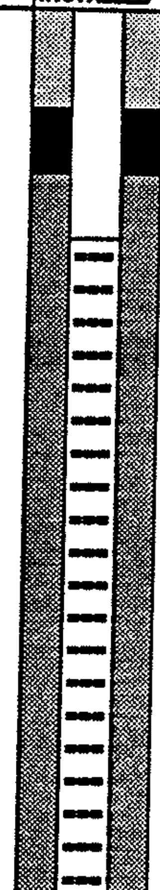


O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING MW-9
		PAGE 1 OF 1
CLIENT: GE Aerospace	SAMPLER: Split Spoon	LOCATION: Between bay 1 & 2
PROJECT LOCATION: Solvent Dock, Utica, NY	HAMMER: 130 lbs	START DATE: 2/9/93
FILE NO.: 5526.009	FALL: 30"	END DATE: 2/9/93

BORING COMPANY: Parratt-Wolff, Inc.
FOREMAN: Arnold Chapel
OBG GEOLOGIST: Susan E. Ferrara

LEGEND: Grout; Sand Pack; Pellets; Screen; Riser

DEPTH BELOW GRADE	NO.	DEPTH (FEET)	BLOWS /6"	PENETR/ RECOVERY	"N" VALUE	SAMPLE DESCRIPTION	STRATUM CHANGE GENERAL DESCRIPT	EQUIPMENT INSTALLED	FIELD TESTING PID	FIELD TESTING HEAD-SPACE
0	1	0-2	29-12-9-5	24"/6"	21	ASPHALT				
						Damp, brown SILT and fine SAND, little medium to coarse gravel, trace fine gravel	0.5'			
1										
2										
3										
4										
5	2	5-7	5-9-20-29	24"/6"	29	Wet, brown SILT, some fine to coarse sand and gravel				
6										
7										
8										
9										
10	3	10-12	34-50/0.3'	9"/5"	—	Damp, brown SILT, some fine sand, little fine to medium gravel				
11										
12										
13										
						Bottom of boring 13.5 ft.				
14										
15										
16										
17										
18										
19										
20										



O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING MW-10 PAGE 1 OF 1
CLIENT: GE Aerospace	SAMPLER: Split Spoon	LOCATION: Near solvent dock
PROJECT LOCATION: Solvent Dock, Utica, NY	HAMMER: 130 lbs	START DATE: 2/10/93
FILE NO.: 5526.009	FALL: 30"	END DATE: 2/10/93

BORING COMPANY: Parratt-Wolff, Inc.
FOREMAN: Arnold Chapel
OBG GEOLOGIST: Susan E. Ferrara

LEGEND: Grout, Sand Pack, Pellets, Screen, Riser

DEPTH BELOW GRADE	NO.	DEPTH (FEET)	BLOWS /6"	PENETR/ RECOVERY	"N" VALUE	SAMPLE DESCRIPTION	STRATUM CHANGE GENERAL DESCRIPT	EQUIPMENT INSTALLED	FIELD TESTING PID	FIELD TESTING HEAD-SPACE
0	1	0-2	44-40-	24"/9"	89	ASPHALT				
			49-30			Bronw, fine to coarse SAND and fine to medium GRAVEL, some silt	0.5'			
1										
2										
3										
4										
5	2	5-7	15-28-	24"/12"	56	Saturated, brown-black, fine to coarse SAND, some fine to medium gravel throughout				
			28-24							
6										
7										
8										
9										
10	3	10-12	28-50-	24"/12"	—	Damp, brown SILT, some fine sand, little coarse sand and fine gravel throughout	10'			
			50/0.2'							
11										
12										
13										
14	4	14-14.8	38-50/0.2'	8"/4"	—	Wet, gray SILT, some fine sand, little coarse gravel				
15						Bottom of boring 14.8 ft.				
16										
17										
18										
19										
20										

O'BRIEN & GERE ENGINEERS, INC.

TEST BORING LOG

REPORT OF BORING **MW-11**
PAGE 1 OF 1

CLIENT: GE Aerospace
PROJECT LOCATION: Solvent Dock, Utica, NY
FILE NO.: 5526.009

SAMPLER: Split Spoon
HAMMER: 130 lbs
FALL: 30"

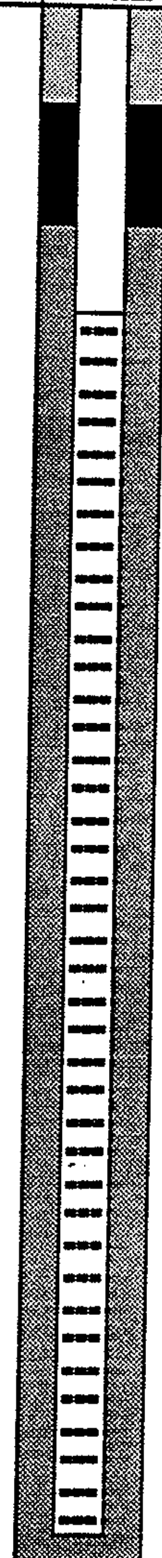
LOCATION: Near storage dock
START DATE: 2/10/93
END DATE: 2/11/93

BORING COMPANY: Parratt-Wolff, Inc.
FOREMAN: Arnold Chapel
OBG GEOLOGIST: Susan E. Ferrara

LEGEND: Grout; Sand Pack; Pellets; Screen; Riser

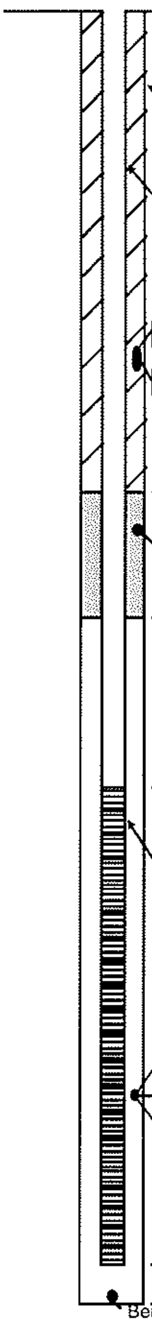
DEPTH BELOW GRADE	NO.	DEPTH (FEET)	BLOWS /6"	PENETR/ RECOVERY	"N" VALUE	SAMPLE DESCRIPTION	STRATUM CHANGE GENERAL DESCRIPT	PID	HEAD-SPACE
0	1	0-2	15-10-10-8	24"/8"	20	ASPHALT			
						Damp, brown SILT, some fine to coarse sand and fine to medium gravel	0.5'		
1									
2									
3									
4									
5	2	5-7	8-12-23-27	24"/12"	35	Dry, brown SILT and fine SAND, some medium to coarse sand, little fine gravel, loose			
6									
7									
8						Dry, rust SILT, some fine sand, little fine to medium gravel	8'		
9									
10	3	10-11	44-50/0.3'	12"/6"	—				
11									
12									
13									
14									
15	4	15-15.5	70/0.5'	0.5'/0.5'	—	Same as above			
16									
17									
18									
19									
20	5	20-21.5	37-49-57	18"/6"	106	Dry, brown SILT, some fine sand, little fine gravel, hard			
21									
22									
23									
24									
25	6	25-25.4	100/0.4'	0.4'/0.3'	—	Same as above			
						Bottom of boring 25.4 ft.			

EQUIPMENT INSTALLED



ARCADIS G&M

Well Construction Log
(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project LMC-Utica Well PZ-8

Town/City Utica, NY

County Oneida State NY

Permit No.

Land-Surface Elevation and Datum:

508.2 feet [X] Surveyed [ ] Estimated

Installation Date(s) 07/24/08-07/25

Drilling Method mud rotary

Drilling Contractor Parratt Wolff

Drilling Fluid potable water

Development Technique(s) and Date(s)

08/05/08 check value

Fluid Loss During Drilling ______ gallons

Water Removed During Development 0.1 gallons

Static Depth to Water 7.6 feet below M.P.

Pumping Depth to Water 9.42 feet below M.P.

Pumping Duration 1 hours

Yield ______ gpm Date 39665

Specific Capacity ______ gpm/ft

Well Purpose

Remarks

Start-DTB 9.15, end 9.56

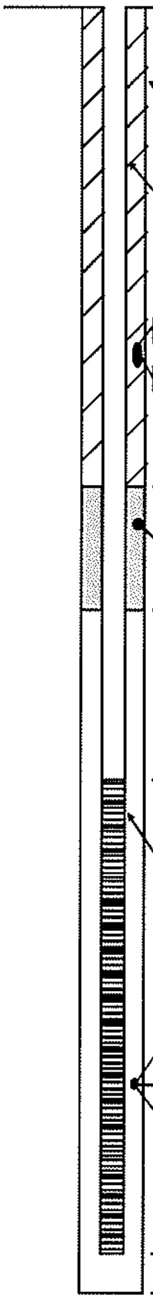
Prepared by GM

G:\TECHNICL\FIELD LOGS\Well Construction (Unconsolidated).XLS- PZ-8

ARCADIS G&M

Well Construction Log

(Unconsolidated)



LAND SURFACE

4 inch diameter drilled hole

Well casing, 1 inch diameter,

☐ Backfill

☒ Grout cement

1 ft*

Bentonite ☐ slurry

2 ft* ☒ pellets

5 ft*

Well Screen. 1 inch diameter

40 pvc , 0 slot

☐ Gravel Pack

☒ Sand Pack

☐ Formation Collaspse

10 ft*

ft*

Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project LMC-Utica Well PZ-9

Town/City Utica, NY

County Oneida State NY

Permit No.

Land-Surface Elevation and Datum:

508.1 feet ☒ Surveyed ☐ Estimated

Installation Date(s) 7/29/2008

Drilling Method mud rotary

Drilling Contractor Parratt Wolff

Drilling Fluid potable water

Development Technique(s) and Date(s)

08/05/08 check valve

Fluid Loss During Drilling ______ gallons

Water Removed During Development 0.15 gallons

Static Depth to Water 7.43 feet below M.P.

Pumping Depth to Water 9.24 feet below M.P.

Pumping Duration ______ hours

Yield ______ gpm Date ______

Specific Capacity ______ gpm/ft

Well Purpose

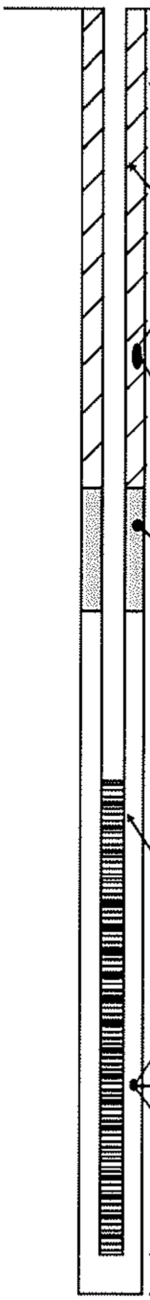
Remarks

Start: DTB 7.80, end: 9.35

Prepared by GM

ARCADIS G&M

Well Construction Log
(Unconsolidated)



LAND SURFACE

4 inch diameter drilled hole

Well casing, 1 inch diameter,

☐ Backfill
☒ Grout cement

1 ft*

Bentonite ☐ slurry ☒ pellets

5 ft*

7 ft*

Well Screen. 1 inch diameter
40 pvc, 0 slot

☐ Gravel Pack
☒ Sand Pack
☐ Formation Collaspse

12 ft*

ft*

Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project LMC-Utica Well PZ-10

Town/City Utica, NY

County Oneida State NY

Permit No.

Land-Surface Elevation and Datum:

508.1 feet ☒ Surveyed ☐ Estimated

Installation Date(s) 7/31/2008

Drilling Method mud rotary

Drilling Contractor Parratt Wolff

Drilling Fluid potable water

Development Technique(s) and Date(s)

08/05/08 check valve

Fluid Loss During Drilling ______ gallons

Water Removed During Development 0.5 gallons

Static Depth to Water 6.94 feet below M.P.

Pumping Depth to Water 11 feet below M.P.

Pumping Duration ______ hours

Yield ______ gpm Date ______

Specific Capacity ______ gpm/ft

Well Purpose

Remarks

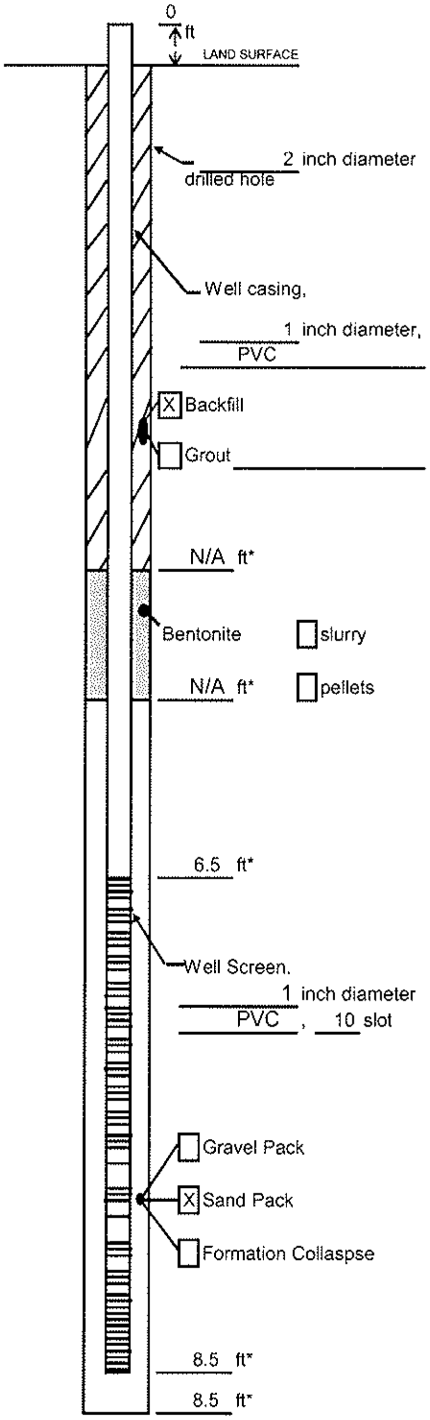
Start: DTB: 7.57, end: 11.16

Prepared by GM

ARCADIS GERAGHTY & MILLER

Well Construction Log

(Unconsolidated)



Measuring Point is Top of Well Casing Unless Otherwise Noted.

* Depth Below Land Surface

Project: LMC- Utica Well: PZ-11

Town/City: Utica, NY

County: Oneida State: NY

Permit No.: N/A

Land-Surface Elevation and Datum:

505.8 (top of PVC) feet [X] Surveyed [ ] Estimated

Installation Date(s): 11/3/2008

Drilling Method: Geoprobe Rig

Drilling Contractor: Thew Associates

Drilling Fluid: None

Development Technique(s) and Date(s)

1" bailer

Fluid Loss During Drilling: 0 gallons

Water Removed During Development: <3 gallons

Static Depth to Water: 6.96 feet below M.P.

Pumping Depth to Water: N/A feet below M.P.

Pumping Duration: N/A hours

Yield: N/A gpm Date: N/A

Specific Capacity: N/A gpm/ft

Well Purpose

Sample Groundwater

Remarks

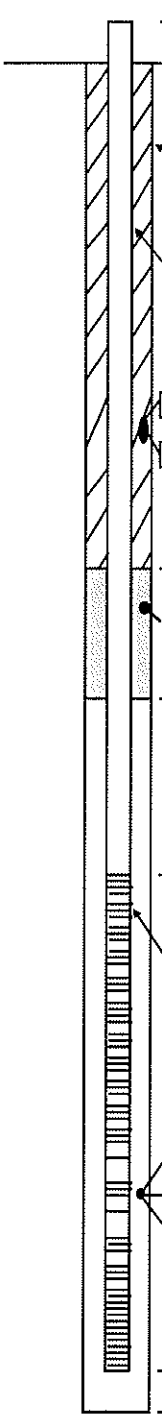
Constructed in a backfilled test pit (TP-4)

Prepared by: J. Rocklin

ARCADIS GERAGHTY & MILLER

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project: LMC- Utica   Well: PZ-12

Town/City: Utica, NY

County: Oneida   State: NY

Permit No.: N/A

Land-Surface Elevation and Datum:

505.8 (top of PVC) feet   [X] Surveyed   [ ] Estimated

Installation Date(s): 11/3/2008

Drilling Method: Geoprobe Rig

Drilling Contractor: Thew Associates

Drilling Fluid: None

Development Technique(s) and Date(s)

1" bailer

Fluid Loss During Drilling: 0 gallons

Water Removed During Development: <3 gallons

Static Depth to Water: 6.94 feet below M.P.

Pumping Depth to Water: N/A feet below M.P.

Pumping Duration: N/A hours

Yield: N/A gpm   Date: N/A

Specific Capacity: N/A gpm/ft

Well Purpose

Water level monitoring and groundwater sampling

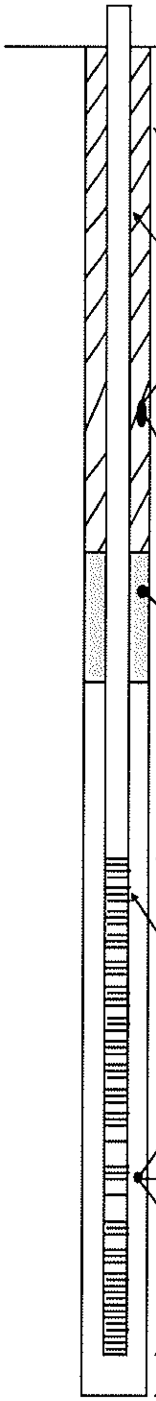
Remarks

Constructed in a backfilled test pit (TP-4)

Prepared by: J. Rocklin

ARCADIS GERAGHTY & MILLER

Well Construction Log
(Unconsolidated)



0 ft
LAND SURFACE

2 inch diameter drilled hole

Well casing, 1 inch diameter, PVC

[X] Backfill

[ ] Grout

N/A ft*

Bentonite [ ] slurry

N/A ft* [ ] pellets

6.5 ft*

Well Screen, 1 inch diameter PVC, 10 slot

[ ] Gravel Pack

[X] Sand Pack

[ ] Formation Collaspse

8.5 ft*

8.5 ft*

Measuring Point is Top of Well Casing Unless Otherwise Noted.

* Depth Below Land Surface

Project: LMC- Utica — Well: PZ-13

Town/City: Utica, NY

County: Oneida — State: NY

Permit No.: N/A

Land-Surface Elevation and Datum:

503.9 (top of PVC) feet — [X] Surveyed [ ] Estimated

Installation Date(s): 11/3/2008

Drilling Method: Geoprobe Rig

Drilling Contractor: Thew Associates

Drilling Fluid: None

Development Technique(s) and Date(s)

1" bailer

Fluid Loss During Drilling: 0 gallons

Water Removed During Development: <3 gallons

Static Depth to Water: 7.10 feet below M.P.

Pumping Depth to Water: N/A feet below M.P.

Pumping Duration: N/A hours

Yield: N/A gpm — Date: N/A

Specific Capacity: N/A gpm/ft

Well Purpose

Sample groundwater

Remarks

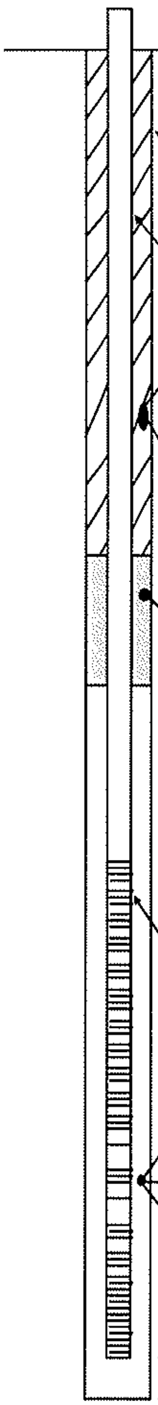
Constructed in a backfilled test pit (TP-5)

Prepared by: J. Rocklin

ARCADIS GERAGHTY & MILLER

Well Construction Log

(Unconsolidated)



0 ft
LAND SURFACE

2 inch diameter drilled hole

Well casing, 1 inch diameter, PVC

[X] Backfill

[ ] Grout

N/A ft*

Bentonite [ ] slurry

N/A ft* [ ] pellets

4.0 ft*

Well Screen. 1 inch diameter PVC, 10 slot

[ ] Gravel Pack

[X] Sand Pack

[ ] Formation Collaspse

9.0 ft*

9.0 ft*

Measuring Point is Top of Well Casing Unless Otherwise Noted.

* Depth Below Land Surface

Project LMC- Utica Well PZ-14

Town/City Utica, NY

County Oneida State NY

Permit No. N/A

Land-Surface Elevation and Datum:

504.1 (top of PVC) feet [X] Surveyed [ ] Estimated

Installation Date(s) 11/3/2008

Drilling Method Geoprobe Rig

Drilling Contractor Thew Associates

Drilling Fluid None

Development Technique(s) and Date(s)

1" bailer

Fluid Loss During Drilling 0 gallons

Water Removed During Development <3 gallons

Static Depth to Water 7.08 feet below M.P.

Pumping Depth to Water N/A feet below M.P.

