Operable Unit 2 Groundwater Remedial System Hydraulic Effectiveness Evaluation

Northrop Grumman Corporation and
NWIRP Bethpage
NYSDEC Site #'s 1-30-003A and B

ARCADIS

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1. Introduction

On behalf of Northrop Grumman Corporation (NGC), ARCADIS has prepared this Groundwater Remedial System Hydraulic Effectiveness Evaluation Report to satisfy one of the requirements of the March 2001 Record of Decision (ROD) that was issued by the New York State Department of Environmental Conservation (NYSDEC) for Operable Unit 2 (OU2) for the NGC and Naval Weapons Industrial Reserve Plant (NWIRP) sites, in Bethpage, New York (NYSDEC 2001). Specifically, this report was produced to evaluate the data collected by Tetra Tech NUS, Inc. (TTNUS) on behalf of the Navy and by ARCADIS on behalf of NGC to address the portion of Section 8 of the ROD requiring an independent study to evaluate the hydraulic effectiveness of the on-site portion of the OU2 Groundwater Remedy (see details below). Between August 2002 and January 2003, the OU2 Hydraulic Effectiveness field investigation was conducted pursuant to the June 2002 NYSDEC-approved work plans (ARCADIS G&M, Inc. 2002a and U.S Navy 2002a). In general, the field investigation consisted of drilling and collection of soil and groundwater samples from vertical profile borings (VPBs) and the drilling, installation, development and sampling of permanent monitoring wells. In November 2002, the Navy issued the GM-39 and GM-73 Vertical Profile Boring and Monitoring Well Summary Report to document the data collected during the field investigation (U.S. Navy 2002b). After completion of the Navy portion of the investigation, ARCADIS (on behalf of NGC) collected additional hydraulic and groundwater quality data and has prepared this interpretive report, in accordance with a NYSDEC-approved work plan, dated June 28, 2002 (ARCADIS G&M, Inc. 2002).

In addition to the ROD requirement satisfied by this report, ARCADIS continues to collect quarterly hydraulic and groundwater quality data in accordance with the NYSDEC-approved groundwater monitoring plan (ARCADIS G&M, Inc., 2001) and produce quarterly groundwater monitoring reports that provide an evaluation of the environmental effectiveness and performance of the OU2 Groundwater Remedy.

This report is organized as follows:

- Section 2 summarizes OU2 groundwater remediation and OM&M activities.
- Section 3 describes the technical approach of the OU2 Hydraulic Effectiveness Evaluation.

- Section 4 summarizes the Navy portion of the field investigation and the methods and procedures used by ARCADIS for collection of hydraulic and groundwater quality data.

- Section 5 includes the detailed evaluation of the hydraulic data collected by ARCADIS.

- Section 6 includes the detailed evaluation of the groundwater quality data collected by the Navy (VPBs) and ARCADIS (monitoring and remedial wells).

- Sections 7 and 8 provide the conclusions and list of references, respectively.

Field records prepared by ARCADIS are provided in Appendix A.

2. Summary of OU2 Groundwater Remedial System and OM&M Activities

The site plan showing the OU2 groundwater remediation system and well locations is provided on Figure 1. Initially, the OU2 Groundwater Remedy was installed as an Interim Remedial Measure (IRM). Installation of IRM Remedial Wells ONCT-1, ONCT-2, and ONCT-3 was completed by NGC in June 1997. The IRM remedial system treating groundwater pumped from the ONCT remedial wells was completed by NGC in November 1997. Full-time OU2 IRM remedial system operation began in September 1998. Additionally, Remedial Well GP-1, initially installed by NGC for on-site industrial supply purposes, along with the associated treatment system, were incorporated into the IRM groundwater remedy in 1998, which consists of:

- Remedial Wells ONCT-1, ONCT-2, and ONCT-3 and the Plant 5E remedial treatment system (also known as the ONCT Remedial Treatment System or the 102 Tower). Treated effluent from the ONCT remedial system is discharged to the South Recharge Basins.

- Remedial Well GP-1 and the Plant 5 remedial treatment system (also known as the GP-1 Remedial Treatment System or the Tower 96 system). Treated effluent from the GP-1 remedial system is discharged to the Plant 5 and South Recharge Basins.

Using the groundwater model developed by ARCADIS on behalf of NGC, it was determined that a combined pumping rate for the OU2 remedial wells of 3,375 gallons per minute (gpm) was required to achieve the IRM goal of preventing volatile organic compound (VOC)-impacted groundwater from migrating south from the NGC site. To

achieve the total design pumping rate, the following design pumping rates for the individual remedial wells were used: Well GP-1 (1,075 gpm), ONCT-1 (1,000 gpm), ONCT-2 (600 gpm), and ONCT-3 (700 gpm) (ARCADIS Geraghty & Miller, Inc. 2000). In addition to the remedial pumping rates described above, Industrial Supply Well GP-3 is also pumped to the GP-1 Remedial Treatment System with the effluent discharged to the recharge basins mentioned above (NGC voluntarily operates Well GP-3 at a current rate of approximately 425 gpm).

In March 2001, the ROD incorporated the IRM (consisting of Remedial Wells GP-1, ONCT-1, ONCT-2, and ONCT-3, the GP-1 and ONCT Remedial Treatment Systems, the South Recharge Basins, and Plant 5 Recharge Basins) as the on-site portion of the final OU2 Groundwater Remedy (referred to in this report as the OU2 Groundwater Remedy).

The field investigation discussed herein was conducted while the OU2 remedial system operated at greater than 90 percent up-time with the OU2 remedial wells operating at or close to the design pumping rates (given above) and associated treated water discharged to the South Recharge Basins/Plant 5 Recharge Basins consistent with the rates specified by the model to prevent the off-site migration of VOCs. Operation of the remedial wells at these rates before and during the field investigation has produced conditions that are representative of the planned long-term operation of the OU2 Groundwater Remedy and serve as the most appropriate basis for the required OU2 Hydraulic Effectiveness Evaluation.

3. Technical Approach to OU2 Hydraulic Effectiveness Evaluation

This section describes the physical setting as well as the approach used to evaluate the effect of the OU2 Groundwater Remedy on groundwater flow (hydraulics) and groundwater quality. This approach was developed based on the ongoing evaluation of the quarterly groundwater monitoring data and conditions predicted in The Groundwater Flow and Contaminant Transport Simulation Report (ARCADIS Geraghty & Miller, 2000, Appendix B).

3.1 Physical Setting

The two aquifer systems relevant to the OU2 Groundwater Remedy and the Hydraulic Effectiveness Evaluation are the Upper Glacial aquifer and the Magothy aquifer. For the purposes of evaluating groundwater flow and groundwater quality in the model,

four hydrogeologic zones within the Upper Glacial and Magothy aquifers were defined, as follows:

- The shallow zone, which extends from the water table (approximately +50 feet [ft] relative to mean sea level [msl]) to +40 ft msl.
- The intermediate zone, which extends from +40 ft msl to -50 ft msl.
- The deep zone, which extends from -50 ft msl to -365 ft msl.
- The Deep2 (D2), zone, which extends from -365 ft msl to -530 ft msl.

For the purposes of this report, the D3 zone has been defined as the basal zone of the Magothy aquifer, which extends from approximately -530 ft msl to -550 ft msl (estimated elevation of the top of the Raritan Confining Unit at the NGC southern boundary).

3.2 Hydraulic Data

The purpose of the OU2 Groundwater Remedy is to prevent the off-site migration of VOC-impacted groundwater through hydraulic control created by a combination of deep pumpage (from the four OU2 remedial wells) and shallow recharge (via the Plant 5 Recharge Basins and South Recharge Basins). The groundwater flow model predicted that, over the long-term, operation of the OU2 Groundwater Remedy will affect groundwater flow in the southern portion of the NGC site and in off-site areas immediately south of the NGC site, establishing a new steady-state condition that will prevent flow of impacted groundwater off-site. The hydraulic containment aspect of the OU2 Groundwater Remedy is described in detail below.

3.2.1 Recharge

Based on groundwater modeling conducted, the effect on groundwater flow of recharging the treated water pumped from the OU2 remedial wells will be seen as groundwater mounds at the Plant 5 Recharge Basins and South Recharge Basins. The purpose of the groundwater mounding created by the OU2 Groundwater Remedy is twofold: (1) to hydraulically contain shallow groundwater and prevent it from moving off-site, and (2) to increase vertical hydraulic gradients and force groundwater downward toward the D2 zone where it will be extracted by the remedial wells for subsequent treatment (see Section 3.2.2 below). As a result of the groundwater mounds, groundwater flow will, locally, be redirected radially away from the basins and downward vertical hydraulic gradients will increase. Based on this scenario, the

data collection and evaluation focused on identifying the presence and extent of localized groundwater mounding and evaluating vertical hydraulic gradients. A key indication that the OU2 Groundwater Remedy, through discharge of treated water to the shallow zone (as recharge to the water table), has created an effective hydraulic barrier to off-site groundwater flow in the shallow and intermediate zones is vertical hydraulic gradients that are close to or greater than those predicted by the groundwater modeling conducted.

3.2.2 Pumpage

The effects of pumping the OU2 remedial wells has been expected to be (and has been) most clearly seen in the D2 zone (i.e., the zone in which the remedial wells are screened) and appear as a zone of capture (i.e., an area of lowered water levels within which all groundwater moves toward and is eventually removed by pumping wells) centered on the OU2 Remedial Wells; ONCT-1, ONCT-2, ONCT-3, and GP-1 (while in operation, Well GP-3 induces a similar effect). The purpose of the remedial well pumpage is to operate in concert with the treated water recharge to the water table (see Section 3.2.1) to hydraulically contain on-site groundwater and prevent it from moving off-site. The D2 zone pumping is expected to result (and has resulted) in the formation of a groundwater divide in the D2 zone south of the NGC site and the OU2 remedial wells. Groundwater south of the divide flows with the regional gradient to the south/southeast while groundwater north of the divide moves toward and is captured by the OU2 remedial wells. The effect of remedial well pumpage in the D2 zone, in combination with shallow local recharge at the basins described above, is expected to be (and has been) an increase in downward vertical hydraulic gradients throughout the vertical thickness of the aquifer system at the NGC site southern boundary, with the groundwater flow oriented downward toward the zone of pumpage. For these reasons, the data collection and evaluation effort also focused on identifying the presence and extent of the composite capture zone created and mapping the potentiometric surfaces in the various aquifer horizons. The occurrence of vertical groundwater migration through the aquifer horizons to the sufficiently-sized composite capture zone around the remedial wells is a key indication that, through pumpage of the remedial wells in the D2 zone, the OU2 Groundwater Remedy has created an effective hydraulic barrier to off-site groundwater flow.

3.2.3 Data

Based on the above discussion, the effect of the on-site OU2 Groundwater Remedy on the groundwater flow system can be shown by: mapping the potentiometric surface of

the various hydrogeologic zones identified above and evaluating water-level data by calculating vertical hydraulic gradients for key well clusters near the OU2 remedial wells and recharge basins and comparing the gradients with the data developed by the groundwater flow model. Hydraulic measurements were collected in November 2002 and January 2003. The November 2002 event focused on obtaining measurements from selected shallow, intermediate, and deep wells to provide an indication of groundwater elevations relative to previous rounds and to calculate vertical hydraulic gradients in key well pairs near the NGC site southern boundary. In addition, measurements were obtained from D2 zone wells to map the potentiometric surface elevations and horizontal groundwater flow directions (illustrating the degree and extent of the composite capture zone created by the OU2 Groundwater Remedy), and determine vertical hydraulic gradients in the deep/D2 zones. The January 2003 event incorporated additional wells (Table 1) which provided sufficient coverage to map the water-table configuration (shallow zone) and potentiometric surface elevations (intermediate zone and D2 zone), as well as determine horizontal groundwater flow directions and vertical hydraulic gradients throughout the various aquifer horizons.

3.3 Groundwater Quality Data

The goal of the on-site OU2 Groundwater Remedy is to capture, remove, and treat groundwater from the on-site portion of the VOC plume and, thereby prevent VOC-impacted groundwater from moving off-site. The operation of the on-site portion of the OU2 Groundwater Remedy is expected to (and current data indicate this is occurring) cause the plume to bifurcate into an on-site portion and an off-site portion. As treated groundwater and precipitation continue to recharge the aquifer, a "clean zone" will develop between the on- and off-site portions of the bifurcated plume, within which VOC impacts will not occur or will be minimal. This clean zone will increase in size as VOC-impacted groundwater downgradient (south) and beyond the capture zone of the OU2 remedial wells continues to migrate through the aquifer in the regional direction of groundwater flow to the south-southeast. The continued growth of this clean zone depends on maintaining the hydraulic barrier created by the OU2 Groundwater Remedy. The rate of growth will largely depend on the regional groundwater velocity in the Magothy aquifer, which is generally less than one foot per day.

Based on the above considerations, groundwater samples collected from wells immediately south (off-site) of the OU2 remedial wells will be the first to show water quality improvement (i.e., a decreasing long-term trend in VOC concentrations over time) although the improvement, due to the natural slow groundwater velocity, will be

slow to occur. Monitoring wells located further downgradient will take a longer time to show an improvement in groundwater quality, as compared to wells immediately south of the OU2 remedial wells, due to the relatively slow groundwater velocity and greater distance from the remedial wells. VOC-impacted groundwater that migrated off-site prior to the implementation of the OU2 Groundwater Remedy would have to migrate past off-site monitoring wells before the wells would show groundwater quality improvement related to operation of the on-site portion of the OU2 Groundwater Remedy. Depending on VOC concentrations and heterogeneity of the off-site groundwater, monitored water quality in off-site wells may show several trend changes before long-term trends associated with the operation of the OU2 Groundwater Remedy are revealed. Depending on the location of the well, water quality in on-site wells may increase, decrease, or stay the same over the short to mid-term, but over the long term a general decrease in VOC concentrations will be observed. It is for these reasons that the evaluation of groundwater quality data has been included in this hydraulic effectiveness evaluation.

3.4 Potential Data Gaps

Based on the information obtained during the remedial investigation at the site, it was concluded that pumpage of on-site industrial supply wells (which in general, are screened in the deep or D2 zones) was the primary mechanism that resulted in the accelerated vertical migration of VOCs in on-site groundwater. Therefore, it was reasonable to expect that VOC impacts below the depths of the deepest of these wells would not occur, or would be minimal. Since the OU2 remedial wells were installed to depths slightly greater than the screen intervals of any of the on-site industrial supply wells, VOC impacts below the well screen zones of the OU2 remedial wells were also not expected. However, as stated in the ROD, discrete groundwater quality data had not been collected from the lower portion of the D2 zone/D3 zone (includes the interval below the total depth of the ONCT wells) to support this conclusion.

Since current VPB methods can provide a complete profile of groundwater quality to such depths, the technology was used to vertically delineate VOC impacts along the NGC southern boundary to the top of the Raritan Confining Unit. Based on the results of the VPB groundwater sampling, the vertical extent of VOC impacts throughout the vertical thickness of aquifer was determined. Subsequently, permanent wells were installed to: better quantify the VOC concentrations obtained from the VPBs, provide permanent locations to collect hydraulic data to determine the vertical extent of the capture zone along the NGC site southern boundary, allow for the determination of

vertical hydraulic gradients, and to monitor long term trends in groundwater quality in zones of interest within the aquifer system.

4. Hydraulic Effectiveness Evaluation Data Collection

The following sections describe the methods for collection of hydraulic and groundwater quality data by the Navy and ARCADIS, and provide the basis for the selection of the screen zones of monitoring wells installed as part of the hydraulic effectiveness evaluation. Sections 5 and 6 of this report discuss the results of hydraulic measurements and the VPB and monitoring well groundwater sample collection, respectively.

4.1 Hydraulic Data

In accordance with the NYSDEC-approved work plan (ARCADIS G&M, Inc. 2002a), two rounds of groundwater-level (hydraulic) measurements were collected by ARCADIS, as follows: the first round was carried out on November 22, 2002 shortly after installation of the new monitoring wells was completed (see Section 4.2 below), followed by the second round on January 29, 2003. Collection of water-level measurements and calculation of water-level elevations were performed consistent with the methods described in the work plan and the quarterly groundwater monitoring reports (ARCADIS Geraghty & Miller, Inc., 2002b). The wells monitored in the November 2002 round consisted of selected wells located around the NGC site southern boundary. The wells monitored in the January 2003 round consisted of wells measured during the quarterly hydraulic measurement rounds and included the wells monitored in November 2002 plus additional wells. The data are discussed in Section 5 of this report.

4.2 Groundwater Quality Data

The locations of, installation of, and sample collection from VPB-39 and VPB-73 (Figure 1) were in accordance with the NYSDEC-approved work plan (ARCADIS G&M, Inc. 2002a). TTNUS supervised the drilling of the VPBs from August to September 2002 using methods consistent with the NYSDEC-approved work plan (U.S. Navy 2002a). The Navy documented the results of the field investigation in the GM-39 and GM-73 Vertical Profile Boring and Monitoring Well Summary Report (U.S. Navy 2002b). During VPB drilling, groundwater samples were collected generally at 20-foot intervals and submitted for laboratory analysis of VOCs. The

VPBs were drilled to the top of the Raritan Confining Unit (estimated to be encountered at 660 feet below land surface [ft bls] at VPB-39 and VPB-73).

TTNUS supervised the installation of Monitoring Wells GM-39D, GM-39D2, and GM-73D at the corresponding VPB locations from September to October 2002 (Figure 1). Screen intervals for Wells GM-39D, GM-39D2, and GM-73D were selected by ARCADIS based on the following factors:

1. Consideration was given to the goals of the hydraulic effectiveness evaluation (see Item 2 below) as well as the nature of the formation material. Positioning well screens within reasonably permeable formation material is important as it ensures that the wells can be properly developed and therefore be open and responsive to water level changes in the formation so that hydraulic (water-level) measurements and representative groundwater samples can be obtained. Split-spoon soil samples and geophysical logs (natural gamma) were therefore obtained at each VPB to determine the precise depth and thickness of both highly permeable deposits (i.e., sands) and comparatively poorly permeable deposits (i.e., silts and clays). The well screen intervals for Wells GM-39D, GM-39D2, and GM-73D were positioned within reasonably permeable deposits while also meeting the goals of the hydraulic effectiveness evaluation.

2. The Magothy aquifer is generally known to be hydraulically connected throughout its vertical thickness, which implies downward groundwater movement where there is a downward hydraulic gradient (i.e., lower water-level elevations with depth). Based on this consideration, the vertical hydraulic gradient obtained from a well couplet comprised of one well screened close to the upper limit of the VOC plume and a second deeper well screened near the screened interval of an OU2 remedial well that is close to or greater than model predictions (see Section 3.2) would provide conclusive evidence that the groundwater flow direction is oriented downward throughout the VOC-impacted segment of aquifer at this location and that operation of the OU2 Groundwater Remedy has created a hydraulic barrier that is effective in preventing the off-site migration of VOC-impacted groundwater. Therefore, Monitoring Wells GM-39D and GM-73D were screened at depths corresponding to the shallowest VOC concentrations in groundwater that exceeded NYSDEC Standards, Criteria, and Guidance values (SCGs) and were coupled with deeper Wells GM-39D2 and GM-73D2, respectively. Vertical hydraulic gradients obtained from Well Clusters GM-39D/GM-39D2 and GM-73D/GM-73D2 that are close to or greater than the model-predicted gradients

would provide strong evidence attesting to the effectiveness of the hydraulic barrier in these areas.

3. Monitoring Well GM-39D2 was screened at an interval that met the first two objectives and also to monitor the interval that exhibited the highest total VOC concentration in groundwater that was detected in VPB-39.

Following well installation and development, ARCADIS collected two rounds of groundwater samples, in November 2002 and January 2003. These rounds consisted of collecting samples from new Monitoring Wells GM-39D, GM-39D2, and GM-73D, along with existing Monitoring Well GM-73D2. The monitoring wells were purged and sampled using methods consistent with the NYSDEC-approved groundwater monitoring, (ARCADIS G&M, Inc., 2001). The samples were analyzed for the Target Compound List (TCL) of VOCs. These data are discussed in Section 6 of this report.

5. Hydraulic Data Evaluation

This section provides an evaluation of the hydraulic data collected as part of the OU2 Hydraulic Effectiveness Evaluation. Water-level measurement data are provided in Table 1. Vertical gradients (observed and predicted) from the November 2002 and January 2003 events are provided in Tables 2 and 3, respectively.

5.1 Shallow Zone

Figure 2 shows the water-table configuration and horizontal groundwater flow directions in the shallow zone on January 29, 2003. The effects of the OU2 Groundwater Remedy treatment system discharges and stormwater runoff (as recharge to the South Recharge Basins and the Plant 5 Recharge Basins) on shallow groundwater flow during the hydraulic effectiveness evaluation are described below. The following sections also describe the calculated vertical hydraulic gradients for shallow/intermediate well pairs and compare these gradients to the simulated steady-state vertical gradients predicted by the groundwater flow model under the scenario where the OU2 remedial wells are preventing the off-site movement of VOC-impacted groundwater.

In general, Figure 2 shows groundwater mounding beneath the NGC site around the South Recharge Basins. Upgradient of the South Recharge Basins, which includes areas on the NGC and NWIRP sites, the horizontal direction of shallow groundwater flow is to the southeast. Specifically, the maximum elevation of the mound beneath

and around the South Recharge Basins is greater than 65 ft msl, and the mound extends across the width of the southern boundary of the site. The regional southeast shallow groundwater flow direction is locally modified by the mounding with the result that the horizontal direction of shallow groundwater flow in the vicinity of the South Recharge Basins is radially to the north, south, west, and east away from the basins, thereby creating a hydraulic barrier that prevents on-site, VOC-impacted groundwater in this area from moving off-site in the shallow zone. The mounding around the South Recharge Basins also increases the vertical hydraulic gradient in the vicinity of the basins, resulting in a downward vertical groundwater flow component from the shallow zone to the intermediate zone. Water-level data collected for this investigation from the shallow-intermediate well pairs near the South Recharge Basins (GM-19S/GM-19I; GM-21S/GM-21I; GM-78S/GM-78I, and GM-79S/GM-79I) show that the vertical hydraulic gradients are oriented downward (Tables 2 and 3).

Vertical gradients calculated from groundwater elevation data (from well pairs) that are close to or greater than vertical hydraulic gradients simulated by the groundwater flow model are a key indication that the OU2 Groundwater Remedy, through pumpage of remedial wells from the D2 zone and recharge to the shallow zone, has created an effective hydraulic barrier to off-site groundwater flow. Vertical gradients at the monitoring well clusters located in the vicinity of the basins (i.e., GM-19S/GM-19I; GM-21S/GM-21I; and GM-79S/GM-79I) are oriented downward and are greater than gradients predicted by the groundwater flow model, while the vertical gradients at Well Clusters GM-16SR/GM-16I, GM-17SR/GM-17I, and GM-78S/GM-78I are also oriented downward and are close to model predictions. These data indicate that in the vicinity of the Plant 5 and South Recharge Basins, there is a strong downward vertical component of groundwater flow from the shallow zone toward the intermediate zone.

In conclusion, the radial horizontal flow components near the South Recharge Basins coupled with the downward vertical gradients near the Plant 5 and South Basins collectively create a hydraulic barrier that prevents on-site, VOC-impacted groundwater from migrating off-site in the shallow zone.

5.2 Intermediate Zone

The intermediate zone potentiometric surface configuration and horizontal groundwater flow directions on January 29, 2003 are shown on Figure 3. The configuration of the potentiometric surface in the intermediate zone is similar to the water-level configuration observed in the shallow zone, with mounding centered beneath and around the South Recharge Basins (maximum water-level elevation at the

South Recharge Basins is greater than 62 ft msl). This indicates that the OU2 Groundwater Remedy treatment system discharge and stormwater runoff are substantially affecting groundwater flow in the intermediate zone, with the horizontal component of flow near the South Recharge Basins oriented radially away from the basins. The resultant vertical gradients in monitoring well clusters near the basins (i.e., GM-15I/GM-15D, GM-17I/GM-17D, GM-18I/GM-18D, GM-20I/GM-20D, GM-21I/GM-21D; GM-74I/GM-74D, and GM-79I/GM-79D) are oriented downward and are greater than or close to those predicted by the model.

Collectively, these data indicate that the hydraulic barrier to groundwater flow extends vertically downward to the intermediate zone and is similar in extent to that observed in the shallow zone, is effective in preventing the off-site migration of VOC-impacted groundwater in the intermediate zone.

5.3 Deep Zone

As a result of remedial well pumpage from the underlying zone (D2 zone) and recharge affecting the overlying zones (shallow and intermediate zones), groundwater in the deep zone is expected to be flowing in a predominantly vertical (downward) direction in the general vicinity of the OU2 remedial wells and the Plant 5 and South Recharge Basins. Therefore, the analysis of the hydraulic effectiveness of the OU2 Groundwater Remedy at achieving the goals in the deep zone is conducted using vertical hydraulic gradients calculations for deep/D2 well pairs. Tables 2 and 3 provide the vertical hydraulic gradients calculated from data collected from well clusters in the deep/D2 zones and compares them to model-predicted gradients.

The vertical gradients in on-site/near site Well Clusters GM-15D/GM-15D2 (northeast of the South Basins), GM-39D/GM-39D2, GM-73D/GM-73D2 and GM-74D/GM-74D2 (at the South Basins), and GM-18D/GM-33D2 (west of the South Basins) are oriented downward as expected, and are close to or greater than model predictions.

In conclusion, vertical hydraulic gradients calculated from deep/D2 monitoring well clusters are oriented downward and are close to or greater than vertical hydraulic gradients predicted by the groundwater flow model. Furthermore, vertical hydraulic gradients in well clusters near the NGC site boundary indicate that the mounding of the water table coupled with pumpage from the OU2 remedial wells in the D2 zone is forcing on-site groundwater downward through the deep zone, toward the pumpage in the D2 zone, and prevents on-site VOC-impacted groundwater from flowing off-site in the deep zone.

5.4 D2 Zone

Figures 4 and 5 depict the D2 zone potentiometric surface configuration and horizontal groundwater flow directions under pumping conditions during the November 22, 2002 and January 29, 2003 events, respectively. As shown on Figures 4 and 5, the result of pumping the OU2 remedial wells and Well GP-3 is the formation of cones of depression (i.e., area of depressed water levels) in the D2 zone that are centered on each well. These individual cones of depression for each well have coalesced into one large zone of capture that extends along the entire NGC southern property boundary and also extends northwest along a portion of the NGC site western boundary. Although a water level cannot currently be measured in Well GP-3, it is reasonable to assume that the cone of depression around this pumping well causes the cumulative capture zone to extend farther to the northwest than is currently shown on Figures 4 and 5. At its farthest downgradient extent the capture zone in November 2002 and January 2003 is approximately 700 ft south of the NGC site boundary. Within the capture zone (upgradient and as far as 700 ft downgradient of the OU2 remedial wells), groundwater flow directions are oriented toward the centers of pumping; indicating that groundwater in this area is fully contained and captured by the OU2 Groundwater Remedy. Beyond the downgradient extent of the capture zone, groundwater continues to flow downgradient until it is influenced by the pumping of nearby public supply wells or continues to flow south-southeast in the direction of regional groundwater flow (Figure 5).

In conclusion, the data from the D2 zone indicate that the pumpage of the OU2 remedial wells and Well GP-3 has created a hydraulic barrier in this zone, thereby preventing the off-site migration of VOC-impacted groundwater in this zone.

5.5 Summary of Groundwater Flow Conditions

In summary, the hydraulic data presented and discussed in Sections 5.1 to 5.4 indicate that operation of the OU2 Groundwater Remedy has created an effective hydraulic barrier throughout the shallow, intermediate, deep, and D2 zones, achieving the ROD-required goal of the OU2 Groundwater Remedy, which is to prevent the off-site migration of on-site, VOC-impacted groundwater. To help summarize the hydraulic data (and groundwater quality data discussed in Section 6 of this report) collected for the hydraulic effectiveness evaluation, ARCADIS has prepared a hydrogeologic cross section (Figure 6) for the area of the NGC southern boundary. This cross section depicts the vertical distribution of water levels with respect to site features, wells, and

groundwater sample results (Section 6), and illustrates the substantial decrease in potentiometric surface elevation with depth across the NGC southern boundary.

Furthermore, in accordance with the ROD, site-wide, quarterly hydraulic monitoring and data evaluation is currently being conducted by ARCADIS. This monitoring will continue to assess monitoring well and remedial well data to evaluate and document the effectiveness of the OU2 Groundwater Remedy at achieving remedial goals.

6. Groundwater Quality Data Evaluation

This section discusses the results of the VPB and permanent monitoring well groundwater sample analysis and compares the data to NYSDEC Standards, Criteria, and Guidance Values (SCGs) and, where available, previous rounds of data.

6.1 Vertical Profile Borings

The complete analytical results of groundwater sampling at VPB-39 and VPB-73 are provided in Table 4. Total VOC concentrations versus depth below land surface are depicted on Cross Section E-E' (Figure 6) along with wells that are located at or near the NGC site southern boundary. As stated in Section 3.4 of this report, VPBs are a useful tool to collect water quality data throughout a vertical section of an aquifer horizon(s). However, it is important to realize that water quality samples collected via the VPB technique may not exactly correlate to water quality data collected from nearby monitoring wells. For this reason, the VPB technique was used as a "screening tool" in this hydraulic effectiveness evaluation and, where necessary, permanent monitoring wells (i.e., GM-39 cluster and Well GM-73D) were installed.

Overall, the VPB groundwater data are generally consistent with the information obtained from the quarterly VOC groundwater monitoring program in that the results indicate no SCG exceedences in the shallow and intermediate zones, and the upper portion (generally above –300 ft msl) of the deep zone. Furthermore, total VOC concentrations in the basal portions of the deep zone and the D2 zone range from less than 1 microgram per liter (ug/L) to 789 ug/L. Trichloroethene (TCE) was the compound most frequently detected and, with the exception of one detection of tetrachloroethene (PCE) (9 ug/L), was the only constituent detected at concentrations exceeding SCGs. In addition, only trace (less than 5 ug/L) concentrations of VOCs were detected in VPB samples in the basal portion of the D2 zone and the D3 zone (i.e., deeper than –460 ft msl and generally below the ONCT screen zones).

In summary, correlation of compounds detected in VPBs with data from nearby monitoring wells (below) and VPB data that shows trace VOC concentrations in the basal D2 zone and D3 zone (i.e., below the screened intervals of the ONCT remedial wells) provide a complete and accurate profile of groundwater quality at the NGC site southern boundary and support the conclusion that the TVOC plume delineation along the NGC site southern boundary is complete.

Based on these findings, ARCADIS concludes that a D3 zone monitoring well(s) is not required.

6.2 Monitoring Wells

The complete analytical results of groundwater sampling at Wells GM-39D, GM-39D2, GM-73D, and GM-73D2 from the November 2002 and January 2003 sampling events are provided in Table 5 and total VOC concentrations versus depth below land surface are depicted on Cross Section E-E' (Figure 6). Total VOC concentrations in wells sampled during the hydraulic effectiveness evaluation generally agree with the current understanding of the VOC plume configuration which depicts the highest concentrations within the on-site portion of the TVOC plume at elevations that are close to or within the screened intervals of the ONCT remedial wells (i.e., the deep zone and upper portion of the D2 zone). The analytical results provide good agreement with the VPB results in that TCE was the constituent most frequently detected and, with the exception of sporadic exceedences of PCE, was the only constituent detected at concentrations exceeding the SCG.

Furthermore, site-wide quarterly groundwater monitoring and data evaluation are currently being conducted by ARCADIS in accordance with ROD requirements. This monitoring program will serve to monitor and document the continued environmental effectiveness of the OU2 Groundwater Remedy at achieving remedial goals established in the ROD.

7. Conclusions

Based on the collective data obtained by the Navy and ARCADIS, for the OU2 Groundwater Remedial System Hydraulic Effectiveness Evaluation, ARCADIS concludes the following:

1. The hydraulic data is consistent with the model-predicted data which indicates that operation of the OU2 Groundwater Remedy has created an effective hydraulic

barrier throughout the shallow, intermediate, deep, and D2 zones that prevents the off-site migration of on-site, VOC-impacted groundwater.

2. Groundwater quality from VPBs exhibit only trace concentrations of VOCs with no SCG exceedences below the ONCT remedial wells (i.e., in the D3 zone). Groundwater quality data from monitoring wells along the site southern boundary is essentially similar to the VPB data in that it indicates similar compounds detected and SCG exceedences. Based on the collective groundwater quality data obtained, the delineation of the VOC plume at the NGC site southern boundary is accurate and complete and supports Conclusion 1 above, that the OU2 Groundwater Remedy prevents the off-site migration of on-site VOC-impacted groundwater. Further, the data show that a D3 zone monitoring well(s) is not required.

3. OU2 quarterly groundwater monitoring/data evaluation will continue to be performed to monitor and document the continued effectiveness of the OU2 Groundwater Remedy. Depending on VOC concentrations and heterogeneity of the off-site groundwater quality, monitored water quality in off-site wells is anticipated to show several short-term trend changes before long-term trends associated with the operation of the OU2 Groundwater Remedy are revealed.

8. References

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U.S. Navy 2002b. GM-39 and GM-73 Vertical Profile Boring and Monitoring Well Summary Report, Naval Weapons Industrial Reserve Plant, Bethpage, New York. November 2002. Prepared by Tetra Tech NUS, Inc. under Contract No. N62467-94-D-0888, Contract Task Order No. 812.

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Table 1. Water-Level Measurement Data, November 2002 and January 2003, Operable Unit 2 Hydraulic Effectiveness Evaluation, Northrop Grumman Corporation, Bethpage, New York.

Well Identification	Measuring Point Elevation (ft msl)	Depth to Water November 22, 2002 (ft bmp)	Water-Level Elevation November 22, 2002 (ft msl)	Depth to Water January 29, 2003 (ft bmp)	Water-Level Elevation January 29, 2003 (ft msl)
Shallow Wells					
FW-03	124.30	--	--	--[1)]	--[1)]
N-9921	94.23	--	--	37.94	56.29
N-10597	109.85	--	--	45.59	64.26
N-10600	102.41	--	--	45.20	57.21
N-10631	103.47	45.12	58.35	44.53	58.94
N-10633	103.80	--	--	43.70	60.10
N-10634	101.20	--	--	44.94	56.26
N-10821	91.58	--	--	39.60	51.98
GM-15S	109.44	51.43	58.01	50.74	58.70
GM-16SR	115.86	--	--	54.90	60.96
GM-17SR	115.79	--	--	55.19	60.60
GM-18S	107.60	--	--	47.58	60.02
GM-19S	109.86	--	--	48.38	61.48
GM-21S	105.81	40.80	65.01	40.11	65.70
GM-78S	104.94	--	--	47.05	57.89
GM-79S (N-10628)	100.88	--	--	45.12	55.76
HN-40S	116.35	--	--	55.54	60.81
HN-42S	120.32	--	--	58.27	62.05
MW-3R	101.45	--	--	40.36	61.09
Intermediate Wells					
N-10624	93.61	--	--	--[2)]	--[2)]
GM-15I	109.25	51.1	58.15	50.29	58.96
GM-16I	115.81	--	--	55.02	60.79
GM-17I	115.83	--	--	55.36	60.47
GM-18I	109.03	--	--	48.97	60.06
GM-19I	109.86	--	--	53.80	56.06
GM-20I	103.88	42.06	61.82	41.34	62.54
GM-21I	105.72	42.94	62.78	42.55	63.17
GM-74I	107.42	44.99	62.43	44.22	63.20
GM-78I	105.06	--	--	47.33	57.73
GM-79I	100.88	--	--	45.49	55.39
HN-24I	125.80	--	--	62.98	62.82
HN-29I	116.42	--	--	53.88	62.54
HN-40I	115.91	--	--	55.33	60.58
HN-42I	119.61	--	--	57.56	62.05

See last page for footnotes

Table 1. Water-Level Measurement Data, November 2002 and January 2003, Operable Unit 2 Hydraulic Effectiveness Evaluation, Northrop Grumman Corporation, Bethpage, New York.

Well Identification	Measuring Point Elevation (ft msl)	Depth to Water November 22, 2002 (ft bmp)	Water-Level Elevation November 22, 2002 (ft msl)	Depth to Water January 29, 2003 (ft bmp)	Water-Level Elevation January 29, 2003 (ft msl)
Deep Wells					
N-10627	93.70	38.55	55.15	37.87	55.83
GM-13D	113.97	--	--	53.17	60.80
GM-15D	109.84	53.73	56.11	52.84	57.00
GM-17D	115.68	--	--	56.84	58.84
GM-18D	108.88	--	--	51.77	57.11
GM-20D	103.92	44.2	59.72	43.50	60.42
GM-21D	105.66	49.08	56.58	48.33	57.33
GM-34D	71.19	--	--	19.58	51.61
GM-36D	91.63	--	--	39.85	51.78
GM-37D	97.26	--	--	44.25	53.01
GM-38D	91.75	--	--	42.60	49.15
GM-39D	102.23	45.42	56.81	44.69	57.54
GM-73D	104.87	50.54	54.33	49.90	54.97
GM-74D	107.43	51.35	56.08	50.58	56.85
GM-79D	101.25	--	--	46.83	54.42
Deep2 Wells					
GM-15D2	109.78	--	--	55.50	54.28
GM-33D2	106.85	56.63	50.22	55.78	51.07
GM-34D2	71.19	--	--	21.05	50.14
GM-35D2	96.28	--	--	44.50	51.78
GM-36D2	91.60	--	--	41.80	49.80
GM-37D2	97.17	--	--	44.84	52.33
GM-38D2	91.56	--	--	44.84	46.72
GM-39D2	102.08	48.46	53.62	47.80	54.28
GM-70D2	99.58	--	--	45.98	53.60
GM-71D2	98.45	--	--	46.36	52.09
GM-73D2	104.62	52.66	51.96	52.13	52.49
GM-74D2	107.36	57.52	49.84	57.28	50.08
GM-75D2	93.63	41.56	52.07	40.95	52.68
GP-1 [3)]	116.78	97	19.78	96.00	20.78
ONCT-1	104.10	75.35	28.75	72.30	31.80
ONCT-2	110.00	69.36	40.64	71.11	38.89
ONCT-3	108.70	71.12	37.58	71.20	37.50

1) Wells FW-03, 10634, GM-34D, GM-34D2 were not accessible for measurement this round.

2) Water-level measurements collected from Well N-10624 are considered anomalous due to silt in the well screen.

3) Water-levels were measured by inflating airline set at 120 ft bmp (gauge at wellhead) and subtracting the reading on the gauge from 120 to obtain the depth to water in feet.

ft msl feet relative to mean sea level

ft bmp feet below measuring point

-- Not Measured

Table 2. Comparison of November 2002 Observed Hydraulic Data and Vertical Gradients to Model Predictions, Operable Unit 2 Hydraulic Effectiveness Evaluation, Northrop Grumman Corporation, Bethpage, New York.

Well Pairing ID	Measuring Point Elevation (ft msl)	Well Screen Midpoint Elevation (ft msl)	11/22/2002 Water-Level Elevation (ft msl)	11/22/2002 Vertical Gradient (ft/ft) * 10^{-3}	Model-Predicted, OU2 Steady-State Vertical Gradient (ft/ft) * 10^{-3}	Increase Compared to Model-Predicted, Steady-State Vertical Gradient
Shallow-Intermediate Wells						
GM-15S	109.35	34.53	58.01			
GM-15I	109.13	9.29	58.15	-5.55	4.20	-9.75
GM-21S	105.81	40.81	65.01			
GM-21I	105.72	-29.28	62.78	31.82	18.44	13.37
Shallow-Deep2 Wells						
10631	103.47	38.47	58.35			
GM-33D2	106.85	-403.15	50.22	18.41	16.83	1.58
Intermediate-Deep Wells						
GM-20I	103.88	3.88	61.82			
GM-20D	103.92	-117.08	59.72	17.36	18.22	-0.86
GM-21I	105.72	-29.28	62.78			
GM-21D	105.66	-177.34	56.58	41.87	43.97	-2.10
GM-74I	107.42	8.42	62.43			
GM-74D	107.43	-192.57	56.08	31.59	20.17	11.42
Deep-Deep 2 Wells						
GM-39D	102.23	-169.77	56.81			
GM-39D2	102.08	-312.92	53.62	22.28	13.46	8.82
GM-73D	104.87	-301.13	54.33			
GM-73D2	104.62	-437.38	51.96	17.39	18.78	-1.39
GM-74D	107.43	-192.57	56.08			
GM-74D2	107.36	-444.64	49.84	24.76	28.26	-3.50
10627	93.70	-198.80	55.15			
GM-75D2	93.63	-421.37	52.07	13.84	2.25	11.59

Vertical hydraulic gradients are calculated as follows:

$$\frac{(\text{Water-Level Elevation}_1 - \text{Water-Level Elevation}_2)}{(\text{Screen Midpoint Elevation}_1 - \text{Screen Midpoint Elevation}_2)}$$

1 - Shallower well of pairing
2 - Deeper well of pairing
A positive "+" gradient value indicates a downward hydraulic gradient.
A negative "-" gradient value indicates an upward hydraulic gradient.

ft msl feet relative to mean sea level
ft feet

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Table 3. Comparison of January 2003 Observed Vertical Hydraulic Gradients to Model Predictions, Operable Unit 2 Hydraulic Effectuiveness Evaluation, Northrop Grumman Corporation, Bethpage, New York.

Well Pairing ID	Measuring Point Elevation (ft msl)	Well Screen Midpoint Elevation (ft msl)	1/29/2003 Water-Level Elevation (ft msl)	1/29/2003 Vertical Gradient (ft/ft) * 10^{-3}	Model-Predicted, OU2 Steady-State Vertical Gradient (ft/ft) * 10^{-3}	Increase Compared to Model-Predicted, Steady-State Vertical Gradient
Shallow-Intermediate Wells						
GM-15S	109.35	34.53	58.61			
GM-15I	109.13	9.29	58.84	-9.11	4.20	-13.31
GM-16SR	115.77	66.77	60.96			
GM-16I	115.81	-24.19	60.79	1.87	1.11	0.76
GM-17SR	115.79	50.79	60.60			
GM-17I	115.83	5.83	60.47	2.89	4.50	-1.61
GM-18S	107.60	42.60	60.02			
GM-18I	109.03	9.03	60.06	-1.19	1.78	-2.97
GM-19S	109.86	64.36	61.48			
GM-19I	109.86	-25.14	56.06	60.56	2.44	58.11
GM-21S	105.81	40.81	65.70			
GM-21I	105.72	-29.28	63.17	36.10	18.44	17.65
GM-78S	104.94	39.94	57.89			
GM-78I	105.06	5.56	57.73	4.65	8.73	-4.07
GM-79S	100.88	35.88	55.76			
GM-79I	101.09	-73.91	55.60	1.46	0.91	0.55
Intermediate-Deep Wells						
GM-15I	109.29	9.29	58.84			
GM-15D	109.66	-227.34	56.82	8.54	6.52	2.01
GM-17I	115.83	5.83	60.47			
GM-17D	115.68	-172.32	58.84	9.15	7.86	1.29
GM-18I	109.03	9.03	60.06			
GM-18D	108.88	-186.12	57.11	15.12	7.74	7.38
GM-20I	103.88	3.88	62.54			
GM-20D	103.92	-117.08	60.42	17.53	18.22	-0.70
GM-21I	105.72	-29.28	63.17			
GM-21D	105.66	-177.34	57.33	39.44	43.97	-4.53
GM-74I	107.42	8.42	63.20			
GM-74D	107.43	-192.57	56.85	31.59	20.17	11.42
GM-79I	101.09	-73.91	55.60			
GM-79D	101.25	-183.75	54.42	10.74	15.48	-4.73

See last page for footnotes

Table 3. Comparison of January 2003 Observed Vertical Hydraulic Gradients to Model Predictions, Operable Unit 2 Hydraulic Effectuiveness Evaluation, Northrop Grumman Corporation, Bethpage, New York.

Well Pairing ID	Measuring Point Elevation (ft msl)	Well Screen Midpoint Elevation (ft msl)	1/29/2003 Water-Level Elevation (ft msl)	1/29/2003 Vertical Gradient (ft/ft) * 10^{-3}	Model-Predicted, OU2 Steady-State Vertical Gradient (ft/ft) * 10^{-3}	Increase Compared to Model-Predicted, Steady-State Vertical Gradient
Deep-Deep 2 Wells						
GM-15D	109.66	-227.34	56.82			
GM-15D2	109.59	-436.41	54.09	13.06	14.19	-1.13
GM-18D	108.88	-186.12	57.11			
GM-33D2	106.85	-403.15	51.07	27.83	12.30	15.53
GM-34D	71.19	-242.81	51.61			
GM-34D2	71.19	-443.81	50.14	7.31	2.33	4.98
GM-36D	91.63	-117.37	51.78			
GM-36D2	91.60	-443.40	49.80	6.07	2.75	3.32
GM-37D	97.26	-154.74	53.01			
GM-37D2	97.17	-282.83	52.33	5.31	3.88	1.43
GM-38D	91.75	-238.25	49.15			
GM-38D2	91.56	-393.44	46.72	15.66	6.08	9.57
GM-39D	102.23	-169.77	57.54			
GM-39D2	102.08	-312.92	54.28	22.77	13.46	9.31
GM-73D	104.87	-301.13	54.97			
GM-73D2	104.62	-437.38	52.49	18.20	18.78	-0.58
GM-74D	107.43	-192.57	56.85			
GM-74D2	107.36	-444.64	50.08	26.86	28.26	-1.40
N-10627	93.70	-198.80	55.83			
GM-75D2	93.63	-421.37	52.68	14.15	2.25	11.91

Vertical hydraulic gradients are calculated as follows:

$$\frac{(\text{Water-Level Elevation}_1 - \text{Water-Level Elevation}_2)}{(\text{Screen Midpoint Elevation}_1 - \text{Screen Midpoint Elevation}_2)}$$

1 - Shallower well of pairing
2 - Deeper well of pairing
A positive "+" gradient value indicates a downward hydraulic gradient.
A negative "-" gradient value indicates an upward hydraulic gradient.

ft msl feet relative to mean sea level
ft feet

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Table 4. Concentrations of Volatile Organic Compounds in Vertical Profile Borings, Operable Unit 2 Hydraulic Effectiveness Evaluation, Northrop Grumman Corporation, Bethpage, New York. [1]

CONSTITUENT (units in ug/L)	NYSDEC Standards Criteria and Guidance Values[2]	Site ID: / Sample Interval [3]: / Sample Date:	VPB-39 62-63 9/23/02	VPB-39 82-83 9/24/02	VPB-39 DUP1 9/24/02	VPB-39 102-103 9/24/02
Chloromethane	5		< 1	< 1	< 1	< 1
Bromomethane	5		< 1	< 1	< 1	< 1
Vinyl Chloride	2		< 1	< 1	< 1	< 1
Chloroethane	5		< 1	< 1	< 1	< 1
Methylene Chloride	5		< 1	< 1	< 1	< 1
Acetone	50		< 10	< 10	< 10	< 10
Carbon disulfide	50		< 1	< 1	< 1	< 1
1,1-Dichloroethene	5		< 1	< 1	< 1	< 1
1,1-Dichloroethane	5		< 1	< 1	< 1	< 1
1,2-Dichloroethene (total)	5		< 2	< 2	< 2	< 2
Chloroform	7		< 1	< 1	< 1	< 1
1,2-Dichloroethane	5		< 1	< 1	< 1	< 1
2-Butanone	50		< 10	< 10	< 10	< 10
1,1,1-Trichloroethane	5		< 1	< 1	< 1	< 1
Carbon Tetrachloride	5		< 1	< 1	< 1	< 1
Bromodichloromethane	50		< 1	< 1	< 1	< 1
1,2-Dichloropropane	5		< 1	< 1	< 1	< 1
cis-1,3-Dichloropropene	5		< 1	< 1	< 1	< 1
Trichloroethene	5		< 1	< 1	**1**	**1**
1,1,2-Trichloroethane	5		< 1	< 1	< 1	< 1
Benzene	0.7		< 1	< 1	< 1	< 1
trans-1,3-Dichloropropene	5		< 1	< 1	< 1	< 1
Bromoform	50		< 1	< 1	< 1	< 1
4-Methyl-2-pentanone	50		< 10	< 10	< 10	< 10
2-Hexanone	50		< 10	< 10	< 10	< 10
Tetrachloroethene	5		< 1	< 1	< 1	< 1
1,1,2,2-Tetrachloroethane	5		< 1	< 1	< 1	< 1
Toluene	5		< 1	< 1	< 1	< 1
Chlorobenzene	5		< 1	< 1	< 1	< 1
Ethyl Benzene	5		< 1	< 1	< 1	< 1
Styrene	5		< 1	< 1	< 1	< 1
m+p Xylene	5		< 2	< 2	< 2	< 2
o-Xylene	5		< 1	< 1	< 1	< 1
Xylene	5		< 1	< 1	< 1	< 1
Freon 113	5		< 1	< 1	< 1	< 1
Dichlorodifluomethane	5		< 1	< 1	< 1	< 1
ter.Butylmethylether	5		< 1	< 1	< 1	< 1
Trichlorofluomethane	5		< 3	< 3	< 3	< 3
Total VOCs			0	0	**1**	1

See last page for footnotes.

Table 4. Concentrations of Volatile Organic Compounds in Vertical Profile Borings, Operable Unit 2 Hydraulic Effectiveness Evaluation, Northrop Grumman Corporation, Bethpage, New York. [1]

CONSTITUENT (units in ug/L)	NYSDEC Standards Criteria and Guidance Values[2]	Site ID: / Sample Interval [3]: / Sample Date:	VPB-39 122-123 9/24/02	VPB-39 142-143 9/24/02	VPB-39 162-163 9/25/02	VPB-39 DUP-2 9/25/02
Chloromethane	5		< 1	< 1	< 1	< 1
Bromomethane	5		< 1	< 1	< 1	< 1
Vinyl Chloride	2		< 1	< 1	< 1	< 1
Chloroethane	5		< 1	< 1	< 1	< 1
Methylene Chloride	5		< 1	< 1	< 1	< 1
Acetone	50		< 10	< 10	< 10	< 10
Carbon disulfide	50		< 1	< 1	< 1	< 1
1,1-Dichloroethene	5		< 1	< 1	< 1	< 1
1,1-Dichloroethane	5		< 1	< 1	< 1	< 1
1,2-Dichloroethene (total)	5		< 2	< 2	< 2	< 2
Chloroform	7		< 1	< 1	< 1	< 1
1,2-Dichloroethane	5		< 1	< 1	< 1	< 1
2-Butanone	50		< 10	< 10	< 10	< 10
1,1,1-Trichloroethane	5		< 1	< 1	< 1	< 1
Carbon Tetrachloride	5		< 1	< 1	< 1	< 1
Bromodichloromethane	50		< 1	< 1	< 1	< 1
1,2-Dichloropropane	5		< 1	< 1	< 1	< 1
cis-1,3-Dichloropropene	5		< 1	< 1	< 1	< 1
Trichloroethene	5		< 1	< 1	**3**	< 1
1,1,2-Trichloroethane	5		< 1	< 1	< 1	< 1
Benzene	0.7		< 1	< 1	< 1	< 1
trans-1,3-Dichloropropene	5		< 1	< 1	< 1	< 1
Bromoform	50		< 1	< 1	< 1	< 1
4-Methyl-2-pentanone	50		< 10	< 10	< 10	< 10
2-Hexanone	50		< 10	< 10	< 10	< 10
Tetrachloroethene	5		< 1	< 1	< 1	< 1
1,1,2,2-Tetrachloroethane	5		< 1	< 1	< 1	< 1
Toluene	5		< 1	< 1	< 1	< 1
Chlorobenzene	5		< 1	< 1	< 1	< 1
Ethyl Benzene	5		< 1	< 1	< 1	< 1
Styrene	5		< 1	< 1	< 1	< 1
m+p Xylene	5		< 2	< 2	< 2	< 2
o-Xylene	5		< 1	< 1	< 1	< 1
Xylene	5		< 1	< 1	< 1	< 1
Freon 113	5		< 1	< 1	< 1	< 1
Dichlorodifluomethane	5		< 1	< 1	< 1	< 1
ter.Butylmethylether	5		< 1	< 1	< 1	< 1
Trichlorofluomethane	5		< 3	< 3	< 3	< 3
Total VOCs			0	0	**3**	0

See last page for footnotes.

Table 4. Concentrations of Volatile Organic Compounds in Vertical Profile Borings, Operable Unit 2 Hydraulic Effectiveness Evaluation, Northrop Grumman Corporation, Bethpage, New York. [1]

CONSTITUENT (units in ug/L)	NYSDEC Standards Criteria and Guidance Values[2]	Site ID: / Sample Interval [3]: / Sample Date:	VPB-39 182-183 9/25/02	VPB-39 202-203 9/25/02	VPB-39 222-223 9/25/02	VPB-39 262-263 9/25/02
Chloromethane	5		< 1	< 1	< 1	< 1
Bromomethane	5		< 1	< 1	< 1	< 1
Vinyl Chloride	2		< 1	< 1	< 1	< 1
Chloroethane	5		< 1	< 1	< 1	< 1
Methylene Chloride	5		< 1	< 1	< 1	< 1
Acetone	50		< 10	< 10	< 10	< 10
Carbon disulfide	50		< 1	< 1	< 1	< 1
1,1-Dichloroethene	5		< 1	< 1	< 1	< 1
1,1-Dichloroethane	5		< 1	< 1	< 1	< 1
1,2-Dichloroethene (total)	5		< 2	< 2	< 2	< 2
Chloroform	7		< 1	< 1	< 1	< 1
1,2-Dichloroethane	5		< 1	< 1	< 1	< 1
2-Butanone	50		< 10	< 10	< 10	< 10
1,1,1-Trichloroethane	5		< 1	< 1	< 1	< 1
Carbon Tetrachloride	5		< 1	< 1	< 1	< 1
Bromodichloromethane	50		< 1	< 1	< 1	< 1
1,2-Dichloropropane	5		< 1	< 1	< 1	< 1
cis-1,3-Dichloropropene	5		< 1	< 1	< 1	< 1
Trichloroethene	5		< 1	**25**	**2**	**120**
1,1,2-Trichloroethane	5		< 1	< 1	< 1	< 1
Benzene	0.7		< 1	< 1	< 1	< 1
trans-1,3-Dichloropropene	5		< 1	< 1	< 1	< 1
Bromoform	50		< 1	< 1	< 1	< 1
4-Methyl-2-pentanone	50		< 10	< 10	< 10	< 10
2-Hexanone	50		< 10	< 10	< 10	< 10
Tetrachloroethene	5		< 1	< 1	< 1	< 1
1,1,2,2-Tetrachloroethane	5		< 1	< 1	< 1	< 1
Toluene	5		< 1	< 1	< 1	< 1
Chlorobenzene	5		< 1	< 1	< 1	< 1
Ethyl Benzene	5		< 1	< 1	< 1	< 1
Styrene	5		< 1	< 1	< 1	< 1
m+p Xylene	5		< 2	< 2	< 2	< 2
o-Xylene	5		< 1	< 1	< 1	< 1
Xylene	5		< 1	< 1	< 1	< 1
Freon 113	5		< 1	< 1	< 1	< 1
Dichlorodifluomethane	5		< 1	< 1	< 1	< 1
ter.Butylmethylether	5		< 1	< 1	< 1	< 1
Trichlorofluomethane	5		< 3	< 3	< 3	< 3
Total VOCs			0	**25**	**2**	**120**

See last page for footnotes.

Table 4. Concentrations of Volatile Organic Compounds in Vertical Profile Borings, Operable Unit 2 Hydraulic Effectiveness Evaluation, Northrop Grumman Corporation, Bethpage, New York. [1]

CONSTITUENT (units in ug/L)	NYSDEC Standards Criteria and Guidance Values[2]	Site ID:	VPB-39	VPB-39	VPB-39	VPB-39
		Sample Interval [3]:	302-303	DM320	322-323	342-343
		Sample Date:	9/26/02	9/26/02	9/26/02	9/26/02
Chloromethane	5		< 1	< 1	< 1	< 1
Bromomethane	5		< 1	< 1	< 1	< 1
Vinyl Chloride	2		< 1	< 1	< 1	< 1
Chloroethane	5		< 1	< 1	< 1	< 1
Methylene Chloride	5		< 1	< 1	< 1	< 1
Acetone	50		< 10	< 10	< 10	< 10
Carbon disulfide	50		< 1	< 1	< 1	< 1
1,1-Dichloroethene	5		< 1	< 1	< 1	< 1
1,1-Dichloroethane	5		< 1	< 1	< 1	< 1
1,2-Dichloroethene (total)	5		< 2	< 2	< 2	< 2
Chloroform	7		< 1	< 1	< 1	< 1
1,2-Dichloroethane	5		< 1	< 1	< 1	< 1
2-Butanone	50		< 10	< 10	< 10	< 10
1,1,1-Trichloroethane	5		< 1	< 1	< 1	< 1
Carbon Tetrachloride	5		< 1	< 1	< 1	< 1
Bromodichloromethane	50		< 1	< 1	< 1	< 1
1,2-Dichloropropane	5		< 1	< 1	< 1	< 1
cis-1,3-Dichloropropene	5		< 1	< 1	< 1	< 1
Trichloroethene	5		**22**	**10**	**11**	**5**
1,1,2-Trichloroethane	5		< 1	< 1	< 1	< 1
Benzene	0.7		< 1	< 1	< 1	< 1
trans-1,3-Dichloropropene	5		< 1	< 1	< 1	< 1
Bromoform	50		< 1	< 1	< 1	< 1
4-Methyl-2-pentanone	50		< 10	< 10	< 10	< 10
2-Hexanone	50		< 10	< 10	< 10	< 10
Tetrachloroethene	5		< 1	< 1	< 1	< 1
1,1,2,2-Tetrachloroethane	5		< 1	< 1	< 1	< 1
Toluene	5		< 1	< 1	< 1	< 1
Chlorobenzene	5		< 1	< 1	< 1	< 1
Ethyl Benzene	5		< 1	< 1	< 1	< 1
Styrene	5		< 1	< 1	< 1	< 1
m+p Xylene	5		< 2	< 2	< 2	< 2
o-Xylene	5		< 1	< 1	< 1	< 1
Xylene	5		< 1	< 1	< 1	< 1
Freon 113	5		< 1	< 1	< 1	< 1
Dichlorodifluomethane	5		< 1	< 1	< 1	< 1
ter.Butylmethylether	5		< 1	< 1	< 1	< 1
Trichlorofluomethane	5		< 3	< 3	< 3	< 3
Total VOCs			**22**	**10**	**11**	**5**

See last page for footnotes.

Table 4. Concentrations of Volatile Organic Compounds in Vertical Profile Borings, Operable Unit 2 Hydraulic Effectiveness Evaluation, Northrop Grumman Corporation, Bethpage, New York. [1]

CONSTITUENT (units in ug/L)	NYSDEC Standards Criteria and Guidance Values[2]	Site ID: / Sample Interval [3]: / Sample Date:	VPB-39 362-363 9/26/02	VPB-39 DUP3 9/27/02	VPB-39 382-383 9/27/02	VPB-39 402-403 9/27/02
Chloromethane	5		< 1	< 1	< 1	< 1
Bromomethane	5		< 1	< 1	< 1	< 1
Vinyl Chloride	2		< 1	< 1	< 1	< 1
Chloroethane	5		< 1	< 1	< 1	< 1
Methylene Chloride	5		< 1	< 1	< 1	< 1
Acetone	50		< 10	< 10	< 10	< 10
Carbon disulfide	50		< 1	< 1	< 1	< 1
1,1-Dichloroethene	5		< 1	< 1	< 1	**2**
1,1-Dichloroethane	5		< 1	< 1	< 1	< 1
1,2-Dichloroethene (total)	5		< 2	< 2	< 2	**2**
Chloroform	7		< 1	< 1	< 1	< 1
1,2-Dichloroethane	5		< 1	< 1	< 1	< 1
2-Butanone	50		< 10	< 10	< 10	< 10
1,1,1-Trichloroethane	5		< 1	< 1	< 1	< 1
Carbon Tetrachloride	5		< 1	< 1	< 1	< 1
Bromodichloromethane	50		< 1	< 1	< 1	< 1
1,2-Dichloropropane	5		< 1	< 1	< 1	< 1
cis-1,3-Dichloropropene	5		< 1	< 1	< 1	< 1
Trichloroethene	5		**22**	**140**	**140**	**780**
1,1,2-Trichloroethane	5		< 1	< 1	< 1	< 1
Benzene	0.7		< 1	< 1	< 1	< 1
trans-1,3-Dichloropropene	5		< 1	< 1	< 1	< 1
Bromoform	50		< 1	< 1	< 1	< 1
4-Methyl-2-pentanone	50		< 10	< 10	< 10	< 10
2-Hexanone	50		< 10	< 10	< 10	< 10
Tetrachloroethene	5		< 1	**1**	**1**	**5**
1,1,2,2-Tetrachloroethane	5		< 1	< 1	< 1	< 1
Toluene	5		< 1	< 1	< 1	< 1
Chlorobenzene	5		< 1	< 1	< 1	< 1
Ethyl Benzene	5		< 1	< 1	< 1	< 1
Styrene	5		< 1	< 1	< 1	< 1
m+p Xylene	5		< 2	< 2	< 2	< 2
o-Xylene	5		< 1	< 1	< 1	< 1
Xylene	5		< 1	< 1	< 1	< 1
Freon 113	5		< 1	< 1	< 1	< 1
Dichlorodifluomethane	5		< 1	< 1	< 1	< 1
ter.Butylmethylether	5		< 1	< 1	< 1	< 1
Trichlorofluomethane	5		< 3	< 3	< 3	< 3
Total VOCs			**22**	**141**	**141**	**789**

See last page for footnotes.

Table 4. Concentrations of Volatile Organic Compounds in Vertical Profile Borings, Operable Unit 2 Hydraulic Effectiveness Evaluation, Northrop Grumman Corporation, Bethpage, New York. [1]

CONSTITUENT (units in ug/L)	NYSDEC Standards Criteria and Guidance Values[2]	Site ID: / Sample Interval [3]: / Sample Date:	VPB-39 421-422 9/30/02	VPB-39 442-443 9/30/02	VPB-39 492-493 10/1/02	VPB-39 502-503 10/1/02
Chloromethane	5		< 1	< 1	< 1	< 1
Bromomethane	5		< 1	< 1	< 1	< 1
Vinyl Chloride	2		< 1	< 1	< 1	< 1
Chloroethane	5		< 1	< 1	< 1	< 1
Methylene Chloride	5		< 1	< 1	< 1	< 1
Acetone	50		< 10	< 10	< 10	< 10
Carbon disulfide	50		< 1	< 1	< 1	< 1
1,1-Dichloroethene	5		< 1	< 1	< 1	< 1
1,1-Dichloroethane	5		< 1	< 1	< 1	< 1
1,2-Dichloroethene (total)	5		< 2	< 2	< 2	< 2
Chloroform	7		< 1	< 1	< 1	< 1
1,2-Dichloroethane	5		< 1	< 1	< 1	< 1
2-Butanone	50		< 10	< 10	< 10	< 10
1,1,1-Trichloroethane	5		< 1	< 1	< 1	< 1
Carbon Tetrachloride	5		< 1	< 1	< 1	< 1
Bromodichloromethane	50		< 1	< 1	< 1	< 1
1,2-Dichloropropane	5		< 1	< 1	< 1	< 1
cis-1,3-Dichloropropene	5		< 1	< 1	< 1	< 1
Trichloroethene	5		**14**	**49**	**4**	< 1
1,1,2-Trichloroethane	5		< 1	< 1	< 1	< 1
Benzene	0.7		< 1	< 1	< 1	< 1
trans-1,3-Dichloropropene	5		< 1	< 1	< 1	< 1
Bromoform	50		< 1	< 1	< 1	< 1
4-Methyl-2-pentanone	50		< 10	< 10	< 10	< 10
2-Hexanone	50		< 10	< 10	< 10	< 10
Tetrachloroethene	5		< 1	**4**	< 1	< 1
1,1,2,2-Tetrachloroethane	5		< 1	< 1	< 1	< 1
Toluene	5		< **1**	< 1	< 1	< 1
Chlorobenzene	5		< 1	< 1	< 1	< 1
Ethyl Benzene	5		< 1	< 1	< 1	< 1
Styrene	5		< 1	< 1	< 1	< 1
m+p Xylene	5		< 2	< 2	< 2	< 2
o-Xylene	5		< 1	< 1	< 1	< 1
Xylene	5		< 1	< 1	< 1	< 1
Freon 113	5		< 1	< 1	< 1	< 1
Dichlorodifluomethane	5		< 1	< 1	< 1	< 1
ter.Butylmethylether	5		< 1	< 1	< 1	< 1
Trichlorofluomethane	5		< 3	< 3	< 3	< 3
Total VOCs			**14**	**53**	**4**	0

See last page for footnotes.

Table 4. Concentrations of Volatile Organic Compounds in Vertical Profile Borings, Operable Unit 2 Hydraulic Effectiveness Evaluation, Northrop Grumman Corporation, Bethpage, New York. [1]

CONSTITUENT (units in ug/L)	NYSDEC Standards Criteria and Guidance Values[2]	Site ID: / Sample Interval [3]: / Sample Date:	VPB-39 522-523 10/1/02	VPB-39 542-543 10/1/02	VPB-39 562-563 10/2/02	VPB-39 582-583 10/2/02
Chloromethane	5		< 1	< 1	< 1	< 1
Bromomethane	5		< 1	< 1	< 1	< 1
Vinyl Chloride	2		< 1	< 1	< 1	< 1
Chloroethane	5		< 1	< 1	< 1	< 1
Methylene Chloride	5		< 1	< 1	< 1	< 1
Acetone	50		< 10	< 10	< 10	< 10
Carbon disulfide	50		< 1	< 1	< 1	< 1
1,1-Dichloroethene	5		< 1	< 1	< 1	< 1
1,1-Dichloroethane	5		< 1	< 1	< 1	< 1
1,2-Dichloroethene (total)	5		< 2	< 2	< 2	< 2
Chloroform	7		< 1	< 1	< 1	< 1
1,2-Dichloroethane	5		< 1	< 1	< 1	< 1
2-Butanone	50		< 10	< 10	< 10	< 10
1,1,1-Trichloroethane	5		< 1	< 1	< 1	< 1
Carbon Tetrachloride	5		< 1	< 1	< 1	< 1
Bromodichloromethane	50		< 1	< 1	< 1	< 1
1,2-Dichloropropane	5		< 1	< 1	< 1	< 1
cis-1,3-Dichloropropene	5		< 1	< 1	< 1	< 1
Trichloroethene	5		**3**	**44**	**23**	< 1
1,1,2-Trichloroethane	5		< 1	< 1	< 1	< 1
Benzene	0.7		< 1	< 1	< 1	< 1
trans-1,3-Dichloropropene	5		< 1	< 1	< 1	< 1
Bromoform	50		< 1	< 1	< 1	< 1
4-Methyl-2-pentanone	50		< 10	< 10	< 10	< 10
2-Hexanone	50		< 10	< 10	< 10	< 10
Tetrachloroethene	5		< 1	< 1	**9**	< 1
1,1,2,2-Tetrachloroethane	5		< 1	< 1	< 1	< 1
Toluene	5		< 1	< 1	< 1	< 1
Chlorobenzene	5		< 1	< 1	< 1	< 1
Ethyl Benzene	5		< 1	< 1	< 1	< 1
Styrene	5		< 1	< 1	< 1	< 1
m+p Xylene	5		< 2	< 2	< 2	< 2
o-Xylene	5		< 1	< 1	< 1	< 1
Xylene	5		< 1	< 1	< 1	< 1
Freon 113	5		< 1	< 1	< 1	< 1
Dichlorodifluomethane	5		< 1	< 1	< 1	< 1
ter.Butylmethylether	5		< 1	< 1	< 1	< 1
Trichlorofluomethane	5		< 3	< 3	< 3	< 3
Total VOCs			**3**	**44**	**32**	0

See last page for footnotes.

Table 4. Concentrations of Volatile Organic Compounds in Vertical Profile Borings, Operable Unit 2 Hydraulic Effectiveness Evaluation, Northrop Grumman Corporation, Bethpage, New York. [1]

CONSTITUENT (units in ug/L)	NYSDEC Standards Criteria and Guidance Values[2]	Site ID: / Sample Interval [3]: / Sample Date:	VPB-39 DM580 10/3/02	VPB-39 602-603 10/3/02	VPB-39 622-623 10/3/02	VPB-39 642-643 10/3/02
Chloromethane	5		< 1	< 1	< 1	< 1
Bromomethane	5		< 1	< 1	< 1	< 1
Vinyl Chloride	2		< 1	< 1	< 1	< 1
Chloroethane	5		< 1	< 1	< 1	< 1
Methylene Chloride	5		< 1	< 1	< 1	< 1
Acetone	50		< 10	< 10	< 10	< 10
Carbon disulfide	50		< 1	< 1	< 1	< 1
1,1-Dichloroethene	5		< 1	< 1	< 1	< 1
1,1-Dichloroethane	5		< 1	< 1	< 1	< 1
1,2-Dichloroethene (total)	5		< 2	< 2	< 2	< 2
Chloroform	7		< 1	< 1	< 1	< 1
1,2-Dichloroethane	5		< 1	< 1	< 1	< 1
2-Butanone	50		< 10	< 10	< 10	< 10
1,1,1-Trichloroethane	5		< 1	< 1	< 1	< 1
Carbon Tetrachloride	5		< 1	< 1	< 1	< 1
Bromodichloromethane	50		< 1	< 1	< 1	< 1
1,2-Dichloropropane	5		< 1	< 1	< 1	< 1
cis-1,3-Dichloropropene	5		< 1	< 1	< 1	< 1
Trichloroethene	5		< 1	**4**	**2**	**2**
1,1,2-Trichloroethane	5		< 1	< 1	< 1	< 1
Benzene	0.7		< 1	< 1	< 1	< 1
trans-1,3-Dichloropropene	5		< 1	< 1	< 1	< 1
Bromoform	50		< 1	< 1	< 1	< 1
4-Methyl-2-pentanone	50		< 10	< 10	< 10	< 10
2-Hexanone	50		< 10	< 10	< 10	< 10
Tetrachloroethene	5		< 1	< 1	< 1	< 1
1,1,2,2-Tetrachloroethane	5		< 1	< 1	< 1	< 1
Toluene	5		< 1	< 1	< 1	< 1
Chlorobenzene	5		< 1	< 1	< 1	< 1
Ethyl Benzene	5		< 1	< 1	< 1	< 1
Styrene	5		< 1	< 1	< 1	< 1
m+p Xylene	5		< 2	< 2	< 2	< 2
o-Xylene	5		< 1	< 1	< 1	< 1
Xylene	5		< 1	< 1	< 1	< 1
Freon 113	5		< 1	< 1	< 1	< 1
Dichlorodifluomethane	5		< 1	< 1	< 1	< 1
ter.Butylmethylether	5		< 1	< 1	< 1	< 1
Trichlorofluomethane	5		< 3	< 3	< 3	< 3
Total VOCs			0	**4**	**2**	**2**

See last page for footnotes.

Table 4. Concentrations of Volatile Organic Compounds in Vertical Profile Borings, Operable Unit 2 Hydraulic Effectiveness Evaluation, Northrop Grumman Corporation, Bethpage, New York. [1]

CONSTITUENT (units in ug/L)	NYSDEC Standards Criteria and Guidance Values[2]	Site ID: / Sample Interval [3]: / Sample Date:	VPB-73 22-23 8/20/02	VPB-73 42-43 8/20/02	VPB-73 DUP1 8/20/02	VPB-73 72-73 8/21/02
Chloromethane	5		< 1	< 1	< 1	< 1
Bromomethane	5		< 1	< 1	< 1	< 1
Vinyl Chloride	2		< 1	< 1	< 1	< 1
Chloroethane	5		< 1	< 1	< 1	< 1
Methylene Chloride	5		< 1	< 1	< 1	< 1
Acetone	50		**16**	< 10	< 10	**12**
Carbon disulfide	50		< 1	< 1	< 1	< 1
1,1-Dichloroethene	5		< 1	< 1	< 1	< 1
1,1-Dichloroethane	5		< 1	< 1	< 1	< 1
1,2-Dichloroethene (total)	5		< 2	< 2	< 2	< 2
Chloroform	7		< 1	< 1	< 1	< 1
1,2-Dichloroethane	5		< 1	< 1	< 1	< 1
2-Butanone	50		< 10	< 10	< 10	< 10
1,1,1-Trichloroethane	5		< 1	< 1	< 1	< 1
Carbon Tetrachloride	5		< 1	< 1	< 1	< 1
Bromodichloromethane	50		< 1	< 1	< 1	< 1
1,2-Dichloropropane	5		< 1	< 1	< 1	< 1
cis-1,3-Dichloropropene	5		< 1	< 1	< 1	< 1
Trichloroethene	5		< 1	< 1	< 1	< 1
1,1,2-Trichloroethane	5		< 1	< 1	< 1	< 1
Benzene	0.7		< 1	< 1	< 1	< 1
trans-1,3-Dichloropropene	5		< 1	< 1	< 1	< 1
Bromoform	50		< 1	< 1	< 1	< 1
4-Methyl-2-pentanone	50		< 10	< 10	< 10	< 10
2-Hexanone	50		< 10	< 10	< 10	< 10
Tetrachloroethene	5		< 1	< 1	< 1	< 1
1,1,2,2-Tetrachloroethane	5		< 1	< 1	< 1	< 1
Toluene	5		< 1	< 1	< 1	< 1
Chlorobenzene	5		< 1	< 1	< 1	< 1
Ethyl Benzene	5		< 1	< 1	< 1	< 1
Styrene	5		< 1	< 1	< 1	< 1
m+p Xylene	5		< 2	< 2	< 2	< 2
o-Xylene	5		< 1	< 1	< 1	< 1
Xylene	5		< 1	< 1	< 1	< 1
Freon 113	5		< 1	< 1	< 1	< 1
Dichlorodifluomethane	5		< 1	< 1	< 1	< 1
ter.Butylmethylether	5		< 1	< 1	< 1	< 1
Trichlorofluomethane	5		< 3	< 3	< 3	< 3
Total VOCs			**16**	0	0	**12**

See last page for footnotes.

Table 4. Concentrations of Volatile Organic Compounds in Vertical Profile Borings, Operable Unit 2 Hydraulic Effectiveness Evaluation, Northrop Grumman Corporation, Bethpage, New York. [1]

CONSTITUENT (units in ug/L)	NYSDEC Standards Criteria and Guidance Values[2]	Site ID: / Sample Interval [3]: / Sample Date:	VPB-73 82-83 8/21/02	VPB-73 102-103 8/21/02	VPB-73 122-123 8/21/02	VPB-73 142-143 8/21/02
Chloromethane	5		< 1	< 1	< 1	< 1
Bromomethane	5		< 1	< 1	< 1	< 1
Vinyl Chloride	2		< 1	< 1	< 1	< 1
Chloroethane	5		< 1	< 1	< 1	< 1
Methylene Chloride	5		< 1	< 1	< 1	< 1
Acetone	50		< 10	< 10	< 10	< 10
Carbon disulfide	50		< 1	< 1	< 1	< 1
1,1-Dichloroethene	5		< 1	< 1	< 1	< 1
1,1-Dichloroethane	5		< 1	< 1	< 1	< 1
1,2-Dichloroethene (total)	5		< 2	< 2	< 2	< 2
Chloroform	7		< 1	< 1	< 1	< 1
1,2-Dichloroethane	5		< 1	< 1	< 1	< 1
2-Butanone	50		< 10	< 10	< 10	< 10
1,1,1-Trichloroethane	5		< 1	< 1	< 1	< 1
Carbon Tetrachloride	5		< 1	< 1	< 1	< 1
Bromodichloromethane	50		< 1	< 1	< 1	< 1
1,2-Dichloropropane	5		< 1	< 1	< 1	< 1
cis-1,3-Dichloropropene	5		< 1	< 1	< 1	< 1
Trichloroethene	5		< 1	< 1	< 1	< 1
1,1,2-Trichloroethane	5		< 1	< 1	< 1	< 1
Benzene	0.7		< 1	< 1	< 1	< 1
trans-1,3-Dichloropropene	5		< 1	< 1	< 1	< 1
Bromoform	50		< 1	< 1	< 1	< 1
4-Methyl-2-pentanone	50		< 10	< 10	< 10	< 10
2-Hexanone	50		< 10	< 10	< 10	< 10
Tetrachloroethene	5		< 1	< 1	< 1	< 1
1,1,2,2-Tetrachloroethane	5		< 1	< 1	< 1	< 1
Toluene	5		< 1	< 1	< 1	< 1
Chlorobenzene	5		< 1	< 1	< 1	< 1
Ethyl Benzene	5		< 1	< 1	< 1	< 1
Styrene	5		< 1	< 1	< 1	< 1
m+p Xylene	5		< 2	< 2	< 2	< 2
o-Xylene	5		< 1	< 1	< 1	< 1
Xylene	5		< 1	< 1	< 1	< 1
Freon 113	5		< 1	< 1	< 1	< 1
Dichlorodifluomethane	5		< 1	< 1	< 1	< 1
ter.Butylmethylether	5		< 1	< 1	< 1	< 1
Trichlorofluomethane	5		< 3	< 3	< 3	< 3
Total VOCs			0	0	0	0

See last page for footnotes.

Table 4. Concentrations of Volatile Organic Compounds in Vertical Profile Borings, Operable Unit 2 Hydraulic Effectiveness Evaluation, Northrop Grumman Corporation, Bethpage, New York. [1]

CONSTITUENT (units in ug/L)	NYSDEC Standards Criteria and Guidance Values[2]	Site ID: / Sample Interval [3]: / Sample Date:	VPB-73 162-163 8/22/02	VPB-73 182-183 8/22/02	VPB-73 DUP-2 8/22/02	VPB-73 202-203 8/22/02
Chloromethane	5		< 1	< 1	< 1	< 1
Bromomethane	5		< 1	< 1	< 1	< 1
Vinyl Chloride	2		< 1	< 1	< 1	< 1
Chloroethane	5		< 1	< 1	< 1	< 1
Methylene Chloride	5		< 1	< 1	< 1	< 1
Acetone	50		< 10	< 10	< 10	< 10
Carbon disulfide	50		< 1	< 1	< 1	< 1
1,1-Dichloroethene	5		< 1	< 1	< 1	< 1
1,1-Dichloroethane	5		< 1	< 1	< 1	< 1
1,2-Dichloroethene (total)	5		< 2	< 2	< 2	< 2
Chloroform	7		< 1	< 1	< 1	< 1
1,2-Dichloroethane	5		< 1	< 1	< 1	< 1
2-Butanone	50		< 10	< 10	< 10	< 10
1,1,1-Trichloroethane	5		< 1	< 1	< 1	< 1
Carbon Tetrachloride	5		< 1	< 1	< 1	< 1
Bromodichloromethane	50		< 1	< 1	< 1	< 1
1,2-Dichloropropane	5		< 1	< 1	< 1	< 1
cis-1,3-Dichloropropene	5		< 1	< 1	< 1	< 1
Trichloroethene	5		< 1	< 1	< 1	< 1
1,1,2-Trichloroethane	5		< 1	< 1	< 1	< 1
Benzene	0.7		< 1	< 1	< 1	< 1
trans-1,3-Dichloropropene	5		< 1	< 1	< 1	< 1
Bromoform	50		< 1	< 1	< 1	< 1
4-Methyl-2-pentanone	50		< 10	< 10	< 10	< 10
2-Hexanone	50		< 10	< 10	< 10	< 10
Tetrachloroethene	5		< 1	< 1	< 1	< 1
1,1,2,2-Tetrachloroethane	5		< 1	< 1	< 1	< 1
Toluene	5		< 1	< 1	< 1	< 1
Chlorobenzene	5		< 1	< 1	< 1	< 1
Ethyl Benzene	5		< 1	< 1	< 1	< 1
Styrene	5		< 1	< 1	< 1	< 1
m+p Xylene	5		< 2	< 2	< 2	< 2
o-Xylene	5		< 1	< 1	< 1	< 1
Xylene	5		< 1	< 1	< 1	< 1
Freon 113	5		< 1	< 1	< 1	< 1
Dichlorodifluomethane	5		< 1	< 1	< 1	< 1
ter.Butylmethylether	5		< 2	< 2	< 2	< 1
Trichlorofluomethane	5		< 3	< 3	< 3	< 3
Total VOCs			0	0	0	0

See last page for footnotes.

Table 4. Concentrations of Volatile Organic Compounds in Vertical Profile Borings, Operable Unit 2 Hydraulic Effectiveness Evaluation, Northrop Grumman Corporation, Bethpage, New York. [1]

CONSTITUENT (units in ug/L)	NYSDEC Standards Criteria and Guidance Values[2]	Site ID:	VPB-73	VPB-73	VPB-73	VPB-73
		Sample Interval [3]:	222-223	242-243	262-263	282-283
		Sample Date:	8/22/02	8/22/02	8/22/02	8/26/02
Chloromethane	5		< 1	< 1	< 1	< 1
Bromomethane	5		< 1	< 1	< 1	< 1
Vinyl Chloride	2		< 1	< 1	< 1	< 1
Chloroethane	5		< 1	< 1	< 1	< 1
Methylene Chloride	5		< 1	< 1	< 1	< 1
Acetone	50		< 10	< 10	< 10	< 10
Carbon disulfide	50		< 1	< 1	< 1	< 1
1,1-Dichloroethene	5		< 1	< 1	< 1	< 1
1,1-Dichloroethane	5		< 1	< 1	< 1	< 1
1,2-Dichloroethene (total)	5		< 2	< 2	< 2	< 2
Chloroform	7		< 1	< 1	< 1	< 1
1,2-Dichloroethane	5		< 1	< 1	< 1	< 1
2-Butanone	50		< 10	< 10	< 10	< 10
1,1,1-Trichloroethane	5		< 1	< 1	< 1	< 1
Carbon Tetrachloride	5		< 1	< 1	< 1	< 1
Bromodichloromethane	50		< 1	< 1	< 1	< 1
1,2-Dichloropropane	5		< 1	< 1	< 1	< 1
cis-1,3-Dichloropropene	5		< 1	< 1	< 1	< 1
Trichloroethene	5		< 1	< 1	< 1	< 1
1,1,2-Trichloroethane	5		< 1	< 1	< 1	< 1
Benzene	0.7		< 1	< 1	< 1	< 1
trans-1,3-Dichloropropene	5		< 1	< 1	< 1	< 1
Bromoform	50		< 1	< 1	< 1	< 1
4-Methyl-2-pentanone	50		< 10	< 10	< 10	< 10
2-Hexanone	50		< 10	< 10	< 10	< 10
Tetrachloroethene	5		< 1	< 1	< 1	< 1
1,1,2,2-Tetrachloroethane	5		< 1	< 1	< 1	< 1
Toluene	5		< 1	< 1	< 1	< 1
Chlorobenzene	5		< 1	< 1	< 1	< 1
Ethyl Benzene	5		< 1	< 1	< 1	< 1
Styrene	5		< 1	< 1	< 1	< 1
m+p Xylene	5		< 2	< 2	< 2	< 2
o-Xylene	5		< 1	< 1	< 1	< 1
Xylene	5		< 1	< 1	< 1	< 1
Freon 113	5		< 1	< 1	< 1	< 1
Dichlorodifluomethane	5		< 1	< 1	< 1	< 1
ter.Butylmethylether	5		< 1	< 1	< 1	< 1
Trichlorofluomethane	5		< 3	< 3	< 3	< 3
Total VOCs			0	0	0	0

See last page for footnotes.

Table 4. Concentrations of Volatile Organic Compounds in Vertical Profile Borings, Operable Unit 2 Hydraulic Effectiveness Evaluation, Northrop Grumman Corporation, Bethpage, New York. [1]

CONSTITUENT (units in ug/L)	NYSDEC Standards Criteria and Guidance Values[2]	Site ID:	VPB-73	VPB-73	VPB-73	VPB-73
		Sample Interval [3]:	DUP3	302-303	322-323	362-363
		Sample Date:	8/26/02	8/26/02	8/26/02	8/27/02
Chloromethane	5		< 1	< 1	< 1	< 1
Bromomethane	5		< 1	< 1	< 1	< 1
Vinyl Chloride	2		< 1	< 1	< 1	< 1
Chloroethane	5		< 1	< 1	< 1	< 1
Methylene Chloride	5		< 1	< 1	< 1	< 1
Acetone	50		< 10	< 10	< 10	< 10
Carbon disulfide	50		< 1	< 1	< 1	< 1
1,1-Dichloroethene	5		< 1	< 1	< 1	< 1
1,1-Dichloroethane	5		< 1	< 1	< 1	< 1
1,2-Dichloroethene (total)	5		< 2	< 2	< 2	< 2
Chloroform	7		< 1	< 1	< 1	< 1
1,2-Dichloroethane	5		< 1	< 1	< 1	< 1
2-Butanone	50		< 10	< 10	< 10	< 10
1,1,1-Trichloroethane	5		< 1	< 1	< 1	< 1
Carbon Tetrachloride	5		< 1	< 1	< 1	< 1
Bromodichloromethane	50		< 1	< 1	< 1	< 1
1,2-Dichloropropane	5		< 1	< 1	< 1	< 1
cis-1,3-Dichloropropene	5		< 1	< 1	< 1	< 1
Trichloroethene	5		< 1	< 1	< 1	**3**
1,1,2-Trichloroethane	5		< 1	< 1	< 1	< 1
Benzene	0.7		< 1	< 1	< 1	< 1
trans-1,3-Dichloropropene	5		< 1	< 1	< 1	< 10
Bromoform	50		< 1	< 1	< 1	< 1
4-Methyl-2-pentanone	50		< 10	< 10	< 10	< 10
2-Hexanone	50		< 10	< 10	< 10	< 10
Tetrachloroethene	5		< 1	< 1	< 1	**3**
1,1,2,2-Tetrachloroethane	5		< 1	< 1	< 1	< 1
Toluene	5		< 1	< 1	< 1	< 1
Chlorobenzene	5		< 1	< 1	< 1	< 1
Ethyl Benzene	5		< 1	< 1	< 1	< 1
Styrene	5		< 1	< 1	< 1	< 1
m+p Xylene	5		< 2	< 2	< 2	< 1
o-Xylene	5		< 1	< 1	< 1	< 1
Xylene	5		< 1	< 1	< 1	< 1
Freon 113	5		< 1	< 1	< 1	< 1
Dichlorodifluomethane	5		< 1	< 1	< 1	< 1
ter.Butylmethylether	5		< 1	< 1	< 1	< 1
Trichlorofluomethane	5		< 3	< 3	< 3	< 10
Total VOCs			0	0	0	**6**

See last page for footnotes.

Table 4. Concentrations of Volatile Organic Compounds in Vertical Profile Borings, Operable Unit 2 Hydraulic Effectiveness Evaluation, Northrop Grumman Corporation, Bethpage, New York. [1]

CONSTITUENT (units in ug/L)	NYSDEC Standards Criteria and Guidance Values[2]	Site ID: / Sample Interval [3]: / Sample Date:	VPB-73 382-383 8/27/02	VPB-73 402-403 8/27/02	VPB-73 422-423 8/27/02	VPB-73 441-442 8/27/02
Chloromethane	5		< 1	< 1	< 1	< 1
Bromomethane	5		< 1	< 1	< 1	< 1
Vinyl Chloride	2		< 1	< 1	< 1	< 1
Chloroethane	5		< 1	< 1	< 1	< 1
Methylene Chloride	5		< 1	< 1	< 1	< 1
Acetone	50		< 10	< 10	< 10	< 10
Carbon disulfide	50		< 1	< 1	< 1	< 1
1,1-Dichloroethene	5		< 1	< 1	< 1	< 1
1,1-Dichloroethane	5		< 1	< 1	< 1	< 1
1,2-Dichloroethene (total)	5		< 2	< 2	**2**	< 2
Chloroform	7		< 1	< 1	< 1	< 1
1,2-Dichloroethane	5		< 1	< 1	< 1	< 1
2-Butanone	50		< 10	< 10	< 10	< 10
1,1,1-Trichloroethane	5		< 1	< 1	< 1	< 1
Carbon Tetrachloride	5		< 1	< 1	< 1	< 1
Bromodichloromethane	50		< 1	< 1	< 1	< 1
1,2-Dichloropropane	5		< 1	< 1	< 1	< 1
cis-1,3-Dichloropropene	5		< 1	< 1	< 1	< 1
Trichloroethene	5		**9**	**40**	**420**	**13**
1,1,2-Trichloroethane	5		< 1	< 1	< 1	< 1
Benzene	0.7		< 1	< 1	< 1	< 1
trans-1,3-Dichloropropene	5		< 1	< 10	< 1	< 1
Bromoform	50		< 1	< 1	< 1	< 1
4-Methyl-2-pentanone	50		< 10	< 10	< 10	< 10
2-Hexanone	50		< 10	< 10	< 10	< 10
Tetrachloroethene	5		< 1	**3**	**5**	**2**
1,1,2,2-Tetrachloroethane	5		< 1	< 1	< 1	< 1
Toluene	5		< 1	< 1	< 1	< 1
Chlorobenzene	5		< 1	< 1	< 1	< 1
Ethyl Benzene	5		< 1	< 1	< 1	< 1
Styrene	5		< 1	< 1	< 1	< 1
m+p Xylene	5		< 2	< 2	< 2	< 2
o-Xylene	5		< 1	< 1	< 1	< 1
Xylene	5		< 1	< 1	< 1	< 1
Freon 113	5		< 1	< 1	< 1	< 1
Dichlorodifluomethane	5		< 1	< 1	< 1	< 1
ter.Butylmethylether	5		< 1	< 1	< 1	< 1
Trichlorofluomethane	5		< 3	< 3	< 3	< 3
Total VOCs			**9**	**43**	**427**	**15**

See last page for footnotes.

Table 4. Concentrations of Volatile Organic Compounds in Vertical Profile Borings, Operable Unit 2 Hydraulic Effectiveness Evaluation, Northrop Grumman Corporation, Bethpage, New York. [1]

CONSTITUENT (units in ug/L)	NYSDEC Standards Criteria and Guidance Values[2]	Site ID: / Sample Interval [3]: / Sample Date:	VPB-73 461-462 8/28/02	VPB-73 482-483 8/28/02	VPB-73 502-503 8/28/02	VPB-73 522-523 8/28/02
Chloromethane	5		< 1	< 1	< 1	< 1
Bromomethane	5		< 1	< 1	< 1	< 1
Vinyl Chloride	2		< 1	< 1	< 1	< 1
Chloroethane	5		< 1	< 1	< 1	< 1
Methylene Chloride	5		< 1	< 1	< 1	< 1
Acetone	50		< 10	< 10	< 10	< 10
Carbon disulfide	50		< 1	< 1	< 1	< 1
1,1-Dichloroethene	5		< 1	< 1	< 1	< 1
1,1-Dichloroethane	5		< 1	< 1	< 1	**1**
1,2-Dichloroethene (total)	5		< 2	< 2	< 2	**2**
Chloroform	7		< 1	< 1	< 1	< 1
1,2-Dichloroethane	5		< 1	< 1	< 1	< 1
2-Butanone	50		< 10	< 10	< 10	< 10
1,1,1-Trichloroethane	5		< 1	< 1	< 1	**1**
Carbon Tetrachloride	5		< 1	< 1	< 1	< 1
Bromodichloromethane	50		< 1	< 1	< 1	< 1
1,2-Dichloropropane	5		< 1	< 1	< 1	< 1
cis-1,3-Dichloropropene	5		< 1	< 1	< 1	< 1
Trichloroethene	5		**370**	**14**	**33**	**330**
1,1,2-Trichloroethane	5		< 1	< 1	< 1	< 1
Benzene	0.7		< 1	< 1	< 1	< 1
trans-1,3-Dichloropropene	5		< 1	< 1	< 1	< 1
Bromoform	50		< 1	< 1	< 1	< 1
4-Methyl-2-pentanone	50		< 10	< 10	< 10	< 10
2-Hexanone	50		< 10	< 10	< 10	< 10
Tetrachloroethene	5		**4**	**5**	**2**	< 1
1,1,2,2-Tetrachloroethane	5		< 1	< 1	< 1	< 1
Toluene	5		< 1	< 1	< 1	< 1
Chlorobenzene	5		< 1	< 1	< 1	< 1
Ethyl Benzene	5		< 1	< 1	< 1	< 1
Styrene	5		< 1	< 1	< 1	< 1
m+p Xylene	5		< 2	< 2	< 2	< 2
o-Xylene	5		< 1	< 1	< 1	< 1
Xylene	5		< 1	< 1	< 1	< 1
Freon 113	5		< 1	< 1	< 1	< 1
Dichlorodifluomethane	5		< 1	< 1	< 1	< 1
ter.Butylmethylether	5		< 1	< 1	< 1	< 1
Trichlorofluomethane	5		< 3	< 3	< 3	< 3
Total VOCs			**374**	**19**	**35**	**334**

See last page for footnotes.

Table 4. Concentrations of Volatile Organic Compounds in Vertical Profile Borings, Operable Unit 2 Hydraulic Effectiveness Evaluation, Northrop Grumman Corporation, Bethpage, New York. [1]

CONSTITUENT (units in ug/L)	NYSDEC Standards Criteria and Guidance Values[2]	Site ID: / Sample Interval [3]: / Sample Date:	VPB-73 542-543 8/28/02	VPB-73 DUP4 8/28/02	VPB-73 562-563 8/30/02	VPB-73 592-593 9/3/02
Chloromethane	5		< 1	< 1	< 1	< 1
Bromomethane	5		< 1	< 1	< 1	< 1
Vinyl Chloride	2		< 1	< 1	< 1	< 1
Chloroethane	5		< 1	< 1	< 1	< 1
Methylene Chloride	5		< 1	< 1	< 1	< 1
Acetone	50		< 10	< 10	< 10	< 10
Carbon disulfide	50		< 1	< 1	< 1	< 1
1,1-Dichloroethene	5		< 1	< 1	< 1	< 1
1,1-Dichloroethane	5		< 1	< 1	< 1	< 1
1,2-Dichloroethene (total)	5		< 2	< 2	< 2	< 2
Chloroform	7		< 1	< 1	< 1	< 1
1,2-Dichloroethane	5		< 1	< 1	< 1	< 1
2-Butanone	50		< 10	< 10	< 10	< 10
1,1,1-Trichloroethane	5		< 1	< 1	< 1	< 1
Carbon Tetrachloride	5		< 1	< 1	< 1	< 1
Bromodichloromethane	50		< 1	< 1	< 1	< 1
1,2-Dichloropropane	5		< 1	< 1	< 1	< 1
cis-1,3-Dichloropropene	5		< 1	< 1	< 1	< 1
Trichloroethene	5		**60**	**58**	**11**	**2**
1,1,2-Trichloroethane	5		< 1	< 1	< 1	< 1
Benzene	0.7		< 1	< 1	< 1	< 1
trans-1,3-Dichloropropene	5		< 1	< 1	< 1	< 1
Bromoform	50		< 1	< 1	< 1	< 1
4-Methyl-2-pentanone	50		< 10	< 10	< 10	< 10
2-Hexanone	50		< 10	< 10	< 10	< 10
Tetrachloroethene	5		**2**	**2**	**2**	**3**
1,1,2,2-Tetrachloroethane	5		< 1	< 1	< 1	< 1
Toluene	5		< 1	< 1	< 1	< 1
Chlorobenzene	5		< 1	< 1	< 1	< 1
Ethyl Benzene	5		< 1	< 1	< 1	< 1
Styrene	5		< 1	< 1	< 1	< 1
m+p Xylene	5		< 2	< 2	< 2	< 2
o-Xylene	5		< 1	< 1	< 1	< 1
Xylene	5		< 1	< 1	< 1	< 1
Freon 113	5		< 1	< 1	< 1	< 1
Dichlorodifluomethane	5		< 1	< 1	< 1	< 1
ter.Butylmethylether	5		< 1	< 1	< 1	< 1
Trichlorofluomethane	5		< 3	< 3	< 3	< 3
Total VOCs			**62**	**60**	**13**	**5**

See last page for footnotes.

Table 4. Concentrations of Volatile Organic Compounds in Vertical Profile Borings, Operable Unit 2 Hydraulic Effectiveness Evaluation, Northrop Grumman Corporation, Bethpage, New York. [1]

CONSTITUENT (units in ug/L)	NYSDEC Standards Criteria and Guidance Values[2]	Site ID: / Sample Interval [3]: / Sample Date:	VPB-73 602-603 9/4/02	VPB-73 622-623 9/4/02	VPB-73 642-643 9/4/02	VPB-73 DUP5 9/4/02
Chloromethane	5		< 1	< 1	< 1	< 1
Bromomethane	5		< 1	< 1	< 1	< 1
Vinyl Chloride	2		< 1	< 1	< 1	< 1
Chloroethane	5		< 1	< 1	< 1	< 1
Methylene Chloride	5		< 1	< 1	< 1	< 1
Acetone	50		< 10	< 10	< 10	< 10
Carbon disulfide	50		< 1	< 1	< 1	< 1
1,1-Dichloroethene	5		< 1	< 1	< 1	< 1
1,1-Dichloroethane	5		< 1	< 1	< 1	< 1
1,2-Dichloroethene (total)	5		< 2	< 2	< 2	< 2
Chloroform	7		< 1	< 1	< 1	< 1
1,2-Dichloroethane	5		< 1	< 1	< 1	< 1
2-Butanone	50		< 10	< 10	< 10	< 10
1,1,1-Trichloroethane	5		< 1	< 1	< 1	< 1
Carbon Tetrachloride	5		< 1	< 1	< 1	< 1
Bromodichloromethane	50		< 1	< 1	< 1	< 1
1,2-Dichloropropane	5		< 1	< 1	< 1	< 1
cis-1,3-Dichloropropene	5		< 1	< 1	< 1	< 1
Trichloroethene	5		< 1	< 1	< 1	< 1
1,1,2-Trichloroethane	5		< 1	< 1	< 1	< 1
Benzene	0.7		< 1	< 1	< 1	< 1
trans-1,3-Dichloropropene	5		< 1	< 1	< 1	< 1
Bromoform	50		< 1	< 1	< 1	< 1
4-Methyl-2-pentanone	50		< 10	< 10	< 10	< 10
2-Hexanone	50		< 10	< 10	< 10	< 10
Tetrachloroethene	5		**2**	**1**	**1**	**1**
1,1,2,2-Tetrachloroethane	5		< 1	< 1	< 1	< 1
Toluene	5		< 1	< 1	< 1	< 1
Chlorobenzene	5		< 1	< 1	< 1	< 1
Ethyl Benzene	5		< 1	< 1	< 1	< 1
Styrene	5		< 1	< 1	< 1	< 1
m+p Xylene	5		< 2	< 2	< 2	< 2
o-Xylene	5		< 1	< 1	< 1	< 1
Xylene	5		< 1	< 1	< 1	< 1
Freon 113	5		< 1	< 1	< 1	< 1
Dichlorodifluomethane	5		< 1	< 1	< 1	< 1
ter.Butylmethylether	5		< 1	< 1	< 1	< 1
Trichlorofluomethane	5		< 3	< 3	< 3	< 3
Total VOCs			**2**	**1**	**1**	**0**

See last page for footnotes.

Table 4. Concentrations of Volatile Organic Compounds in Vertical Profile Borings, Operable Unit 2 Hydraulic Effectiveness Evaluation, Northrop Grumman Corporation, Bethpage, New York. (1)

Notes:

(1)	Data collected by Tetratech NUS, Inc. on behalf of the U.S. Navy.
(2)	Standards, Criteria, and Guidance (SCG) values based on documents referenced in the Groundwater Feasibility Study Report (ARCADIS Geraghty & Miller 2000); most stringent value listed.
(3)	Sampling intervals in feet below land surface.
VOCs	Volatile Organic Compounds
ug/L	Micrograms per liter
DM	Drilling Mud
DUP	Field Duplicate
NYSDEC	New York State Department of Environmental Conservation
	Value exceeds associated SCG value.

Freon 113 also known as 1,1,1-Trichloro-2,2,2-trifluoroethane.

Bold value indicates a detection.

Table 5. Concentrations of Volatile Organic Compounds in Monitoring Wells, Operable Unit 2 Hydraulic Effectiveness Evaluation, Northrop Grumman Corporation, Bethpage, New York. [1]

CONSTITUENT (Units in ug/L)	NYSDEC Standards Criteria and Guidance Values [2]	SITE ID:	GM-39D	GM-39D	GM-39D2	GM-39D2
		SAMPLE ID:	GM-39D	GM-39D	GM-39D2	GM-39D-2
		SAMPLE DATE:	11/26/02	01/07/03	11/25/02	01/07/03
Chloromethane	5		<5 J	<5	<5	<5
Bromomethane	5		<5	<5	<5	<5
Vinyl Chloride	2		<2	<2	<2	<2
Chloroethane	5		<5 J	<5	<5	<5
Methylene chloride	5		<5 J	<5	<5	<5
Acetone	50		<10 J	<10	<10 J	<10
Carbon disulfide	50		<5	<5	<5	<5
1,1-Dichloroethene	5		<5	<5	<5	<5
1,1-Dichloroethane	5		<5	<5	<5	<5
cis-1,2-Dichloroethene	5		<5	<5	<5	**0.6 J**
trans-1,2-Dichloroethene	5		<5	<5	<5	<5
Chloroform	7		<5	<5	<5	<5
1,2-Dichloroethane	5		<5	<5	<5	<5
2-Butanone	50		<10 J	<10	<10	<10
1,1,1-Trichloroethane	5		<5	<5	<5	<5
Carbon tetrachloride	5		<5	<5	<5	<5
Bromodichloromethane	50		<5	<5	<5	<5
1,2-Dichloropropane	5		<5	<5	<5	<5
cis-1,3-Dichloropropene	5		<5	<5	<5	<5
Trichloroethene	5		**23**	**21**	**110**	**110**
Dibromochloromethane	5		<5	<5	<5	<5
1,1,2-Trichloroethane	5		<5	<5	<5	<5
Benzene	0.7		<0.7	<0.7	<0.7	<0.7
trans-1,3-Dichloropropene	5		<5	<5	<5	<5
Bromoform	50		<5	<5	<5	<5
4-Methyl-2-pentanone	50		<10	<10	<10	<10
2-Hexanone	50		<10	<10	<10	<10
Tetrachloroethene	5		<5	<5	<5	**0.4 J**
1,1,2,2-Tetrachloroethane	5		<5	<5	<5	<5
Toluene	5		<5	<5	<5	<5
Chlorobenzene	5		<5	<5	<5	<5
Ethylbenzene	5		<5	<5	<5	<5
Styrene	5		<5	<5	<5	<5
Xylene (total)	5		<5	<5	<5	<5
Vinyl Acetate	NE		<5	<5	<5	<5
Freon-113	5		<5	<5	<5	<5
Total VOCs			**23**	**21**	**110**	**111**

See last page for footnotes

Table 5. Concentrations of Volatile Organic Compounds in Monitoring Wells, Operable Unit 2 Hydraulic Effectiveness Evaluation, Northrop Grumman Corporation, Bethpage, New York. [1]

CONSTITUENT (Units in ug/L)	NYSDEC Standards Criteria and Guidance Values [2]	SITE ID:	GM-73D	GM-73D	GM-73D	GM-73D	GM-73D2
		SAMPLE ID:	GM-73D	GM-73D	REP-1	73D	GM-73D2
		SAMPLE DATE:	10/18/02	11/25/02	11/25/02	01/15/03	06/19/02
Chloromethane	5		<25	<5	<5	<25	<25
Bromomethane	5		<25	<5	<5	<25 J	<25
Vinyl Chloride	2		<10	<2	<2	<10	<10
Chloroethane	5		<25	<5	<5	<25	<25
Methylene chloride	5		<25	<5	<5	<25	<25
Acetone	50		<50	<10	<10	<50 J	<50 J
Carbon disulfide	50		<25	<5	<5	<25	<25
1,1-Dichloroethene	5		<25	<5	<5	<25	<25
1,1-Dichloroethane	5		<25	<5	<5	<25	<25
cis-1,2-Dichloroethene	5		<25	<5	<5	<25	**3 J**
trans-1,2-Dichloroethene	5		<25	<5	<5	<25	<25
Chloroform	7		<25	<5	<5	<25	<25
1,2-Dichloroethane	5		<25	<5	<5	<25	<25
2-Butanone	50		<50	<10	<10	<50 J	<50
1,1,1-Trichloroethane	5		<25	<5	<5	<25	<25
Carbon tetrachloride	5		<25	<5	<5	<25	<25
Bromodichloromethane	50		<25	<5	<5	<25	<25
1,2-Dichloropropane	5		<25	<5	<5	<25	<25
cis-1,3-Dichloropropene	5		<25	<5	<5	<25	<25
Trichloroethene	5		**780**	**510**	**490**	**680**	**840**
Dibromochloromethane	5		<25	<5	<5	<25	<25
1,1,2-Trichloroethane	5		<25	<5	<5	<25	<25
Benzene	0.7		<4	<0.7	<0.7	<4	<4
trans-1,3-Dichloropropene	5		<25	<5	<5	<25	<25
Bromoform	50		<25	<5	<5	<25	<25
4-Methyl-2-pentanone	50		<50	<10	<10	<50	<50
2-Hexanone	50		<50	<10	<10	<50 J	<50
Tetrachloroethene	5		<25	<5	<5	**2 J**	<25
1,1,2,2-Tetrachloroethane	5		<25	<5	<5	<25	<25
Toluene	5		<25	<5	<5	<25	<25
Chlorobenzene	5		<25	<5	<5	<25	<25
Ethylbenzene	5		<25	<5	<5	<25	<25
Styrene	5		<25	<5	<5	<25	<25
Xylene (total)	5		<25	<5	<5	<25	<25
Vinyl Acetate	NE		<25 J	<5	<5	<25	<25
Freon-113	5		<25	<5	<5	<25	<25
Total VOCs			**780**	**510**	**490**	**682**	**843**

See last page for footnotes

Table 5. Concentrations of Volatile Organic Compounds in Monitoring Wells, Operable Unit 2 Hydraulic Effectiveness Evaluation, Northrop Grumman Corporation, Bethpage, New York. [1]

CONSTITUENT (Units in ug/L)	NYSDEC Standards Criteria and Guidance Values [2]	SITE ID:	GM-73D2	GM-73D2
		SAMPLE ID:	GM-73D2	GM-73D-2
		SAMPLE DATE:	11/22/02	01/13/03
Chloromethane	5		<5	<50
Bromomethane	5		<5	<50 J
Vinyl Chloride	2		<2	<20
Chloroethane	5		<5	<50
Methylene chloride	5		<5	<50
Acetone	50		<10	<100
Carbon disulfide	50		<5	<50
1,1-Dichloroethene	5		<5	<50
1,1-Dichloroethane	5		<5	<50
cis-1,2-Dichloroethene	5		<5	<50
trans-1,2-Dichloroethene	5		<5	<50
Chloroform	7		<5	<50
1,2-Dichloroethane	5		<5	<50
2-Butanone	50		<10	<100
1,1,1-Trichloroethane	5		<5	<50
Carbon tetrachloride	5		<5	<50
Bromodichloromethane	50		<5	<50
1,2-Dichloropropane	5		<5	<50
cis-1,3-Dichloropropene	5		<5	<50
Trichloroethene	5		**1200**	**1100**
Dibromochloromethane	5		<5	<50
1,1,2-Trichloroethane	5		<5	<50
Benzene	0.7		<0.7	<7
trans-1,3-Dichloropropene	5		<5	<50
Bromoform	50		<5	<50
4-Methyl-2-pentanone	50		<10	<100 J
2-Hexanone	50		<10	<100
Tetrachloroethene	5		**4**	**5 J**
1,1,2,2-Tetrachloroethane	5		<5	<50
Toluene	5		<5	<50
Chlorobenzene	5		<5	<50
Ethylbenzene	5		<5	<50
Styrene	5		<5	<50
Xylene (total)	5		<5	<50
Vinyl Acetate	NE		<5	<50 J
Freon-113	5		<5	<50
Total VOCs			**1204**	**1105**

See last page for footnotes

Table 5. Concentrations of Volatile Organic Compounds in Monitoring Wells, Operable Unit 2 Hydraulic Effectiveness Evaluation, Northrop Grumman Corporation, Bethpage, New York. [1]

Notes

[1] Groundwater sampling data collected by ARCADIS G&M, Inc. on behalf of Northrop Grumman Corporation.

[2] Standards, Criteria, and Guidance (SCG) values based on documents referenced in the Groundwater Feasibility Study Report (ARCADIS Geraghty & Miller 2000); most stringent value listed.

VOCs Volatile organic compounds

ug/L Micrograms per liter

J Estimated value

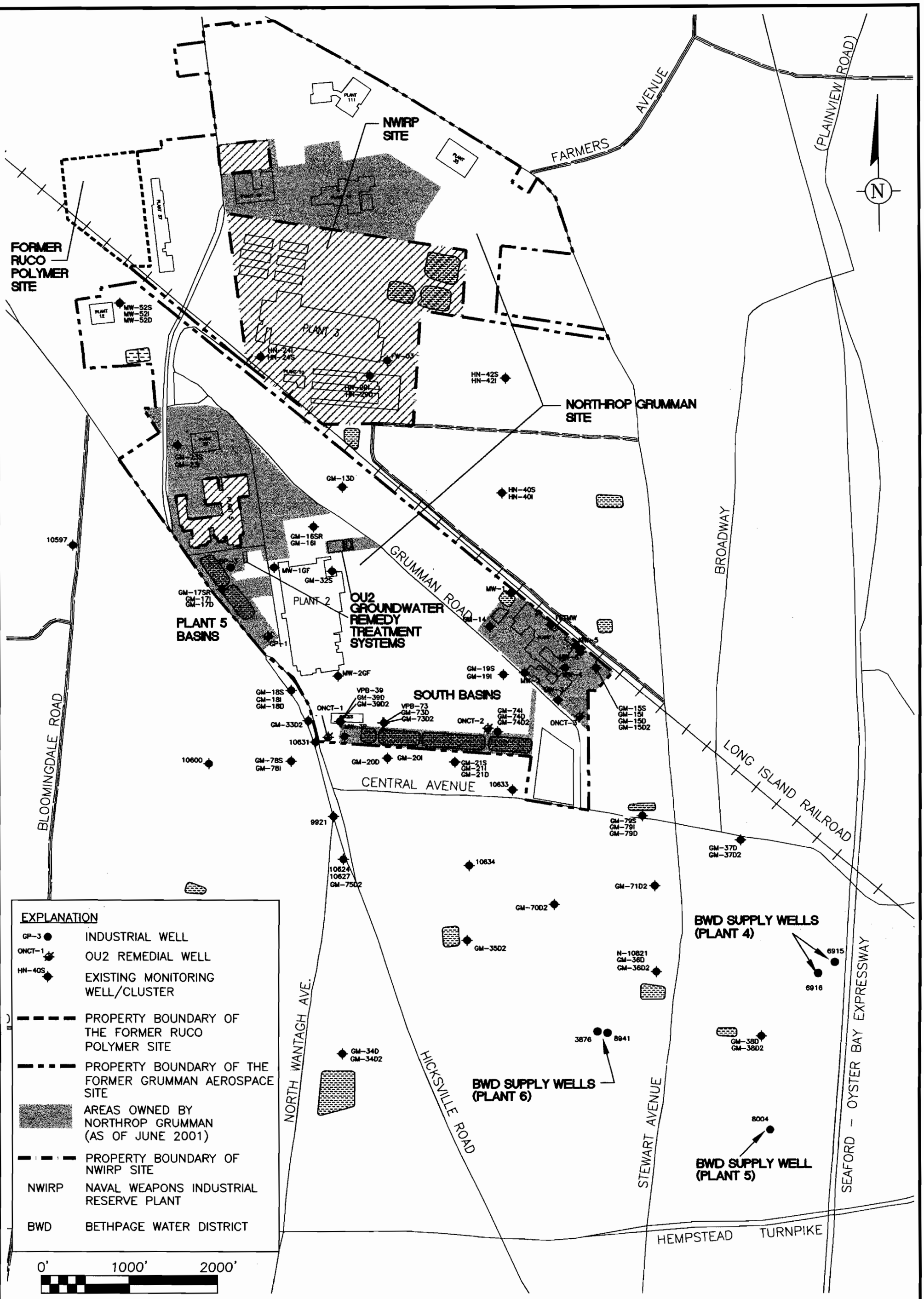
NYSDEC New York State Department of Environmental Conservation

Freon 113 also known as 1,1,1-Trichloro-2,2,2-trifluoroethane.

[ ] Value exceeds associated SCG value.

NE No SCG established

Bold value indicates a detection.



FILE: G:\PROJECT\NORTHROP GRUMMAN\CADD\OU2SYS_LOCATION_REV5.DWG, DATE: 05/07/2003 12:08:53PM, LAYOUT NAME: REMEDIAL

ARCADIS G&M 65 DUFFY ROAD MELVILLE, NEW YORK 11747 TEL: 516/249-7600 FAX: 516/249-7610	NORTHROP GRUMMAN CORPORATION BETHPAGE, NEW YORK	DRAWN A.G.	DATE 10/23/02	PROJECT MANAGER CSG	DEPARTMENT MANAGER
	LOCATION OF OU2 GROUNDWATER REMEDY AND WELLS			LEAD DESIGN PROF.	CHECKED D.S.
				PROJECT NUMBER NY001348.001	DRAWING NUMBER 1

Appendix A

ARCADIS Water-Level Measurement and Sample Collection Logs

ARCADIS GERAGHTY & MILLER

Water Level/Pumping Test Record

Page 1 of 1

Project NY001348.0006.00002 Well — Site Northrop Grumman

Screen Setting — Measuring Point Description — Height Above Ground Surface —

Static Water Level — Measured With — Date/Time 11/22/02

Drawdown ☐ Start of Test — Pumping Well Oact 1, 2, 3 / GP-1

Recovery ☐ End of Test —

Distance From Well Measured To Pumping Well® — Discharge Rate — Orifice —

Date & Time	Well Or t (mins)	Held (ft)	Wet (ft)	Depth to Water (ft)	s (ft)	Dew. 1) Corr. (ft)	Art. 2) s' (ft)		Q (gpm)	Mano-meter (in)	Remarks 3) BLOW
11/22/02											
Oact-2				69.36							725.4 gpm
OACT-1				75.35							870.4 gpm
GM39-D				45.42							no lock
GM39-D2				48.46							no lock
OACT-3				71.12							568.8 gpm
GM15-I				51.10							needs new lock, keyho cement
GM15-S				51.43							needs new sea for s
GM15-D2				56.24							
GM 15-D				53.73							
GM 33-D2				56.63							
GM 21-D				49.09							
GM 21-I				42.94							
GM 21-S				40.80							
GM 20-D				44.20							
GM-20-I				42.06							
GM-74-I				44.99							Grout fell
GM-74-D				51.35							
GM-74-D2				51.52							
GM-73D				50.41							
GM-73D2				52.66							needs new sanitary seal
GP-1				97.00							1100 gpm

1) Dewatering Correction 2) Equivalent Artesian Drawdown 3) pH, Spec. Cond., Temp., Weather, Sand, Turbidity, etc.

ARCADIS GERAGHTY & MILLER

Laboratory Task Order No./P.O. No. _____

CHAIN-OF-CUSTODY RECORD

Page 1 of 1

Project Number/Name NY001348.0006.00002

Project Location Bethpage NY

Laboratory STL

Project Manager David Stern

Sampler(s)/Affiliation SH/KS

ANALYSIS / METHOD / SIZE

Sample ID/Location	Matrix	Date/Time Sampled	Lab ID	40 ML VOA VITAL (UNP) VOC ASP 95-1						Remarks	Total
GM-39D	L	11/26/02		2							2
TB 11/26/02	L	↓		2							2
FB 11/26/02	L	↓		2							2

Sample Matrix: L = Liquid; S = Solid; A = Air

Total No. of Bottles/Containers 6

Relinquished by: Shawn Blaley	Organization: Arcadis GM	Date 11/26/02	Time	Seal Intact?
Received by:	Organization:	Date / /	Time	Yes No N/A
Relinquished by:	Organization:	Date / /	Time	Seal Intact?
Received by:	Organization:	Date / /	Time	Yes No N/A

Special Instructions/Remarks:

Delivery Method: ☐ In Person ☒ Common Carrier Fed Ex (SPECIFY) ☐ Lab Courier ☐ Other _____ (SPECIFY)

AG 05-0587

ARCADIS GERAGHTY & MILLER

Laboratory Task Order No./P.O. No. _____

CHAIN-OF-CUSTODY RECORD

Page 1 of 1

Project Number/Name 14001348.0006.00002

Project Location Bethpage NY

Laboratory STL

Project Manager David Stern

Sampler(s)/Affiliation SH / BH

Sample ID/Location	Matrix	Date/Time Sampled	Lab ID	40 ML VOA VIAL (HCl) VOC (ASP-95-1)						Remarks	Total
GM 73D	L	11/25/02		2							2
GM 39D2				6 (+ MS/MSD)							6
REP-1				2							2
TB 11/25/02				2							2
FB 11/25/02				2							2

Sample Matrix: L = Liquid; S = Solid; A = Air

Total No. of Bottles/ Containers 14

Relinquished by: Shawn Kealy	Organization: Arcadis G&M	Date 11/25/02	Time _____	Seal Intact?	
Received by: _____	Organization: _____	Date / /	Time _____	Yes	No N/A
Relinquished by: _____	Organization: _____	Date / /	Time _____	Seal Intact?	
Received by: _____	Organization: _____	Date / /	Time _____	Yes	No N/A

Special Instructions/Remarks: _____

+ Please Use GM 39D2 For A MS/MSD

Delivery Method: ☐ In Person ☒ Common Carrier Fed Ex ☐ Lab Courier ☐ Other _____

SPECIFY SPECIFY

AG 05-0597

ARCADIS GERAGHTY & MILLER

Laboratory Task Order No./P.O. No. _____

CHAIN-OF-CUSTODY RECORD

Page _____ of _____

Project Number/Name NY001348.0006.00002

Project Location Bethpage, NY

Laboratory STL J

Project Manager David Stern

Sampler(s)/Affiliation SH / BH

Sample ID/Location	Matrix	Date/Time Sampled	Lab ID	ANALYSIS / METHOD / SIZE: 40 ML VOA VIAL (UNP) VOC (ASP 95-1)						Remarks	Total
GM-73D2	L	11/22/02		2							2
TB 11/22/02	L	↓		2							2
										Total No. of Bottles/ Containers	4

Sample Matrix: L = Liquid; S = Solid; A = Air

Relinquished by: Shawn Neely	Organization: Arcadis G&M	Date 11/22/02	Time _____	Seal Intact?	
Received by: _____	Organization: _____	Date / /	Time _____	Yes	No N/A
Relinquished by: _____	Organization: _____	Date / /	Time _____	Seal Intact?	
Received by: _____	Organization: _____	Date / /	Time _____	Yes	No N/A

Special Instructions/Remarks: E-Port to David Stern

Delivery Method: ☐ In Person ☑ Common Carrier FED-EX (SPECIFY) ☐ Lab Courier ☐ Other _____ (SPECIFY)

ARCADIS G&M, Inc.

Low-Flow Groundwater Sampling Log

Project Number: NY001348.0006 Task: 0002 Well ID: GM-39D
Date: 11/26/02 Sampled By: SH/KS
Sampling Time: 1160 Recorded By: SH/KS
Weather: Clear, 50° Coded Replicate No.: None

Instrument Identification
Water Quality Meter(s): Horiba U-22 Serial #: — 00946

Purging Information
Casing Material: PVC Purge Method: Low Flow / Non Ded. Bladder
Casing Diameter: 4" Screen Interval (ft bmp): Top 262 Bottom 282
Sounded Depth (ft bmp): 282 Pump Intake Depth (ft bmp): 272
Depth to Water (ft bmp): 45.37 (Before Install. of Pump) Purge time Start: 1150 Finish:

Field Parameter Measurements Taken During Purging

Time	Minutes Elapsed	Rate (mL/min)	Volume Purged	Temp (°C)	pH (SI Units)	Conductivity (mS/cm)	REDOX (mV)	DO (mg/L)	Turbidity (NTU)	Depth to Water (ft bmp)	Comments
1155				14.3	5.80	.121	190	8.55	2.7	—	
1200				14.3	6.08	.094	183	8.73	374	44.55'	
1205				14.0	5.73	.093	204	8.83	220	—	
1210				13.9	5.73	.093	255	8.83	210	—	
1215				14.1	5.76	.093	218	8.79	302	—	
1220				14.2	5.77	.093	221	8.79	354	—	
1225				14.2	5.72	.093	221	8.85	407	44.73	
1230				13.8	5.76	.093	227	8.86	465	—	
1235				13.8	5.72	.093	226	8.80	413	—	
1240				14.0	5.75	.094	227	8.85	283	—	
1245				13.9	5.75	.094	227	8.77	246	—	
1250				14.1	5.77	.094	228	8.80	209	~~43~~ 44.84	SH
1255				14.0	5.75	.094	228	8.84	140	—	
									31.0	— Cleaned Bottom	
										of Flow Cell — Sediment	
										had dropped out of	
										column of Water	

Sample Condition Color: None Odor: None Appearance: Turbid
Sample Collection

Parameter:	Container:	No.	Preservative:
VOC	40 ML VOA VIAL	2	None

PID Reading —

Comments # 20' Screen #

ARCADIS G&M, Inc.

Low-Flow Groundwater Sampling Log

Project Number: NV001348.0006 Task: 00007 Well ID: GM-39D2
Date: 11/25/02 Sampled By: SH/BH
Sampling Time: 1400 Recorded By: SH/BH
Weather: Clear, 55° Coded Replicate No.: None

Instrument Identification
Water Quality Meter(s): Mult. (In House Equipment) Serial #: —

Purging Information
Casing Material: PVC Purge Method: Low Flow / Non-Ded. Bladder
Casing Diameter: 4" Screen Interval (ft bmp): Top 410 Bottom 420
Sounded Depth (ft bmp): 420 Pump Intake Depth (ft bmp): 415
Depth to Water (ft bmp): 48.50 Purge time Start: 1425 Finish: 1535

Field Parameter Measurements Taken During Purging

Time	Minutes Elapsed	Rate (mL/min)	Volume Purged	Temp (°C)	pH (SI Units)	Conductivity (mS/cm)	REDOX (mV)	DO (mg/L)	Turbidity (NTU)	Depth to Water (ft bmp)	Comments
2:25				14.6	7.12	333	223	1.80		48.50	
2:30				14.4	6.85	309	231	1.94			
2:35				14.3	6.79	290	233	1.95		47.15	
2:40				14.4	6.49	278	240	1.99			
2:45				14.3	6.13	304	256	2.09		45.73	
2:50				14.4	5.74	364	269	2.06			
2:55				14.4	5.62	375	272	2.00			
3:00				14.2	5.54	393	279	2.06			
3:05				14.2	5.54	373	280	2.06		45.63	
3:10				14.2	5.53	389	282	2.04			
3:15				14.2	5.52	388	282	2.00			
3:20				14.2	5.52	397	285	1.99			
3:24				14.2	5.52	394	286	1.97	267		

Sample Condition Color: Clear Odor: None Appearance: Turbid.
Sample Collection

Parameter:	Container:	No.	Preservative:
VOC	40 mL VOA VIAL	2 —	None

PID Reading

Comments * DO Meter not Working Properly, Will be used to show stability. Not for Groundwater Parameter Readings.

ARCADIS G&M, Inc.

Low-Flow Groundwater Sampling Log

Project Number: IN900134 8.0006.0000 Task: 2 Well ID: 73D2
Date: 11.22.02 Sampled By: BH SH
Sampling Time: 1030 - 1515 Recorded By: BH SH
Weather: Cloudy - 55° Coded Replicate No.: —

Instrument Identification
Water Quality Meter(s): Horiba U-22 Serial #: 00946

Purging Information
Casing Material: PVC Purge Method: Dedicated Bladder Pump / Low Flow
Casing Diameter: 4" