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50 to 75% Design Report
Operable Unit 3
Soil Gas Interim Remedial Measure

Former Grumman Setting Ponds,
Bethpage, New York
Site # 1-30-003A

August 2, 2007

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Tables

Figures

Drawings

Appendices

1. Introduction

This Operable Unit 3 (OU3) Soil Gas Interim Remedial Measure (soil gas IRM) 50 to 75% Design Report was prepared by ARCADIS of New York, Inc. (ARCADIS) on behalf of Northrop Grumman Systems Corporation (Northrop Grumman), and is being submitted pursuant to the Order On Consent (Consent Order or CO) Index # W1-0018-04-01 that was executed by the New York State Department of Environmental Conservation (NYSDEC) and Northrop Grumman, effective July 4, 2005 (NYSDEC 2005). The present day Bethpage Community Park property (Park), which the NYSDEC has termed the "Former Grumman Settling Ponds Area" and designated as OU3, is referred to herein as the Site. The Park has been owned and operated by the Town of Oyster Bay since 1962.

The CO allows the implementation of Interim Remedial Measures (IRMs) for OU3. In response to NYSDEC's December 22, 2006 letter to Northrop Grumman, Northrop Grumman has elected to implement a soil gas mitigation system as an IRM as outlined in Operable Unit 3 – Soil Gas Interim Remedial Measure Work Plan, Former Grumman Settling Ponds, Bethpage, New York, Site #1-30-003A ([Work Plan] ARCADIS, February 16, 2007). This report describes and presents the 50 to 75% design for the soil gas IRM. Included in this report is an update of the current environmental setting, objectives of the soil gas IRM, design criteria of the soil gas IRM, and a set (50 to 75% completion level) of soil gas IRM construction drawings.

This report is organized into the following sections:

- Section 2 provides a brief description of the Site.
- Section 3 summarizes the soil gas IRM rationale and objectives.
- Section 4 presents a summary of the pneumatic conductivity test methodology and results.
- Section 5 describes the design criteria used for design calculations and development of the 50 to 75% design.
- Section 6 provides a description of the soil gas IRM components
- Section 7 summarizes the references cited within this document.

2. Project Background

A summary of the site description, location, background, and environmental setting can be found in the Operable Unit 3, Soil Gas Interim Remedial Measure Work Plan (ARCADIS 2007). Much of the information related to site description and background, that is presented in the Work Plan, can also be found in the December 2003 Field Report - Town of Oyster Bay, Bethpage Community Park, Investigation Sampling Report, prepared by Dvirka & Bartilucci Consulting Engineers (D&B) on behalf of Northrop Grumman.

3. Project Objectives

As outlined in the Work Plan, the specific objectives of the soil gas IRM are:

- To mitigate the off-site migration of non-Freon related VOCs in the on-site soil gas through the implementation of a soil gas control system along the former Plant 24 South Access Road property of the Park.

- To comply with applicable NYSDEC Standards, Criteria and Guidelines (SCGs).

Subsequent to submittal of the Work Plan, site-related VOCs were found along the southwestern Park boundary. Accordingly, an additional objective of the soil gas IRM is:

- To mitigate the off-site migration of non-Freon related VOCs in the on-site soil gas through the implementation of a soil gas control system along the former Plant 24 access road west of the Park.

4. Summary of Pre-Design Activities and Pneumatic Conductivity Testing

The following section provides a brief summary of the methodology and results for the pre-design investigatory and pneumatic conductivity testing activities conducted at the Site.

4.1 Pre-Design Investigatory Activities

As outlined in Section 6.1 of the Work Plan, the following pre-design investigation activities were completed to assist in the development of the soil gas IRM:

- Soil gas sampling was performed to investigate soil gas east, west and south of the Park and to refine the scope of the soil gas IRM. Results of this investigation will be presented in the CO required monthly progress reports. This data will be taken into consideration, as appropriate, during development of the soil gas IRM design.

- A series of cone penetrometer (CPT) borings were drilled along the former Plant 24 South Access Road to help delineate the low permeability zone (LPZ) in this area. This work provided information regarding perched water including where LPZ soils might be present. The results of the CPT boring program will be presented in the Remedial Investigation (RI) Report, currently under preparation.

- Perched water levels are periodically monitored along the Plant 24 South Access Road, the data will be presented in the RI Report.

- Soil gas samples west of the Park were collected during the most recent pneumatic conductivity testing and will be incorporated into the 95 percent design submittal.

4.2 Pneumatic Conductivity Testing

As outlined in Section 6.1 of the Work Plan, pneumatic conductivity testing was conducted to collect site-specific field data for use in designing the full-scale soil gas IRM. A summary of the pneumatic conductivity testing methodology, objectives, and results is provided below. In addition, Appendix A provides an as-built figure and table summarizing the testing locations and the depressurization and monitoring well construction details, completed field parameter logs, and pertinent calculations related to the testing.

4.2.1 Pneumatic Conductivity Testing Methodology

Pneumatic conductivity testing was completed according to the Pneumatic Conductivity Test Work Plan (ARCADIS 2007) which was provided as Appendix C of the Work Plan. As outlined in the Pneumatic Conductivity Test Work Plan, pneumatic conductivity tests were completed at three locations with two separate depth intervals at each testing location (for a total of six tests). This design utilizes the results for two of the locations, as the third location was recently tested and the findings will be summarized in the 95 percent design report. Table 1 provides a summary of the depressurization and monitoring well network construction details. Figure A-1 provides an as-built of testing areas 1 and 2. Tests were completed using a 5 horsepower (hp) regenerative blower capable of 280 standard cubic feet per minute (scfm) at 8 inches of water column vacuum.

It should be noted that only active (e.g., traditional negative pressure generating blower) testing was performed. It was not necessary to perform testing for any passive (e.g. natural "barometric pumping" and/or the use of wind turbines or alternative measures) systems, as the results for the active system were acceptable.

4.2.2 Objectives

The primary objective of the pneumatic conductivity testing program was to collect site-specific field data for use in designing the full-scale soil gas IRM. The sub-objectives of the testing were as follows:

- Determine the site-specific pneumatic conductivity along the southern boundary of the former Plant 24 Access Road above and below the LPZ.
- Estimate the quantity of surface leakage in wells screened above the LPZ.
- Estimate the quantity of water generation during subsurface depressurization.
- Estimate the influent vapor concentration and contaminant mass loading rate.
- Obtain additional site specific geologic data within the test area.

A brief summary of the results, conclusions, and recommendations is provided below.

4.2.3 Results, Conclusions, and Recommendations

The following results and design calculations have been provided in Appendix A:

- The recorded field parameters for each pneumatic conductivity test location in Tables A-1 through A-4.
- A summary of the calculated pneumatic conductivity for each pneumatic conductivity test location is in Table A-5 with an example calculation.

- The summary of the vapor analytical results for each testing location and the total effluent is in Table A-6.

- The summary of the analytical results for collected condensate (knockout tank) generated during the test is in Table A-7.

- Lithological stratum encountered during well installation is presented in Figure A-1 in Appendix A.

The following conclusions are made based on the results provided in Appendix A:

- Field parameters and soil lithology indicate that the vadose zone geology is suitable for subsurface depressurization technology. Specifically, soil gas depressurization can be accomplished at reasonable wellhead vacuums.

- The calculated pneumatic conductivity is consistent with the vadose zone geology. Likewise, it is consistent with published values for clean sands (USEPA, 1994). The calculated values further corroborate field parameters and indicate that the proposed technology is suitable for the site.

- As expected, considerable surface leakage was observed in the shallow zone. Although not quantified, surface leakage is evidenced by the observation of vacuum above the shallow well screens (e.g., DW-1S screened 15-30 feet below land surface (ft bls) and vacuum levels greater than baseline readings observed in VMWC-1A screened 7.5-8.5 ft bls, Table A-1, Page 2.)

- Vapor analytical results were consistent with site investigatory data (i.e., analytical results for DW-2S and DW-2D were similar to results for SGP-2 (15 and 40 foot interval, respectively) and analytical results for DW-1S and DW-1D were similar to results for SGP-05 (34 and 49 foot intervals, respectively).

- Minimal water was generated as part of the pneumatic conductivity test. A total of 1 quart of water was collected, over an 8-hour time period at one of the four depressurization well points (DW-2D).

- Analytical results for collected condensate were non-detect for all compounds analyzed.

In summary, the pneumatic conductivity is consistent with published values for clean sands, and indicates that subsurface depressurization technology using vertical radial depressurization wells is an efficient and effective technology to prevent the off-site migration of on-site soil gas.

5. Design Criteria

Design criteria were established for the soil gas IRM based on the overall objectives of the system and based on the results of the currently available pre-design activities data referenced previously. Accordingly, the following design criteria have been established:

- The system will mitigate the off-site migration of non-Freon related VOCs in the on-site soil gas through the implementation of a soil gas control system along the former Plant 24 South Access Road and along the former Plant 24 access road west of the Park.

- Mitigation will be provided through the generation of negative pressure and/or through the removal of existing soil gas.

- The system will be designed to maintain 0.1 inches of water column (IWC) of negative pressure within the negative pressure curtain (e.g., along the southern and western access roads) based on a twelve-month rolling average.

- Collected vapors will be treated to meet or be less than the NYSDEC DAR-1 Annual Guidance Concentrations (AGCs) on a twelve-month rolling average and Short-Term Guidance Concentrations (SGCs) for any given grab sample (NYSDEC 2003).

- Collected condensate will initially be transferred to the point of discharge under the existing approval for OU3 wells. The point of discharge, located near the Northrop Grumman OU2 Treatment Building 96, ultimately terminates at the Town of Oyster Bay's Cedar Creek treatment facility. The condensate may be transferred to the OU3 groundwater IRM following its construction if appropriate.

- Operation of the soil gas IRM will allow for ease of visual monitoring, testing, and maintenance, with automatic control of the principal equipment units.

- Piping connections and valving will provide flexibility in operation of the recovery and treatment system.

A summary of the proposed soil gas IRM design based on the above criteria is provided below.

6. Depressurization System Design

The following subsections of this design report identify the primary components of the system, discuss design considerations, and present descriptions of the treatment equipment, the treatment building, emission controls, and process controls and operation. A site plan is provided as Drawing 1. A process and instrumentation diagram (P&ID) is provided as Drawing 2; and, a building layout is provided as Drawing 3. Finally, design calculations have been provided in Appendix B.

6.1 Overall System Process

The soil gas IRM system will consist of the following major components:

- Vertical Depressurization Wells and Recovery Pipelines – A series of vertical depressurization wells (herein after referred to as depressurization wells) will be installed along the former Plant 24 South Access Road property and along the western leg of the access road to extract vapors (soil gas) from the vadose zone soils. Individual pipelines will be connected to each depressurization well to convey soil gas to the treatment facility. The number of depressurization wells, well spacing, design rationale, and well construction details are provided in Section 6.2.

- Depressurization System – Regenerative type blowers will be connected to recovery pipelines and used to generate negative pressure within the vadose zone and to push extracted soil gas through the emission control system. A detailed description of the proposed depressurization system and design rationale is provided in Section 6.3.

- Temporary Emission Control System – Prior to atmospheric discharge, the soil gas will be treated with a temporary vapor phase granular activated carbon (VPGAC) adsorption bed. A detailed description of the proposed emission control system and design rationale is provided in Section 6.4.

- Treatment Buildings – The blowers and the majority of the process equipment, system instrumentation and electrical controls will be housed in two (2) treatment buildings located immediately north of the Robert Plan building (Drawing 1) on an existing concrete slab. A detailed description of the proposed treatment buildings and layouts are provided in Section 6.5.

6.2 Wells and Pipeline

Drawing 1 shows the locations of the proposed depressurization wells, vacuum monitoring wells, and recovery pipelines. Table 1 provides a summary of the construction details for the wells. As shown on Drawing 1, 11 shallow and 7 deep depressurization wells will be used to maintain negative pressure within the subsurface along the entire target zone of the soil gas IRM system. The proposed well locations were selected using a distance-vacuum approach for each pilot study depressurization well. The subsurface geology at VP-4 was used as the cutoff location for determining which pilot test data to use for the full-scale design. More specifically, the pneumatic conductivity was assumed to be similar to pilot test well locations DW-2S and DW-2D for all locations east of VP-4 and be similar to pilot test well locations DW-1S and DW-1D for all locations west of VP-4. This assumption was based on the change in depth and nature of the LPZ in the vicinity of VP-4 including the locations along the western leg. Distance-vacuum calculations and the selected flowrate and radius of influence for each well tested are provided in Tables B-1 through B-4 of Appendix B. Figure 2 shows the location and anticipated radius of influence for soil gas depressurization system.

Each well will be enclosed in a 12-inch diameter traffic rated well vault that will house the well head and a vacuum gauge. As referenced previously, soil gas will be conveyed through individual well pipelines. Accordingly, the remaining flow controls, electrical devices, and accessories associated with the well will be housed inside Treatment Building Number 1.

Individual well recovery pipelines will be SDR 17 high density polyethylene (HDPE). Piping will be installed using conventional trenching and backfilling methods. A below grade piping size schedule is provided as Table B-5 in Appendix B. Pipe sizes were selected to keep the total head loss per pipeline below grade equal to or less than 10 IWC. Above grade piping installed at or within the treatment sheds and emission control unit will be constructed of various materials and sizes suitable for intended purpose of the piping.

6.3 Depressurization System

As referenced previously, regenerative type blowers will be connected to recovery pipelines and used to generate negative pressure within the vadose zone and to push extracted soil gas through the temporary emission control system. Specifically, one Rotron Model EN979 20-horsepower (hp) blower (or equivalent) will be connected to deep zone wells DW-1D through DW-7D and two Rotron Model EN979 20-hp blowers (or equivalent) will be operated in parallel and will be connected to shallow zone wells DW-1S through DW-11S. All blowers will be connected in such a way that they can be used as "backups" during routine Operation, Maintenance & Monitoring (OM&M) or emergency OM&M, if needed. The blowers were selected based on the design flowrates provided in Table B-6 and design vacuum and pressure heads provided in Table B-7. As shown in Table B-7, each blower was designed to accommodate the use of permanent emission controls, if necessary. Furthermore, each blower was designed with a 1.3 factor of safety on flow to account for seasonal variations in efficiency and/or unknown site conditions.

Each blower will have a dedicated air filter and moisture separator to remove particulates and condensate prior to entering the blowers and temporary emission control system. Each blower will be operated with a variable frequency drive (VFD) to allow flexibility in system operation and account for seasonal variability in operation. Finally, collected moisture will be transferred to a 300-gallon polyethylene vertical bulk storage tank and then transferred to the publicly owned treatment works through manual means (under the existing approval).

6.4 Temporary Emission Control System

An air model was prepared using the NYSDEC DAR-1 air model. Specifically, influent design concentrations were developed using existing soil gas data collected as part of the RI and the results of the soil gas data from the pneumatic conductivity testing program as referenced in Section 4.1. When a proposed full-scale design well was not located adjacent to a pneumatic conductivity test well, the nearest RI soil gas concentration (at the most applicable depth) was used as the design basis. A summary of the design concentrations and design basis for each proposed depressurization well location is provided in Table B-8. Next, the design concentrations were converted into an influent mass loading rate based on the design flowrate for each respective depressurization well. A summary of the design mass loading rates is provided in Table B-9. Finally, the influent mass loading rate and design concentrations were evaluated using the NYSDEC DAR-1 air model and compared to each compounds respective Annual Guidance Concentration (AGC); which represents the most conservative (stringent) regulatory level. The results of the air model are provided in Table B-10. As shown in Table B-10, treatment of the collected soil gas will not be required to meet applicable discharge criteria based on the assumed design variables (including a stack height of 30-feet).

In accordance with the air model analysis provided herein, a 30-foot high stack will be provided to ensure that all emissions are below their applicable discharge criteria. In addition, as a conservative measure, a single 10,000 lb VPGAC unit (minimum) will be provided to remove VOCs (primarily trichloroethylene [TCE]) from the recovered soil-gas prior to discharge to the atmosphere during startup. The sizing and configuration of the VPGAC were determined based on expected air flow rates, VOC characteristics and loadings. Finally, a fan-drafted heat exchanger will be provided before the temporary VPGAC to lower the discharge temperature of the process air prior to entering the VPGAC and/or stack.

The temporary VPGAC unit will be taken off-line upon confirmation (through laboratory analytical results for the influent vapor stream) that the influent mass loading rate is below applicable standards. It is anticipated that the temporary VPGAC unit will be operated for one month or less. Conversely, if influent vapor analytical data indicate that VPGAC is needed for a longer period, consideration will be given to installing permanent emission control units. It should be noted that the depressurization blowers have been designed to accommodate the use of permanent emission controls, if needed.

6.5 Treatment Buildings

All process related mechanical equipment and electrical controls will be housed within two 20-foot by 8-foot by 8-foot "dry van" type storage containers. The treatment building equipment layout is presented on Drawing 3. As shown on Drawing 3, Treatment Building Number 1 will house the influent depressurization well manifold, the moisture separators and transfer pumps, the liquid storage tank, and associated piping and controls. Treatment Building Number 2 will enclose the regenerative blowers, electrical controls, and associated piping and appurtenances.

Each building will be provided with double doors on the south side to allow for access of mechanical equipment during maintenance activities. In addition, each building will contain appropriate heating, ventilation, and lighting to adequately maintain the environment for proper operation of the system. All building, mechanical, and electrical components will be installed in strict conformance with local, New York State, and Federal building code requirements.

6.6 Utility Service

Electric service will be obtained from an existing transformer located west of the proposed treatment building. The power will be transferred via underground conduit from the power pole to Treatment Building Number 2. Telephone service will be provided to Treatment Building Number 2 for operation of the proposed autodialer. A potable water supply may be conveyed to the vicinity of the treatment buildings for cleaning.

6.7 Process Controls and Operation

The process control system is designed to provide the necessary safeties and interlocks to ensure that the components of the soil gas IRM operate smoothly, efficiently, and as one unit. The process control system will be designed with a graphical user interface (GUI) to allow the user to adjust control set points. Additionally, the system will include an autodialer which will notify the operator(s) of any system fault. Controls and instrumentation will be interconnected via serial network, utilizing network wiring installed in exposed conduit. The main control panel (MCP), located in Treatment Building Number 2, will house a programmable logic controller (PLC) to monitor and integrate the operation of the system.

A summary of the controls, alarms, and interlocks is provided on Drawing 2. Further detail will be provided in the 95-percent design submittal.

7. References

ARCADIS G&M, Inc. 2006. Remedial Investigation/Feasibility Work Plan, Former Grumman Settling Ponds (Operable Unit 3), Bethpage Community Park, Bethpage, New York. March 8, 2006.

ARCADIS of New York, Inc. 2007. Operable Unit 3 – Soil Gas Interim Remedial Measure Work Plan, Former Grumman Settling Ponds, Bethpage, New York, Site #1-30-003A February 16, 2007.

Dvirka & Bartilucci Consulting Engineers (D&B) 2003. Field Report - Town of Oyster Bay, Bethpage Community Park, Investigation Sampling Report, December 2003

New York State Department of Environmental Conservation (NYSDEC) Letter to Northrop Grumman, RE: Former Settling Ponds, NYSDEC Nassau County Site No. 1-30-003A (Bethpage Community Park) dated, December 22, 2006.

New York State Department of Environmental Conservation (NYSDEC), 2005a, Order on Consent Index #WI-0018-04-01, Site # 1-30-003A, July 4, 2005.

New York State Department of Environmental Conservation, Division of Air Resources-1 (DAR-1) Guidelines for the Control of Toxic Ambient Air Contaminants dated 1991 and the AGC/SGC Tables dated December 22, 2003.

U.S. Environmental Protection Agency (USEPA), *Soil Vapor Extraction SVE Chapter II*, http://www.epa.gov, October 1994.

Table 1. Summary of Existing and Proposed Depressurization and Vapor Monitoring Well Cluster Construction Details, Northrop Grumman Operable Unit 3, Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York.

Well Designation	Well Purpose	Nominal Well Diameter (inches)	Screened Interval (feet bls)		
Western Leg of Access Road					
Depressurization Wells					
DW-3S	Depressurization	4	10	to	30
DW-3D	Depressurization	4	26	to	46
DW-7S[1]	**Depressurization**	**4**	**10**	**to**	**30**
DW-7D[1]	**Depressurization**	**4**	**30**	**to**	**50**
Vacuum Monitoring Wells					
VMWC-9A	Vacuum Monitoring	0.75	6	to	7
VMWC-9B	Vacuum Monitoring	0.75	18	to	19
VMWC-10B	Vacuum Monitoring	0.75	18	to	19
VMWC-10D	Vacuum Monitoring	0.75	38	to	39
VMWC-11B	Vacuum Monitoring	0.75	18	to	19
VMWC-11D	Vacuum Monitoring	0.75	38	to	39
VMWC-12D	Vacuum Monitoring	0.75	38	to	39
VMWC-14A[1]	**Vacuum Monitoring**	**0.75**	**6**	**to**	**7**
VMWC-14B[1]	**Vacuum Monitoring**	**0.75**	**18**	**to**	**19**
VMWC-14D[1]	**Vacuum Monitoring**	**0.75**	**38**	**to**	**39**
South Access Road					
Depressurization/Monitoring Wells					
DW-1S	Depressurization	4	15	to	30
DW-1D	Depressurization	4	42	to	47
DW-2S	Depressurization	4	10	to	17
DW-2D	Depressurization	4	27	to	47
DW-4S[1]	**Depressurization**	**4**	**15**	**to**	**30**
DW-4D	Depressurization	4	27	to	47
DW-5S[1]	**Depressurization**	**4**	**15**	**to**	**30**
DW-5D[1]	**Depressurization**	**4**	**42**	**to**	**47**
DW-6S[1]	**Depressurization**	**4**	**15**	**to**	**30**
DW-6D[1]	**Depressurization**	**4**	**42**	**to**	**47**
DW-8S[1]	**Depressurization**	**4**	**10**	**to**	**17**
DW-9S[1]	**Depressurization**	**4**	**10**	**to**	**17**
DW-10S[1]	**Depressurization**	**4**	**10**	**to**	**17**
DW-11S[1]	**Depressurization**	**4**	**10**	**to**	**17**
VMWC-13D	Vacuum Monitoring / Potential Depressurization	4	27	to	47

Note and abbreviations on last page.

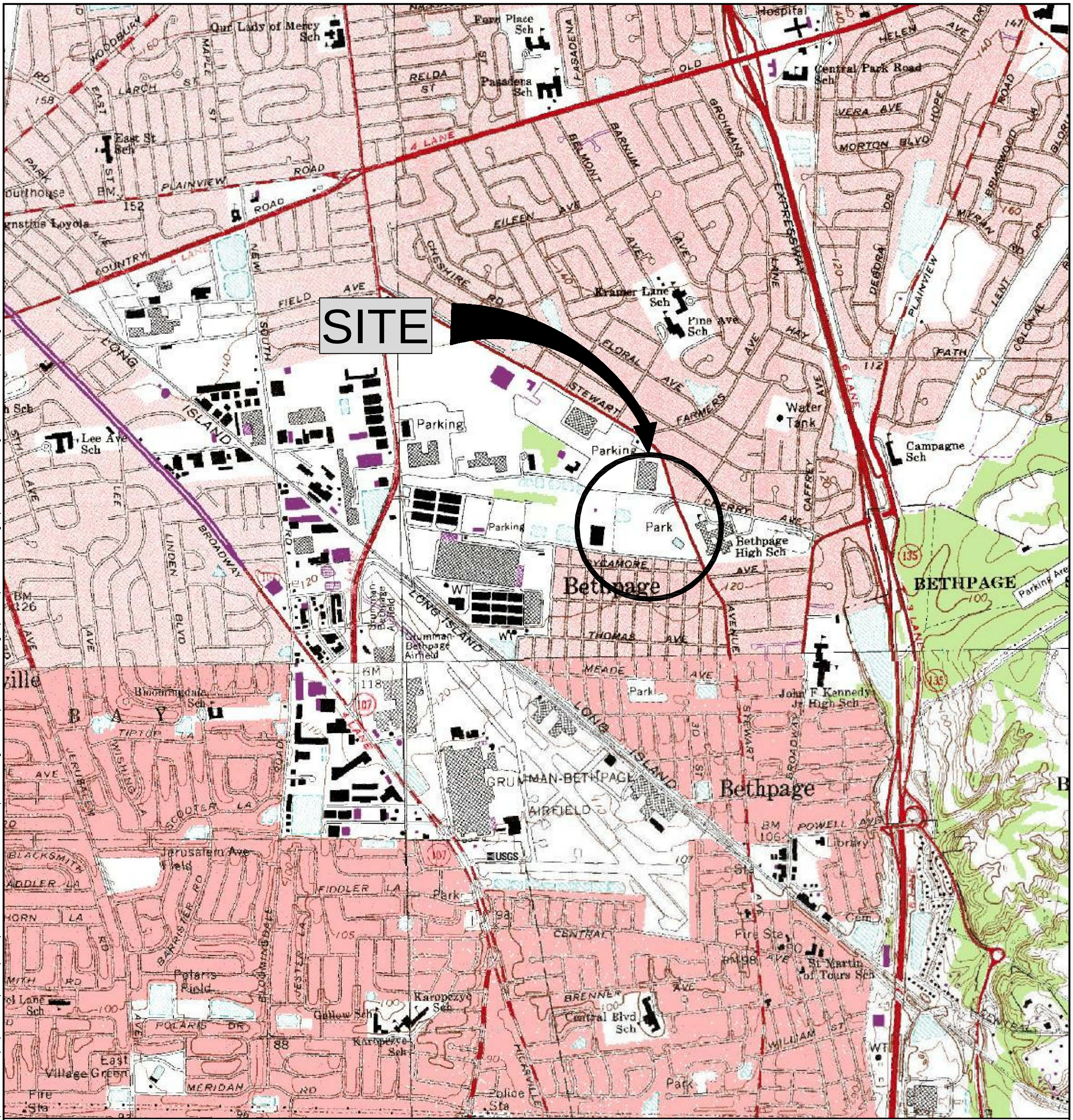
Table 1. Summary of Existing and Proposed Depressurization and Vapor Monitoring Well Cluster Construction Details, Northrop Grumman Operable Unit 3, Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York.

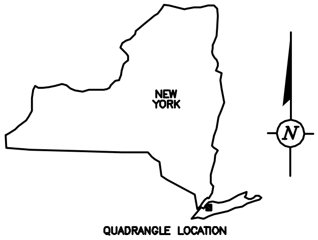
Well Designation	Well Purpose	Nominal Well Diameter (inches)	Screened Interval (feet bls)		
<u>South Access Road</u>					
<u>Monitoring Wells</u>					
VMWC-1A	Vacuum Monitoring	0.75	7.5	to	8.5
VMWC-1B	Vacuum Monitoring	0.75	12	to	13
VMWC-1C	Vacuum Monitoring	0.75	24.7	to	39.7
VMWC-1D	Vacuum Monitoring	0.75	44	to	54
VMWC-2A	Vacuum Monitoring	0.75	9	to	10
VMWC-2C	Vacuum Monitoring	0.75	21	to	22
VMWC-2D	Vacuum Monitoring	0.75	44	to	45
VMWC-3A	Vacuum Monitoring	0.75	7.5	to	8.5
VMWC-3B	Vacuum Monitoring	0.75	13	to	14
VMWC-3C	Vacuum Monitoring	0.75	22	to	23
VMWC-3D	Vacuum Monitoring	0.75	45	to	46
VMWC-4A	Vacuum Monitoring	0.75	6	to	7
VMWC-4B	Vacuum Monitoring	0.75	12	to	13
VMWC-4C	Vacuum Monitoring	0.75	21	to	22
VMWC-4D	Vacuum Monitoring	0.75	44	to	45
VMWC-5A	Vacuum Monitoring	0.75	7	to	8
VMWC-5B	Vacuum Monitoring	0.75	15.2	to	19.2
VMWC-5D	Vacuum Monitoring	0.75	40	to	50
VMWC-6A	Vacuum Monitoring	0.75	8	to	9
VMWC-6B	Vacuum Monitoring	0.75	15	to	16
VMWC-6D	Vacuum Monitoring	0.75	39	to	40
		0.75			
VMWC-7A	Vacuum Monitoring		7	to	8
VMWC-7B	Vacuum Monitoring	0.75	14	to	15
VMWC-7D	Vacuum Monitoring	0.75	36	to	37
VMWC-8A	Vacuum Monitoring	0.75	7	to	8
VMWC-8B	Vacuum Monitoring	0.75	13	to	14
VMWC-8D	Vacuum Monitoring	0.75	35	to	36
VMWC-15A(1)	**Vacuum Monitoring**	**0.75**	**7**	**to**	**8**
VMWC-15B(1)	**Vacuum Monitoring**	**0.75**	**13**	**to**	**14**
VMWC-15D(1)	**Vacuum Monitoring**	**0.75**	**45**	**to**	**46**
VMWC-16A(1)	**Vacuum Monitoring**	**0.75**	**7**	**to**	**8**
VMWC-16B(1)	**Vacuum Monitoring**	**0.75**	**13**	**to**	**14**
VMWC-17D(1)	**Vacuum Monitoring**	**0.75**	**35**	**to**	**36**
VMWC-18A(1)	**Vacuum Monitoring**	**0.75**	**7**	**to**	**8**
VMWC-18B(1)	**Vacuum Monitoring**	**0.75**	**13**	**to**	**14**

<u>Note & Abbreviations:</u>

Bold - proposed locations
bls- below land surface
DW- depressurization well
VMWC- vapor monitoring well cluster

(1) - Proposed Location and depth, actual locations and depths will be based on field conditions.





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SCALE IN FEET

SOURCE:
USGS 7.5 MIN. AMITYVILLE QUADRANGLE, AMITYVILLE, NY. 1994
USGS 7.5 MIN. FREEPORT QUADRANGLE, FREEPORT, NY., 1994
USGS 7.5 MIN. HICKSVILLE QUADRANGLE, HICKSVILLE, NY., 1967, PHOTOREVISED 1979
USGS 7.5 MIN. HUNTINGTON QUADRANGLE, HUNTINGTON, NY. 1967, PHOTOREVISED 1979

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C. SAN GIOVANNI	C. TUOHY	C. TUOHY	K. ZEGEL
SITE LOCATION MAP		TASK/PHASE NUMBER 00004	DRAWN BY A. SANCHEZ
		PROJECT NUMBER NY001464.1407	FIGURE 1

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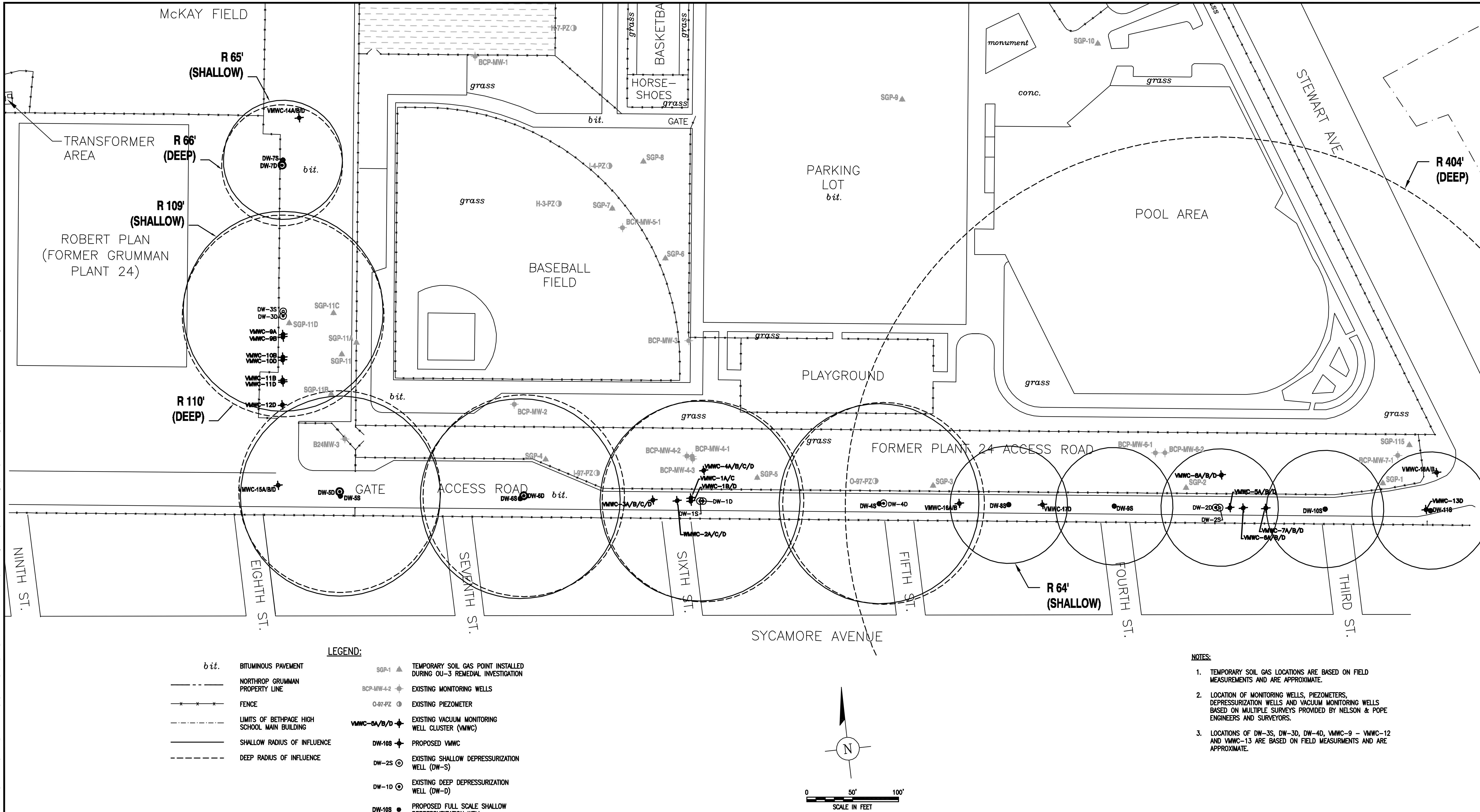
Path\Name : G:\APROJECT\Northrop Grumman\Superfund\2007\OU3\NY001464.1407 VCS IRM\VCS Desig-Const\50-75% Design\Cadd\Final Drawings\Client_50-7Fig 1_Location Map.dwg



LEGEND:

bit.	BITUMINOUS PAVEMENT
	NORTHROP GRUMMAN PROPERTY LINE
	FENCE
	LIMITS OF BETHPAGE HIGH SCHOOL MAIN BUILDING
	SHALLOW RADIUS OF INFLUENCE
	DEEP RADIUS OF INFLUENCE
SGP-1	TEMPORARY SOIL GAS POINT INSTALLED DURING OU-3 REMEDIAL INVESTIGATION
BCP-MW-4-2	EXISTING MONITORING WELLS
O-97-PZ	EXISTING PIEZOMETER
VMWC-5A/B/D	EXISTING VACUUM MONITORING WELL CLUSTER (VMWC)
DW-10S	PROPOSED VMWC
DW-2S	EXISTING SHALLOW DEPRESSURIZATION WELL (DW-S)
DW-1D	EXISTING DEEP DEPRESSURIZATION WELL (DW-D)
DW-10S	PROPOSED FULL SCALE SHALLOW DEPRESSURIZATION WELL
DW-7D	PROPOSED FULL SCALE DEEP DEPRESSURIZATION WELL

NOTES:

1. TEMPORARY SOIL GAS LOCATIONS ARE BASED ON FIELD MEASUREMENTS AND ARE APPROXIMATE.
2. LOCATION OF MONITORING WELLS, PIEZOMETERS, DEPRESSURIZATION WELLS AND VACUUM MONITORING WELLS BASED ON MULTIPLE SURVEYS PROVIDED BY NELSON & POPE ENGINEERS AND SURVEYORS.
3. LOCATIONS OF DW-3S, DW-3D, DW-4D, VMWC-9 – VMWC-12 AND VMWC-13 ARE BASED ON FIELD MEASURMENTS AND ARE APPROXIMATE.

NO.	ISSUED DATE	REVISION DESCRIPTION	BY/CKD

KEYPLAN

SEAL

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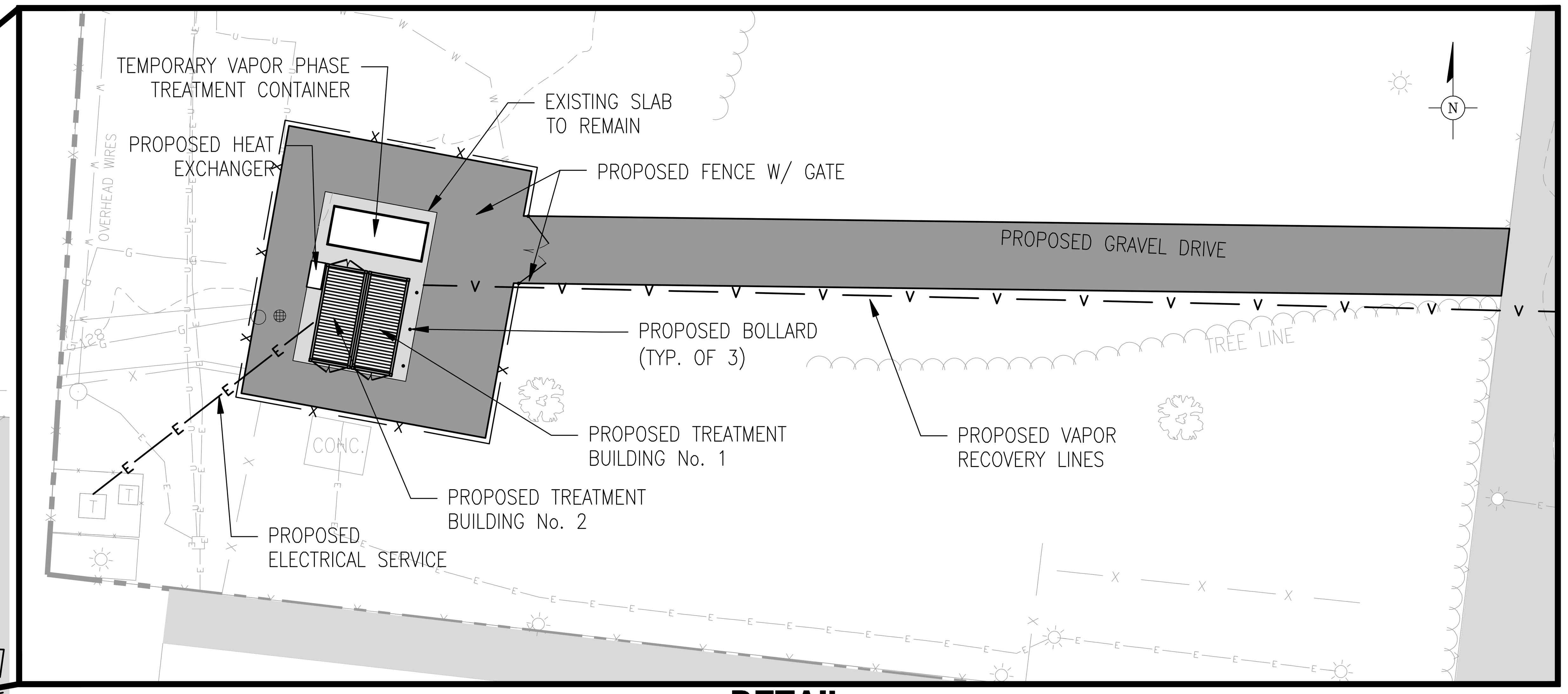
PROJECT TITLE

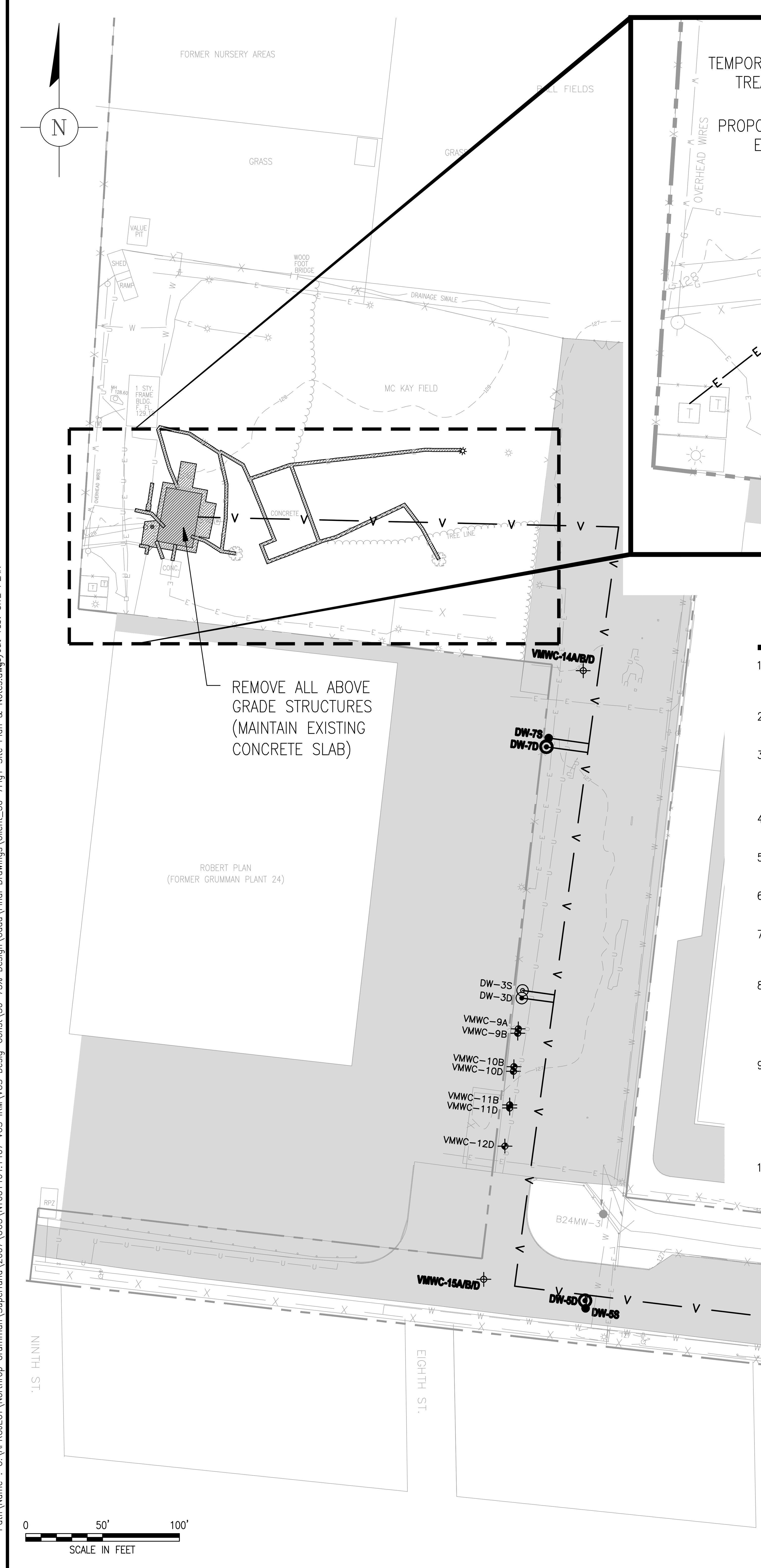
NORTHROP GRUMMAN OPERABLE UNIT 3
SOIL GAS REMEDIAL MEASURE
FORMER GRUMMAN SETTLING PONDS
BETHPAGE, NEW YORK

PROJECT MANAGER	DEPARTMENT MANAGER	LEAD DESIGN PROF.	CHECKED BY
C. SAN GIOVANNI	C. TUOHY	C. TUOHY	K. ZEGEL
SHEET TITLE		TASK/PHASE NUMBER	DRAWN BY
RADIUS OF INFLUENCE FOR SOIL GAS DEPRESSURIZATION SYSTEM		00004	A. SANCHEZ
		PROJECT NUMBER	FIGURE
		NY001464.1407	2



DETAIL

0 20' 40'
SCALE IN FEET



LEGEND

- PROPERTY LINE NORTHROP GRUMMAN
- EXISTING WATER MAIN
- UNKNOWN EXISTING UNDERGROUND UTILITY
- EXISTING GAS LINE
- EXISTING SANITARY LINE
- EXISTING UNDERGROUND ELECTRIC LINE
- EXISTING 6' CHAIN LINK FENCE
- EXISTING CONTOUR ELEVATION
- EXISTING CONCRETE CURB
- EXISTING DROP CURB
- EXISTING MONITORING WELLS
- EXISTING PIEZOMETER
- EXISTING GUIDE RAIL
- UTILITY POLE
- LIGHT POLE
- HYDRANT
- WATER VALVE
- WATER METER
- LIMITS OF WOODED AREA
- TRANSFORMER
- EXISTING PAVED AREA
- VMWC-5A/B/D — EXISTING VACUUM MONITORING WELL CLUSTER (VMWC)
- DW-10S — PROPOSED VMWC
- DW-2S — EXISTING SHALLOW DEPRESSURIZATION WELL (DW-S)
- DW-1D — EXISTING DEEP DEPRESSURIZATION WELL (DW-D)
- DW-10S — PROPOSED FULL SCALE SHALLOW DEPRESSURIZATION WELL
- DW-7D — PROPOSED FULL SCALE DEEP DEPRESSURIZATION WELL
- V — PROPOSED VAPOR RECOVERY LINES
- PROPOSED FENCE LINE
- PROPOSED WATER LINE
- PROPOSED ELECTRIC LINE
- ITEM TO BE DEMOLISHED/ABANDONED
- PROPOSED GRAVEL AREA

GENERAL NOTES

1. LOCATION OF WORK: ALL WORK DESCRIBED IN THESE DRAWINGS/SPECIFICATIONS SHALL BE PERFORMED ON BEHALF OF NORTHROP GRUMMAN SYSTEMS CORPORATION, INC.
2. THE CONTRACTOR SHOULD VISIT THE SITE AND EXAMINE ALL OF THE PHYSICAL CONDITIONS THAT AFFECT THE FINAL BID PRICE.
3. THE CONTRACTOR SHALL OBTAIN ALL NECESSARY FIELD MEASUREMENTS TO VERIFY THE ABILITY TO EXECUTE THE WORK IN ACCORDANCE WITH THIS SCOPE OF WORK AND DRAWINGS. NO ADDITIONS OR REVISIONS TO THE BID OR CONTRACT PRICE WILL BE PERMITTED BASED ON EXISTING CONDITIONS.
4. THE CONTRACTOR SHALL PROVIDE ALL LABOR, MATERIAL, AND EQUIPMENT, UNLESS OTHERWISE STATED, NECESSARY TO PERFORM THIS WORK.
5. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ALL TRADE PERMITS, AND APPROVALS NECESSARY TO PERFORM THIS WORK.
6. ALL INFORMATION PRESENTED IN THIS REQUEST REGARDING THE SITE IS CONFIDENTIAL.
7. WHILE CONSTRUCTION ACTIVITIES ARE UNDER WAY AT LEAST ONE CONTRACTOR, FOREMAN, OR CREW SUPERVISOR SHALL BE PRESENT AT THE JOB SITE AT ALL TIMES.
8. THE CONTRACTOR SHALL SEGREGATE ALL EXCAVATED MATERIALS INTO TWO CATEGORIES: CONCRETE/ASPHALT MATERIAL AND SOIL MATERIAL. CONCRETE/ASPHALT MATERIAL SHALL BE DISPOSED OF BY CONTRACTOR. SOIL MATERIAL WILL BE CHARACTERIZED AND DISPOSED OF IN ACCORDANCE WITH FEDERAL, STATE AND LOCAL REGULATIONS.
9. CONTRACTOR IS RESPONSIBLE FOR LOCATING AND VERIFYING LOCATION OF ALL UTILITIES WITHIN AREA AFFECTED BY CONSTRUCTION. COPIES OF PRINTS OBTAINED OR LOCATIONS PROVIDED TO CONTRACTOR WITH RESPECT TO UTILITIES SHALL BE SUPPLIED TO THE ENGINEER WITH A RECORD SET OF DRAWINGS AT COMPLETION OF CONSTRUCTION. IF A CONFLICT EXISTS BETWEEN THE UTILITY LOCATION AND THE CONSTRUCTION DRAWINGS, CONTRACTOR IS TO NOTIFY THE ENGINEER IMMEDIATELY SO THAT THE CONFLICT MAY BE RESOLVED.
10. CONTRACTOR IS RESPONSIBLE FOR PROVIDING THE ENGINEER WITH ALL INFORMATION REQUIRED TO COMPLETE A SET OF "RECORD" DRAWINGS BY KEEPING A RECORD SET OF DAILY PROGRESSION OF WORK.
11. UNLESS OTHERWISE NOTED, ALL AREAS DISTURBED BY THIS WORK SHALL BE RESTORED TO ORIGINAL OR BETTER CONDITION.
12. CONTRACTOR TO PROTECT AND PRESERVE ALL EXISTING FEATURES (I.E. MONITORING WELLS, EQUIPMENT, ETC.) WITHIN AREAS AFFECTED BY CONSTRUCTION. DAMAGE SUSTAINED TO AN EXISTING FEATURE WILL BE REPAIRED/REPLACED AT CONTRACTOR'S EXPENSE.
13. THE CONTRACTOR SHALL PERFORM ALL WORK IN ACCORDANCE WITH ALL COUNTY, LOCAL, STATE, AND FEDERAL REGULATIONS, INCLUDING, BUT NOT LIMITED TO, ALL APPLICABLE LOCAL, STATE, AND/OR FEDERAL (OSHA, USEPA AND DOT, ETC.) RULES AND REGULATIONS.
14. UNLESS OTHERWISE INDICATED HEREIN, ALL MATERIALS AND EQUIPMENT FURNISHED UNDER THIS CONTRACT SHALL BE NEW, FREE FROM DEFECTS, AND SHALL BE GUARANTEED FOR A PERIOD OF AT LEAST ONE YEAR FROM THE DATE OF ACCEPTANCE OF THE WORK. THE CONTRACTOR SHALL FURNISH, AT NO COST TO THE ENGINEER, ALL LABOR AND MATERIALS NECESSARY TO CORRECT PROBLEMS DUE TO FAULTY WORKMANSHIP OR MATERIALS.
15. OTHER CONSTRUCTION ACTIVITIES MAY BE TAKING PLACE CONCURRENTLY WITH THIS PROJECT. THE CONTRACTOR SHALL CONSULT WITH THE VARIOUS PARTIES AND SHALL COORDINATE SCHEDULES.
16. THE INFORMATION SHOWN ON THE DRAWINGS CONCERNING TYPE AND LOCATION OF UNDERGROUND UTILITIES IS NOT GUARANTEED TO BE ACCURATE OR ALL INCLUSIVE. THE CONTRACTOR IS RESPONSIBLE FOR MAKING HIS OWN DETERMINATIONS AS TO THE TYPE AND LOCATION OF UNDERGROUND UTILITIES AS MAY BE NECESSARY TO AVOID DAMAGE THERETO.
17. TRENCHING WILL BE PERFORMED IN AREAS WHERE VEHICULAR TRAFFIC MAY BE PRESENT. THE CONTRACTOR(S) SHALL NOTIFY THE TOWN OF OYSTER BAY HIGHWAY DEPARTMENT AND ENGINEER OF THE PROPOSED START OF WORK WITHIN THESE TRAFFIC AREAS A MINIMUM OF 48 HOURS PRIOR TO THE START OF THE WORK. FURTHERMORE, THE CONTRACTOR WILL PERFORM THIS WORK IN A MANNER TO ALLOW FOR MINIMAL DISRUPTION TO TRAFFIC. THIS WILL INCLUDE PERFORMING WORK IN ACCORDANCE WITH TOWN OF OYSTER BAY HIGHWAY DEPARTMENT REQUIREMENTS IN SECTIONS AND/OR PROVIDING TRAFFIC PLATES TO ALLOW TRENCH SECTIONS TO BE DRIVEN OVER. TRAFFIC CONTROLS SHALL BE PROVIDED AS REQUIRED BY TOWN OF OYSTER BAY HIGHWAY DEPARTMENT REQUIREMENTS.
18. PIPE ROUTING SHOWN FOR CONSTRUCTION LAYOUT PURPOSES ONLY. ACTUAL ROUTING TO BE FIELD DETERMINED AND IS SUBJECT TO ENGINEER'S APPROVAL.
19. CONTRACTOR SHALL EXTEND ALL PROCESS PIPING AND MAKE ALL NECESSARY CONNECTIONS TO WELL VAULTS.
20. ALL PIPING PRESSURE TESTS SHALL BE MADE BY THE CONTRACTOR IN THE PRESENCE OF THE ENGINEER.
21. THE CONTRACTOR SHALL PROVIDE ALL PRODUCTS AND PROPERLY CALIBRATED TESTING EQUIPMENT REQUIRED TO PERFORM THE PIPING PRESSURE TESTING WORK.
22. PRIOR TO BACKFILLING EXCAVATIONS, ALL RECOVERY PIPING SHALL BE PRESSURE TESTED. PIPING JOINTS SHALL BE EXPOSED DURING THE TESTS. TESTS MAY BE PERFORMED ON SEPARATE SECTIONS OF PIPING TO EXPEDITE CONSTRUCTION. THE CONTRACTOR SHALL NOT PERFORM PRESSURE TESTING AGAINST SYSTEM VALVES. VAPOR RECOVERY LINE SECTIONS SHALL BE PNEUMATICALLY TESTED AT 50 PSI FOR ONE HOUR.
23. AFTER THE INITIAL PRESSURE TEST ON PIPING IS COMPLETED SUCCESSFULLY, THE CONTRACTOR SHALL BACKFILL THE TRENCHES AS SPECIFIED.
24. EXCAVATIONS SHALL BE KEPT FREE FROM STANDING WATER.
25. CONTRACTOR SHALL NOTIFY THE ENGINEER AT THE COMPLETION OF EXCAVATIONS AND TRENCHING TO ALLOW FOR INSPECTIONS.
26. CONTRACTOR SHALL PROVIDE APPROPRIATE SAFETY BARRICADES AROUND TRENCHING AND EXCAVATION TO PREVENT ACCIDENTS OR UNAUTHORIZED ENTRY.
27. BACKFILL OF TRENCHES IN UNPAVED AREAS WILL BE APPLIED IN 1-FOOT COMPACTED LIFTS SUCH THAT A MINIMUM 85% PROCTOR DENSITY IS ACHIEVED (95% MODIFIED PROCTOR DENSITY SHALL BE ACHIEVED IN PAVED AREAS AND UNDER TREATMENT BUILDING FOUNDATIONS).
28. CONTRACTOR'S FILL SOURCE MUST BE TESTED BY CONTRACTOR AND APPROVED BY THE ENGINEER PRIOR TO COMMENCING THE WORK AND/OR PLACING THE MATERIAL.
29. EXCAVATIONS WILL BE BACKFILLED AS PROMPTLY AS WORK PERMITS ONCE REQUIRED INSPECTIONS HAVE BEEN COMPLETED.
30. DO NOT PLACE MATERIALS ON SURFACES THAT ARE MUDDY, FROZEN, OR CONTAIN ICE OR FROST.
31. CONTRACTOR SHALL PLACE A SINGLE STRIP OF UTILITY WARNING TAPE IN ALL TRENCHED AREAS. THIS TAPE SHALL CONTAIN A WIRE FOR METAL DETECTION OR HAVE AN ALUMINUM CORE. TAPE SHALL BE PLACED AT A DEPTH OF 6 INCHES IN NON-PAVED AREAS AND BELOW THE SUBBASE IN PAVED AREAS.
32. ALL CONCRETE AND PAVEMENT CUTS ARE TO BE SMOOTH EDGE SAW CUTS BY CIRCULAR SAW BLADES.
33. SILT FENCE AND HAY BALES SHALL BE UTILIZED ON ALL EXCAVATION/TRENCHING.
34. SURVEY NOTE: MAP FEATURES BASED ON SURVEY PREPARED BY NELSON & POPE ENGINEERS AND SURVEYORS, "EXISTING TOPOGRAPHY", DATED 4-19-07.
35. LOCATION OF MONITORING WELLS, PIEZOMETERS, DEPRESSURIZATION WELLS AND VACUUM MONITORING WELLS BASED ON MULTIPLE SURVEYS PROVIDED BY NELSON & POPE ENGINEERS AND SURVEYORS.
36. EXISTING FEATURES ON PARK AND OFF-SITE ARE BASED ON AERIAL PHOTOGRAPHY AND ARE APPROXIMATE.
37. LOCATIONS OF DW-3S, DW-3D, DW-4D, VMWC-9 – VMWC-12 AND VMWC-13 ARE BASED ON FIELD MEASURMENTS AND ARE APPROXIMATE.

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Acad Version : R17.0s (LMS Tech) User Name : alsanchez

SCALE VERIFICATION
THIS BAR REPRESENTS ONE INCH ON THE ORIGINAL DRAWING:
USE TO VERIFY FIGURE REPRODUCTION SCALE

NO.	ISSUED DATE	REVISION DESCRIPTION	BY/CKD
0	7/2007	50 TO 75 % DESIGN SUBMITIAL	AS/KZ

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NORTHROP GRUMMAN OPERABLE UNIT 3
SOIL GAS INTERIM REMEDIAL MEASURE
FORMER GRUMMAN SETTLING PONDS
BETHPAGE, NEW YORK

SITE PLAN AND NOTES

PROJECT MANAGER	DEPARTMENT MANAGER	LEAD DESIGN PROF.	CHECKED BY
C. SAN GIOVANNI	C. TUOHY	C. TUOHY	K. ZEGEL
		TASK/PHASE NUMBER	DRAWN BY
		00004	A. SANCHEZ
		PROJECT NUMBER	DRAWING NUMBER
		NY001464.1407	1

GENERAL NOTES

1. ALL PRESSURE INDICATORS, FLOW INDICATORS, AND TEMPERATURE INDICATORS SHALL BE TAGGED (DOG TAG STYLE) IN FIELD AS SHOWN BELOW WITH METHOD APPROVED BY THE ENGINEER.
2. UNLESS MAKE AND/OR MODEL OF EQUIPMENT IS SHOWN, CONTRACTOR IS RESPONSIBLE FOR SPECIFYING EQUIPMENT WHICH MEETS LISTED CRITERIA AS DESCRIBED BELOW. CONTRACTOR SHALL SUBMIT TO ENGINEER SHOP DRAWINGS AND TECHNICAL SPECIFICATIONS OF ALL PROPOSED EQUIPMENT.
3. UNLESS NOTED OTHERWISE, ALL PIPING, VALVES, AND FITTINGS SHALL BE SCH. 80 PVC OR APPROVED EQUIVALENT.
4. ALL WATER SAMPLE PORTS SHALL BE COMPRISED OF ONE 1/4" NIPPLE, ONE 1/4" BALL VALVE AND ONE 1/4" HOSE BIB CONNECTOR.
5. ALL AIR SAMPLE PORTS SHALL BE COMPRISED OF 1/4" OD COPPER TUBING WITH END CONNECTION OF 1/4" ID FERRUL AND 1/4" SWAGELOCK NUT.
6. FLOW ELEMENT ACCESS SHALL CONSIST OF 1/4" THREADED HOLE CAPPED WITH A 1/4" STEEL PLUG.
7. UNIONS SHALL BE INSTALLED AS DIRECTED BY ENGINEER TO ALLOW FULL DISCONNECTION OF PIPING\EQUIPMENT DURING MAINTENANCE ACTIVITY.

PIPING SYMBOLS

- CONDENSATE LINE
- PROCESS VAPOR LINE
- BALL VALVE (NORMALLY OPEN)
- BALL VALVE (NORMALLY CLOSED)
- CHECK VALVE
- BTV — BUTTERFLY VALVE (NORMALLY OPEN)
- BTV — BUTTERFLY VALVE (NORMALLY CLOSED)
- TEMPORARY CONNECTION
- SAMPLE PORT/DRAIN
- VACUUM BREAK

INSTRUMENT SYMBOLS

- INLINE INSTRUMENT
- ISOLATED INSTRUMENT CONNECTED TO PROCESS LINE
- INSTRUMENT CONNECTED TO PROCESS LINE
- FIELD MOUNTED
- PRIMARY PANEL MOUNTED
- RUN INDICATOR LIGHT
- PLC INTERLOCK

SOIL GAS SYSTEM PROCESS FLOW TABLE

LOCATION ON DRAWING	CORRESPONDING GAUGE ID	WELL ID	FLOW RATE (SCFM)	PRESSURE (IWC)	VACUUM (IWC)	DESIGN TVOC LOAD (UG/M3)	TEMPERATURE (° F)
A	VI-101	DW-7D	9	—	-4.0	1,698	50
B	VI-102	DW-3D	75	—	-33.5	1,698	50
C	VI-103	DW-5D	75	—	-33.5	1,698	50
D	VI-104	DW-6D	75	—	-33.5	5,260	50
E	VI-105	DW-1D	75	—	-33.5	2,007	50
F	VI-106	DW-4D	75	—	-33.5	4,942	50
G	VI-107	DW-2D	100	—	-5.0	1,093	50
H	VI-108	DW-7S	82	—	-2.1	8,870	50
I	VI-109	DW-3S	150	—	-3.9	8,870	50
J	VI-110	DW-5S	150	—	-3.9	8,870	50
K	VI-111	DW-6S	150	—	-3.9	1,424	50
L	VI-112	DW-1S	150	—	-3.9	1,346	50
M	VI-113	DW-4S	150	—	-3.9	1,910	50
N	VI-114	DW-8S	66	—	-3.8	1,910	50
O	VI-115	DW-9S	66	—	-3.8	1,058	50
P	VI-116	DW-2S	66	—	-3.8	1,058	50
Q	VI-117	DW-10S	66	—	-3.8	632	50
R	VI-118	DW-11S	66	—	-3.8	632	50
S	VI-201	—	484	—	-43.5	2,676	50
T	VI-301	—	581	—	-13.9	3,845	50
U	VI-401	—	581	—	-13.9	3,845	50
V	VI-202	—	484	—	-53.5	2,676	50
W	VI-302	—	581	—	-23.9	3,845	50
X	VI-402	—	581	—	-23.9	3,845	50
Y	PI-601	—	1646	10	---	3,501	150
Z	—	—	1646	0	---	<AGC/SGC	100

EQUIPMENT DESCRIPTIONS

AIR FILTERS
DESIGNATION: AF–200, AF–300 AND AF–400
MAKE: SOLBERG CSL–245P–500
TYPE: IN–LINE PARTICULATE

BLOWERS
DESIGNATION: BL–200, BL–300 AND BL–400
MAKE: ROTRON EN979
TYPE: REGENERATIVE
SIZE: 20 HP, 3ø, 480V
CAPACITY: 1000 CFM, 0 IWC.

HEAT EXCHANGER
DESIGNATION: HX–600
MAKE: XCHANGER AA–2750
TYPE: FAN FORCED AIR
SIZE: 2 HP, 3ø, 480 V

LIQUID KNOCKOUT TANKS
DESIGNATION: KO–200, KO–300 AND KO–400
MAKE: GASHO GX–90
SIZE: 22' X 56"
CAPACITY: 90 GAL. TOTAL 30 GAL. STORAGE

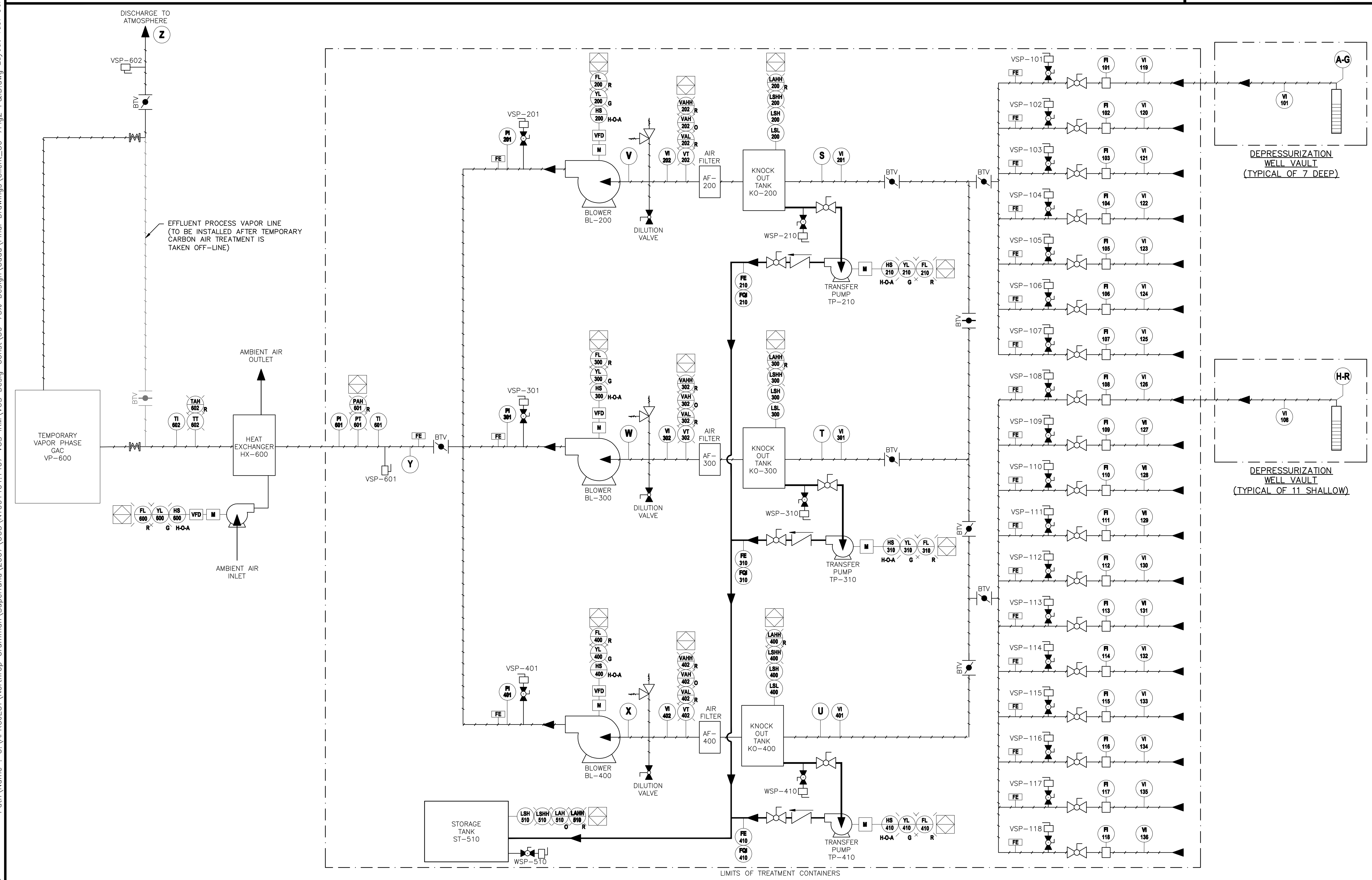
STORAGE TANK
DESIGNATION: ST–510
MAKE: CHEMTAINER
TYPE: VERTICAL BULK STORAGE
SIZE: 300 GALLON

TRANSFER PUMPS
DESIGNATION: TP–210, TP–310 AND TP–410
MAKE: OBERDORFER BRONZE GEAR 992R
TYPE: POSITIVE DISPLACMENT
SIZE: 0.5 HP, 3ø, 480V

TEMPORARY VAPOR PHASE GAC
DESIGNATION: VP–600
MAKE: US FILTER RB–10 OR EQUAL
SIZE: 10,000 LB

PIPE IDENTIFICATION

LINE SIZE
PIPING SPECIFICATION (SEE PROCESS ABBREVIATIONS)
6"ø SCH. 80PVC
DIRECTION OF FLOW



PLC INTERLOCK DESCRIPTIONS

THE MAIN CONTROL PANEL WILL CONSIST OF A PROGRAMMABLE LOGIC CONTROLLER (PLC) AND SERVE AS THE CENTRAL CONTROL POINT FOR THE SYSTEM. NEGATIVE PRESSURE WILL BE MAINTAINED WITHIN THE SUBSURFACE THROUGH 18 EXTRACTION WELLS CONNECTED TO A DEPRESSURIZATION SYSTEM. THE DEPRESSURIZATION SYSTEM WILL CONSIST OF THREE (3) REGENERATIVE TYPE BLOWERS ARRANGED IN PARALLEL. ONE BLOWER (BL–200) WILL BE DEDICATED FOR DEEP EXTRACTION WELLS DW–1D THROUGH DW–7D. TWO ADDITIONAL BLOWERS (BL–300 AND BL–400) WILL BE DEDICATED FOR SHALLOW EXTRACTION WELLS DW–1S THROUGH DW–11S. HOWEVER, ALL BLOWERS WILL BE VALVED IN SUCH A WAY THAT THEY CAN BE USED AS BACKUPS IN CASE OF FAILURE OF ANY INDIVIDUAL BLOWER. MOISTURE WILL BE REMOVED FROM THE EXTRACTED SOIL GAS USING LIQUID KNOCKOUT TANKS KO–200, KO–300, AND KO–400. COLLECTED MOISTURE WILL BE AUTOMATICALLY TRANSFERRED TO STORAGE TANK ST–510 BY TRANSFER PUMPS TP–210, TP–310, AND TP–410. EXTRACTED SOIL GAS WILL BE TREATED USING A TEMPORARY VAPOR PHASE TREATEMENT SYSTEM (VP–600) UNTIL IT IS DEMONSTRATED THAT THE INFLUENT VAPOR CONCENTRATION IS BELOW APPLICABLE AIR STANDARDS (NYSDEC DAR–1 AGC/SGCs) AS ANTICIPATED. WATER COLLECTED IN STORAGE TANK ST–510 WILL INITIALLY BE TRANSFERRED TO THE LOCAL POTW THROUGH EXISTING AGREEMENT. THE SYSTEM WILL CONTAIN A SERIES OF ALARMS AND INTERLOCKS TO ENSURE PROPER OPERATION AND OPTIMIZE SYSTEM OPERATION TIME.

A DESCRIPTION OF THE ALARMS AND INTERLOCKS THAT WILL BE USED TO CONTROL THE SYSTEM IS DESCRIBED BELOW:

INTERLOCK ID	ALARM	DESCRIPTION	REASON	ALARM RANGE
A	FL–200	BLOWER MOTOR BL–200	BLOWER MOTOR BL–200 FAILURE	
B	FL–210	TRANSFER PUMP MOTOR TP–210	TRANSFER PUMP MOTOR TP–210 FAILURE	
A	LAHH–200	KNOCKOUT TANK HIGH HIGH LEVEL	TRANSFER PUMP MOTOR TP–210 FAILURE.	
B	VAH–202	BLOWER VACUUM HIGH LEVEL	AIR FILTER OR LINE OBSTRUCTION	–60 IWC
A	VAHH–202	BLOWER VACUUM HIGH HIGH LEVEL	AIR FILTER OR LINE OBSTRUCTION	–70 IWC
A	VAL–202	DEEP DEPRESSURIZATION WELL VACUUM LOW	RECOVERY LINE OR BLOWER FAILURE	–30 IWC
A	FL–300	BLOWER MOTOR BL–300	BLOWER MOTOR BL–300 FAILURE	
B	FL–310	TRANSFER PUMP MOTOR TP–310	TRANSFER PUMP MOTOR TP–310 FAILURE	
A	LAHH–300	KNOCKOUT TANK HIGH HIGH LEVEL	TRANSFER PUMP MOTOR TP–310 FAILURE.	
B	VAH–302	BLOWER VACUUM HIGH LEVEL	AIR FILTER OR LINE OBSTRUCTION	–30 IWC
A	VAHH–302	BLOWER VACUUM HIGH HIGH LEVEL	AIR FILTER OR LINE OBSTRUCTION	–40 IWC
A	VAL–302	SHALLOW DEPRESSURIZATION WELL VACUUM LOW	RECOVERY LINE OR BLOWER FAILURE	–15 IWC
A	FL–400	BLOWER MOTOR BL–400	BLOWER MOTOR BL–400 FAILURE	
B	FL–410	TRANSFER PUMP MOTOR TP–410	TRANSFER PUMP MOTOR TP–410 FAILURE	
A	LAHH–400	KNOCKOUT TANK HIGH HIGH LEVEL	TRANSFER PUMP MOTOR TP–410 FAILURE	
B	VAH–402	BLOWER VACUUM HIGH LEVEL	AIR FILTER OR LINE OBSTRUCTION	–30 IWC
A	VAHH–402	BLOWER VACUUM HIGH HIGH LEVEL	AIR FILTER OR LINE OBSTRUCTION	–40 IWC
A	VAL–402	SHALLOW DEPRESSURIZATION WELL VACUUM LOW	RECOVERY LINE OR BLOWER FAILURE	–15 IWC
B	LAH–510	STORAGE TANK HIGH LEVEL	STORAGE TANK ST–510 FULL	
A	LAHH–510	STORAGE TANK HIGH HIGH LEVEL	STORAGE TANK ST–510 OVER FILLED	
B	FL–600	HEAT EXCHANGER MOTOR HX–600	HX–600 MOTOR FAILURE	
A	PAH–601	EFFLUENT HIGH PRESSURE	PRESSURE HIGH ON DISCHARGE	+20 IWC
A	TAH–602	EFFLUENT HIGH TEMPERATURE	HEAT EXCHANGER FAILURE	130°F

1. ALARM SETPOINTS SHOWN ARE APPROXIMATE. FINAL SETPOINTS TO BE FIELD DETERMINED DURING SYSTEM STARTUP.
2. ALL ALARM SETPOINTS SHALL BE OPERATOR ADJUSTABLE ON THE GRAPHICAL USER INTERFACE.
3. HEAT EXCHANGER HX–600 MOTOR SPEED TO BE CONROLLED BY THE TEMPERATURE FROM TT–602. DESIRED DISCHARGE TEMPERATUTRE TO BE AN OPERATOR INPUT ON THE GRAPHICAL USER INTERFACE.

A MAIN SYSTEM INTERLOCK–RESULTS IN SHUTDOWN OF ALL SYSTEM COMPONENTS.

B MINOR SYSTEM INTERLOCK–RESULTS IN CALLOUT OF THE AUTODIALER ONLY. IF ALARM IS NOT CLEARED MANUALLY WITHIN 24 HOURS, THE MAIN SYSTEM INTERLOCK WILL BE ENGAGED.

GENERAL ABBREVIATIONS

ø	DIAMETER
AF	AIR FILTER
AGC	ANNUAL GUIDANCE CRITERIA
BL	BLOWER
BV	BALL VALVE
BTV	BUTTERFLY VALVE
CFM	CUBIC FEET PER MINUTE
CV	CHECK VALVE
FE	FLOW MONITORING ELEMENT
FI	FLOW RATE INDICATOR
FL	FAULT LIGHT
FQI	FLOW TOTALIZER INDICATOR
G	GREEN INDICATOR LIGHT
GAC	GRANULAR ACTIVATED CARBON
GPM	GALLONS PER MINUTE
H–O–A	HAND–OFF–AUTO
HS	HAND SWITCH
HX	HEAT EXCHANGER
IWC	INCHES OF WATER COLUMN
KO	KNOCKOUT TANK
LAHH	LEVEL ALARM LIGHT HIGH HIGH
LSH	LEVEL SWITCH HIGH
LSHH	LEVEL SWITCH HIGH HIGH
LSL	LEVEL SWITCH LOW
M	MOTOR
mg/L	MILLIGRAMS PER LITER
O	ORANGE INDICATOR LIGHT
PAH	PRESSURE ALARM HIGH
PI	PRESSURE INDICATOR
PLC	PROGRAMMABLE LOGIC CONTROLLER
PPMV	PARTS PER MILLION BY VOLUME
PSIG	POUNDS PER SQUARE INCH GAUGE
PT	PRESSURE TRANSMITTER
PVC	POLYVINYL CHLORIDE
R	RED INDICATOR LIGHT
SCFM	STANDARD CUBIC FEET PER MINUTE
SCH	SCHEDULE
SGC	SHORT–TERM GUIDANCE CRITERIA
ST	STORAGE TANK
TAH	TEMPERATURE ALARM HIGH
TP	TRANSFER PUMP
TT	TEMPERATURE TRANSMITTER
VAH	VACUUM ALARM HIGH
VAHH	VACUUM ALARM HIGH HIGH
VAL	VACUUM ALARM LOW
VALL	VACUUM ALARM LOW LOW
VFD	VARIABLE FREQUENCY DRIVE
VI	VACUUM INDICATOR
VS	VACUUM SWITCH
VSH	VACUUM SWITCH HIGH
VSP	VAPOR SAMPLE POINT
WSP	WATER SAMPLE POINT
YL	INDICATING LIGHT

NO.	ISSUED DATE	REVISION DESCRIPTION	BY/CKD
0	7/2007	50 TO 75 % DESIGN SUBMITTAL	AS/KZ

KYRIACOS PIERIDES, PH.D. P.E.
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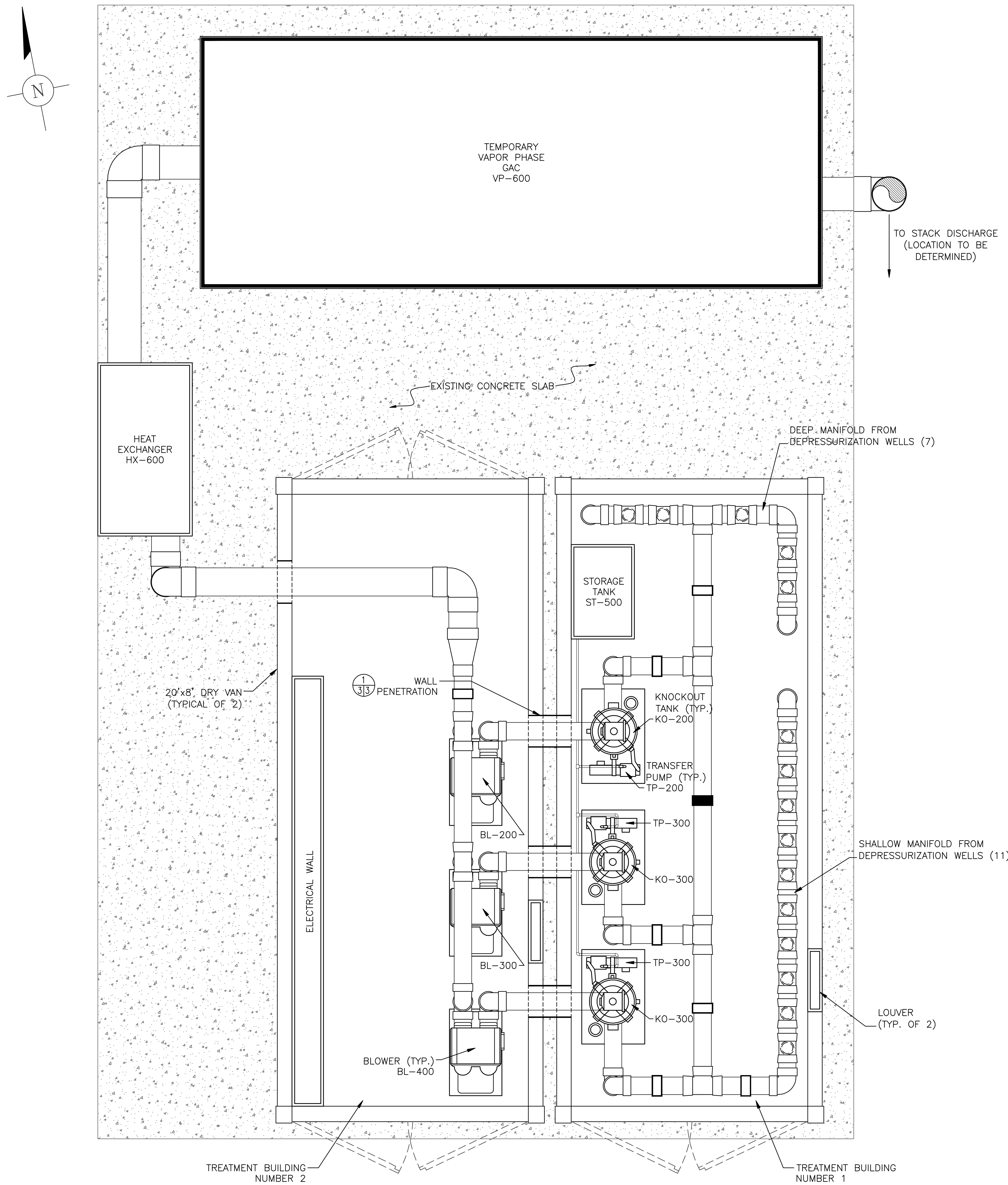
NORTHROP GRUMMAN OPERABLE UNIT 3
SOIL GAS INTERIM REMEDIAL MEASURE
FORMER GRUMMAN SETTLING PONDS
BETHPAGE, NEW YORK

PROCESS AND INSTRUMENTATION DIAGRAM

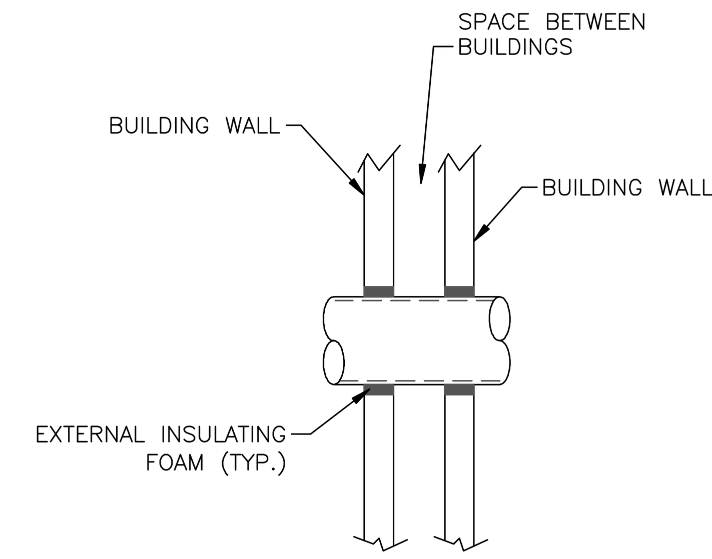
PROJECT MANAGER	DEPARTMENT MANAGER	LEAD DESIGN PROF.	CHECKED BY
C. SAN GIOVANNI	C. TUOHY	C. TUOHY	K. ZEGEL
		TASK/PHASE NUMBER: 00004	DRAWN BY: A. SANCHEZ
		PROJECT NUMBER: NY001464.1407	DRAWING NUMBER: 2

Acad Version : R17.0s (LMS Tech) User Name : alsanchez
Date\Time : Wed, 01 Aug 2007 – 5:38pm Path\Name : G:\APROJECT\Northrop Grumman\Superfund\2007\OU3\NY001464.1407 VCS IRM\VCS Desig–Const\50–75% Design\Cadd\Final Drawings\Client_50–7Fig2 P&ID.dwg Layout Tab: 36x24
Current Plotsyle : ByColor



EQUIPMENT/BUILDING LAYOUT PLAN

SCALE: 1" = 2'-0"



1
3|3 **TYPICAL WALL PENETRATION**

SCALE: N.T.S.

CONSTRUCTION NOTES:

1. PIPE ROUTING AND EQUIPMENT LAYOUT SHOWN FOR LAYOUT PURPOSES ONLY. CONTRACTOR TO FOLLOW PIPING AND INSTRUMENTATION DIAGRAM (DRAWING NO.2) WHILE ASSEMBLING PIPING FOR VALVING, INSTRUMENTATION, AND REDUCTION REQUIREMENTS. PROVIDE LAYOUT/FABRICATION DRAWINGS FOR APPROVAL PRIOR TO CONSTRUCTION.
2. PLACEMENT OF VALVES TO BE SUCH THAT THEY ARE ACCESSIBLE AND OPERATE WITH EASE.
3. PLACEMENT OF INSTRUMENTATION TO BE SUCH THAT THEY ARE VISIBLE WITH GAUGES AND READOUTS CLEARLY IN VIEW AND ORIENTATED CORRECTLY.
4. ALL INSTRUMENTS, EQUIPMENT, AND VALVING TO BE INSTALLED PER MANUFACTURER'S REQUIREMENTS.
5. CONTRACTOR TO PROVIDE PIPE SUPPORTS AS REQUIRED. TYPE, PLACEMENT, AND NUMBER OF SUPPORTS ARE SUBJECT TO ENGINEER'S APPROVAL.
6. ALL EQUIPMENT, ELECTRICAL PANELS, AND PIPING OF CONSIDERABLE WEIGHT LOADING TO BE MOUNTED AND SUPPORTED AS FREESTANDING OR TO HAVE ADEQUATE FLOOR SUPPORTS.
7. NON-SHRINK GROUT IS TO BE USED TO FILL ALL VOIDS AROUND PIPE PENETRATIONS IN CONCRETE.
8. INTERIOR PIPES SHALL BE LABELED WITH APPROPRIATE STICKERS INDICATING FLOW DIRECTION AND CONTENTS OF PIPE.
9. REFER TO DRAWING 2 FOR PROCESS DESCRIPTIONS, INCLUDING LEVEL SWITCH INTERPRETATIONS.
10. CONTRACTOR SHALL SUBMIT TO ENGINEER FOR APPROVAL SHOP DRAWINGS PRIOR TO CONSTRUCTION FOR ALL PROPOSED EQUIPMENT. PROPOSED TANK SHALL INCLUDE ALL PROPOSED LEVEL SWITCH LOCATIONS AND BULKHEAD FITTING FOR PIPE CONNECTIONS.
11. EQUIPMENT SHOULD BE PLACED IN LOCATIONS SPECIFIED, UNLESS APPROVED BY ENGINEER. ALL EQUIPMENT SHALL BE POSITIONED PRIOR TO MOUNTING (BOLTING) EQUIPMENT TO FLOOR. EXACT EQUIPMENT LOCATIONS MAY BE MODIFIED TO ALLOW FOR EASE OF MOVEMENT AND ACCESS BUT IS SUBJECT TO FIELD ENGINEERS APPROVAL.
12. ALL PIPING\ELECTRICAL CONDUITS SHALL BE ROUTED ALONG WALLS AND/OR OVERHEAD TO ALLOW EQUIPMENT ACCESS AND PREVENT TRIPPING HAZARDS. PIPING\ELECTRICAL CONDUITS SHALL NOT BE INSTALLED ALONG FLOORS UNLESS APPROVED BY THE ENGINEER.

SCALE VERIFICATION
THIS BAR REPRESENTS ONE INCH ON THE ORIGINAL DRAWING:
USE TO VERIFY FIGURE REPRODUCTION SCALE

NO.	ISSUED DATE	REVISION DESCRIPTION	BY/CKD
0	7/2007	50 TO 75 % DESIGN SUBMITTAL	AS/KZ

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BUILDING LAYOUT

PROJECT MANAGER	DEPARTMENT MANAGER	LEAD DESIGN PROF.	CHECKED BY
C. SAN GIOVANNI	C. TUOHY	C. TUOHY	K. ZEGEL
		TASK/PHASE NUMBER: 00004	DRAWN BY: A. SANCHEZ
		PROJECT NUMBER: NY001464.1407	DRAWING NUMBER: 3

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Appendix A

Pneumatic Conductivity Test Results

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Table A-1. Pneumatic Conductivity Test, Depressurization Well 1-Shallow Field Monitoring Parameters, Northrop Grumman Operable Unit 3, Soil Gas IRM, Former Grumman Settling Ponds, Bethpage, New York.

Data Recording Interval	Time	DW-1S Wellhead Vacuum	VCS Air Flow (6)	Wellhead Effluent PID	Knockout Tank Vacuum	Post Knockout Vacuum	Blower Influent Vacuum	Blower Influent Temperature	Blower Effluent Pressure	Blower Effluent Temperature	Carbon Influent Pressure Approximate	Carbon Effluent PID
		VI-1 (iwc)	Hand Held/FM-1 (fpm)/(scfm)	ASP-1 (ppm)	VI-2 (iwc)	(iwc)	VI-3 (iwc)	TI-1 (F)	PI-1 (iwc)	TI-2 (F)	(iwc)	ASP-2 (ppm)
Baseline[5]	8:30-12 PM	-0.0036										
Steady State[9]	12:37 PM	-4.040	2134/NM	NM		-22	-36	50	32	122	18	NM
1 hr	1:30 PM	-4.046	2733/~190	NM	-6	-22	-36	58	31	132	18	NM
2 hr	2:45 PM	-3.957	(7,8) /230	NM	-6	-22	-36	62	31	134	18	NM
3 hr	3:50 PM	-4.015	3025/230	NM	-6	-22	-36	60	30	130	17	NM
4 hr [3]	4:30 PM	-4.040	3153/230	0.0	-6	-22	-36	58	30	132	18	42.5
Special 4 Hr. - 100% Manifold -94 SCFM	*~5:10 PM*	*-2.415*	*2530/285*	*NM*	*-46*	*-54*	*-62*	*58*	*14*	*150*	*8*	*NM*
~5 hr / 75% Changed at 5:20 pm	5:50 PM	-2.750	2200-3100/171	NM	-2	-14	-20	58	38	120	20	NM
~6 hr / 50% Changed at 6:00 pm	6:30 PM	-2.482	2200-3000/171	NM	-1	-12	-16	54	40	120	20	NM
Special 7Hr. - 100% Manifold -94 SCFM	*7:10 PM*	*-2.464*	*1534/94*	*NM*	*-46*	*-54*	*-62*	*52*	*15*	*NM*	*8*	*NM*

Initials:	PAR	Date: 3/22/07	(+/-)[2]
Barometric Pressure (inHg)	2:12 PM	30.21	Steady / 76% RH
Ambient Temperature	12:05 PM	56.5 F	86% RH
Ambient Conditions	12:05 PM	Overcast, Cool	
Ambient Conditions	2:15 PM	Sunny, Breezy	
Ambient Conditions	6:30 PM	Overcast, Cool, Breezy Front rolling in	
Ambient Conditions	7:17 PM	Rain Start	

% Dilution Valve opened at start of test	**None**
Total Volume of water collected from knockout tank	**0 Gallons**

Notes on last page

Table A-1. Pneumatic Conductivity Test, Depressurization Well 1-Shallow Field Monitoring Parameters, Northrop Grumman Operable Unit 3, Soil Gas IRM, Former Grumman Settling Ponds, Bethpage, New York.

Data Recording Interval	Time	Induced Vacuum Readings (iwc) Vacuum Points											
		VMWC-1			VMWC-2			VMWC-3			VMWC-4		
		Radial Distance[1] 10 ft			Radial Distance[1] 25 ft			Radial Distance[1] 55 ft			Radial Distance[1] 35 ft		
		Depth A	Depth B	Depth C	Depth A		Depth C	Depth A	Depth B	Depth C	Depth A	Depth B	Depth C
		(7.5-8.5 ft bls)	(12.4-13.4 ft bls)	(24.7-39.7 ft bls)	(9-10 ft bls)		(21-22 ft bls)	(7.5-8.5 ft bls)	(13-14 ft bls)	(22-23 ft bls)	(6-7 ft bls)	(12-13 ft bls)	(21-22 ft bls)
Baseline[5]		+0.0321	+0.0200	+0.0319	+0.0366		+0.0382	+0.0187	+0.0194	+0.0233	+0.0071	+0.0261	+0.0264
Steady State	12:56 PM	-0.4633	-0.5270	-0.3935	-0.3193		-0.3288	-0.1722	-0.1749	-0.1692	-0.2570	-0.2803	-0.2891
1 hr	1:33 PM	-0.4782	-0.5108	-0.3988	-0.3206		-0.3245	-0.1622	-0.1762	-0.1807	-0.2486	-0.2773	-0.2589
2 hr	2:50 PM	-0.4824	-0.5084	-0.4238	-0.3197		-0.3242	-0.1735	-0.1881	-0.1889	-0.2590	-0.2950	-0.2887
3 hr	3:50 PM	-0.4730	-0.5209	-0.4108	-0.3119		-0.3220	-0.1749	-0.1868	-0.1763	-0.2511	-0.2818	-0.2726
4 hr [3]	4:35 PM	-0.4857	-0.5316	-0.4187	-0.3173		-0.3312	-0.1799	-0.1874	-0.1738	-0.2583	-0.2829	-0.2718
Special 4 Hr. - Manifold - 94 SCFM	*~5:10 PM*	*NM*	*NM*	*NM*	*NM*		*NM*	*NM*	*NM*	*NM*	*NM*	*NM*	*NM*
~5 hr / 75% Changed at 5:20 pm	5:50 PM	-0.3503	-0.3936	-0.3069	-0.2439		-0.2448	-0.1449	-0.1494	-0.1456	-0.1933	-0.2358	-0.2198
~6 hr / 50% Changed at 6:00 pm	6:30 PM	-0.3374	-0.3672	-0.2966	-0.2442		-0.2414	-0.1270	-0.1322	-0.1215	-0.1778	-0.2103	-0.2041
Special 7Hr. - 100% Manifold -94 SCFM	*7:10 PM*	*-0.3280*	*-0.3855*	*-0.2942*	*-0.2270*		*-0.2400*	*-0.1334*	*-0.1174*	*-0.1239*	*-0.1621*	*-0.1760*	*-0.1682*

Notes on last page

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Table A-1. Pneumatic Conductivity Test, Depressurization Well 1-Shallow Field Monitoring Parameters, Northrop Grumman Operable Unit 3, Soil Gas IRM, Former Grumman Settling Ponds, Bethpage, New York.

Data Recording Interval	Time	Induced Vacuum Readings (iwc) Vacuum Points — Monitoring Wells (if applicable)			Water Level Measurements — Monitoring Wells (if applicable)			Comments
		I-97-PZ Stick-up Screened (35-45)	MW - __	MW - ___	DW-1S Screened (15-30)	VMWC-3C	MW - __	
					DTW	DTW	DTW	
		(ft bmp)	(ft bmp)	(ft bmp)	(ft bls)	(ft bls)	(ft bmp)	
Baseline(5)		+0.0308			DRY	53.7		
Steady State	1:09 PM	-0.0615				NM		
1 hr	1:50 PM	-0.0341				NM		2:15PM weather changed, sunny, breezy
2 hr	3:15 PM	-0.0622				NM		Sun shining bright now with light breeze
3 hr	4:00 PM	-0.0625				NM		
4 hr (3)	5:06 PM	-0.0883				NM		
Special 4 Hr. - Manifold -94 SCFM	*~5:10 PM*	*NM*				*NM*		
~5 hr / 75% Changed at 5:20 pm	5:59 PM	-0.0583				NM		Flow changed at 5:20PM readings taken at 5:50PM.
~6 hr / 50% Changed at 6:00 pm	6:49 PM	-0.0651				NM		Weather changed Overcast, Cold, Breezy ,Front rolling in Flow changed at 6:00PM readings taken at 6:30PM.
Special 7Hr. - 100% Manifold -94 SCFM	*7:29 PM*	*-0.0382*				*NM*		6:55PM add manifold and increased flow back to 100%, readings taken at 7:10PM rain starts at 7:17PM

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Table A-1. Pneumatic Conductivity Test, Depressurization Well 1-Shallow Field Monitoring Parameters, Northrop Grumman Operable Unit 3, Soil Gas IRM, Former Grumman Settling Ponds, Bethpage, New York.

Notes:

(1) Radial Distances for VMWCs 1-4 are measured from DW-1S.
(2) + indicates increasing, - indicates decreasing
(3) Air sample was collected in 6-liter suma canister and submitted to Columbia Analytical Labs, Rochester, New York for TO-15 analysis; 24 Hr. TAT requested. Pre-carbon sample was collected at test hour 4.
(4) Water was not generated during this event therefore, water sample was not collected or submitted for analysis.
(5) Initial measurement after start-up for wellhead vacuum.
(6) Velocity measured at 4"D PVC pipe with thermal anemometer. Rotron Flowmeter supplied by system vendor did not function properly.
(7) Anemometer readings at 2:45pm: 2440, 3059, 2285, 2939, 2949, 2968, 2984.
(8) Anemometer readings at 3:18pm: 3075 &3018
(9) Test started at 12:31PM readings stabilized 6 mins later.

DW depressurization well
DTW depth to water
fpm feet per minute
ft. bls feet below land surface
ft. bmp feet below measuring point
in Hg inches of mercury
iwc inches of water column
PID photoionization detector
ppm parts per million
VCS vapor control system
VMWC vacuum monitoring well cluster

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Table A-2. Pneumatic Conductivity Test, Depressurization Well 1-Deep Field Monitoring Parameters, Northrop Grumman Operable Unit 3, Soil Gas IRM, Former Grumman Settling Ponds, Bethpage, New York.

Data Recording Interval	Time	DW-1D Wellhead Vacuum	VCS Air Flow	Wellhead Effluent PID	Knockout Tank Vacuum	Post Knockout Vacuum	Blower Influent Vacuum	Blower Influent Temperature	Blower Effluent Pressure	Blower Effluent Temperature	Carbon Influent Pressure	Carbon Effluent PID
		VI-1 (iwc)	Hand Held/FM-1 (fpm)/(scfm)	ASP-1 (ppm)	VI-2 (iwc)	(iwc)	VI-3 (iwc)	TI-1 (F)	PI-1 (iwc)	TI-2 (F)	(iwc)	ASP-2 (ppm)
Baseline[5]		0.0013										
Steady State[8]	1:50 PM	-40.86	1441/NM	NM		-50	-60	50	20	144	8	NM
1 hr[6]	2:50 PM	-41.89	1431/NM	NM	-42	-52	-61	52	18	146	8	NM
2 hr	3:50 PM	-42.75	NM	NM	-42	-52	-61	54	18	154	8	NM
2 Hr Additional Points	3:50 PM	Same as above	Same as above	Same as above	Same as above	-52	Same as above	Same as above	Same as above	Same as above	8	Same as above
3 hr[3]	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
4 hr	5:55 PM	-42.74	NM	NM	-42	-52	-60	52	18	154	8	NM
Special - 100% with Manifold - 80 scfm[7]	*6:29 PM*	*-33.57*	*NM/80*	*NM*	*-61*	*-68*	*-72*	*52*	*10*	*172*	*4*	*NM*
5 hr / 75% Changed at 6:40 PM with Manifold - 54 scfm[7]	6:50 PM	-24.01	NM/54	NM	-39	-44	-48	52	24	140	12	NM
~6 hr / 50% Changed at 7:05 PM with Manifold - 49 scfm[7]	7:15 PM	-21.35	NM/49	NM	*-30*	-39	-40	52	28	132	*16*	NM

Initials:	PAR	Date: 3/23/07	(+/-)[2]
Barometric Pressure (inHg)	3:30 PM	30.17	-
Ambient Temperature (F)	1:53 PM	52.00	69% RH
Ambient Conditions	AM	Overcast, Still , Humid and Wet	
Ambient Conditions	1:45 PM	Raining	
Ambient Conditions	5:55 PM	Rain Ends	

% Dilution Valve opened at start of test	**None**
Total Volume of water collected from knockout tank	**0 Gallons**

Notes on last page

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Table A-2. Pneumatic Conductivity Test, Depressurization Well 1-Deep Field Monitoring Parameters, Northrop Grumman Operable Unit 3, Soil Gas IRM, Former Grumman Settling Ponds, Bethpage, New York.

Data Recording Interval	Time	Induced Vacuum Readings (iwc) Vacuum Points			
		VMWC-1	VMWC-2	VMWC-3	VMWC-4
		Radial Distance(1) 13 ft	Radial Distance(1) 28 ft	Radial Distance(1) 58 ft	Radial Distance(1) ~35 ft
		Depth D	Depth D	Depth D	Depth D
		(44-54 ft bls)	(44-45 ft bls)	(45-46 ft bls)	(44-45 ft bls)
Baseline(5)		-0.0115	+0.0135	-0.0288	-0.0628
Steady State (8)	1:50 PM	-4.678	-2.955	-1.593	-2.006
1 hr	2:50 PM	NM	NM	NM	NM
2 hr	3:50 PM	-4.386	-2.771	-1.475	-1.819
2 Hr Additional Points	3:50 PM	A / B / C -0.1244 / -0.1292 / -0.2029	A / X / C -0.1110 / X / -0.1209	A / B / C -0.0830 / -0.0839 / -0.0917	A / B / C -0.0956 / -1.096 / -0.1219
3 hr(3)	NM	NM	NM	NM	NM
4 hr	5:55 PM	-4.340	-2.694	-1.453	-1.754
Special - 100% with Manifold - 80 scfm	6:29 PM	-3.231	-2.096	-1.222	-1.428
5 hr / 75% Changed at 6:40 PM with Manifold - 54 scfm	7:02 PM	-2.327	-1.522	-0.8575	-1.031
~6 hr / 50% Changed at 7:05 PM with Manifold - 49 scfm	7:15 PM	-2.104	-1.368	-0.7999	-0.9273

Notes on last page

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Table A-2. Pneumatic Conductivity Test, Depressurization Well 1-Deep Field Monitoring Parameters, Northrop Grumman Operable Unit 3, Soil Gas IRM, Former Grumman Settling Ponds, Bethpage, New York.

Data Recording Interval	Time	Induced Vacuum Readings (iwc) VAC Points – Monitoring Wells (if applicable): BCP-MW-4-1 Screened (45-65)	MW - ___	MW - ___	Water Level Measurements – Monitoring Wells (if applicable): DW-1D Screened (42-47) DTW	VMWC-1D Screened (44-54) DTW	BCP-MW-4-1 Stick-up Screened (45-65) DTW	Comments
		(iwc)	(ft bmp)	(ft bmp)	(ft bmp)	(ft bls)	(ft bmp)	
Baseline[5]		-0.0695			Dry	53.6	56.6	Pull dedicated tubing from Well BCP-MW-4-1, and get shim to align well casing to get cap on for induced vacuum readings.
Steady State[8]	2:09 PM	-1.196				53.16	56.63	Weather Changed -1:45 PM Rain Start--
1 hr	2:50 PM	NM				NM	NM	Anemometer malfunction due to rain conditions -
2 hr	3:50 PM	-1.086				53.31	53.51	Data adjusted from 53.36 and 53.56 (JCs water level measurements are +0.05 from actual)
2 Hr Additional Points	3:50 PM	Same as above				Same as above	Same as above	
3 hr[3]	4:50 PM	NM				NM	NM	DW-1D and Carbon Effluent Air Samples taken.
4 hr	5:50 PM	-0.9032				NM	NM	Weather changed - Stopped Raining
Special - 100% with Manifold - 80 scfm	6:29 PM	*-0.7894*				53.33	56.62	
5 hr / 75% Changed at 6:40 PM with Manifold - 54 scfm	6:50 PM	-0.6211				53.42	56.61	Changed Flow at 6:40 PM readings taken at 6:50 PM.
~6 hr / 50% Changed at 7:05 PM with Manifold - 49 scfm	7:15 PM	-0.5486				53.42	56.65	Changed Flow at 7:05 PM readings taken at 7:15 PM.

Notes on last page

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Table A-2. Pneumatic Conductivity Test, Depressurization Well 1-Deep Field Monitoring Parameters,
Northrop Grumman Operable Unit 3, Soil Gas IRM, Former Grumman Settling Ponds, Bethpage, New York.

Notes:

(1) Radial Distances for VMWCs 1-4 are measured from DW-1D.
(2) + indicates increasing, - indicates decreasing
(3) Air samples were collected in 6-liter suma canister and submitted to Columbia Analytical Labs, Rochester, New York for TO-15 analysis; 24 Hr. TAT requested.
Pre-carbon sample was collected at 5:15 pm and post carbon effluent sample, for the entire PCT Test, was collected at 5:55 pm.
(4) Water was not generated during this event therefore, water sample was not collected or submitted for analysis.
(5) Initial measurement after start-up for wellhead vacuum.
(6) Velocity measured at 4"D well pipe with thermal anemometer, skid mounted Rotron flow meter malfunctioned.
(7) Hand held anemometer malfunctioned due to rain conditions after 1 Hr readings taken. Installed manifold with Dwyer flow meter and used in-line for 6:29pm - 7:15pm parameter readings.
(8) Test started at 1:45 PM readings stabilized 6 mins later.

DW	depressurization well
DTW	depth to water
fpm	feet per minute
ft. bls	feet below land surface
ft. bmp	feet below measuring point
in Hg	inches of mercury
iwc	inches of water column
PID	photoionization detector
ppm	parts per million
VCS	vapor control system
VMWC	vacuum monitoring well cluster

Table A-3. Pneumatic Conductivity Test, Depressurization Well 2-Shallow Field Monitoring Parameters, Northrop Grumman Operable Unit 3, Soil Gas IRM, Former Grumman Settling Ponds, Bethpage, New York.

Data Recording Interval	Time	DW-2S Wellhead Vacuum (8)	VCS Air Flow (9)	Wellhead Effluent PID	Knockout Tank Vacuum	Post Knockout Vacuum	Blower Influent Vacuum	Blower Influent Temperature	Blower Effluent Pressure	Blower Effluent Temperature	Carbon Influent Pressure	Carbon Effluent PID
		VI-1 (iwc)	Hand Held/FM-1 (fpm)/(scfm)	ASP-1 (ppm)	VI-2 (iwc)	(iwc)	VI-3 (iwc)	TI-1 (F)	PI-1 (iwc)	TI-2 (F)	(iwc)	ASP-2 (ppm)
Baseline[5]	~2:00 PM	-0.0058										
Steady State[10]	2:26 PM	-8.832	2461/304	7.8 & 0.0 [6]		NM	-39	62	31	120	NM	9-11 [6]
1 hr	3:41 PM	-8.79	2172/305	0.00-1.1	-10	NM	-39	49	30	124	NM	(7)
2 hr	4:35 PM	-8.86	2117/NM	0.1	-10	NM	-39	49	30	124	18	19.2
3 hr	5:35 PM	-8.854	2110/305	NM	-10	NM	-39	48	30	121	19.2	NM
4 hr [3]	6:25 PM	-8.867	1703/NM	NM	-10	NM	-39	42	30	120	18	NM
5 hr / 75% Changed at 7:00 PM	7:30 PM	-6.071	1232/NM	NM	-5	NM	-22	40	39	108	NM	NM
6 hr / 50% Changed at 7:40PM	8:11 PM	-5.504	1144/NM	NM	-4	NM	-19	40	40	107	NM	NM

Initials:	PAR	Date: 3/20/07	(+/-)[2]
Barometric Pressure (inHg)		30.39	(+) @ ~4PM
Ambient Temperature		48 F	--
Ambient Conditions		Dry & Cold	--

% Dilution Valve opened at start of test	**None**
Total Volume of water collected from knockout tank	**0 Gallons**

Notes on last page

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Table A-3. Pneumatic Conductivity Test, Depressurization Well 2-Shallow Field Monitoring Parameters, Northrop Grumman Operable Unit 3, Soil Gas IRM, Former Grumman Settling Ponds, Bethpage, New York.

Data Recording Interval	Time	Induced Vacuum Readings (iwc) Vacuum Points											
		VMWC-5			VMWC-6			VMWC-7			VMWC-8		
		Radial Distance(1) 10 ft			Radial Distance(1) 25 ft			Radial Distance(1) 50 ft			Radial Distance(1) 35 ft		
		Depth A (7-8 ft bls)	Depth B (15.2-19.2 ft bls)	Depth D (40-50 ft bls)	Depth A (8-9 ft bls)	Depth B (15-16 ft bls)	Depth D (39-40 ft bls)	Depth A (7-8 ft bls)	Depth B (14-15 ft bls)	Depth D (36-37 ft bls)	Depth A (7-8 ft bls)	Depth B (13-14 ft bls)	Depth D (35-36 ft bls)
Baseline(5)	~2:00 PM	-0.014	-0.0200	-0.143	-0.0167	-0.0181	-0.1460	-0.8898	-0.0102	-0.2009	-0.0223	-0.0207	-0.1572
Steady State(11)	2:26 PM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
1 hr	3:41 PM	-1.795	-1.912	-0.1207	-0.9466	-1.016	-0.1880	-0.3974	-0.4273	-0.1657	-0.8067	-0.8522	-0.1472
2 hr	4:35 AM	-1.807	-1.927	-0.1118	-0.9658	-1.018	-0.1702	-0.4177	-0.4319	-0.1953	-0.8130	-0.8467	-0.1532
3 hr	5:35 AM	-1.808	-1.938	-0.129	-0.9799	-1.025	-0.1660	-0.3936	-0.4367	-0.1637	-0.8077	-0.8540	-0.1312
4 hr (3)	6:25 PM	-1.821	-1.937	-0.1151	-0.9747	-1.028	-0.1374	-0.4040	-0.4441	-0.1496	-0.8194	-0.8684	-0.2099
5 hr / 75% Changed at 7:00 PM	7:30 PM	-1.297	-1.388	0.1991	-0.7075	-0.7345	-0.2160	-0.3039	-0.3061	-0.2370	-0.5784	-0.627	-0.1851
6 hr / 50% Changed at 7:40PM	8:11 PM	-1.197	-1.282	-0.2795	-0.6465	-0.6684	-0.2796	-0.2643	-0.2882	-0.2567	-0.5357	-0.5634	-0.2075

Notes on last page

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Table A-3. Pneumatic Conductivity Test, Depressurization Well 2-Shallow Field Monitoring Parameters, Northrop Grumman Operable Unit 3, Soil Gas IRM, Former Grumman Settling Ponds, Bethpage, New York.

Data Recording Interval	Time	Induced Vacuum Readings (iwc) Vacuum Points Monitoring Wells (if applicable)				Water Level Measurements Monitoring Wells (if applicable)			Comments
		MW - __	MW - __	MW - ___		DW-2S Screen (10-17)	VMWC-5B Screened (15.2-19.2)	MW -__	
						DTW	DTW	DTW	
		(ft bmp)	(ft bmp)	(ft bmp)		(ft bmp)	(ft bmp)	(ft bmp)	
Baseline(5)	2:15 PM					Dry	Dry		Wells Dry yesterday also, DTW on 5D yesterday was 49.24 ft bls.
Steady State(11)	2:26 PM						NM		Stack reading 68% RH and 71F 3:08 PM Carbon Effluent 64% RH 81.8F
1 hr	3:41 PM						NM		EFF PID Readings 17, 18, 25, 35, 39, 28; EFF PID Readings 6, 1.9, 0.1, 0.7, 0.1, 0.2, 0.0 EFF PID Readings 19, 32, 79, 119, 131, 153--
2 hr	4:35 AM						NM		
3 hr	5:35 AM						NM		5:48 PM Carbon Eff RH 22.8% and 96.2 F
4 hr (3)	6:25 PM						NM		
5 hr / 75% Changed at 7:00 PM	7:30 PM						NM		7 PM changed flow to 75% of Original
6 hr / 50% Changed at 7:40PM	8:11 PM						NM		7:40 PM changed flow to 50% of Original

Notes on last page

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Table A-3. Pneumatic Conductivity Test, Depressurization Well 2-Shallow Field Monitoring Parameters,
Northrop Grumman Operable Unit 3, Soil Gas IRM, Former Grumman Settling Ponds, Bethpage, New York.

Notes:

(1) Radial Distances for VMWCs 5-8 are measured from DW-2S.
(2) + indicates increasing, - indicates decreasing
(3) Air sample was collected in 6-liter suma canister and submitted to Columbia Analytical Labs, Rochester, New York for TO-15 analysis; 24 Hr. TAT requested. Pre-carbon sample was collected at test hour 4.
(4) Water was not generated during this event therefore, water sample was not collected or submitted for analysis.
(5) Initial measurement after start-up for wellhead vacuum.
(6) PID readings taken with 2 separate Minirae 2000 units and no correlation was observed. Unit # 3881 INF 7.8 Eff 83-85 Calibration gas check 116-118 ppm. Unit # 8708 INF 0.0ppm; EFF 7.1ppm; calibration gas check 91ppm. One PID unit was recalibrated, sample bags were left in field vehicle with the PID to normalize to stable temperature. Screened samples 30 mins later- results not stable (see note 7). Samples collected again and results varied largely, moisture determined to be one of the problems and meters not holding calibration, new minirae meters (11.7) ordered from another vendor.
(7) Measurement varied from 0-153 moisture problem from effluent of carbon RH >60%
(8) Wellhead temperature 46.2-46.4F with thermal anemometer; RH approx. 87% at 1 time during sampling. When probe from anemometer removed at end of day there was moisture beading on the probe.
(9) Velocity measured at 4"D well pipe with thermal anemometer (see note 8), skid mounted Rotron flow meter malfunctioned.
(10) Test started at 2:24 PM readings stabilized 2 mins later.

DW	depressurization well
DTW	depth to water
fpm	feet per minute
ft. bls	feet below land surface
ft. bmp	feet below measuring point
in Hg	inches of mercury
iwc	inches of water column
PID	photoionization detector
ppm	parts per million
VCS	vapor control system
VMWC	vacuum monitoring well cluster

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Table A-4. Pneumatic Conductivity Test, Depressurization Well 2-Deep Field Monitoring Parameters,
Northrop Grumman Operable Unit 3, Soil Gas IRM, Former Grumman Settling Ponds, Bethpage, New York.

Data Recording Interval	Time	DW-2D Wellhead Vacuum	VCS Air Flow	DW-2D Wellhead Temperature	Wellhead Effluent PID	Knockout Tank Vacuum	Post Knockout Vacuum	Blower Influent Vacuum	Blower Influent Temperature	Blower Effluent Pressure	Blower Effluent Temperature	Carbon Influent Pressure Approximate	Carbon Effluent PID
		VI-1 (iwc)	Hand Held/FM-1 (fpm)/(scfm)	(F)	ASP-1 (ppm)	VI-2 (iwc)	(iwc)	VI-3 (iwc)	TI-1 (F)	PI-1 (iwc)	TI-2 (F)	(iwc)	ASP-2 (ppm)
Baseline[5]	10:10 AM	-8.090		38.1									
Steady State [12]	10:55 AM	-11.13	2390/314	NM	NM	-12	-28	-40	52	30	138	18	NM
1 hr	12:18 PM	-11.06	2390/NM	NM	NM	-12	-30	-41	52	30	134	18	NM
2 hr	1:23 PM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
3 hr	1:57 PM	-11.12	2527/NM	56.3	NM	-12	-28	-41	50	30	132	18	NM
4 hr [3]	~3:00 PM	-11.08	2437/NM	55.4	0.0	-12	-29	-40	46	30	130	18	16.4
5 hr / 75% Changed at 4:12 PM	4:55 PM	-7.846	1754/285	54.8	NM	-7	-19	-24	44	38	NM	18-30	NM
6 hr / 50% Changed at 5:24 PM	~5:50 PM	-7.191	1564/265	55.7	NM	-6	-16	-22	42	40	110	20-32	NM

Initials:	PAR	Date: 03/21/07	(+/-)[2]
Barometric Pressure (inHg)		30.79 & 33% RH	(-) @ 9:22 am
Ambient Temperature		41.4 F	25.4% RH @ 11:58 am
Ambient Conditions		Cold, Sunny, Slight Breeze	

% Dilution Valve opened at start of test	**None**
Total Volume of water collected from knockout tank	**1 Quart**

Notes on last page

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Table A-4. Pneumatic Conductivity Test, Depressurization Well 2-Deep Field Monitoring Parameters, Northrop Grumman Operable Unit 3, Soil Gas IRM, Former Grumman Settling Ponds, Bethpage, New York.

Data Recording Interval	Time	Induced Vacuum Readings (iwc)					
		Vacuum Points					
		VMWC-5	VMWC-5	VMWC-5	VMWC-6	VMWC-6	VMWC-6
		Radial Distance[1] 13 ft	Radial Distance[1] 13 ft	Radial Distance[1] 13 ft	Radial Distance[1] 28 ft	Radial Distance[1] 28 ft	Radial Distance[1] 28 ft
		Depth A	Depth B	Depth D	Depth A	Depth B	Depth D
		(7-8 ft bls)	(15.2-19.2 ft bls)	(40-50 ft bls)	(8-9 ft bls)	(15-16 ft bls)	(39-40 ft bls)
Baseline[5]	8:50 AM	+0.0681	+0.0263	0.0061	-0.0188	-0.002	+0.0501
Steady State [12]	10:55 AM	-0.0065	0.0041	-3.498	-0.0079	-0.0074	-2.864
1 hr	12:18 PM	-0.0151 [9]	-0.0257	-3.477	-0.0095	-0.0105	-2.855
2 hr	1:23 PM	NM	NM	NM	NM	NM	NM
3 hr	1:57 PM	-0.0155	-0.0115 [6]	-3.406	-0.0147	+0.0023	-2.755
4 hr [3]	~3:20 PM	-0.0199	-0.0145	-3.392	-0.0105	+0.0015	-2.788
5 hr / 75% Changed at 4:12 PM	4:55 PM	-0.0162	-0.0008	-2.469	+0.0012	-0.0027	-2.009
6 hr / 50% Changed at 5:24 PM	~5:50 PM	-0.0084	-0.0112	-2.347	-0.0204	-0.0124	-1.928

Notes on last page

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Table A-4. Pneumatic Conductivity Test, Depressurization Well 2-Deep Field Monitoring Parameters, Northrop Grumman Operable Unit 3, Soil Gas IRM, Former Grumman Settling Ponds, Bethpage, New York.

Data Recording Interval	Time	Induced Vacuum Readings (iwc)					
		Vacuum Points					
		VMWC-7	VMWC-7	VMWC-7	VMWC-8	VMWC-8	VMWC-8
		Radial Distance[1] 53 ft	Radial Distance[1] 53 ft	Radial Distance[1] 53 ft	Radial Distance[1] ~35 ft	Radial Distance[1] ~35 ft	Radial Distance[1] ~35 ft
		Depth A	Depth B	Depth D	Depth A	Depth B	Depth D
		(7-8 ft bls)	(14-15 ft bls)	(36-37 ft bls)	(7-8 ft bls)	(13-14 ft bls)	(35-36 ft bls)
Baseline[5]	9:26 AM	-0.0124	+0.0002 [8]	-0.0319	+0.0089	+0.0117	+0.0071
Steady State [12]	10:55 AM	-0.0164	-0.0187	-2.193	-0.0273	-0.0148	-2.613
1 hr	12:18 PM	-0.006	-0.0006 [7]	-2.163	-0.020	-0.0181	-2.600
2 hr	1:23 PM	NM	NM	NM	NM	NM	NM
3 hr	1:57 PM	-0.0013	-0.0019	-2.063	-0.0116	-0.0119	-2.475
4 hr [3]	~3:35 PM	-0.0120	-0.0184	-2.08	-0.0004	-0.0019	-2.556
5 hr / 75% Changed at 4:12 PM	4:55 PM	-0.0039	-0.0238	-1.498	-0.0099	-0.0101	-1.845
6 hr / 50% Changed at 5:24 PM	~5:50 PM	-0.0016	-0.012	-1.432	-0.0143	-0.0072	-1.783

Notes on last page

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Table A-4. Pneumatic Conductivity Test, Depressurization Well 2-Deep Field Monitoring Parameters, Northrop Grumman Operable Unit 3, Soil Gas IRM, Former Grumman Settling Ponds, Bethpage, New York.

Data Recording Interval	Time	Induced Vacuum Readings (iwc) Vacuum Points Monitoring Wells (if applicable)				Water Level Measurements Monitoring Wells (if applicable)			Comments
		MW -__	MW -__	MW -___		DW-2D Screen (27-47)	VMWC5-D Screen (40-50)	MW -___	
						DTW	DTW	DTW	
		(ft bmp)	(ft bmp)	(ft bmp)		(ft bls)	(ft bls)	(ft bls)	
Baseline	8:50 AM					Dry	NM		9:15 am calls from GWTT to troubleshoot skid system FM - run system start close influent valve Note: FM SCFM actually increased. 10:02 AM reading at DW-2D +0.0239 prior to start-up.
Steady State (12)	12:11 PM					Dry	49.9		
1 hr	12:18 PM						NM		
2 hr	1:23 PM						NM		Unable to take readings phone calls to office discussion of readings/vendor calls regarding FM. Jen Gasho 610-692-5650.
3 hr	1:57 PM						NM		Moisture Build-up on well head anemometer
4 hr (3)	~3:56 PM						NM		Vacuum Gauge for air sample was borrowed from IRM work - location SGP 11A 7.5-8 ft @ 1450.
5 hr / 75% Changed at 4:12 PM	4:55 PM						Dry		Carbon influent pressure indicator needle bouncing vigorously during reading.
6 hr / 50% Changed at 5:24 PM	~5:50 PM						NM		Carbon influent pressure indicator needle bouncing vigorously during reading. Barb on Effluent of well left open from 5 Hr reading until before VMWC-8 (last) readings.

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Table A-4. Pneumatic Conductivity Test, Depressurization Well 2-Deep Field Monitoring Parameters, Northrop Grumman Operable Unit 3, Soil Gas IRM, Former Grumman Settling Ponds, Bethpage, New York.

Notes:

(1) Radial Distances for VMWCs 5-8 are measured from DW-2D.
(2) + indicates increasing, - indicates decreasing
(3) Air sample was collected in 6-liter suma canister and submitted to Columbia Analytical Labs, Rochester, New York for TO-15 analysis; 24 Hr. TAT requested. Pre-carbon sample was collected at test hour 4.
(4) One water sample was collected from the moisture separator at the end of the test and was submitted (on 3/26) to Columbia Analytical Labs, Rochester, New York for VOC Analysis (ASP 2000) TO-15 analysis; 2 week TAT requested.
(5) Initial measurement after start-up for wellhead vacuum.
(6) Barb found loose on 5B during this reading
(7) Readings varied +0.0010, -0.0153, +0.0034, -0.0081, 0.0146
(8) Reading varying from - to +.
(9) Readings varied -0.0152, -0.0174, -0.0147, -0.0203, -0.0230
(10) Vacuum Gauge for air sample was borrowed from IRM work - location SGP 11A 7.5-8 ft @ 1450.
(11) Carbon effluent end of day (5:38 PM) 91.8F and 21.0% RH.
(12) Test started at 10:10 AM readings stabilized approximately 42 mins later.

DW depressurization well
DTW depth to water
fpm feet per minute
ft. bls feet below land surface
ft. bmp feet below measuring point
in Hg inches of mercury
iwc inches of water column
PID photoionization detector
ppm parts per million
VCS vapor control system
VMWC vacuum monitoring well cluster

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Table A-5. Pneumatic Conductivity Calculation Summary Table, Northrop Grumman Operable Unit 3, Soil Gas IRM, Former Grumman Settling Ponds Bethpage, New York.

Pneumatic Conductivity [1,2]

Depressurization Well					Depressurization Well				
DW-1S [3]					DW-2S [4]				
Between	VMWC-1C	and	VMWC-2C	1.35×10^{-4}	Between	VMWC-5B	and	VMWC-6B	3.15×10^{-5}
Between	VMWC-1C	and	VMWC-3C	8.00×10^{-5}	Between	VMWC-5B	and	VMWC-7B	3.36×10^{-5}
Between	VMWC-2C	and	VMWC-3C	5.43×10^{-5}	Between	VMWC-6B	and	VMWC-7B	3.70×10^{-5}
			Average:	8.98×10^{-5}				Average:	3.41×10^{-5}
DW-1S [3]					DW-2S [4]				
Between	VMWC-1C	and	VMWC-4C	7.95×10^{-5}	Between	VMWC-5B	and	VMWC-8B	3.66×10^{-5}
Between	VMWC-2C	and	VMWC-4C	3.75×10^{-5}	Between	VMWC-6B	and	VMWC-8B	6.58×10^{-5}
Between	VMWC-4C	and	VMWC-3C	8.16×10^{-5}	Between	VMWC-8B	and	VMWC-7B	2.62×10^{-5}
			Average:	6.62×10^{-5}				Average:	4.29×10^{-5}
DW-1D [3]					DW-2D [4]				
Between	VMWC-1D	and	VMWC-2D	1.38×10^{-5}	Between	VMWC-5D	and	VMWC-6D	1.68×10^{-5}
Between	VMWC-1D	and	VMWC-3D	1.52×10^{-5}	Between	VMWC-5D	and	VMWC-7D	1.42×10^{-5}
Between	VMWC-2D	and	VMWC-3D	1.70×10^{-5}	Between	VMWC-6D	and	VMWC-7D	1.19×10^{-5}
			Average:	1.53×10^{-5}				Average:	1.43×10^{-5}
DW-1D [3]					DW-2D [4]				
Between	VMWC-1D	and	VMWC-4D	1.12×10^{-5}	Between	VMWC-5D	and	VMWC-8D	1.57×10^{-5}
Between	VMWC-2D	and	VMWC-4D	6.82×10^{-6}	Between	VMWC-6D	and	VMWC-8D	1.27×10^{-5}
Between	VMWC-4D	and	VMWC-3D	5.00×10^{-5}	Between	VMWC-8D	and	VMWC-7D	1.15×10^{-5}
			Average:	2.27×10^{-5}				Average:	1.33×10^{-5}

cm/s -centimeters per second
DW -depressurization well
VMWC -vapor monitoring well cluster

Notes:

1. Pneumatic conductivity values shown based on data collected during test conducted the week of March 19, 2007. Data interpreted using "Soil Vapor Extraction System Design Calculation Method" by ARCADIS.
2. Units are in cm/s.
3. Pneumatic conductivity calculated using air flow measurements collected with a variable area flow meter.
4. Pneumatic conductivity calculated using air flow measurements collected with a hand-held anemometer.

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Table A-5. Pneumatic Conductivity Calculation Summary Table, Northrop Grumman Operable Unit 3, Soil Gas IRM, Former Grumman Settling Ponds Bethpage, New York.

Evaluation of Pneumatic Conductivity Test Data Depressurization Well 1S with Manifold (Variable Area Flowmeters),

Factor of Safety on Flow =	1	Based on pilot test data.
Acceleration due to Gravity	980	cm/sec^2

Parameter	Value	Units	Basis
Input Parameters			
Air Flow	-94	scfm	Flow is Negative for Vacuum; Air flow reading from VA meters during 100% flow with manifold in line.
Distance From Vacuum Well to Inner Point	10.00	feet	Inner Point = VMWC-1C
Distance From Vacuum Well to Outer Point	25.00	feet	Outer Point = VMWC-2C
Vadose Zone Thickness	15.00	feet	Screened Interval
Vacuum at Inner Point(1C)	0.29420	in. H2O	Vacuum reading at 7 hrs.
Vacuum at Outer Point(2C)	0.24000	in. H2O	Vacuum reading at 7 hrs.
Output Parameters			
Air Flow	-96.94	ft^3/min	Assumes temp 52F blower inlet temp; P=P
Air Mass Flow (Q)	-57.15	grams/sec	Assumes air density = 1.25 g/L
Distance From Vacuum Well to Inner Point	304.80	cm	
Distance From Vacuum Well to Outer Point	762.00	cm	
Vadose Zone Thickness	457.20	cm	
Vacuum at Inner Point	732.26	grams/cm-sec^2	
Vacuum at Outer Point	597.36	grams/cm-sec^2	
Pressure Drop Over Interval	134.90	grams/cm-sec^2	
Pneumatic Conductivity (Kair)	**1.35E-04**	**sec**	
	1.32E-01	**cm/s**	Kair * g
Effective Air Permeability (kair)	**1.88E-05**	**cm^2**	
Intrinsic Permeability (kint)	**2.58E-05**	**cm^2**	Assumes fraction of soil volume occupied by water is equal to 10% of the porosity
Hydraulic Conductivity (Kwater)	**1.81E+00**	**cm/s**	

$$Q(b, ER) = \frac{ER \cdot \pi \cdot (b^2 - a^2) \cdot h \cdot \eta \cdot \rho_{air}}{1440 \cdot 60}$$

$ER = Pore\_Volume\_Exchange\_Rate\_(g/\sec)$

$b = Radial\_Dis\tan ce\_to\_Outter\_Monitoring\_Po\text{int}\_(cm)$

$a = Radia\_Dis\tan ce\_to\_Inner\_Monitoring\_Po\text{int}\_(cm)$

$h = Vadose\_Zone\bar{}Thickness$

$b = Dis\tan ce\_From\_Vacuum\_to\_Outter\_Monitoring\_Po\text{int}\ (ft)$

$$k_{air} = \frac{K_{air} \cdot \mu_{air}}{\rho_{air} \cdot g}$$

$\mu_{air} = Vis\cos ity\_Air\_10^{o}C$

$\rho_{air} = Density\_Air\_10^{o}C$

$g = Acceleration\_due\_to\_gravity$

$$k_{\text{int}} = \frac{k_{air}}{\left(n - S_w/n\right)^3}$$

$n = Porosity$

$S_w = Fraction\_of\_soil\_volume\_occupied\_by\_water$

$$K_{water} = \frac{k_{\text{int}} \cdot \rho_{water} \cdot g}{\mu_{water}}$$

$\rho_{water} = Density\_Water\_10^{o}C$

$g = Acceleration\_due\_to\_gravity$

$\mu_{water} = Vis\cos ity\_Water\_10^{o}C$

Table A-6. Summary of Vapor Analytical Results, Pneumatic Conductivity Test, Northrop Grumman Operable Unit 3, Soil Gas IRM, Former Grumman Settling Ponds, Bethpage, New York.

CONSTITUENT (ug/m3)	Site ID: / Sample ID: / Sample Date:	DW-2S PCT ASP-1 3/20/2007	DW-2D DW-2D INF 3/21/2007	DW-1S DW1S 3/22/2007	DW-1D DWID 3/23/2007	Carbon Effluent Day 4 (1) DWID-C EFF 3/23/2007
Volatile Organic Compounds						
1,1,1-Trichloroethane		**1.4**	**59**	**54**	**88**	< 800
1,1,2,2-Tetrachloroethane		< 0.15	< 1.3	< 4.1	< 4.2	< 200
1,1,2-Trichloroethane		< 0.6	< 5.3	< 16	< 17	< 800
1,1-Dichloroethane		< 0.45	< 3.9	< 12	< 12	< 590
1,1-Dichloroethlene		**1.5**	< 3.9	< 12	**18**	< 580
1,2-Dichloroethane		< 0.45	< 3.9	< 12	< 12	< 590
1,2-Dichloropropane		< 0.51	< 4.5	< 14	< 14	< 680
1,3-Butadiene		< 0.49	< 4.3	< 13	< 14	< 650
2-Butanone		**35 D**	**49**	**47**	**42**	< 860
4-Methyl-2-Pentanone		< 0.9	< 8	< 24	< 25	< 1200
Acetone		**8.4**	< 11	< 32	< 33	**11,000 J**
Benzene		< 0.35	< 3.1	< 9.5	< 9.8	< 470
Bromodichloromethane		< 0.15	< 1.3	< 4	< 4.1	< 200
Bromomethane		< 0.43	< 3.8	< 12	< 12	< 570
Carbon Disulfide		< 0.34	< 3	< 9.2	< 9.5	< 460
Carbon Tetrachloride		< 0.14	< 1.2	**31**	**40**	< 180
CFC-11		**1.1**	**32**	< 17	< 17	< 820
Freon 113		**0.46**	**4.8**	**17**	**45**	< 220
Chlorobenzene		< 0.51	< 4.5	< 14	< 14	< 670
Chlorodibromomethane		< 0.19	< 1.7	< 5.1	< 5.2	< 250
Chloroethane		< 0.58	< 5.1	< 16	< 16	< 770
Chloroform		**0.68**	< 4.8	< 14	**22**	< 710
Chloromethane		< 0.45	< 4	< 12	< 13	< 600
cis-1,2-Dichloroethene		**630 D**	**83**	**130**	**36**	< 580
cis-1,3-Dichloropropene		< 1	< 8.9	< 27	< 28	< 1300
Dichloromethane		< 0.38	< 3.4	< 10	< 11	< 510
Ethylbenzene		< 0.95	< 8.5	< 26	< 27	< 1300
m,p-Xylenes		**2.3**	< 17	**68**	< 53	< 2500
Methyl n-Butyl Ketone		< 0.45	< 4	< 12	< 13	< 600
Methyl tert-Butyl Ether		< 0.79	< 7	< 21	< 22	**85,000 D**
Methylbenzene		**1.5**	< 3.7	**59**	< 12	< 550
o-Xylene		**1.1**	< 8.5	**28**	< 27	< 1300
Styrene		< 0.94	< 8.3	< 25	< 26	< 1200
Tetrachloroethene		**9.5**	**25**	**44**	**83**	< 200
trans-1,2-Dichloroethene		< 0.44	< 3.9	< 12	< 12	< 580
trans-1,3-Dichloroethene		< 0.5	< 4.4	< 13	< 14	< 660
Tribromomethane		< 1.1	< 10	< 31	< 32	< 1500
Trichloroethlene		**140 D**	**390**	**840**	**1,600 D**	< 160
Vinyl Chloride		**3.1**	< 5	**28**	**33**	< 750
Total VOCs (2)		**836.04**	**642.8**	**1,346**	**2,007**	**96,000**

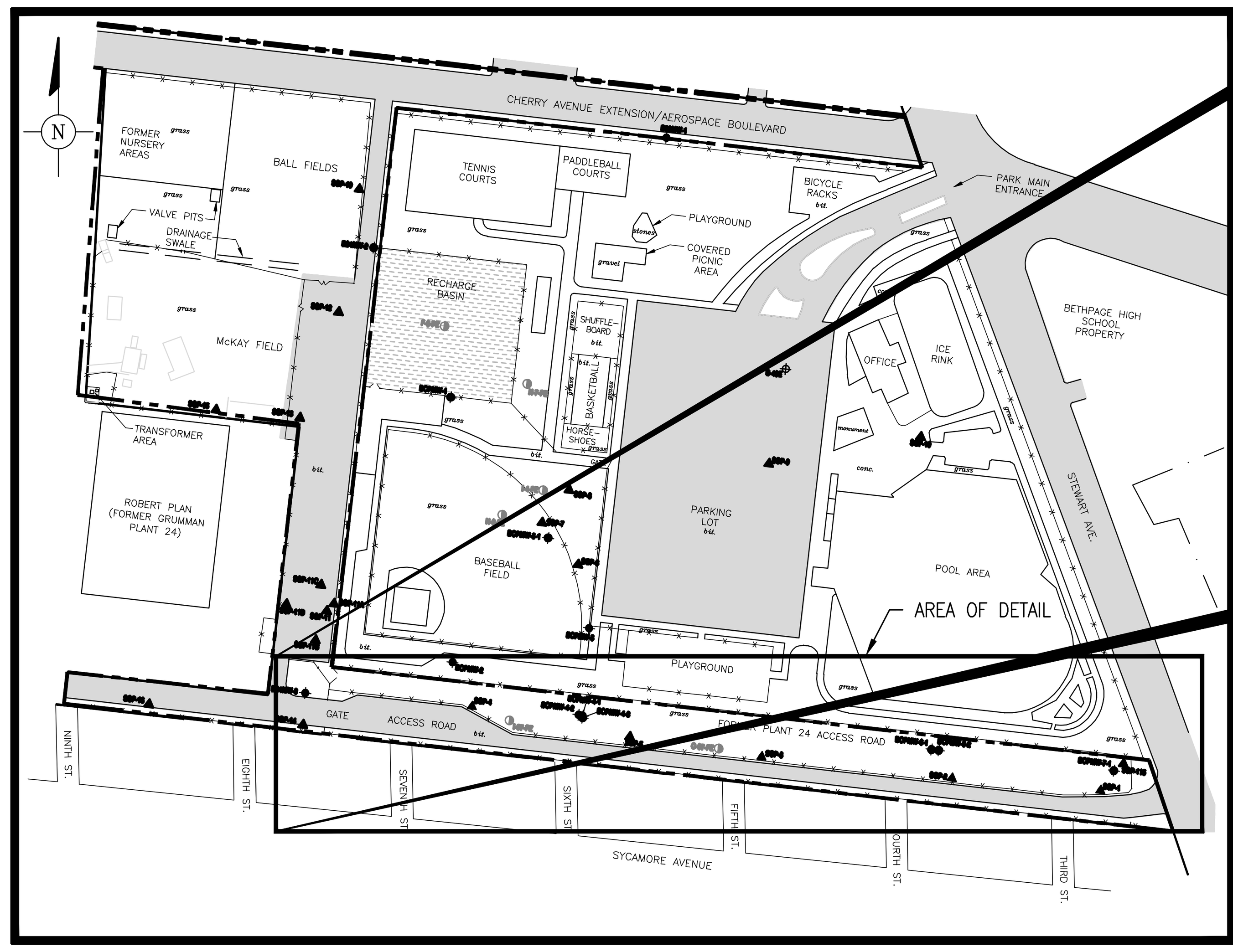
Notes on last page.

Table A-6. Summary of Vapor Analytical Results, Pneumatic Conductivity Test, Northrop Grumman Operable Unit 3, Former Grumman Settling Ponds, Bethpage, New York.

Bold	-detected compound
<	-less than MDL
ASP	-air sample port
C EFF	-effluent from vapor extraction pilot system carbon
D	-concentrations identified from analysis of the sample at a secondary dilution
DW	-depressurization well
INF	-influent to vapor extraction pilot system
J	-estimated value
PCT	-pneumatic conductivity test
ug/m3	-microgram per meter cubed
VOCs	-volatile organic compounds

Notes:

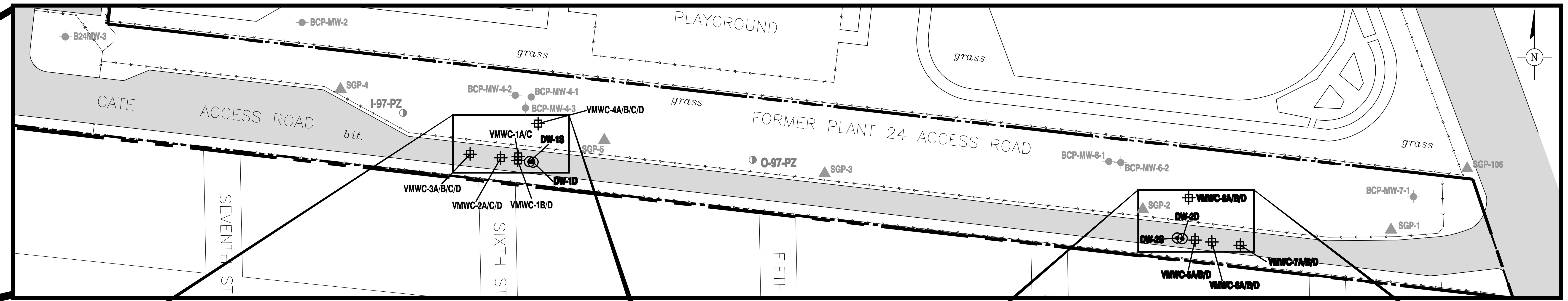
1. Analytical results for system carbon effluent are not consistent with system influents and are attributable to regenerated carbon supplied by vendor.
2. "Total VOCs" represents the sum of individual concentrations of constituents listed in this table.



SITE PLAN

0 200' 400'

SCALE IN FEET



AREA OF DETAIL–
FORMER PLANT 24
ACCESS ROAD

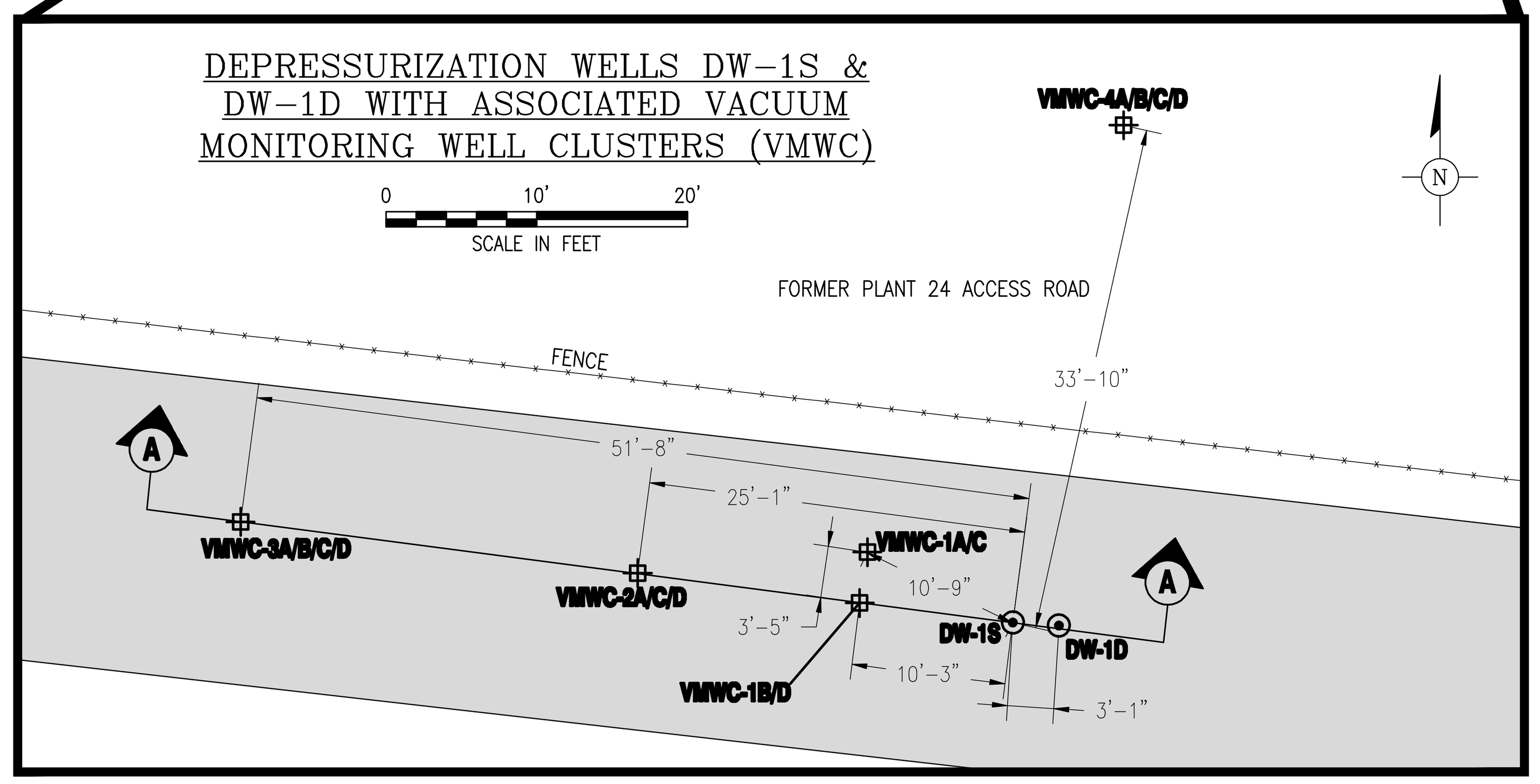
0 60' 120'

SCALE IN FEET

DEPRESSURIZATION WELLS DW–1S & DW–1D WITH ASSOCIATED VACUUM MONITORING WELL CLUSTERS (VMWC)

0 10' 20'

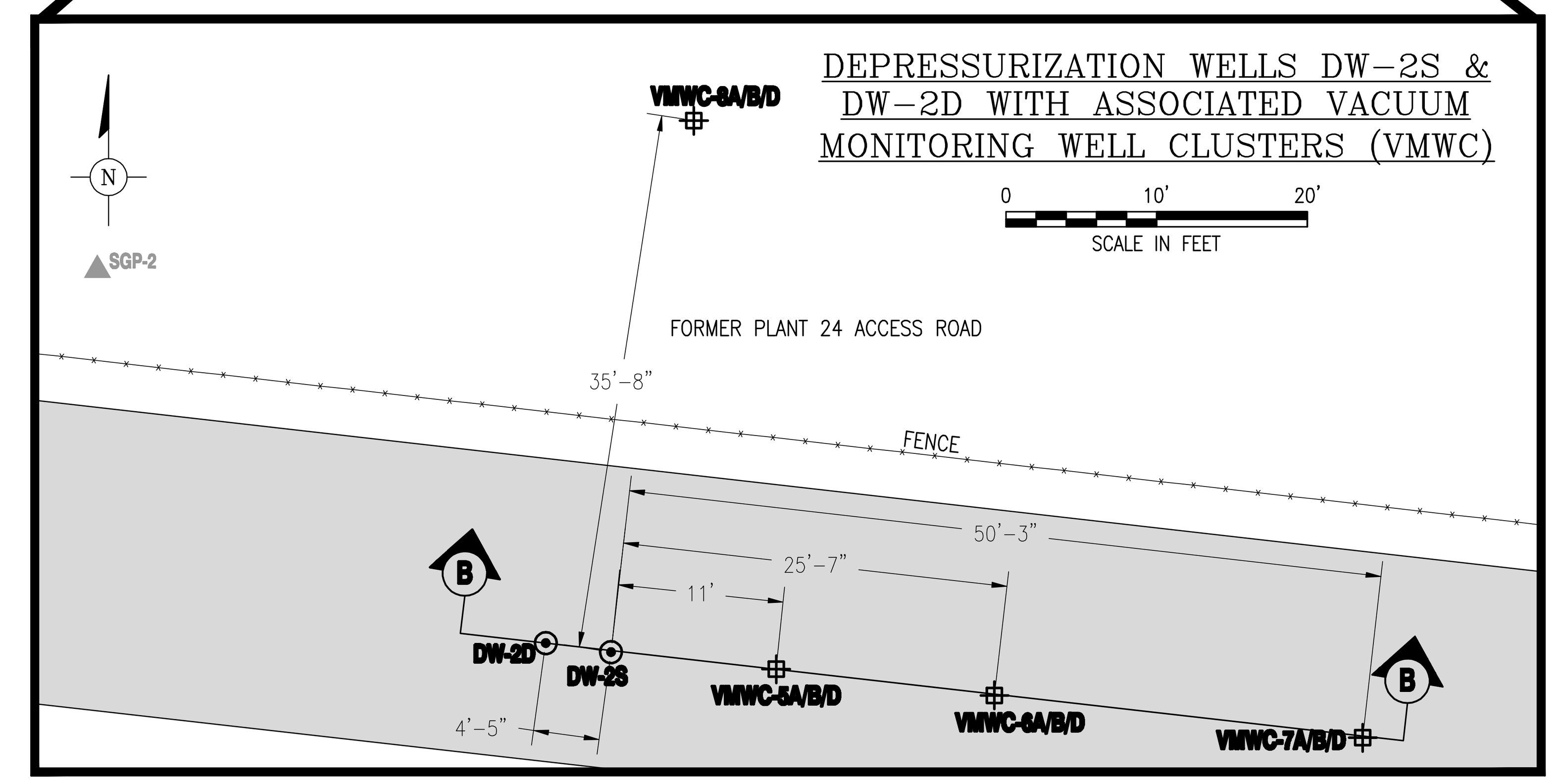
SCALE IN FEET



DEPRESSURIZATION WELLS DW–2S & DW–2D WITH ASSOCIATED VACUUM MONITORING WELL CLUSTERS (VMWC)

0 10' 20'

SCALE IN FEET

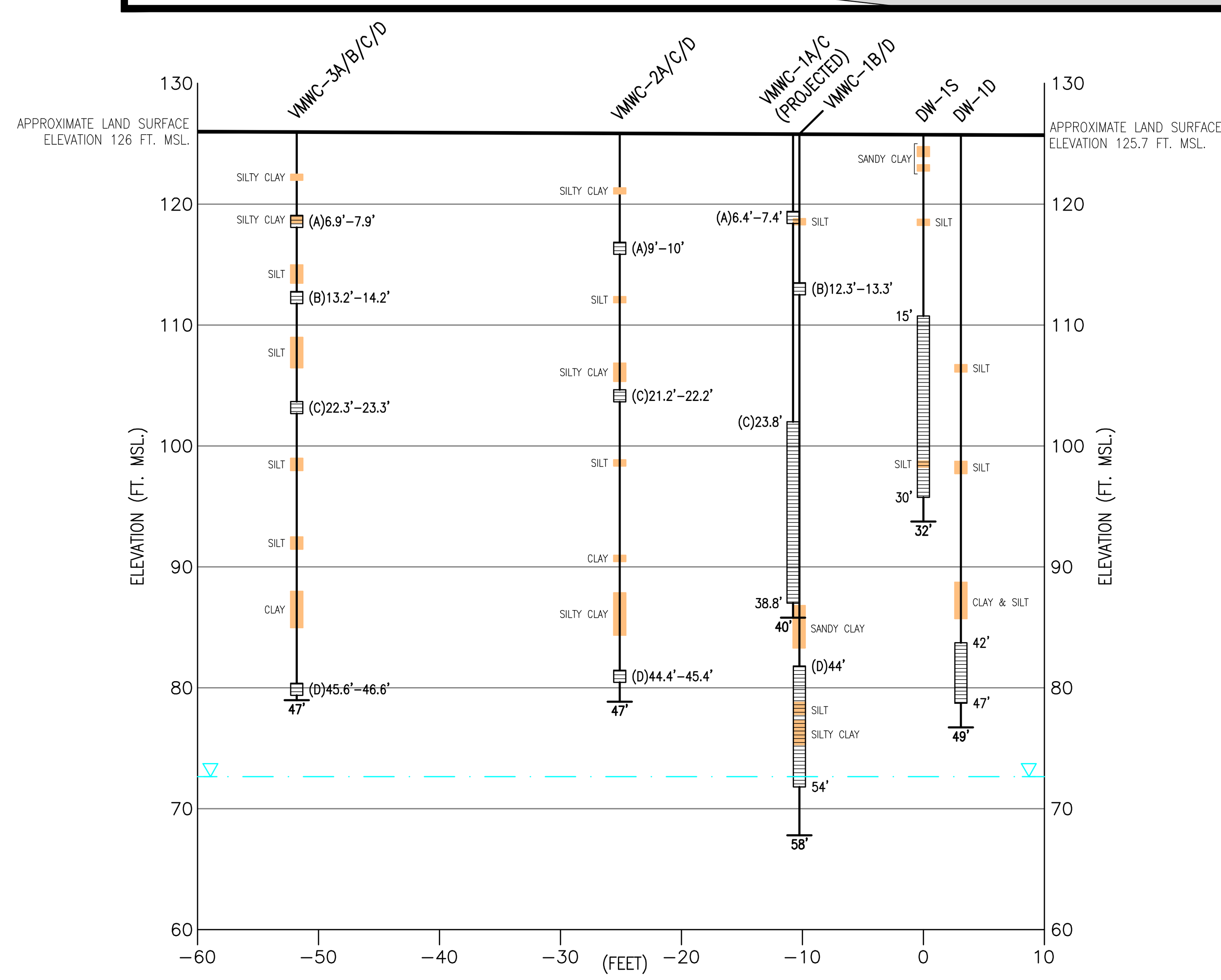


LEGEND:

	NORTHROP GRUMMAN PROPERTY LINE
	FENCE
	LIMITS OF BETHPAGE HIGH SCHOOL MAIN BUILDING
bit.	BITUMINOUS PAVEMENT
SGP-1	TEMPORARY SOIL GAS POINT INSTALLED DURING OU–3 REMEDIAL INVESTIGATION
BCP-MW-4-2	EXISTING MONITORING WELLS
O-97-PZ	EXISTING PIEZOMETER
DW-1S	DEPRESSURIZATION WELL (DW)
VMWC-6A/B/D	VACUUM MONITORING WELL CLUSTER (VMWC)

NOTES:

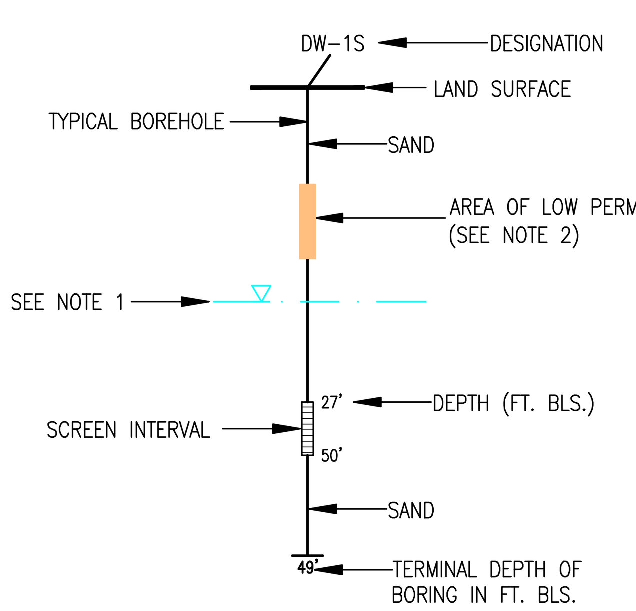
1. WATER TABLE ESTIMATE WAS OBTAINED DURING PNEUMATIC CONDUCTIVITY TEST FROM LOCATIONS VMWC–1D AND VMWC–5D ON MARCH 22, 2007.
2. LOW PERMEABILITY ZONES (CLAY, SILT, SILTY CLAY AND SANDY CLAY) WITH A THICKNESS GREATER THAN 6–INCHES ARE SHOWN.
3. TEMPORARY SOIL GAS LOCATIONS ARE BASED ON FIELD MEASUREMENTS AND ARE APPROXIMATE.
4. LOCATION OF MONITORING WELLS, PIEZOMETERS, DEPRESSURIZATION WELLS AND VACUUM MONITORING WELLS BASED ON MULTIPLE SURVEYS PROVIDED BY NELSON & POPE ENGINEERS AND SURVEYORS.



CROSS–SECTION A–A

HORIZONTAL SCALE: 1"=10'
VERTICAL SCALE: 1"= 10'

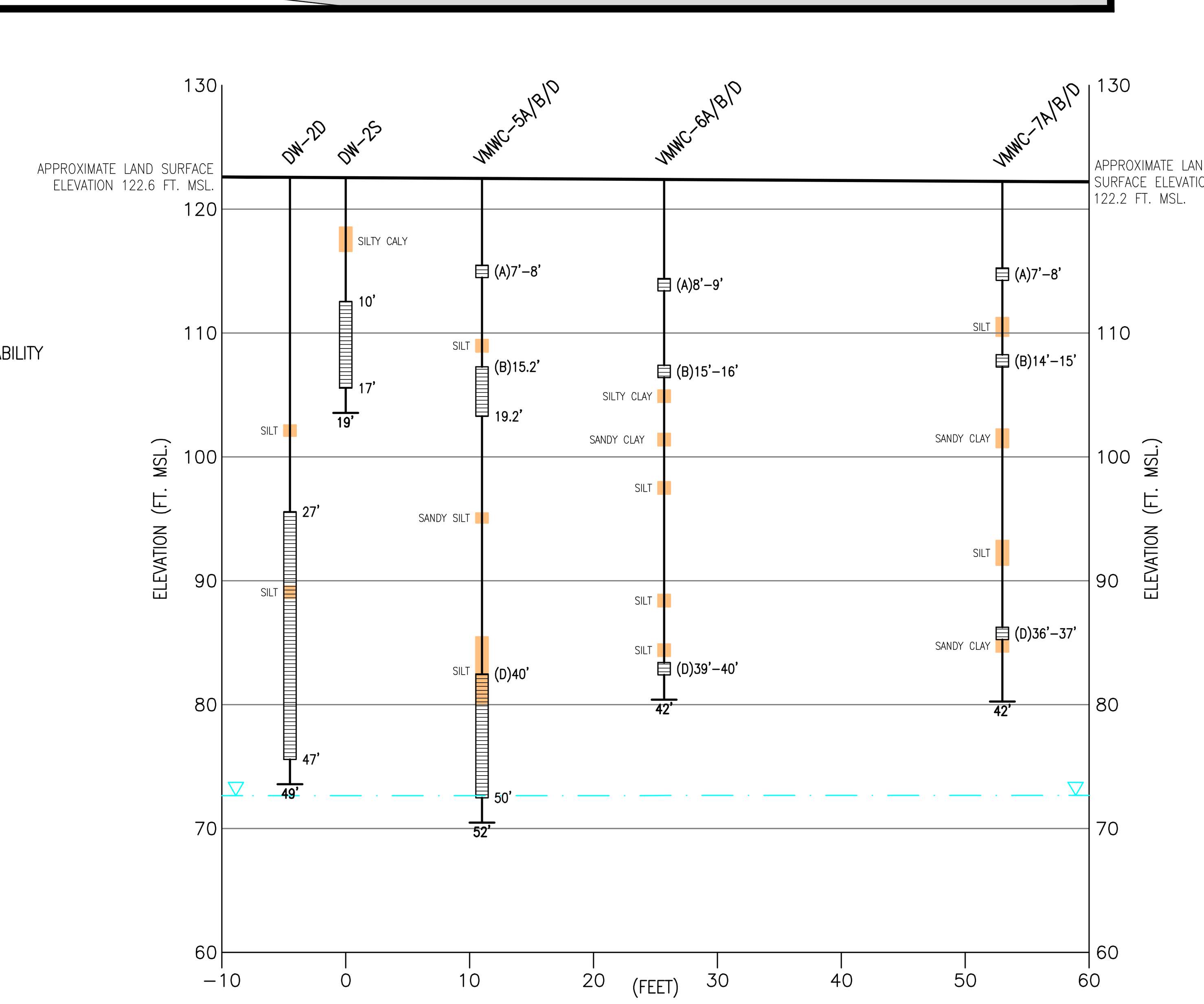
EXPLANATION



DEFINITIONS:
FT. BLS. – FEET BELOW LAND SURFACE

SCREEN INTERVALS FOR WELLS NOT DISPLAYED

	VMWC–4		VMWC–8
A	6–7 FT.	A	7.4–8.4 FT.
B	12.3–13.3 FT.	B	13–14 FT.
C	21.3–22.3 FT.	C	–
D	44–45 FT.	D	35–36 FT.



CROSS–SECTION B–B

HORIZONTAL SCALE: 1"=10'
VERTICAL SCALE: 1"= 10'

NO.	ISSUED DATE	REVISION DESCRIPTION	BY/CKD
0	07/2007	50 – 75% DESIGN SUBMITTAL	PR

KEYPLAN

SEAL

KYRIACOS PIERIDES, PH.D. P.E.
N.Y. LIC. NO. 073670

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PROJECT TITLE

NORTHROP GRUMMAN OPERABLE UNIT 3
SOIL GAS INTERIM REMEDIAL MEASURE
FORMER GRUMMAN SETTLING PONDS
BETHPAGE, NEW YORK

PROJECT MANAGER: C. SAN GIOVANNI
DEPARTMENT MANAGER: C. TUOHY
LEAD DESIGN PROF.: C. TUOHY
CHECKED BY: K. ZEGEL
TASK/PHASE NUMBER: 00004
DRAWN BY: A. SANCHEZ
PROJECT NUMBER: NY001464.1407

SHEET TITLE

AS BUILT
PNEUMATIC CONDUCTIVITY
TEST LOCATIONS AND
WELL CONFIGURATIONS

FIGURE

A-1

Acad Version : R17.0s (LMS Tech) Date\Time : Wed, 01 Aug 2007 – 5:37pm
User Name : alsanchez Path\Name : G:\APROJECT\Northrop Grumman\Superfund\2007\OU3\NY001464.1407 VCS IRM\VCS Desig–Const\50–75% Design\Cadd\Final Drawings\Client_50–75%\As-built_DW Layout.dwg
Current Plotstyle : ByColor

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Appendix B

Design Calculations

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Table B-1. Data Evaluation for Depressurization Well DW-1S, Pneumatic Conductivity Test, Northrop Grumman Operable Unit 3, Soil Gas IRM, Former Grumman Settling Ponds, Bethpage, New York.

Assumptions -

Well Screen Length (feet) -	15
Well Diameter (feet) -	0.33
Formation Porosity (v/v) -	0.25
Percent Moisture (%) -	10%

Distance-Vacuum Relationships -

Distance (Feet)	Observed/Calculated Vacuum (IWC) '@ Air Flow (SCFM)					
	250 SCFM	210 SCFM	200 SCFM	150 SCFM	**94 SCFM**	82 SCFM
10	-0.81	-0.68	-0.65	-0.49	**-0.29**	-0.27
25	-0.56	-0.47	-0.45	-0.34	**-0.24**	-0.18
35	-0.47	-0.40	-0.38	-0.28	**-0.17**	-0.16
55	-0.35	-0.29	-0.28	-0.21	**-0.12**	-0.12
70	-0.29	-0.24	-0.23	-0.17	-0.11	-0.09
85	-0.23	-0.20	-0.19	-0.14	-0.09	-0.08
100	-0.19	-0.16	-0.15	-0.11	-0.07	-0.06
115	-0.15	-0.13	-0.12	-0.09	-0.06	-0.05
130	-0.12	-0.10	-0.10	-0.07	-0.04	-0.04
145	-0.09	-0.08	-0.07	-0.05	-0.03	-0.03
160	-0.06	-0.05	-0.05	-0.04	-0.02	-0.02
175	-0.04	-0.03	-0.03	-0.02	-0.01	-0.01
190	-0.02	-0.01	-0.01	-0.01	-0.01	-0.01
205	0.00	0.00	0.00	0.00	0.00	0.00

Data Analysis -

Parameter	Value @ Air Flow (SCFM)					
	250	210	200	150	**94**	82
R^2	NA	NA	NA	NA	0.938092222	NA
Slope	0.620337699	0.521083667	0.496270159	0.372202619	0.233246975	0.203470765
y-intercept	-1.430648793	-1.201744986	-1.144519035	-0.858389276	-0.537923946	-0.469252804
Maximum ROI (Feet)	202	202	202	202	202	202
Observed Well Efficiency (%)	NA	NA	NA	NA	22%	NA
Design Parameters -						
Desired Minimum Vacuum (IWC)	0.1	0.1	0.1	0.1	0.1	0.1
ROI @ Minimum Vacuum (feet)	140	130	127	109	75	65
Pore Volume Exchange (per day)	1.74	1.68	1.68	1.71	2.24	2.61
Pore Volume Exchange (per week)	12.19	11.79	11.74	11.99	15.71	18.29
Required Wellhead Vacuum (IWC)	-6.553	-5.505	-5.243	-3.932	**-2.464**	-2.149

Notes/Formulas -

1. Values in BOLD represent field data. Values in regular font represent calculated values based on distance-drawdown relationship.
2. Field data used is from Depth C for each location during Hr 7 VCS Test on 3/22/07.
3. Maximum ROI (feet) based on minimum ROI during VCS Test.
4. Boxed solid line values represent selected design assumptions for all wells except DW-7S.
5. Boxed dotted line values represent selected design assumption for well DW-7S.

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Table B-1. Data Evaluation for Depressurization Well DW-1S, Pneumatic Conductivity Test, Northrop Grumman Operable Unit 3, Soil Gas IRM, Former Grumman Settling Ponds, Bethpage, New York.

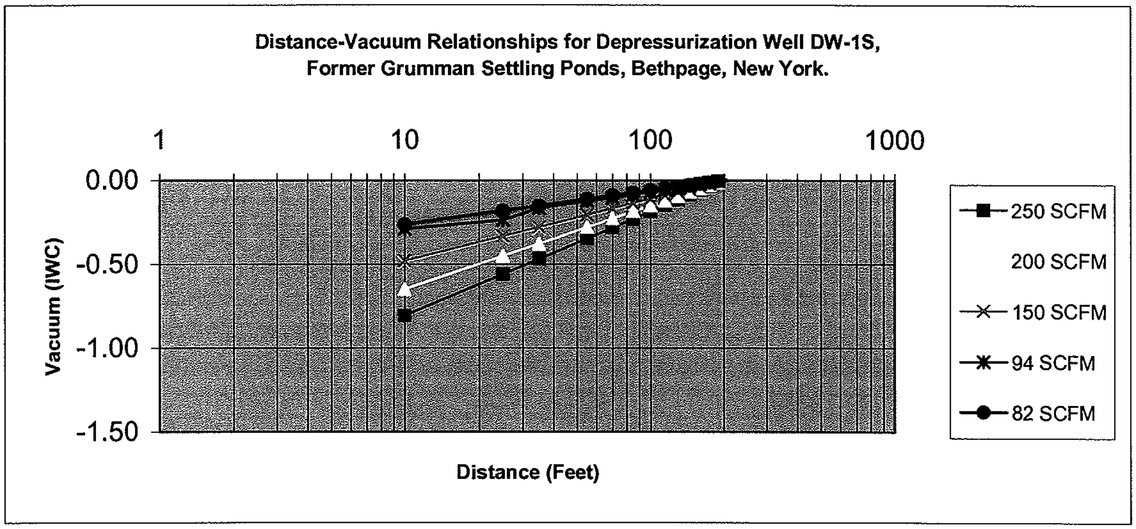

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Table B-2. Data Evaluation for Depressurization Well DW-2S, Pneumatic Conductivity Test, Northrop Grumman Operable Unit 3, Soil Gas IRM, Former Grumman Settling Ponds, Bethpage, New York.

Assumptions -

Well Screen Length (feet) -	7
Well Diameter (feet) -	0.33
Formation Porosity (v/v) -	0.25
Percent Moisture (%) -	10%

Distance-Vacuum Relationships -

Distance (Feet)	Observed/Calculated Vacuum (IWC) @ Air Flow (SCFM)						
	250 SCFM	200 SCFM	**146 SCFM**	**105 SCFM**	**98 SCFM**	66 SCFM	45 SCFM
10	-3.24	-2.60	**-1.94**	**-1.39**	**-1.28**	-0.86	-0.58
25	-1.83	-1.46	**-1.03**	**-0.73**	**-0.67**	-0.48	-0.33
35	-1.31	-1.05	**-0.87**	**-0.63**	**-0.56**	-0.35	-0.24
50	-0.76	-0.61	**-0.44**	**-0.36**	**-0.29**	-0.20	-0.14
53	-0.67	-0.54	-0.41	-0.32	-0.26	-0.18	-0.12
56	-0.59	-0.47	-0.36	-0.29	-0.23	-0.15	-0.11
59	-0.51	-0.40	-0.32	-0.26	-0.20	-0.13	-0.09
61	-0.45	-0.36	-0.29	-0.23	-0.18	-0.12	-0.08
64	-0.38	-0.30	-0.24	-0.20	-0.15	-0.10	-0.07
67	-0.31	-0.25	-0.20	-0.18	-0.12	-0.08	-0.06
70	-0.24	-0.19	-0.16	-0.15	-0.10	-0.06	-0.04
73	-0.18	-0.14	-0.12	-0.12	-0.07	-0.05	-0.03
76	-0.12	-0.09	-0.09	-0.10	-0.05	-0.03	-0.02
79	-0.06	-0.04	-0.05	-0.07	-0.02	-0.01	-0.01
81	-0.02	-0.01	-0.03	-0.06	-0.01	0.00	0.00
82	0.00	0.00	-0.02	-0.05	0.00	0.00	0.00
84	0.04	0.03	0.00	-0.03	0.02	0.01	0.01
87	0.09	0.07	0.04	-0.01	0.04	0.02	0.02
88	0.11	0.09	0.05	0.00	0.04	0.03	0.02
90	0.15	0.12	0.07	0.01	0.06	0.04	0.03

Data Analysis -

Parameter	'Value @ Air Flow (SCFM)						
	250	200	**146**	**105**	**98**	66	45
R^2	NA	NA	0.990491182	0.989758068	0.990417317	NA	NA
Slope	3.551931862	2.84154549	2.086797	1.447112903	1.39235729	0.937710012	0.63934774
y-intercept	-6.79608222	-5.436865776	-4.012268706	-2.818408033	-2.66406423	-1.794165706	-1.2232948
Maximum ROI (Feet)	82	82	84	89	82	82	82
Observed Well Efficiency (%)	NA	NA	45%	46%	48%	NA	NA

Design Parameters -

	250	200	**146**	**105**	**98**	66	45
Desired Minimum Vacuum (IWC)	0.1	0.1	0.1	0.1	0.1	0.1	0.1
ROI @ Minimum Vacuum (feet)	77	76	75	76	69	64	57
Pore Volume Exchange (per day)	12.34	10.20	7.56	5.35	5.92	4.68	4.01
Pore Volume Exchange (per week)	86.41	71.41	52.95	37.43	41.42	32.75	28.08
Required Wellhead Vacuum (IWC)	-14.555	-11.644	**-8.867**	**-6.071**	**-5.504**	-3.843	-2.620

Notes/Formulas -

1. Values in BOLD represent field data. Values in regular font represent calculated values based on distance-drawdown relationship.
2. Field data used is from Depth B for each location during Hrs 4, 5 & 6 of VCS Test on 3/20/07.
3. Maximum ROI (feet) based on minimum ROI during VCS Test.
4. Boxed values represent selected design assumptions.

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Table B-2, Data Evaluation for Depressurization Well DW-2S, Pneumatic Conductivity Test, Northrop Grumman Operable Unit 3, Soil Gas IRM, Former Grumman Settling Ponds, Bethpage, New York.

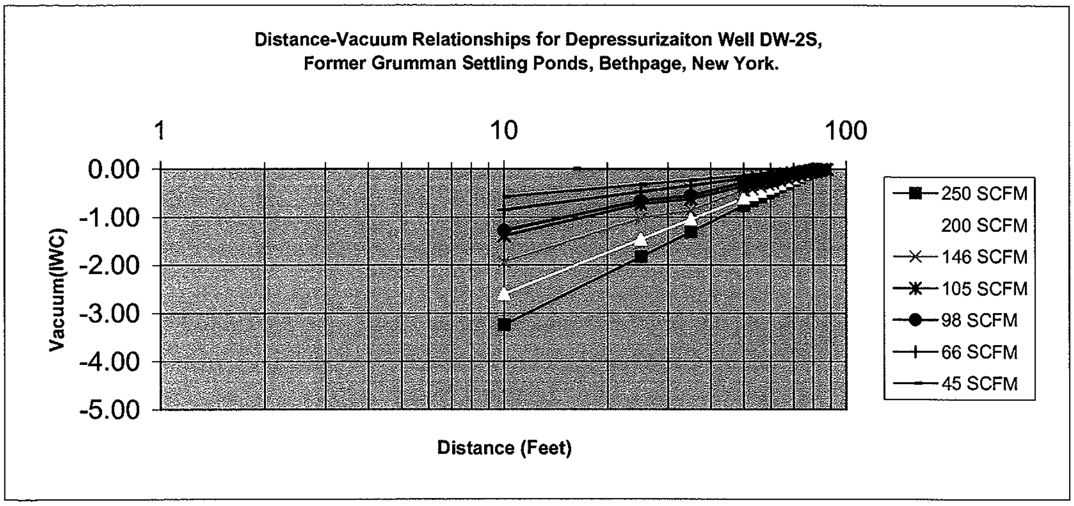

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Table B-3. Data Evaluation for Depressurization Well DW-1D, Pneumatic Conductivity Test, Northrop Grumman Operable Unit 3, Soil Gas IRM, Former Grumman Settling Ponds, Bethpage, New York.

Assumptions -

Well Screen Length (feet) -	5
Well Diameter (feet) -	0.33
Formation Porosity (v/v) -	0.25
Percent Moisture (%) -	10%

Distance-Vacuum Relationships -

Distance (Feet)	Observed/Calculated Vacuum (IWC) @ Air Flow (SCFM)						
	150 SCFM	125 SCFM	**80 SCFM**	75 SCFM	**54 SCFM**	**49 SCFM**	9 SCFM
13	-6.31	-5.26	**-3.23**	-3.16	**-2.327**	**-2.104**	-0.38
28	-4.12	-3.43	**-2.096**	-2.06	**-1.522**	**-1.37**	-0.25
35	-3.48	-2.90	**-1.428**	-1.74	**-1.031**	**-0.97**	-0.21
58	-2.03	-1.69	**-1.222**	-1.02	**-0.86**	**-0.80**	-0.12
60	-1.94	-1.61	-0.98	-0.97	-0.70	-0.66	-0.12
65	-1.71	-1.42	-0.87	-0.85	-0.61	-0.59	-0.10
70	-1.49	-1.25	-0.77	-0.75	-0.54	-0.52	-0.09
75	-1.30	-1.08	-0.67	-0.65	-0.47	-0.46	-0.08
80	-1.11	-0.93	-0.58	-0.56	-0.40	-0.40	-0.07
85	-0.94	-0.78	-0.49	-0.47	-0.34	-0.34	-0.06
90	-0.78	-0.65	-0.41	-0.39	-0.28	-0.29	-0.05
95	-0.62	-0.52	-0.33	-0.31	-0.22	-0.24	-0.04
100	-0.47	-0.40	-0.26	-0.24	-0.17	-0.19	-0.03
105	-0.33	-0.28	-0.19	-0.17	-0.12	-0.15	-0.02
110	-0.20	-0.17	-0.13	-0.10	-0.07	-0.11	-0.01
115	-0.07	-0.06	-0.07	-0.04	-0.03	-0.07	0.00
118	0.00	0.00	-0.03	0.00	0.00	-0.04	0.00
120	0.05	0.04	-0.01	0.02	0.02	-0.03	0.00
123	0.12	0.10	0.03	0.06	0.04	-0.01	0.01

Data Analysis -

Parameter	Value @ Air Flow (SCFM)						
	150	125	**80**	75	**54**	**49**	9
R^2	NA	NA	0.940732079	NA	0.946706321	0.954016295	NA
Slope	6.587099	5.489248847	3.249772292	3.293549308	2.371355502	2.095750227	0.395225917
y-intercept	-13.64863249	-11.37386041	-6.762151323	-6.824316244	-4.913507696	-4.386003595	-0.818917949
Maximum ROI (Feet)	118	118	120	118	118	124	118
Observed Well Efficiency (%)	NA	NA	20%	NA	20%	21%	NA
Design Parameters -							
Desired Minimum Vacuum (IWC)	0.1	0.1	0.1	0.1	0.1	0.1	0.1
ROI @ Minimum Vacuum (feet)	114	113	112	110	107	111	66
Pore Volume Exchange (per day)	4.70	3.98	2.59	2.52	1.92	1.62	0.84
Pore Volume Exchange (per week)	32.93	27.83	18.12	17.66	13.42	11.35	5.91
Required Wellhead Vacuum (IWC)	-66.958	-55.799	**-33.570**	-33.479	**-24.010**	**-21.350**	-4.018

Notes/Formulas -

1. Values in BOLD represent field data. Values in regular font represent calculated values based on distance-drawdown relationship.
2. Field data used is from Depth D for each location during Hrs 4, 5 & 6 (all with Manifold) of VCS Test on 3/20/07.
3. Maximum ROI (feet) based on minimum ROI during VCS Test.
4. Boxed solid line values represent selected design assumptions for all wells except DW-7D.
5. Boxed dotted line values represent selected design assumption for well DW-7D.

Table B-3. Data Evaluation for Depressurization Well DW-1D, Pneumatic Conductivity Test, Northrop Grumman Operable Unit 3, Soil Gas IRM, Former Grumman Settling Ponds, Bethpage, New York.

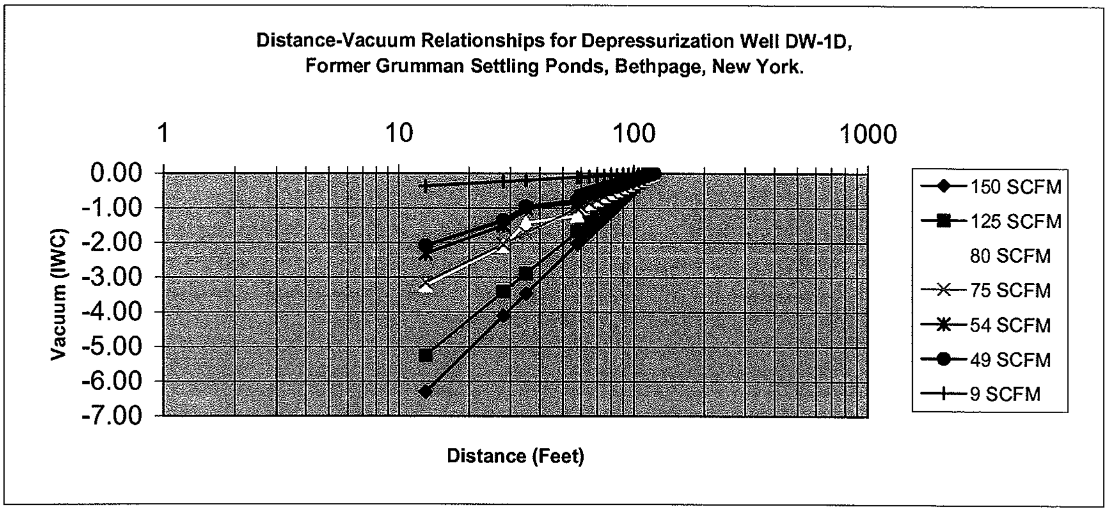

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Table B-4. Data Evaluation for Depressurization Well DW-2D, Pneumatic Conductivity Test, Northrop Grumman Operable Unit 3, Soil Gas IRM, Former Grumman Settling Ponds, Bethpage, New York.

Assumptions -

Well Screen Length (feet) -	20
Well Diameter (feet) -	0.33
Formation Porosity (v/v) -	0.25
Percent Moisture (%) -	10%

Distance-Vacuum Relationships -

Distance (Feet)	Observed/Calculated Vacuum (IWC) @ Air Flow (SCFM)					
	219 SCFM	**158 SCFM**	**141 SCFM**	100 SCFM	75 SCFM	50 SCFM
13	**-3.39**	**-2.47**	**-2.35**	-1.58	-1.18	-0.79
28	**-2.79**	**-2.01**	**-1.93**	-1.25	-0.94	-0.62
35	**-2.56**	**-1.85**	**-1.78**	-1.15	-0.86	-0.58
53	**-2.08**	**-1.50**	**-1.43**	-0.97	-0.73	-0.49
100	-1.56	-1.11	-1.08	-0.70	-0.53	-0.35
150	-1.19	-0.83	-0.82	-0.53	-0.39	-0.26
200	-0.92	-0.64	-0.63	-0.40	-0.30	-0.20
250	-0.72	-0.48	-0.49	-0.31	-0.23	-0.15
300	-0.55	-0.36	-0.38	-0.23	-0.17	-0.11
350	-0.41	-0.25	-0.28	-0.16	-0.12	-0.08
400	-0.28	-0.16	-0.19	-0.10	-0.08	-0.05
450	-0.18	-0.08	-0.12	-0.05	-0.04	-0.03
500	-0.08	-0.01	-0.05	-0.01	-0.01	0.00
550	0.01	0.05	0.01	0.03	0.02	0.02

Data Analysis -

Parameter	Value @ Air Flow (SCFM)					
	219	**158**	**141**	100	75	50
R^2	0.98826527	0.990816361	0.985319298	NA	NA	NA
Slope	2.114664833	1.565801386	1.467744435	0.991013535	0.743260152	0.495506768
y-intercept	-5.786830742	-4.238438381	-4.011533974	-2.682555938	-2.011916953	-1.341277969
Maximum ROI (Feet)	545	509	541	509	509	509
Observed Well Efficiency (%)	52%	54%	56%	NA	NA	NA

Design Parameters -

Desired Minimum Vacuum (IWC)	0.1	0.1	0.1	0.1	0.1	0.1
ROI @ Minimum Vacuum (feet)	489	440	462	404	374	320
Pore Volume Exchange (per day)	0.09	0.08	0.07	0.06	0.05	0.05
Pore Volume Exchange (per week)	0.65	0.58	0.47	0.44	0.38	0.35
Required Wellhead Vacuum (IWC)	**-11.08**	**-7.846**	**-7.191**	-4.967	-3.725	-2.483

Notes/Formulas -

1. Values in BOLD represent field data. Values in regular font represent calculated values based on distance-drawdown relationship.
2. Field data used is from Depth D for each location during Hrs 3, 5 & 6 of VCS Test on 3/21/07.
3. Maximum ROI (feet) based on minimum ROI during VCS Test.
4. Boxed values represent selected design assumptions.

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Table B-4. Data Evaluation for Depressurization Well DW-2D, Pneumatic Conductivity Test, Northrop Grumman Operable Unit 3, Soil Gas IRM, Former Grumman Settling Ponds, Bethpage, New York.

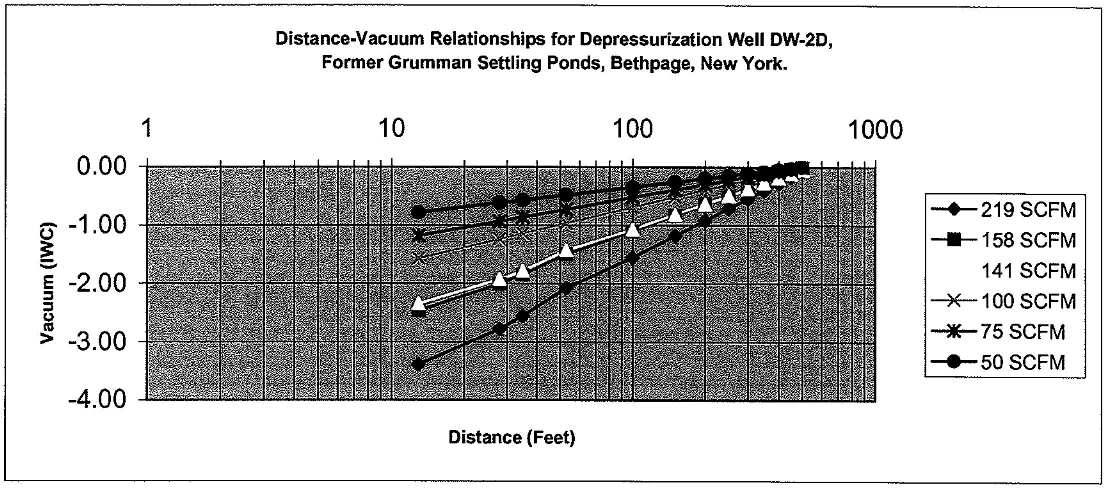

Table B-5. Individual Depressurization Pipe Sizing Preliminary Calculations, Northrop Grumman Operable Unit 3, Soil Gas IRM, Former Grumman Settling Ponds, Bethpage, New York.

Pressure Loss formula:

$$\Delta P = \left(\frac{0.0625Lv^2}{25{,}000*d} \right) / \ C$$

L	= length of pipe in feet
v	= velocity of air through pipe in feet per second
d	= inside diameter of pipe in inches
C	= Conversion (0.361 psi)
ΔP	= pressure loss in iwc

Well ID	Design Flow Rate (scfm)	Nominal Diameter (inches)	Effective Inside Diameter (inches)	Pipe Length (feet)	Velocity (ft/min)	Velocity (ft/s)	Pressure Loss (iwc)
DW-7D	9.0	2	2.078	350	382	6	0.473
DW-7S	82.0	3	3.063	370	1602	27	5.967
DW-3D	75.0	3	3.063	555	1466	24	7.488
DW-3S	150.0	4	3.938	560	1773	30	8.603
DW-5D	75.0	4	3.938	755	887	15	2.900
DW-5S	150.0	6	5.798	760	818	14	1.688
DW-6S	150.0	6	5.798	950	818	14	2.110
DW-6D	75.0	4	3.938	951	887	15	3.653
DW-1S	150.0	6	5.798	1142	818	14	2.536
DW-1D	75.0	4	3.938	1145	887	15	4.398
DW-4S	150.0	6	5.798	1335	818	14	2.964
DW-4D	75.0	4	3.938	1345	887	15	5.166
DW-8S	66.0	4	3.938	1485	780	13	4.417
DW-9S	66.0	4	3.938	1600	780	13	4.759
DW-2D	100.0	6	5.798	1710	545	9	1.688
DW-2S	66.0	4	3.938	1713	780	13	5.095
DW-10S	66.0	4	3.938	1828	780	13	5.437
DW-11S	66.0	4	3.938	1943	780	13	5.779

Notes and Abbreviations:

ft/s- feet per second
ft/min- feet per minute
iwc- inches of water column
psi- pounds per square inch
scfm - standard cubic feet per minute

1. This calculation sheet is for pipe sizing only.
2. Pipe size for individual wells based on maximum pressure loss of 10 iwc.

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Table B-6. Summary Table Schedule of Depressurization Wells for Northrop Grumman, Operable Unit 3 Soil Gas IRM , Former Grumman Settling Ponds, Bethpage, New York.

Shallow Wells

Western Leg	Radius (feet)	Flow (4) (scfm)	Screen (ft bls)	Well Head Req. Vac (iwc)
DW-7S	65	82	10-30	-2.149
DW-3S	109	150	10-30	-3.932

Southern Leg	Radius (feet)	Flow (4) (scfm)	Screen (ft bls)	Well Head Req. Vac (iwc)
DW-5S	109	150	15-30	-3.932
DW-6S	109	150	15-30	-3.932
DW-1S	109	150	15-30	-3.932
DW-4S(2)	109	150	15-30	-3.932
DW-8S	64	66	10-17	-3.843
DW-9S	64	66	10-17	-3.843
DW-2S	64	66	10-17	-3.843
DW-10S	64	66	10-17	-3.843
DW-11S	64	66	10-17	-3.843

Total for 11 Shallow wells 1,162 scfm
Safety factor 30%
1,511 scfm

Deep Wells

Western Leg	Radius (feet)	Flow (4) (scfm)	Screen (ft bls)	Well Head Req. Vac (iwc)
DW-7D	66	9	30-50	-4.018
DW-3D	110	75	30-50	-33.479

Southern Leg	Radius (feet)	Flow (4) (scfm)	Screen (ft bls)	Well Head Req. Vac (iwc)
DW-5D	110	75	42-47	-33.479
DW-6D	110	75	42-47	-33.479
DW-1D	110	75	42-47	-33.479
DW-4D(3)	110	75	42-47	-33.479
DW-2D	404	100	27-47	-4.967

Total for 7 Deep wells 484 scfm
Safety factor 30%
629 scfm

ft bls - feet below land surface
iwc - inches water column
scfm - standard cubic feet per minute

Notes:
1. Shallow and deep well radii based on design minimum vacuum of 0.1 iwc.
2. Shallow screen design 15 feet based on data collected during nearby CPT at location VP-4.
3. Deep well screen design 5 feet due to data collected during nearby CPT at location VP-4.
4. Flow estimated in scfm some measurements recorded using anemometer in fpm and calculated, pressures negligible and temperature near 55.5° F.

Table B-7. 50 to 75 Percent Design Criteria for Blower Selection, Northrop Grumman Operable Unit 3, Soil Gas IRM, Former Grumman Settling Ponds, Bethpage, New York.

Design Parameter	Blower ID: Units	BL-200	BL-300	BL-400
Maximum Wellhead Vacuum	IWC	-33.48	-3.93	-3.93
Maximum Belowgrade Pipe Vacuum Loss	IWC	-10.00	-10.00	-10.00
Maximum Abovegrade Pipe Vacuum Loss	IWC	-10.00	-10.00	-10.00
Total Design Vacuum	IWC	**-53.48**	**-23.93**	**-23.93**
Pressure Loss Through Carbon	IWC	10.00	10.00	10.00
Maximum Abovegrade Pipe Pressure Loss	IWC	5.00	5.00	5.00
Total Design Pressure	IWC	**15.00**	**15.00**	**15.00**
Design Flowrate	SCFM	**629**	**756**	**756**

IWC - inches of water column
SCFM - standard cubic feet per minute

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Table B-8. Basis of Vapor Design Concentrations, Northrop Grumman Operable Unit 3, Soil Gas IRM, Former Grumman Settling Ponds, Bethpage, New York.

Individual Depressurization Well Design Concentrations

Depressurization Well ID:	DW-7S(1)	DW-7D(1)	DW-3S	DW-3D	DW-5S(1)	DW-5D(1)	DW-6S	DW-6D	DW-1S(3)	DW-1D(4)	DW-4S	DW-4D	DW-8S(1)	DW-9S(2)	DW-2S(5)	DW-2D(6)	DW-10S(1)	DW-11S
Screened:	(10-30)	(30-50)	(10-30)	(30-50)	(15-30)	(42-47)	(15-30)	(42-47)	(15-30)	(42-47)	(15-30)	(42-47)	(10-17)	(10-17)	(10-17)	(27-47)	(10-17)	(10-17)
Well Design Flow (scfm):	82	9	150	75	150	75	150	75	150	75	150	75	66	66	66	100	66	66
Well Design Flow (m3/min)	2.3	0.3	4.2	2.1	4.2	2.1	4.2	2.1	4.2	2.1	4.2	2.1	1.9	1.9	1.9	2.8	1.9	1.9
Design Basis:	SGP-11D	SGP-11D	SGP-11D	SGP-11D	SGP-11D	SGP-11D	SVP-4	SVP-4	DW-1S	DW-1D	SVP-3	SVP-3	SVP-3	DW-2S	DW-2S	DW-2D	SVP-1	SVP-1
CONSTITUENT (ug/m3) Sample ID:	19.5-20	44.5-45	19.5-20	44.5-45	19.5-20	44.5-45	SVP-4(15')	SVP-4(40')	DW1S	DWID INF	SVP-3(15')	SVP-3(40')	SVP-3(15')	PCT ASP-1	PCT ASP-1	DW-2D INF	SVP-1(15')	SVP-1(15')
Sample Date:	3/23/2007	3/22/2007	3/23/2007	3/22/2007	3/23/2007	3/22/2007	10/26/2004	10/26/2004	3/22/2007	3/23/2007	10/26/2004	10/26/2004	10/26/2004	3/20/2007	3/20/2007	3/21/2007	10/27/2004	10/27/2004
Depth:	19.5-20	44.5-45	19.5-20	44.5-45	19.5-20	44.5-45	15	40	15-30	42-47	15	40	15	10-17	10-17	27-47	15	15
Units:	(ug/m3)	(ug/m3)	(ug/m3)	(ug/m3)	(ug/m3)	(ug/m3)	(ug/m3)	(ug/m3)	(ug/m3)	(ug/m3)	(ug/m3)	(ug/m3)	(ug/m3)	(ug/m3)	(ug/m3)	(ug/m3)	(ug/m3)	(ug/m3)
Volatile Organic Compounds																		
1,1,1-Trichloroethane	320	37	320	37	320	37	71	<110	54	88	150	310	150	1.4	1.4	59	9.8	9.8
1,1-Dichloroethane	<66	3.3	<66	3.3	<66	3.3	19	<85	< 12	< 12	29	160	29	< 0.45	< 0.45	< 3.9	<2	<2
1,1-Dichloroethylene	<66	<1.2	<66	<1.2	<66	<1.2	<9.9	<83	< 12	18	<12	<40	<12	1.5	1.5	< 3.9	<2	<2
1,2-Dichloroethene	--	--	--	--	--	--	<9.9	<83	<24	<39	34	150	34	<2	<2	<2	<2	<2
1,3-Butadiene	<66	77	<66	77	<66	77	31	400	< 13	< 14	17	110	17	< 0.49	< 0.49	< 4.3	29	29
2,2,4-Trimethylpentane	--	--	--	--	--	--	<12	<98	NA	NA	<14	<47	<14	2.6	2.6	<2.3	<2.3	<2.3
Methyl ethyl ketone (2-Butanone)	<66	120	<66	120	<66	120	18	270	47	42	35	56	35	35	35	49	15	15
2-Hexanone	<66	15	<66	15	<66	15	<10	<86	< 12	< 13	<12	<41	<12	< 0.45	< 0.45	< 4	<2	<2
4-Methyl-2-Pentanone	<66	4.4	<66	4.4	<66	4.4	--	--	< 24	< 25	--	--	--	< 0.9	< 0.9	< 8	NA	NA
Acetone	<660	490	<660	490	<660	490	140	2100	< 32	< 33	330	570	330	8.4	8.4	< 11	240	240
Benzene	<66	46	<66	46	<66	46	45	640	< 9.5	< 9.8	22	83	22	< 0.35	< 0.35	< 3.1	27	27
Benzene, 1,2,4-trimethyl	--	--	--	--	--	--	<12	<100	NA	NA	<15	<49	<15	6.4	6.4	6.9	4.9	4.9
Methyl bromide (Bromomethane)	<66	1.5	<66	1.5	<66	1.5	<9.7	<82	< 12	< 12	<12	<39	<12	< 0.43	< 0.43	< 3.8	<1.9	<1.9
Carbon disulfide	<66	35	<66	35	<66	35	17	<65	< 9.2	< 9.5	78	65	78	< 0.34	< 0.34	< 3	18	18
Carbon tetrachloride	<66	1.8	<66	1.8	<66	1.8	<16	<130	31	40	<19	<63	<19	< 0.14	< 0.14	< 1.2	<3.1	<3.1
Chlorobenzene	<66	2.7	<66	2.7	<66	2.7	<12	100	< 14	< 14	<14	<46	<14	< 0.51	< 0.51	< 4.5	<2.3	<2.3
Chloroform	<66	4.2	<66	4.2	<66	4.2	<12	<100	< 14	22	<15	<49	<15	0.68	0.68	< 4.8	<2.4	<2.4
Methyl chloride(Chloromethane)	<66	2	<66	2	<66	2	<5.2	<43	< 12	< 13	<6.2	<21	<6.2	< 0.45	< 0.45	< 4	<1	<1
cis-1,2-Dichloroethylene	840	94	840	94	840	94	<9.9	<83	130	36	23	120	23	630	630	83	<2	<2
Cyclohexane	--	--	--	--	--	--	72	260	NA	NA	76	220	76	79	79	130	<1.7	<1.7
Ethylbenzene	--	--	--	--	--	--	12	<91	< 26	< 27	<13	<43	<13	< 0.95	< 0.95	< 8.5	7.8	7.8
Freon 113	<66	1.7	<66	1.7	<66	1.7	<19	<160	17	45	<23	<77	<23	0.46	0.46	4.8	<3.8	<3.8
m&p-Xylenes	<66	43	<66	43	<66	43	30	140	68	< 53	26	52	26	2.3	2.3	< 17	23	23
n-Heptane	--	--	--	--	--	--	82	290	NA	NA	45	110	45	53	53	130	40	40
n-Hexane	--	--	--	--	--	--	74	340	NA	NA	19	74	19	31	31	120	23	23
o-Xylene	<66	19	<66	19	<66	19	11	<91	28	< 27	<13	<43	<13	1.1	1.1	< 8.5	7.4	7.4
p-Dichlorobenzene	--	--	--	--	--	--	<15	<130	NA	NA	<18	<60	<18	11	11	NA	9	9
p-Ethyltoluene	--	--	--	--	--	--	<12	<100	NA	NA	<15	<49	<15	<2.5	<2.5	NA	5.9	5.9
Styrene	<66	3.2	<66	3.2	<66	3.2	<11	<89	< 25	< 26	<13	<43	<13	< 0.94	< 0.94	< 8.3	<2.1	<2.1
tert-Butyl alcohol	--	--	--	--	--	--	<76	<640	NA	NA	<91	<300	<91	<15	<15	39	18	18
Tetrachloroethylene	110	8.1	110	8.1	110	8.1	56	<140	44	83	81	160	81	9.5	9.5	25	55	55
Toluene	<66	65	<66	65	<66	65	64	570	59	< 12	45	110	45	1.5	1.5	< 3.7	41	41
trans-1,2-Dichloroethene	<66	4.3	<66	4.3	<66	4.3	<9.9	<83	< 12	< 12	13	40	13	< 0.44	< 0.44	< 3.9	<2	<2
Trichloroethylene	7,600	620	7,600	620	7,600	620	640	<110	840	1600	860	2500	860	140	140	390	24	24
Vinyl chloride	<66	<1.2	<66	<1.2	<66	<1.2	<6.4	<54	28	33	<7.7	<26	<7.7	3.1	3.1	< 5	<1.3	<1.3
Xylene (total)	--	--	--	--	--	--	42	150	<26	<43	27	52	27	40	40	56	31	31
Total VOCs:	8,870	1,698	8,870	1,698	8,870	1,698	1424	5260	1346	2007	1910	4942	1910	1057.9	1057.9	1092.7	631.7	631.7

Notes on next page

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Table B-8. Basis of Vapor Design Concentrations, Northrop Grumman Operable Unit 3, Soil Gas IRM, Former Grumman Settling Ponds, Bethpage, New York.

Notes:

--	not analyzed
ND	not detected
Bold	detected compound.
ug/m3	micrograms per meter cubed
<26	underlined and italic values were not analyzed for in subject sample, value taken from adjacent SGP locations.

(1) - Data based on nearby SGP new locations sampled in June 2007 may be more representative of actual constituents.
(2) - Data based on nearby PCT location.
(3) - Underlined and italic values for location DW-1S are from SGP-05 interval 34-34.5 ft for sampling conducted on 5/5/06.
(4) - Underlined and italic values for location DW-1D are from SGP-05 interval 49-49.5 ft for sampling conducted on 5/5/06.
(5) - Underlined and italic values for location DW-2S are from SGP-2 interval 15 ft for sampling conducted on 10/26/04.
(6) - Underlined and italic values for location DW-2D are from SGP-2 interval 40 ft for sampling conducted on 10/27/04.

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Table B-9. Summary of Vapor Design Concentrations and Mass Loading Rates, Northrop Grumman Operable Unit 3, Soil Gas IRM, Former Grumman Settling Ponds, Bethpage, New York.

CONSTITUENT (ug/m3)	Shallow Well System Design Concentration	Deep Well System Design Concentration	Total Influent Design Concentration	Shallow Well System Design Concentration	Deep Well System Design Concentration	Total Influent Design Concentration	Shallow Well System Design Mass Loading	Deep Well System Design Mass Loading	Total Influent Design Mass Loading
Units:	(ug/m3)	(ug/m3)	(ug/m3)	(ppbv)	(ppbv)	(ppbv)	(lbs/yr)	(lbs/yr)	(lbs/yr)
Volatile Organic Compounds									
1,1,1-Trichloroethane	150.7	86.0	131.6	26.77	15.28	23.39	5.74	1.37	7.10
1,1-Dichloroethane	7.8	25.9	13.1	1.88	6.19	3.15	0.30	0.41	0.71
1,1-Dichloroethylene	0.2	2.8	1.0	0.05	0.68	0.23	0.01	0.04	0.05
1,2-Dichloroethene	6.3	23.2	11.3	1.54	5.68	2.76	0.24	0.37	0.61
1,3-Butadiene	10.9	104.3	38.4	4.77	45.71	16.81	0.40	1.66	2.05
2,2,4-Trimethylpentane	0.3	0.0	0.2	0.07	0.00	0.05	0.01	0.00	0.01
Methyl ethyl ketone (2-Butanone)	21.3	106.6	46.4	7.01	35.03	15.24	0.78	1.69	2.48
2-Hexanone	0.0	4.9	1.4	0.00	1.17	0.34	0.00	0.08	0.08
4-Methyl-2-Pentanone	0.0	1.4	0.4	0.00	0.34	0.10	0.00	0.02	0.02
Acetone	111.3	574.7	247.6	45.41	234.47	101.00	4.10	9.12	13.23
Benzene	13.4	127.1	46.8	4.06	38.58	14.21	0.49	2.02	2.51
Benzene, 1,2,4-trimethyl	1.5	1.4	1.4	0.29	0.28	0.28	0.05	0.02	0.07
Methyl bromide (Bromomethane)	0.0	0.5	0.1	0.00	0.12	0.04	0.00	0.01	0.01
Carbon disulfide	19.0	21.6	19.8	5.92	6.72	6.15	0.71	0.34	1.06
Carbon tetrachloride	4.0	6.8	4.8	0.62	1.05	0.74	0.15	0.11	0.26
Chlorobenzene	0.0	16.4	4.8	0.00	3.45	1.01	0.00	0.26	0.26
Chloroform	0.1	4.8	1.5	0.02	0.95	0.29	0.00	0.08	0.08
Methyl chloride(Chloromethane)	0.0	0.7	0.2	0.00	0.31	0.09	0.00	0.01	0.01
cis-1,2-Dichloroethylene	378.1	72.2	288.1	92.42	17.65	70.43	14.06	1.15	15.20
Cyclohexane	33.6	101.2	53.5	9.45	28.51	15.06	1.23	1.61	2.84
Ethylbenzene	2.6	0.0	1.8	0.57	0.00	0.40	0.09	0.00	0.09
Freon 113	2.3	8.5	4.1	0.28	1.08	0.52	0.09	0.14	0.22
m&p-Xylenes	20.7	43.9	27.5	4.72	9.99	6.27	0.78	0.70	1.47
n-Heptane	30.9	88.8	47.9	7.30	21.01	11.34	1.13	1.41	2.54
n-Hexane	20.0	88.9	40.3	5.50	24.46	11.08	0.73	1.41	2.14
o-Xylene	6.1	6.2	6.2	1.39	1.42	1.40	0.23	0.10	0.33
p-Dichlorobenzene	2.6	0.0	1.8	0.41	0.00	0.29	0.09	0.00	0.09
p-Ethyltoluene	0.8	0.0	0.5	0.15	0.00	0.11	0.03	0.00	0.03
Styrene	0.0	1.1	0.3	0.00	0.24	0.07	0.00	0.02	0.02
tert-Butyl alcohol	2.3	8.1	4.0	0.74	2.58	1.28	0.08	0.13	0.21
Tetrachloroethylene	72.4	45.5	64.5	10.34	6.50	9.21	2.72	0.72	3.45
Toluene	29.7	126.7	58.2	7.64	32.60	14.98	1.11	2.01	3.12
trans-1,2-Dichloroethene	2.4	7.6	3.9	0.59	1.86	0.96	0.09	0.12	0.21
Trichloroethylene	2870.4	919.6	2296.8	517.76	165.87	414.29	109.32	14.60	123.92
Vinyl chloride	4.0	5.1	4.3	1.52	1.94	1.64	0.15	0.08	0.23
Xylene (total)	19.6	42.9	26.4	4.45	9.76	6.01	0.71	0.68	1.39
Total VOCs:	**3845**	**2676**	**3501**	**763.6**	**721.5**	**751.2**	**145.6**	**42.48**	**188.1**

Notes and Abbreviations:

-- Not Analyzed
ND Not Detected
Bold Detected compound
ug/m3 micrograms per meter cubed

$$\text{ppmv} = \frac{\text{mass removed}(\mu g)}{\text{air flow}(m^3)} \times \frac{0.0237}{\text{molecular weight}}$$

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Table B-10. Preliminary NYSDEC DAR-1 Annual Guidance Concentration Air Modeling Analysis, Northrop Grumman Operable Unit 3, Soil Gas IRM, Former Grumman Settling Ponds, Bethpage, New York.

Discharge Temperature	T	540	°R
Ambient Temperature	T_a	525	°R
Exit Flow	Q	2140	scfm
Stack Height	h_s	30	ft
Building Height	h_b	8	ft
Ratio of Heights	h_s/h_b	3.75	
Plume rise credit? $h_s/h_b > 1.5$?	(If no, $h_e=h_s$)	(If Yes, $h_e = h_s + 1.1\,(F_m)^{1/3}$)	
Momentum Flux	Fm = Ta/T * V2 * R2	n/a	ft^4/s^2
Effective Stack Height	h_e	30.0	ft
Reduction Factor? $2.5 > h_s/h_b > 1.5$?	RF	No, do not reduce impact	
Actual Annual Impact	C_a	$RF*6*Q_a/h_e^{2.25}$	
Mass Flow	Q_a	S lbs emitted for last 12 months	

fps: feet per second
scfm: standard cubic feet per minute
ug/m^3: micrograms per cubic meter
lb/yr: pounds per year
lb/hr: pounds per hour
ppb: parts per billion
°R = °F + 460

Notes/Assumptions:

1. The stack discharge temperature is 80 °F based on anticipated conditions.
2. The ambient temperature is estimated at 65 °F for design purposes.
3. AGC refers to the Annual Guideline Concentration as determined using the hand calculations in the DAR-1 AGC/SGC Tables dated December 22, 2003.

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Table B-10. Preliminary NYSDEC DAR-1 Annual Guidance Concentration Air Modeling Analysis, Northrop Grumman Operable Unit 3, Soil Gas IRM, Former Grumman Settling Ponds, Bethpage, New York.

Compounds	Molecular Weight	Maximum Limit on C_a (AGC^3) ug/m^3	Maximum Allowable Annual Mass Flow Q_a lb/yr	Design Mass Flow per Year lb/yr	**Percent of Maximum Allowable Annual Mass Flow %**
1,1,1-Trichloroethane	133.4	1,000	351,052.10	7.10	**0.00**
1,1-Dichloroethane	99	0.63	221.16	0.71	**0.32**
1,1-Dichloroethylene	97	70	24,573.65	0.05	**0.00**
1,2-Dichloroethene	97	1,900	666,998.99	0.61	**0.00**
1,3-Butadiene	54.09	0.028	9.83	2.05	**20.91**
2,2,4-Trimethylpentane	114.22	3,300	1,158,471.92	0.01	**0.00**
Methyl ethyl ketone (2-Butanone)	72.11	5,000	1,755,260.49	2.48	**0.00**
2-Hexanone	100.2	48	16,850.50	0.08	**0.00**
4-Methyl-2-Pentanone	100.2	3,000	1,053,156.29	0.02	**0.00**
Acetone	58.09	28,000	9,829,458.74	13.23	**0.00**
Benzene	78.1	0.13	45.64	2.51	**5.51**
Benzene, 1,2,4-trimethyl	120.2	290	101,805.11	0.07	**0.00**
Methyl bromide (Bromomethane)	94.95	5	1,755.26	0.01	**0.00**
Carbon disulfide	76.1	700	245,736.47	1.06	**0.00**
Carbon tetrachloride	153.8	0.067	23.52	0.26	**1.11**
Chlorobenzene	112.6	110	38,615.73	0.26	**0.00**
Chloroform	119.4	0.043	15.10	0.08	**0.52**
Methyl chloride (Chloromethane)	50.49	90	31,594.69	0.01	**0.00**
cis-1,2-Dichloroethylene	96.95	1,900	666,998.99	15.20	**0.00**
Cyclohexane	84.16	6,000	2,106,312.59	2.84	**0.00**
Ethylbenzene	106.2	1,000	351,052.10	0.09	**0.00**
Freon 113	187.4	180,000	63,189,377.62	0.22	**0.00**
m&p-Xylenes	104.1	100	35,105.21	1.47	**0.00**
n-Heptane	100.21	3,900	1,369,103.18	2.54	**0.00**
n-Hexane	86.18	200	70,210.42	2.14	**0.00**
o-Xylene	104.1	100	35,105.21	0.33	**0.00**
p-Dichlorobenzene	147	0.09	31.59	0.09	**0.27**
p-Ethyltoluene	120.19	NA	NA	0.03	**--**
Styrene	104.15	1,000	351,052.10	0.02	**0.00**
tert-Butyl alcohol	74.12	720	252,757.51	0.21	**0.00**
Tetrachloroethylene	165.9	1	351.05	3.45	**0.98**
Toluene	92.14	400	140,420.84	3.12	**0.00**
trans-1,2-Dichloroethene	96.95	1,900	666,998.99	0.21	**0.00**
Trichloroethylene	131.39	0.50	175.53	123.92	**70.60**
Vinyl chloride	62.5	0.11	38.62	0.23	**0.60**
Xylene (total)	104.1	100	35,105.21	1.39	**0.00**