Pumping Duration N/A hours

Yield N/A gpm Date N/A

Specific Capacity N/A gpm/ft

Well Purpose

Water level monitoring and groundwater sampling

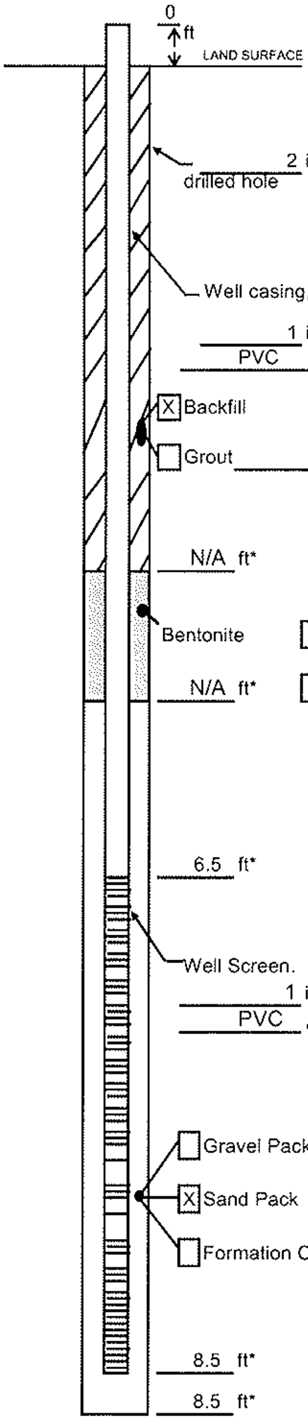
Remarks

Constructed in a backfilled test pit (TP-5)

Prepared by J. Rocklin

ARCADIS GERAGHTY & MILLER

Well Construction Log
(Unconsolidated)



2 inch diameter drilled hole

Well casing, 1 inch diameter, PVC

[X] Backfill
[ ] Grout

N/A ft*

Bentonite [ ] slurry

N/A ft* [ ] pellets

6.5 ft*

Well Screen. 1 inch diameter PVC, 10 slot

[ ] Gravel Pack
[X] Sand Pack
[ ] Formation Collaspse

8.5 ft*

8.5 ft*

Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project LMC- Utica Well PZ-15

Town/City Utica, NY

County Oneida State NY

Permit No. N/A

Land-Surface Elevation and Datum:

504.4 (top of PVC) feet [X] Surveyed
[ ] Estimated

Installation Date(s) 11/4/2008

Drilling Method Geoprobe Rig

Drilling Contractor Thew Associates

Drilling Fluid None

Development Technique(s) and Date(s)

1" bailer

Fluid Loss During Drilling 0 gallons

Water Removed During Development <3 gallons

Static Depth to Water 6.88 feet below M.P.

Pumping Depth to Water N/A feet below M.P.

Pumping Duration N/A hours

Yield N/A gpm Date N/A

Specific Capacity N/A gpm/ft

Well Purpose

Groundwater sampling

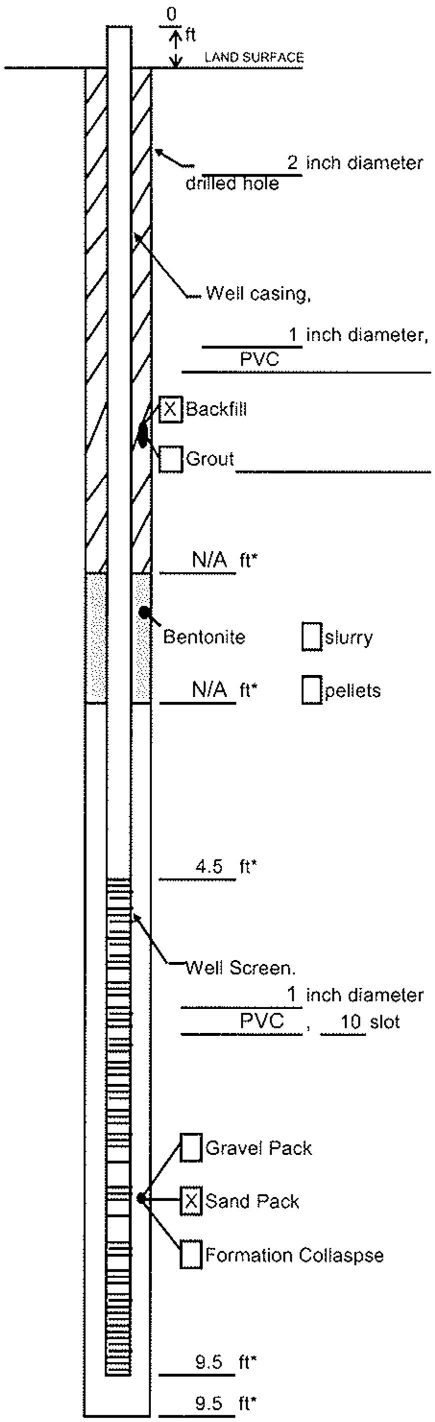
Remarks

Prepared by J. Rocklin

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project: LMC- Utica Well: PZ-16

Town/City: Utica, NY

County: Oneida State: NY

Permit No. N/A

Land-Surface Elevation and Datum:

504.5 (top of PVC) feet [X] Surveyed [ ] Estimated

Installation Date(s): 11/4/2008

Drilling Method: Geoprobe Rig

Drilling Contractor: Thew Associates

Drilling Fluid: None

Development Technique(s) and Date(s)

1" bailer

Fluid Loss During Drilling: 0 gallons

Water Removed During Development: <3 gallons

Static Depth to Water: 6.90 feet below M.P.

Pumping Depth to Water: N/A feet below M.P.

Pumping Duration: N/A hours

Yield: N/A gpm Date: N/A

Specific Capacity: N/A gpm/ft

Well Purpose:

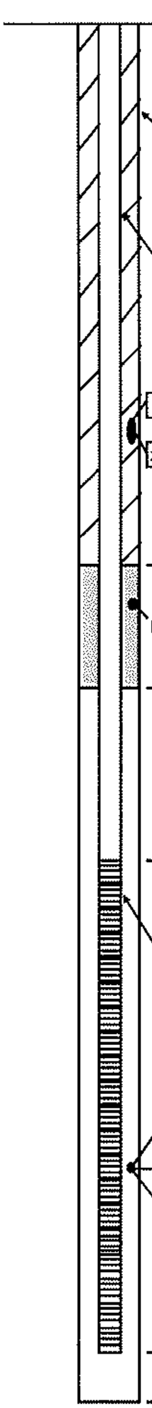
Remarks:

Prepared by: J. Rocklin

ARCADIS G&M

Well Construction Log

(Unconsolidated)



8 inch diameter drilled hole

Well casing, 2" pvc inch diameter,

☐ Backfill

☒ Grout 1

0.5 ft*

Bentonite ☐ slurry ☒ pellets

1.5 ft*

2 ft*

Well Screen. 2 inch diameter 40 PVC , 0.01 slot

☐ Gravel Pack

☒ Sand Pack

☐ Formation Collaspse

7 ft*

8 ft*

Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project LMC-Utica Well MW-13S

Town/City Utica, NY

County Oneida State NY

Permit No.

Land-Surface Elevation and Datum:

506.3 feet ☒ Surveyed ☐ Estimated

Installation Date(s) 7/16/2008

Drilling Method Hollow Stem Auger

Drilling Contractor Parratt Wolff

Drilling Fluid N/A

Development Technique(s) and Date(s)

Submersible pump 7/21/2008

Fluid Loss During Drilling N/A gallons

Water Removed During Development 12 gallons

Static Depth to Water 40.76 feet below M.P.

Pumping Depth to Water 42.4 feet below M.P.

Pumping Duration 0.66 hours

Yield N/A gpm Date

Specific Capacity N/A gpm/ft

Well Purpose GW sampling

N/A

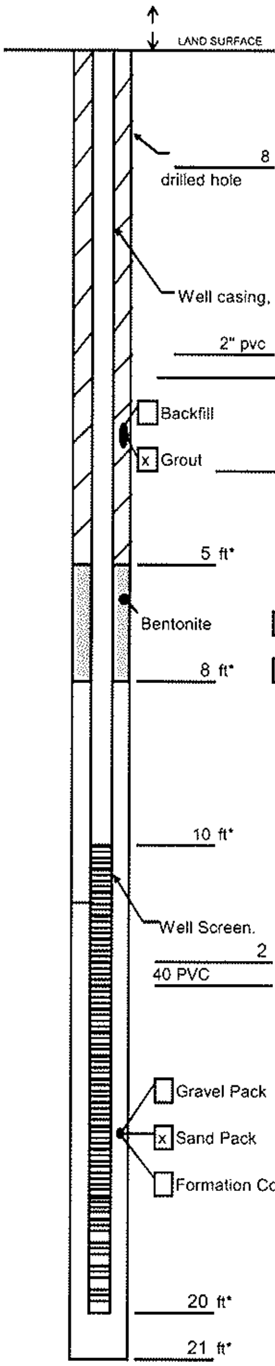
Remarks

Prepared by GM

ARCADIS G&M

Well Construction Log

(Unconsolidated)



8 inch diameter drilled hole

Well casing, 2" pvc inch diameter,

☐ Backfill

☒ Grout 1

5 ft*

Bentonite ☐ slurry

8 ft* ☒ pellets

10 ft*

Well Screen, 2 inch diameter

40 PVC , 0.01 slot

☐ Gravel Pack

☒ Sand Pack

☐ Formation Collaspse

20 ft*

21 ft*

Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project: LMC-Utica Well: MW-13T

Town/City: Utica, NY

County: Oneida State: NY

Permit No.

Land-Surface Elevation and Datum:

506.1 feet ☒ Surveyed ☐ Estimated

Installation Date(s): 7/16/2008

Drilling Method: Hollow Stem Auger

Drilling Contractor: Parratt Wolff

Drilling Fluid: N/A

Development Technique(s) and Date(s)

N/A

Fluid Loss During Drilling: N/A gallons

Water Removed During Development: N/A gallons

Static Depth to Water: N/A feet below M.P.

Pumping Depth to Water: N/A feet below M.P.

Pumping Duration: N/A hours

Yield: N/A gpm Date

Specific Capacity: N/A gpm/ft

Well Purpose: GW sampling

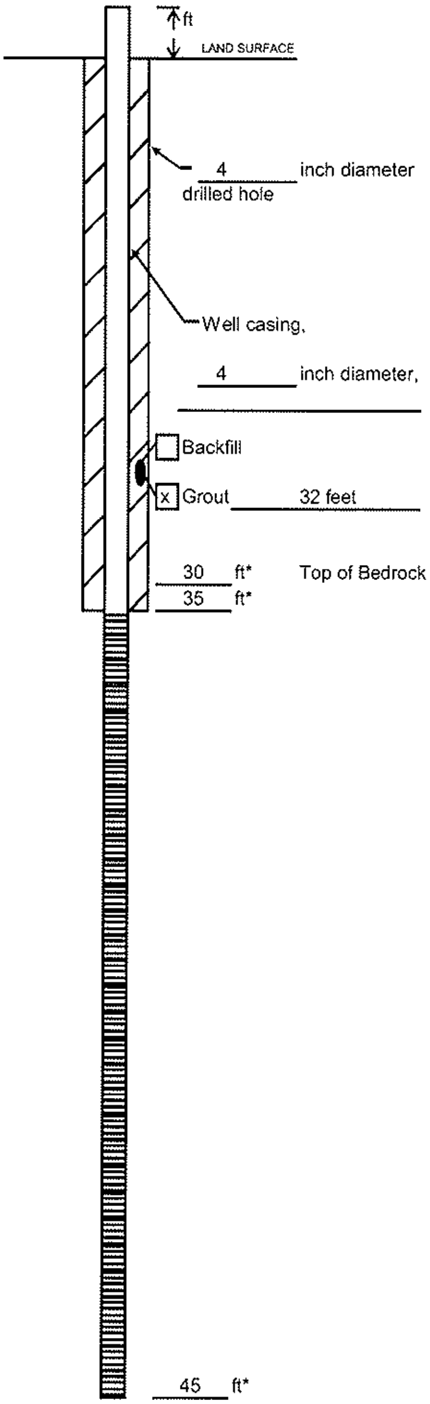
N/A

Remarks

Prepared by: GM

ARCADIS G&M

Well Construction Log
(Bedrock)



Project LMC:NJ000630.0001 Well MW-13BR

Town/City Utica, NY

County Oneida State NY

Permit No.

Land-Surface Elevation and Datum:

506.5 feet [X] Surveyed

[ ] Estimated

Installation Date(s) 5/19/08-5/22/08

Drilling Method Hollow Auger/Mud Rotary

Drilling Contractor Parratt Wolff

Drilling Fluid potable water

Development Technique(s) and Date(s)

Submersible pump 7/21/2008

Fluid Loss During Drilling N/A gallons

Water Removed During Development 12 gallons

Static Depth to Water 40.76 feet below M.P.

Pumping Depth to Water 42.4 feet below M.P.

Pumping Duration 0.66 hours

Yield N/A gpm Date

Specific Capacity N/A gpm/ft

Well Purpose GW sampling

Fracture Zones N/A

Remarks

well screen 35-45; sand 34-45, bent. 34-32, grout to top

Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

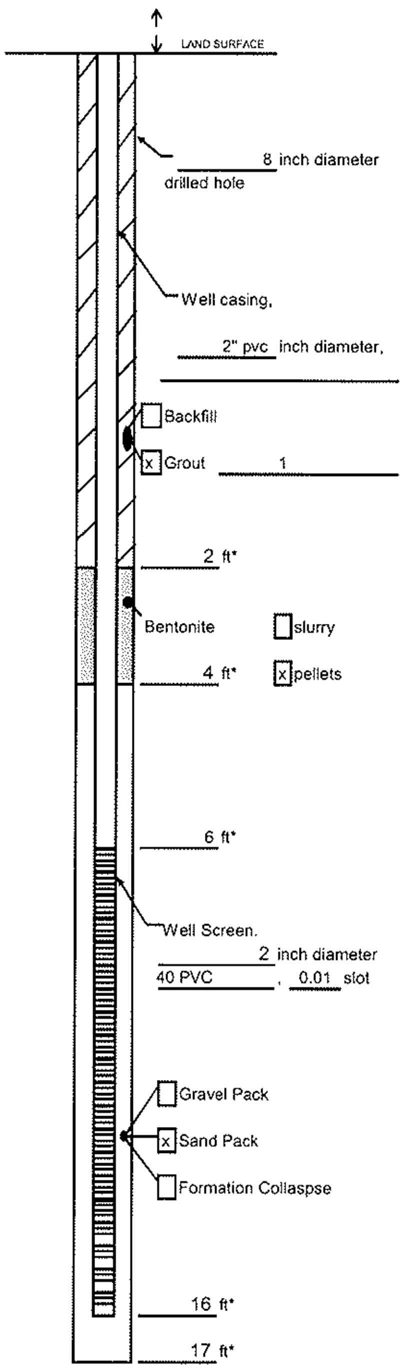
* Depth Below Land Surface

Prepared by GM

G:\TECHNICL\FIELD LOGS\Well Construction (Bedrock).XLS- MW-13BR

ARCADIS G&M

Well Construction Log
(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project LMC-Utica Well MW-14S

Town/City Utica, NY

County Oneida State NY

Permit No.

Land-Surface Elevation and Datum:

508.2 feet [X] Surveyed [ ] Estimated

Installation Date(s) 7/17/2008

Drilling Method Hollow Stem Auger

Drilling Contractor Parratt Wolff

Drilling Fluid

Development Technique(s) and Date(s)

Submersible pump 7/21/2008

Fluid Loss During Drilling N/A gallons

Water Removed During Development 1 gallons

Static Depth to Water 10.51 feet below M.P.

Pumping Depth to Water 15.45 feet below M.P.

Pumping Duration 2 hours

Yield N/A gpm Date

Specific Capacity N/A gpm/ft

Well Purpose GW sampling

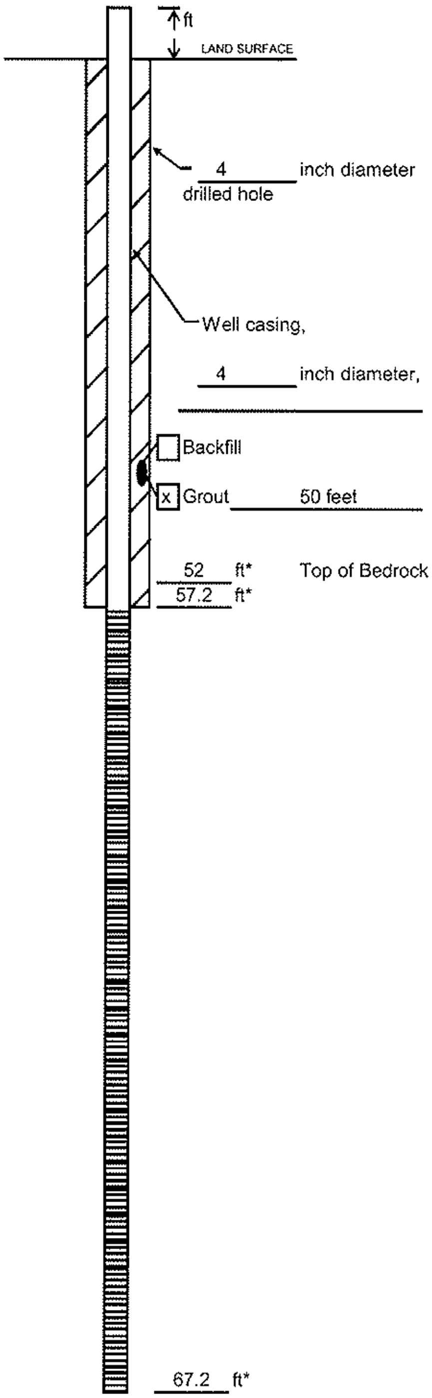
N/A

Remarks

Prepared by GM

ARCADIS G&M

Well Construction Log
(Bedrock)



Project: LMC:NJ000630.0001 Well: MW-14BR

Town/City: Utica, NY

County: Oneida State: NY

Permit No.:

Land-Surface Elevation and Datum:

508.2 feet [X] Surveyed [ ] Estimated

Installation Date(s): 5/19/08-5/22/08

Drilling Method: Hollow Auger/Mud Rotary

Drilling Contractor: Parratt Wolff

Drilling Fluid: potable water

Development Technique(s) and Date(s)

Submersible pump 7/21/2008

Fluid Loss During Drilling: N/A gallons

Water Removed During Development: 23.5 gallons

Static Depth to Water: 8.01 feet below M.P.

Pumping Depth to Water: 23.5 feet below M.P.

Pumping Duration: 2 hours

Yield: N/A gpm Date:

Specific Capacity: N/A gpm/ft

Well Purpose: GW sampling

Fracture Zones: N/A

Remarks:

well screen 57.2-67.2; sand 67.7-55, bent. 49.8-55, grout to top

Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

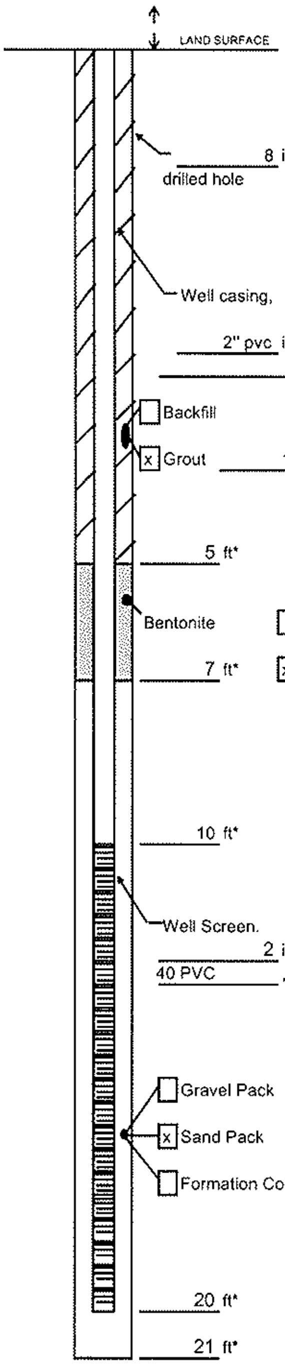
* Depth Below Land Surface

Prepared by: GM

ARCADIS G&M

Well Construction Log

(Unconsolidated)



8 inch diameter drilled hole

Well casing, 2" pvc inch diameter,

☐ Backfill

☒ Grout 1

5 ft*

Bentonite ☐ slurry

7 ft* ☒ pellets

10 ft*

Well Screen. 2 inch diameter 40 PVC, 0.01 slot

☐ Gravel Pack

☒ Sand Pack

☐ Formation Collaspse

20 ft*

21 ft*

Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project LMC-Utica Well MW-15S

Town/City Utica, NY

County Oneida State NY

Permit No.

Land-Surface Elevation and Datum:

507.7 feet ☒ Surveyed

☐ Estimated

Installation Date(s) 7/17/2008

Drilling Method Hollow Stem Auger

Drilling Contractor Parratt Wolff

Drilling Fluid

Development Technique(s) and Date(s)

Submersible pump 7/21/2008

Fluid Loss During Drilling N/A gallons

Water Removed During Development 3.2 gallons

Static Depth to Water 9.9 feet below M.P.

Pumping Depth to Water 19.5 feet below M.P.

Pumping Duration 1.5 hours

Yield N/A gpm Date

Specific Capacity N/A gpm/ft

Well Purpose GW sampling

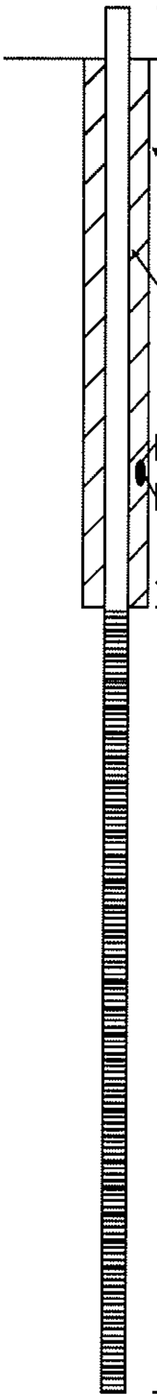
N/A

Remarks

Prepared by GM

ARCADIS G&M

Well Construction Log
(Bedrock)



Project LMC:NJ000630.0001 Well MW-15BR

Town/City Utica, NY

County Oneida State NY

Permit No. ______

Land-Surface Elevation and Datum:

507.5 feet [X] Surveyed

[ ] Estimated

Installation Date(s) 5/19/08-5/22/08

Drilling Method Hollow Auger/Mud Rotary

Drilling Contractor Parratt Wolff

Drilling Fluid potable water

Development Technique(s) and Date(s)

Submersible pump 7/21/2008

Fluid Loss During Drilling N/A gallons

Water Removed During Development 13 gallons

Static Depth to Water 5.57 feet below M.P.

Pumping Depth to Water 61.1 feet below M.P.

Pumping Duration 2 hours

Yield N/A gpm Date ______

Specific Capacity N/A gpm/ft

Well Purpose GW sampling

Fracture Zones N/A

Remarks

well screen 57.6-67.6; sand 68.5-55.6, bent. 52-55.6, grout to top

Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Prepared by GM

G:\TECHNICL\FIELD LOGS\Well Construction (Bedrock) XLS- MW-15BR

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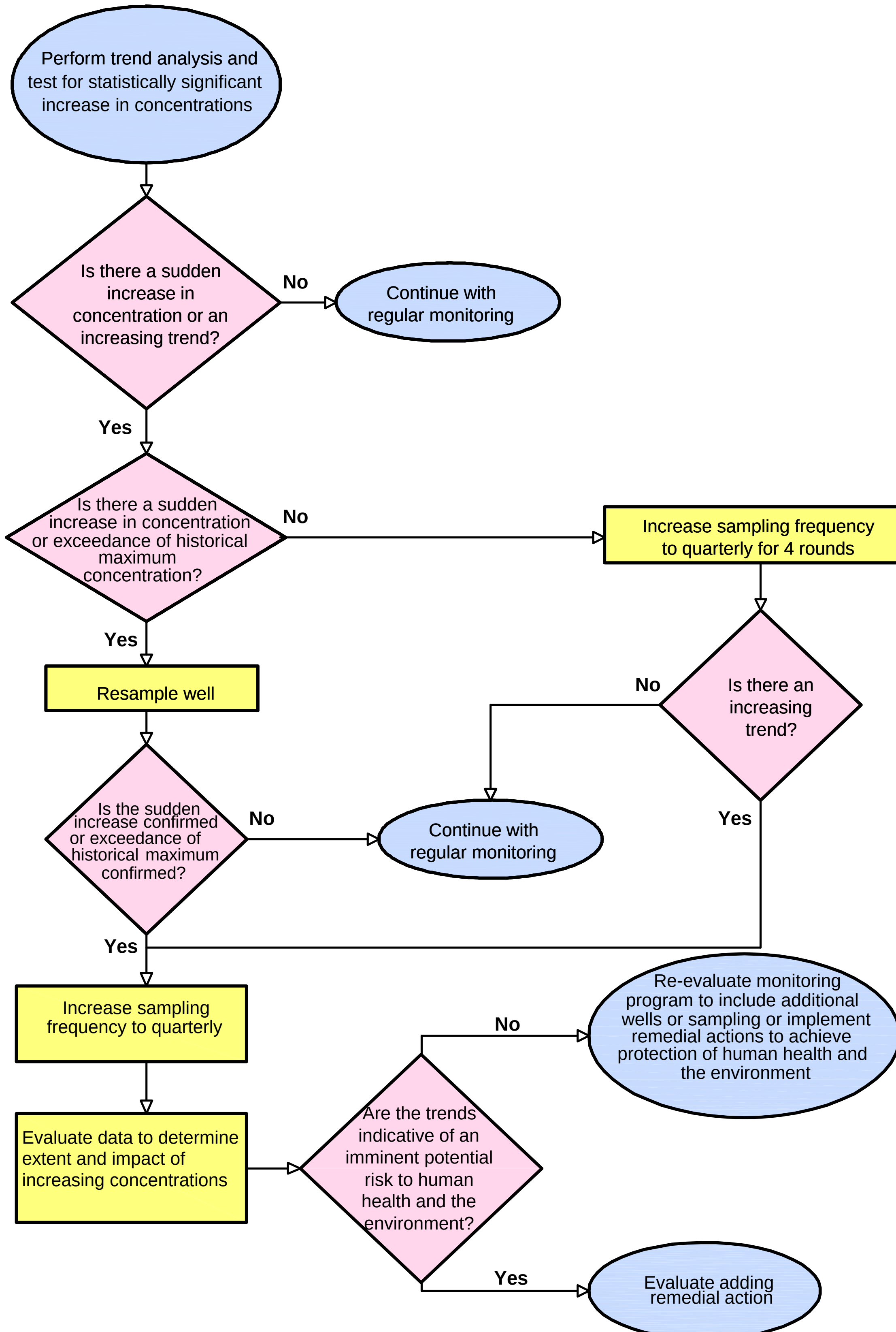
Appendix B

Decision Tree for
Performance Monitoring



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DECISION TREE FOR PERFORMANCE MONITORING

MONITORED NATURAL ATTENUATION PLAN

FORMER LOCKHEED MARTIN
FRENCH ROAD FACILITY
UTICA, NEW YORK

APPENDIX

B

PATH: G:\ENVCAD\Mahwah\ACT\NJ001000\0001\00001\2009-08\FIG-B DECISION TREE - OBJECTIVE 1 LOCATIONS.DWG 9/29/2009 - 3:09:58 PM Layout: 85x11 Hor

DWG DATE: 7/31/07 | PRJCT NO: GP3LCAAP.HNE1 | DRAWING: DRAWING | CHECKED: J. MCDONOUGH | APPROVED: E. PANHORST | DRAFTER: M. WASILEWSKI

ARCADIS

Appendix C

Draft Monitoring-Well Decommissioning Policy

DRAFT Monitoring Well Decommissioning Policy

New York State Department of Environmental Conservation

Date Issued:	Latest Date Revised:

I. Summary:

Monitoring wells provide an essential access to the subsurface so that scientific and engineering investigations can be made. Any monitoring well is an environmental liability to some degree because it has the potential to act as a conduit for pollution to reach the groundwater. To lessen this liability, when the effective life of a monitoring well has been reached, it must be properly decommissioned. This document provides guidance for satisfactorily decommissioning monitoring wells in New York State. Topics include how to choose the most appropriate well decommissioning method and how to implement that method in the field.

II. Policy:

It is the policy of the New York State Department of Environmental Conservation (Department) that environmental monitoring wells be properly decommissioned when they are no longer needed or when their integrity is suspect or compromised. The choice of decommissioning method shall be appropriate for the situation and will be determined based upon well construction and environmental parameters. The selected method shall be designed to protect our groundwater and shall be implemented according to current best engineering practices and shall follow all applicable federal, state and local regulations.

III. Purpose and background:

Other synonyms for well decommissioning include “plugging,” “capping” and “abandoning.” For consistency only the term “decommissioning” is used in remainder of this document.

Unprotected, neglected and improperly abandoned monitoring wells are a serious environmental liability. They can function as a pollution conduit for surface contaminants to reach the subsurface and pollute our groundwater. They also can cause unwanted mixing of groundwaters which degrade the overall water quality within the aquifer. Improperly constructed, poorly maintained or damaged monitoring wells can yield anomalous poor data which in turn can compromise the findings of an environmental investigation or remediation project. Unneeded monitoring wells must be physically removed or plugged in order to prevent harm to our groundwater.

Since 1980 the Department has installed, directed or overseen the installation of thousands of monitoring wells across the state in various state and federal programs including programs for Superfund, solid waste, Resource Conservation and Recovery Act (RCRA), spill response, petroleum bulk storage and chemical bulk storage. This guidance addresses the environmental liability associated with this aging network of wells.

Within its boring zone, a successfully decommissioned well prevents the following:

1. migration of existing or future contaminants into an aquifer or between aquifers;

2. migration of existing or future contaminants within the vadose zone;

3. the potential for vertical or horizontal migration of fluids in the well or adjacent to the well; and

4. any change in aquifer yield and hydrostatic head unless due to natural conditions.

Monitoring well construction in New York State varies considerably due to the age of the well, the local geology and the presence or absence of contamination. No single decommissioning method is recommended for all situations in New York State.

IV. Responsibility:

The Division of Environmental Remediation (DER) is responsible updating this policy. Compliance with the guidance does not relieve any party of the obligation to successfully and satisfactorily decommission a monitoring well. Enforcement and oversight responsibility will be carried out by each Department Regional Engineer.

V. Procedure:

The following information pertains to the procedures for monitoring well decommissioning. Sections of the guidance are arranged by topic in the following order:

1. Preparation
2. Selecting the appropriate well decommissioning method and a discussion of pertinent techniques
3. Locating and setting up on the well
4. Removing the protective casing
5. Selecting, mixing, and placing grout
6. Backfilling and site restoration
7. Documentation
8. Field oversight

1.0 PREPARATION

The first step in the well decommissioning process is to review all pertinent site information. This includes boring and well logs, field inspection sheets, and laboratory analytical results performed on the site's soil and groundwater samples. This site information will form the basis for decisions throughout the decommissioning process.

Field inspection of the wells prior to decommissioning is also recommended to verify the characteristics and conditions of the wells. Special conditions such as access problems, well extensions through capped and covered landfills, and cap conditions due to seasonal weather patterns should be assessed. At well locations where the riser has been extended, the burial of a previous concrete pad may require the excavation of soil to the top of the concrete pad to remove the well. Decommissioning work requiring the use of heavy vehicular equipment on RCRA landfill caps should be scheduled during dry weather if possible so as to minimize damage to the cover. If work must be performed during the spring, winter or inclement weather, special measures such as placement of plywood to reduce ruts should be employed to maintain the integrity of the completed landfill cover system. A sample "Monitoring Well Field Inspection Log," which indicates the minimum information to be collected during field verification activities, is included as Figure 2.

2.0 SELECTING THE WELL DECOMMISSIONING METHOD

The primary rationale for well decommissioning is to prevent contaminant migration along the disturbed construction zone created by the original well boring. This requires selection of a decommissioning procedure that takes into account factors such as:

1. hydrogeological conditions at the well site;
2. presence or absence of contamination in the groundwater; and
3. original well construction details.

The proper well decommissioning methods and selection process are presented on the flow chart presented as Figure 1. For each decommissioning method, the specific procedures are determined by (1) geology; (2) contaminants; and (3) well design. For example, decommissioning a well that penetrates a confining layer may require a different approach than decommissioning an unconfined water table well. This section presents a summary of the well decommissioning methods and the selection process. The four primary well decommissioning methods are:

1. casing pulling;
2. overdrilling;
3. grouting the casing in-place; and
4. perforating the casing followed by grouting in-place.

A general discussion of each decommissioning method is presented in Sections 2.1 through 2.5. A form to be used in the field to record the decommissioning construction is included as Figure 3. When either casing pulling or overdrilling are required, due to the uncertainty of successfully pulling a well or overboring a well, we strongly recommend that the driller tremie grout the well first. Then without allowing the grout to dry, the driller proceeds with pulling the casing or overdrilling the well. Refer to Figure 1 for the complete method selection process.

2.1 CASING PULLING

In general, referring to Figure 1, casing pulling is the preferred method for decommissioning wells where: no contamination is present; contamination is present but the well does not penetrate a confining layer; and when both contamination and a confining layer are present but the contamination cannot cross the confining layer. Additionally, the well construction materials and well depth must be such that pulling can be effected without breaking the riser. The majority of “gas station wells,” ie. shallow, petroleum spill monitoring wells, can be grouted as they are pulled. These are the simplest wells to remove but the removal and sealing still needs to be complete!

Most monitoring wells are finished with a protective casing (guard pipe) and a cement rain pad. The riser will usually be bonded to the guard pipe and rain pad. When the protective casing and cement pad are "yanked out," a polyvinyl chloride (PVC) riser will typically break off at the bottom of the guard pipe several feet below grade. Once this happens, it may become impossible to center a drill rig upon the well. The riser may become splintered and structurally unstable for pulling. The well may fill with dirt. Before pulling a casing or overdrilling a well, a method must be devised for removing these pieces without jeopardizing the remaining decommissioning effort.

Casing pulling involves removing the well casing by lifting. The procedure for removing the casing must allow grout to be added during pulling. The grout will fill the space once occupied by the material being withdrawn. Grout mixing and placement must be performed according to the procedures in Section 5.0.

An acceptable procedure to remove casing involves puncturing the bottom of the well or using a casing cutter to cut away the screen, filling the casing with grout tremied from the bottom of the well, using jacks to free casing from the hole, and lifting the casing out by using a drill rig, backhoe, crane, or other suitable equipment. Additional grout must be added to the casing as it is withdrawn. In wells or well points in which the bottom cannot be punctured, the casing or screened interval will be perforated or cut away prior to being filled with grout. This procedure should be followed for wells installed in collapsible formations or for highly contaminated wells. In situations where well materials such as PVC screens and risers are expected to sever, and removal of all well materials is required (i.e., at wells where it is suspected that inadequate construction procedures have resulted in poor annular seals or the formation was allowed to collapse on the casing along a portion of it's length, overdrilling will be required. Overdrilling is discussed in Section 2.4.

At sites in which well casings have been grouted into a rock socket, the casing pulling procedure may not be feasible. Grouting casings in-place is the preferred method of abandonment where the removal of the casing may be problematic, and the annulus of the well has been documented to be properly sealed.

2.2 GROUTING IN-PLACE

Grouting in-place is the simplest decommissioning procedure, but if improperly applied, offers the least long-term protection of all the methods. As discussed in Section 2.5, however, this method is preferred for the bedrock portion of bedrock wells, and is used for decommissioning cased wells in certain situations. For cased wells, the procedure involves filling the casing with grout to a level of five feet below the land surface, cutting the well casing at the five-foot depth, and removing the top portion of the casing and associated well materials from the ground. The casing must be grouted according to the procedures in Section 5.0. In addition, the upper five feet of the borehole is filled to land surface and restored according to the procedures described in Section 6.0.

For wells installed in bedrock, the procedure involves filling the casing (or open hole) with grout to the top of rock according to the procedures in Section 5.0. The grout mix, however, will vary according to the hydrogeological conditions as discussed in Section 2.5.

It should be noted that for wells located on landfills regulated under 6NYCRR Part 360, the screened interval of the well must be sealed separately and hydrostatically tested to ensure its adequacy before sealing the remaining borehole. The Standard Operating Procedure (SOP) for the hydrostatic test has been included under Appendix A.

2.3 CASING PERFORATION/GROUTING IN-PLACE

At this time, casing perforation is the preferred method for wells with four-inch or larger inside diameter which are designated to be grouted in-place in accordance with the selection flow chart, and the well's annulus is suspected of being improperly backfilled. Perforating the casing and screen allows plugging material to come in contact with the annular space and formation. The procedure involves perforating the well casing and screen then grouting the well. A wide variety of commercial equipment is available for perforating casings and screens in wells with four-inch or larger inside diameters. Due to the diversity of application, experienced contractors must recommend a specific technique based on site-specific conditions. A minimum of four rows of perforations several inches long and a minimum of five perforations per linear foot of casing or screen is recommended (American Society for Testing and Materials, Standard D 5299-99, 1999).

After perforating is complete, the borehole must be grouted according to the procedures in Section 5.0 and the upper five feet of borehole must be restored according to the procedures in Section 6.0.

2.4 OVERDRILLING

Because of it's complicated nature, difficulty and uncertain outcome, overdrilling is the least preferred abandonment option. Overdrilling is used where casing pulling is determined to be unfeasible, or where installation of a temporary casing is necessary to prevent cross-contamination, such as when a confining layer is present and contamination in the deeper aquifer could migrate to the upper aquifer as the well was pulled (see Section 2.5). The overdrilling method should:

1. follow the original well bore;
2. create a borehole of the same or greater diameter than the original boring;
3. remove all of the well construction materials.

Acceptable methods for overdrilling include the following. Please note that these methods are not suitable for all types of casing, and the advice of an experienced driller should be sought:

1. Using conventional augering (i.e., a hollow stem auger fitted with a pilot bit). The pilot bit will grind the well construction materials, which will be brought to the well surface by the auger.

2. Using a conventional cable tool rig to advance casing having a larger diameter than the original boring. The cable tool kit is advanced within the casing to grind the well construction materials and soils, which are periodically removed with large diameter bailer. This method is not applicable to bedrock wells.

3. Using an over-reaming tool with a pilot bit nearly the same size as the inside diameter of the casing and a reaming bit slightly larger than the original borehole diameter.

4. Using a hollow-stem auger with outward facing carbide cutting teeth having a diameter two to four inches larger than the casing. Outward-facing cutting teeth will prevent severing the casing and drifting off center.

Prior to overdrilling, the bottom of the well should be perforated or cut away, and the casing filled with grout as with the casing removal method.

In all cases above, overdrilling should advance beyond the original bore depth by a distance of 0.5 feet to ensure complete removal of the construction materials. Oversight attention should be focused on the drill cuttings, looking for fragments of well materials. Absence of these indicators is a sign that the augers have wandered off the well. When the overdrilling is complete, the casing and screen can be retrieved from the center of the auger (American Society for Testing and Materials, Standard D 5299-99, 1999), if one of the hollow stem auger methods described above is employed. Subsequent to overdrilling at flush mount well locations where it may be impractical to remove well materials from inside the augers, a 1-2 foot deep area should be excavated by hand around the flush-mount well to facilitate a conventional well removal while tremie-grouting inside the well. Alternatively, the soil within the annular space may be removed by raising the augers to allow the soil to fall out and re-advance the augers to the original target depth. Grout should then be tremied within the annular space between the augers and well casings. The grout level in the borehole should be maintained as the drilling equipment and well materials are sequentially removed. After overdrilling is completed, the borehole must be grouted according to the procedures in Section 5.0 and the upper five feet of borehole must be restored according to the procedures in Section 6.0.

2.5 SELECTION PROCESS AND IMPLEMENTATION

The decommissioning procedure selection flow chart, Figure 1, presents the logic behind selecting a particular decommissioning method. A discussion of the selection criteria and decommissioning methodology is presented below.

2.5.1 Contaminated Monitoring Wells/Piezometers

For wells and piezometers suspected or known to be contaminated with non-aqueous phase liquid (NAPL) and/or dense non-aqueous phase liquid (DNAPL) both also referred to as “product,” the decision to decommission the well should be reviewed. If decommissioning is determined to be the proper course of action, measurement of the product volume will be determined and the product will be removed. Subsequent to product recovery, all contaminated materials will be disposed of in accordance with appropriate regulations for solid waste and hazardous waste.

2.5.2 Bedrock Wells

Referring to Figure 1, if the well is constructed within a bedrock formation, the screened or the open hole portion of the well is grouted to the top of the bedrock. Prior to grouting, the depth of the well will be measured to determine if any silt or debris has plugged the well. If plugging has occurred, all reasonable attempts to clear it should be made before grouting. The borehole will then be tremie grouted from the bottom of the well to the top of bedrock to ensure a continuous grout column. Note that if the bedrock well is cased, the screen should be perforated to the top of the rock if the inside diameter of the casing is 4-inches or larger. Furthermore, if the screened interval transects multiple water bearing zones the special grout mix discussed in Section 5.1.2 should be used to ensure penetration of the sand pack.

After the rock hole is grouted, the overburden portion of the well is decommissioned in accordance with the rest of Section 2.0. If the bedrock extends to the ground surface, grouting can extend to the ground surface or to slightly below so that the site can be restored as appropriate in accordance with Section 6.0.

2.5.3 Uncontaminated Overburden Wells

For overburden wells and the overburden portion of bedrock wells, the first decision point in determining the decommissioning method considers whether the overburden portion of the well exhibits evidence of contamination, as determined through historical groundwater and/or soil sampling results. If the overburden portion of the well is uncontaminated, the next criteria considers whether the well penetrates a confining layer. In the case that the overburden portion of the well does not penetrate a confining layer, the casing should be tremie-grouted and pulled. As a general rule, PVC wells greater than 25-feet deep should not be pulled unless site-specific conditions or other factors indicate that the well can be pulled without breaking. If the well cannot be pulled, such as in the case that a bedrock portion of the well has already been grouted in-place, or if the well materials and depth prohibit pulling or will likely result in breakage, the well should be grouted in-place as accordance with Section 2.2 (if the casing is less than 4-inch in diameter) or Section 2.3 (if the casing diameter is 4-inches or larger).

If the overburden portion of the well penetrates a confining layer, the casing should be removed by pulling (if possible) in accordance with Section 2.1. If the casing cannot be removed by pulling, the well should be grouted in-place if appropriate or removed by overdrilling. The overdrilling method used will depend on the site-specific conditions and requirements. If pulling is attempted and fails (i.e., a portion of the riser breaks) the remaining portion of the well should be removed by using the conventional augering procedure identified in Section 24. Note that if the riser is broken during pulling, it is highly unlikely that the driller will be able to target it to overdrill it. In all cases, after the well construction materials have been removed to the extent possible, the borehole will be grouted in accordance with Section 5.0 and the upper five feet will be restored in accordance with Section 6.0.

2.5.4 Contaminated Overburden Wells

If an overburden well or the overburden portion of a bedrock well is contaminated as evidenced by historical sampling results, the first decision point in selecting a decommissioning procedure is whether the well penetrates a confining layer. If the well does not penetrate a confining layer, the selection process follows the same pathway as for uncontaminated wells that penetrate a confining layer (i.e., the casing is pulled, if possible; otherwise the well is grouted in-place or overdrilled - see Sections 2.1– 2.3).

For overburden wells that are contaminated and which penetrate a confining layer, the next selection criteria is whether the well riser is a single stem or is telescoped inside one or more outer casings.

2.5.4.1 Single Stem Riser

If the riser is a single stem, the potential for contamination across confining layers must be addressed. In this event, well construction details are critical to the decision process. If construction details are well documented, and formation collapse has not been permitted as annular backfill, it may be best to grout in-place. In cases of poor documentation or shoddy construction practices, it will be necessary to install an outer casing having a diameter larger than the original borehole into the top of the confining layer. This casing should be permanently set in-place with it’s annulus properly sealed and grouted. If the confining layer is less than 5 feet thick, the casing should be installed to the top of the confining layer. Otherwise, it is installed to a depth of 2 feet below the top of the confining layer. After the outer casing has been set, the well can be removed and grouted through pulling (if possible) or grouted in-place. After well is grouted, the upper 5 feet of the well surface should then be restored in accordance with Section 6.0.

2.5.4.2 Telescoped Riser

If the riser is telescoped in one or more outer casings, the decommissioning approach is dependent on the integrity of the well seal. For the purpose of the monitoring well decommissioning procedures, the well seal is defined as the bentonite seal above the sand pack. Although it is not possible to visually inspect or otherwise test the well seal to assess its condition, an indication of the well seal integrity may be obtained through review of the boring logs and/or a comparison of groundwater elevations if the well is part of a cluster. Any problems noted on the boring logs pertaining to the well seal, such as bridging of bentonite pellets or running sands, or disparities between field notes (if available) and the well log would indicate the potential for a poor well seal. Alternatively, if the well is part of a cluster, a comparison of groundwater elevations between the shallow and deep wells should also be performed. By observing trends at other clusters, it may be possible to identify inconsistencies in groundwater elevations at the well slated for decommissioning, thereby indicating a poor well seal.

If there is no evidence that the well seal integrity is compromised, the riser should be grouted in-place in accordance with Section 2.2 or 2.3, depending on the diameter of the well casing, and the upper 5 feet of the well surface should be restored in accordance with Section 6.0. If indications are that the well seal is not competent, it will be necessary to design and implement a special procedure to remove the well construction materials, as the presence and configuration of the outer casing(s) will be specific in the individual wells and will be a key factor in the decommissioning approach. The special procedure should be designed to mitigate the potential for cross-contamination during removal of the well construction materials, and should be designed prior to initiating field work.

3.0 LOCATING AND SETTING-UP ON THE WELL

Typically the following tasks will be performed to locate the well to be decommissioned.

1. Notify the property owner and/or other interested parties including the governing regulatory agency prior to site mobilization whenever possible.

2. Review all information about the well contained in the site file. This information may include one or more of the following: the site map, well boring log, well construction diagram, field inspection log, well photograph, and proposed well decommissioning procedure.

3. Verify the well location and identification by locating the identifying marker.

4. Verify the depth of the well in the well construction log by sounding with a weighted tape.

After the well has been located, the decommissioning procedure should be selected in accordance with Section 2.0 based on the available boring and sampling data. If a drill rig is used, it must be set up prior to initiating drilling to ensure proper alignment with the well (i.e., the drill string must be aligned with the monitoring well).

4.0 REMOVING THE PROTECTIVE CASING

4.1 GENERAL

Removing the protective casing of a well must not interfere with or compromise the integrity of decommissioning activities performed at the well.

The procedure for removing the protective casing of a well depends upon the decommissioning method used. When the decommissioning procedure requires casing perforation or grouting in-place, the outer protective casing should be removed after grout is added to the well. When a well is decommissioned by the casing pulling method, the protective casing should be removed before the well casing is removed to prevent untimely breakage of the well casing. The protective casing handling and disposal must be consistent with the methods used for the well materials, unless an alternate disposal method can be employed (i.e., steam cleaning followed by disposal as non-hazardous waste).

4.2 WELL HEAD PREPARATION PRIOR TO DECOMMISSIONING

When overdrilling, the protective casing must be removed first, unless the drilling tools have an outside diameter larger than the protective casing. The variety of protective casings available preclude developing a specific removal procedure. In all instances, however, the specific procedure used must minimize the risk of:

1. breaking the well casing off below ground; and
2. allowing foreign material to enter the well casing.

An acceptable protective casing removal method involves breaking up the concrete seal surrounding the casing and jacking or hoisting the protective casing out of the ground. A check should be made during pulling to ensure that the inner well casing is not being hoisted with the protective casing. If this occurs, the well casing should be cut off after the base of the protective casing is lifted above the land surface.

4.3 AFTER SEALING THE WELL

If the decommissioning method used allows well casing to remain in the ground, the protective casing should be removed after the well has been properly filled with grout. This will ensure that the well is properly sealed regardless of problems with protective casing removal. Upon completion of grouting in-place, the well casing should be removed approximately five feet below the land surface so as to be below the frost line and out of the way of any subsequent shallow digging. The upper 5 feet of casing and the protective casing can be removed in one operation if a casing cutter is used. If the height of the protective casing makes working conditions at the well awkward, the casing can be cut off at a lower level.

5.0 SELECTING, MIXING, AND PLACING GROUT

5.1 SELECTING GROUT MIXTURE

There are two types of grout mixes that may be used to seal wells: a standard mix and a special mix. Both mixes use Type 1 Portland cement and four percent bentonite by weight. However, the special mix uses a smaller volume of water and is used in situations where excessive loss of the standard grout mix is possible (e.g., highly-fractured bedrock or coarse gravels).

5.1.1 Standard Grout Mixture

For most boreholes, the following standard mixture will be used:

1. one 94-pound bag Type I Portland cement;
2. 3.9 pounds powdered bentonite; and
3. 7.8 gallons potable water.

This mixture results in a grout with a bentonite content of four percent by weight and will be used in all cases except in boreholes where excessive use of grout is anticipated. In these cases a special mixture will be used (see Section 5.1.2).

See Section 5.2 for grout mixing procedures.

5.1.2 Special Mixture

In cases where excessive use of grout is anticipated, such as high permeability formations and highly fractured or cavernous bedrock formations, the following special mixture will be used:

1. one 94-pound bag type I Portland cement;
2. 3.9 pounds powdered bentonite;
3. 1 pound calcium chloride; and
4. 6.0-7.8 gallons potable water (depending on desired thickness).

The special mixture results in a grout with a bentonite content of four percent by weight. It is thicker than the standard mixture because it contains less water. This grout is expected to set faster than the Standard Grout Mixture. The least amount of water that can be added for the mixture to be readily pumpable is 6 gallons per 94-pound bag of cement.

See Section 5.2 for grout mixing procedures.

5.2 GROUT MIXING PROCEDURE

To begin the grout-mixing procedure, calculate the volume of grout required to fill the borehole. If possible, the mixing basin should be large enough to hold all of the grout necessary for the borehole.

Mix grout until a smooth, homogeneous mixture is achieved. Grout can be mixed manually or with a mechanized mixer. Colloidal mixers should not be used as they tend to excessively decrease the thickness of the grout for the above recipes.

5.3 GROUT PLACEMENT

Grout will be placed in the borehole from the bottom to the top using a tremie pipe of not less than 1-inch diameter. Grout will then be pumped into the borehole until the grout appears at the land surface (when grouting open holes in bedrock, the grout level only needs to reach above the bedrock surface). Any groundwater displaced during grout placement will be pumped via suction lift to a 55-gallon drum for proper disposal.

At this time the rate of settling should be observed. When the grout level stabilizes, casing or augers will be removed from the hole. As each section is removed, grout will be added to keep the level between 0 and 5 feet below grade. If the grout level drops below the land surface to an excessive degree, an alternate grouting method must be used. One possibility is to grout in stages; i.e., the first batch of grout is allowed to partially cure before a second batch of grout is added.

Upon completion of grouting, ensure that the final grout level is approximately five feet below land surface. A ferrous metal marker will be embedded in the top of the grout to indicate the location of the former monitoring well. A metal detector may not be able to detect a deeply buried marker so if this locator is important for future utility runs or foundations, a map should be submitted to the property owner and the town engineer showing the decommissioned well locations. Global Positioning System (GPS) coordinates should be indicated on this map. Lastly, a fabric "utility" marking should be placed one foot above the grout so an excavator can see it clearly.

6.0 BACKFILLING AND SITE RESTORATION

The uppermost 5 feet of the borehole at the land surface will be filled with a material appropriate to the intended use of the land. The materials will be physically similar to the natural soils. No materials will be used that limit the use of the property in any way. The surface of the borehole will be restored to the condition of the area surrounding the borehole. For example, concrete or asphalt will be patched with concrete or asphalt of the same type and thickness, grassed areas will be seeded, and topsoil will be used in other areas. All solid waste materials generated during the decommissioning process must be disposed of properly.

7.0 DOCUMENTATION

It is common practice for the Department to contract with an engineering firm (the Engineer) to accomplish monitoring well decommissioning. As may be required by the NYSDEC project manager, the Engineer's on-site construction inspector will document monitoring well decommissioning activities. Completed field inspection logs, Figures 1 and 2, may be required by the Department project manager. Other backup documentation will include, at a minimum, daily reports of construction activities, photographs, and sketches as necessary. Daily report forms to be completed by the construction inspector are presented in Appendix B.

The Engineer will maintain complete and detailed records associated with all construction and related activities during the duration of the project. These records will be maintained at the Engineer's office(s) and will include, but not be limited to, the following:

1. daily work completed and important conversations;

2. contractor's daily use of personnel, material and equipment;

3. records documenting the contractor's deviation from work as specified in the contract documents, and any instructions issued regarding deviations;

4. unusual circumstances (i.e., weather conditions, labor disputes, environmental problems, health and safety hazards encountered, etc.);

5. general files including correspondence and other documentation related to the project;

6. job meeting minutes with documentation on resolution of issues raised;

7. records of contractor's submittals including shop drawings, modifications/change orders, soil tests, material tests and action taken (i.e., owner approval/disapproval, further information needed);

8. construction photos;

9. telephone conversations;

10. as-built diagrams of the boreholes as they have been left after decommissioning; and

11. maps locating the decommissioned boreholes in relation to permanent land marks.

Documentation on the condition of the removed wells with respect to the impacts of hazardous waste, minerals and other pertinent environmental factors, or which is otherwise discernable through direct observation, will be presented along with any recommendations for future well installation techniques and materials.

8.0 FIELD OVERSIGHT

The successful implementation of a decommissioning work plan depends upon proper direction and oversight. Methods to be employed must be clearly worked through and all parties must understand what they have to do before going into the field. Flexibility is allowed where necessary but the work effort must be thorough and effective; the basic goal of monitoring well decommissioning is the protection of our groundwater.

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FIGURES:

APPENDICES:

FIGURE 1

DECOMMISSIONING PROCEDURE SELECTION

Decommissioning Procedure Selection

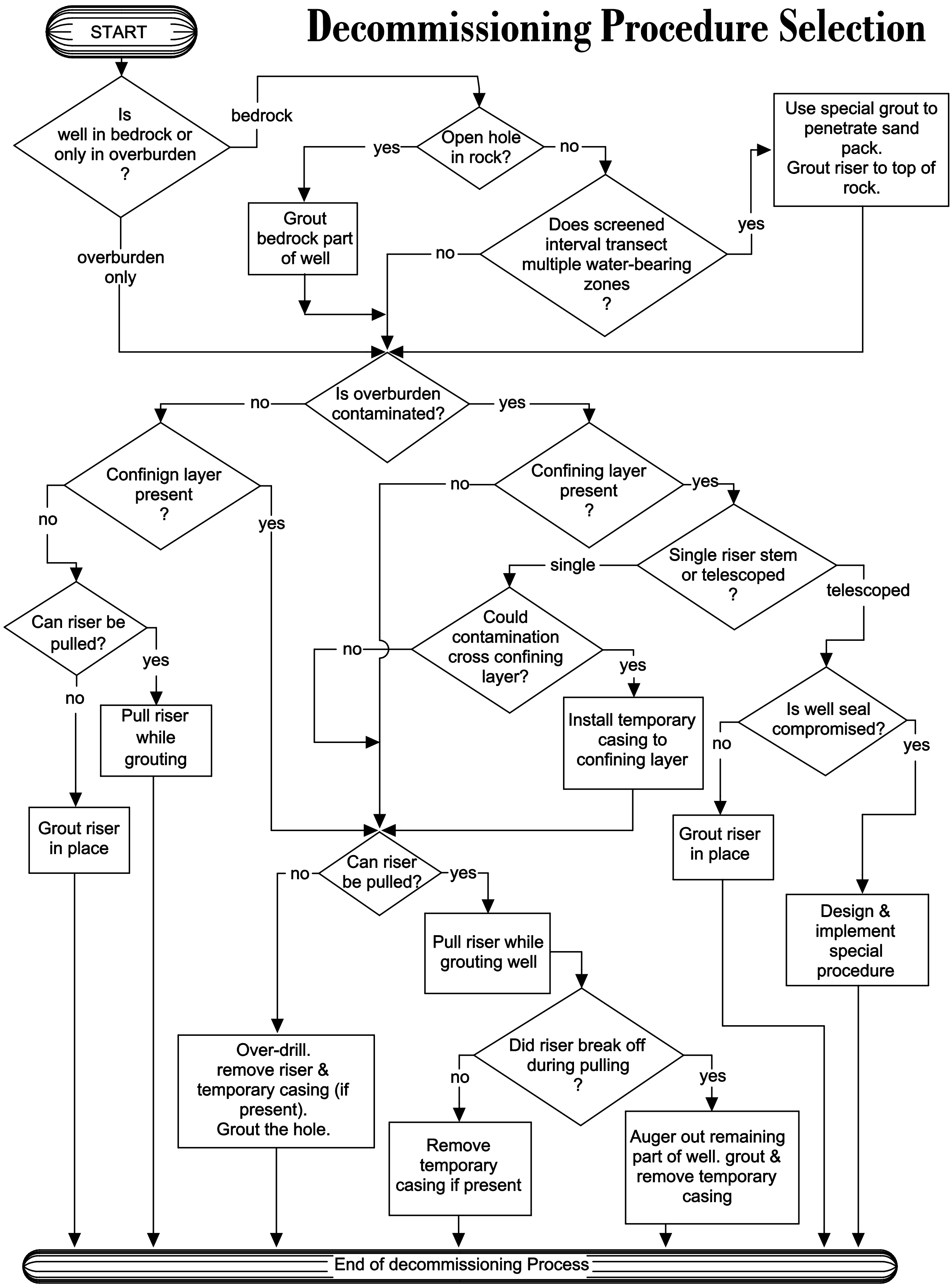

FIGURE 1

FIGURE 2

MONITORING WELL FIELD INSPECTION LOG

SITE NAME: ______________________

SITE ID.:	______
INSPECTOR:	______
DATE/TIME:	______
WELL ID.:	______

MONITORING WELL FIELD INSPECTION LOG

	YES	NO
WELL VISIBLE? (If not, provide directions below)		
WELL I.D. VISIBLE?		
WELL LOCATION MATCH SITE MAP? (if not, sketch actual location on back).....................		

WELL I.D. AS IT APPEARS ON PROTECTIVE CASING OR WELL: ....

	YES	NO
SURFACE SEAL PRESENT?		
SURFACE SEAL COMPETENT? (If cracked, heaved etc., describe below)		
PROTECTIVE CASING IN GOOD CONDITION? (If damaged, describe below)		

HEADSPACE READING (ppm) AND INSTRUMENT USED.. ______

TYPE OF PROTECTIVE CASING AND HEIGHT OF STICKUP IN FEET (If applicable) ______

PROTECTIVE CASING MATERIAL TYPE: .... ______

MEASURE PROTECTIVE CASING INSIDE DIAMETER (Inches): .... ______

	YES	NO
LOCK PRESENT?		
LOCK FUNCTIONAL?		
DID YOU REPLACE THE LOCK?		
IS THERE EVIDENCE THAT THE WELL IS DOUBLE CASED? (If yes,describe below)		
WELL MEASURING POINT VISIBLE?		

MEASURE WELL DEPTH FROM MEASURING POINT (Feet): .... ______

MEASURE DEPTH TO WATER FROM MEASURING POINT (Feet): .... ______

MEASURE WELL DIAMETER (Inches): .... ______

WELL CASING MATERIAL: .... ______

PHYSICAL CONDITION OF VISIBLE WELL CASING: .... ______

ATTACH ID MARKER (if well ID is confirmed) and IDENTIFY MARKER TYPE .... ______

PROXIMITY TO UNDERGROUND OR OVERHEAD UTILITIES.. ______

DESCRIBE ACCESS TO WELL: (Include accessibility to truck mounted rig, natural obstructions, overhead power lines, proximity to permanent structures, etc.); ADD SKETCH OF LOCATION ON BACK, IF NECESSARY.

____

____

DESCRIBE WELL SETTING (For example, located in a field, in a playground, on pavement, in a garden, etc.) AND ASSESS THE TYPE OF RESTORATION REQUIRED.

____

____

IDENTIFY ANY NEARBY POTENTIAL SOURCES OF CONTAMINATION, IF PRESENT (e.g. Gas station, salt pile, etc.):

____

____

REMARKS:

____

____

FIGURE 3

WELL DECOMMISSIONING RECORD

WELL DECOMMISSIONING RECORD

Site Name:	Well I.D.:
Site Location:	Driller:
Drilling Co.:	Inspector:
	Date:

DECOMMISSIONING DATA
(Fill in all that apply)

<u>OVERDRILLING</u>

Interval Drilled	
Drilling Method(s)	
Borehole Dia. (in.)	
Temporary Casing Installed? (y/n)	
Depth temporary casing installed	
Casing type/dia. (in.)	
Method of installing	

<u>CASING PULLING</u>

Method employed	
Casing retrieved (feet)	
Casing type/dia. (in)	

<u>CASING PERFORATING</u>

Equipment used	
Number of perforations/foot	
Size of perforations	
Interval perforated	

<u>GROUTING</u>

Interval grouted (FBLS)	
# of batches prepared	

<u>For each batch record:</u>

Quantity of water used (gal.)	
Quantity of cement used (lbs.)	
Cement type	
Quantity of bentonite used (lbs.)	
Quantity of calcium chloride used (lbs.)	
Volume of grout prepared (gal.)	
Volume of grout used (gal.)	

WELL SCHEMATIC*

Depth
(feet)

COMMENTS:

* Sketch in all relevant decommissioning data, including:
interval overdrilled, interval grouted, casing left in hole,
well stickup, etc.

Drilling Contractor

Department Representative

APPENDIX A

HYDRAULIC PRESSURE TESTING OF SCREENED INTERVAL

Appendix A

HYDRAULIC PRESSURE TESTING OF SCREENED INTERVAL

1.0 INTRODUCTION

This guideline presents a method for evaluating the integrity of a grout seal in the screened interval of a well being decommissioned by grouting in place.

2.0 METHODOLOGY

1. Grout the screened interval of the well using a tremie pipe, up to a level of one to two feet above the screened section.

2. Allow the grout to set for a period of not less than 24 hours and not greater than 72 hours before pressure testing of the grouted interval is begun.

3. Place a pneumatic packer at a maximum of four and one half feet above the top of the screened section of the well casing.

4. Apply an inflation pressure to the packer, not exceeding the pressure rating of the well casing material. If the interval between the top of the grout and the bottom of the packer is not saturated, use potable water to fill the interval.

5. Apply a gauge pressure of 5 psig at the well head to the interval for a period of 5 minutes to allow for temperature stabilization. After 5 minutes maintain the pressure at 5 psig for 30 minutes.

6. The grout seal shall be considered acceptable if the total loss of water to the seal does not exceed 0.5 gallons over a 30-minute period.

7. If the grout seal is determined to be unacceptable, an additional 5 feet of grout will ve added to the well casing with a tremie pipe. The interval will be retested as described above.

APPENDIX B - REPORTS:

INSPECTOR'S DAILY REPORT
PROBLEM IDENTIFICATION REPORT
CORRECTIVE MEASURES REPORT

Inspector's Daily Report

CONTRACTOR:
ADDRESS:

TELEPHONE:
LOCATION ______ FROM ______ TO ______
WEATHER ______ TEMP ______ A.M. ______ P.M. ______ DATE ______

CONTRACTOR'S WORK FORCE AND EQUIPMENT

DESCRIPTION	*H*	*#*	*DESCRIPTION*	*H*	*#*	*DESCRIPTION*	*H*	*#*	*DESCRIPTION*	*H*	*#*
Field Engineer						Equipment			Front Loader Ton		
Superintendent			Ironworker			Generators			Bulldozer		
						Welding Equip.					
Laborer Foreman			Carpenter								
Laborer									Backhoe		
Operating Engineer			Concrete Finisher								
Carpenter						Paving Equip. & Roller					
						Air compressor					

SEE REVERSE SIDE FOR SKETCH YES ☐ NO ☐ ______
WORK PERFORMED: ______

PAY ITEMS

CONTRACT		STA		DESCRIPTION	QUANTITY	REMARKS
Number	ITEM	FROM	TO			

TEST PERFORMED: ______
PICTURES TAKEN: ______

VISITORS: ______

QA PERSONNEL
SIGNATURE ______

REPORT NUMBER ______
SHEET ______ Of ______

MEETINGS HELD AND RESULTS

REMARKS

REFERENCES TO OTHER FORMS

SKETCHES

SAMPLE LOG

SAMPLE NUMBER

APPROXIMATE LOCATION OF STOCKPILE

NUMBER OF STOCKPILE

DATE OF COLLECTION

CLIMATIC CONDITIONS

FIELD OBSERVATION

SHEETS OF

PROBLEM IDENTIFICATION REPORT

Date ______________________

Day | Su | M | T | W | Th | F | Sa |

Project ____________________ Job Number __________

Contractor ______________________________

Subject ______________________________

Sky/Precip.	Clear	Partly Cloudy	Cloudy	Rainy	Snow
TEMP.	<32F	32-40F	40-70F	70-80F	80-90F
WIND	No	Light	Strong		
HUMIDITY	Dry	Mod.	Humid		

PROBLEM DESCRIPTION Reference Daily Report Number 1: ______________________

PROBLEM LOCATION - REFERENCE TEST RESULTS AND LOCATION (Note: Use sketches on back of form as appropriate):

PROBABLE CAUSES: ______________________

SUGGESTED CORRECTIVE MEASURES: ______________________

APPROVALS:

QA ENGINEER: ______________________

PROJECT MANAGER: ______________________

Distribution:

1. Project Manager
2. Field Office
3. File
4. Owner

QA Personnel
Signature: ______________________

CORRECTIVE MEASURES REPORT

Date ____________________

Project ____________________ Job Number __________

Contractor ____________________

Subject ____________________

Day: Su | M | T | W | Th | F | Sa

Sky/Precip.	Clear	Partly Cloudy	Cloudy	Rainy	Snow
TEMP.	<32F	32-40F	40-70F	70-80F	80-90F
WIND	No	Light	Strong		
HUMIDITY	Dry	Mod.	Humid		

CORRECTIVE MEASURES TAKEN (Reference Problem Identification Report No.): ____________________

RETESTING LOCATION: ____________________

SUGGESTED METHOD OF MINIMIZING RE-OCCURRENCE: ____________________

SUGGESTED CORRECTIVE MEASURES: ____________________

APPROVALS:

QA ENGINEER: ____________________

PROJECT MANAGER: ____________________

Distribution:

1. Project Manager
2. Field Office
3. File
4. Owner

QA Personnel
Signature: ____________________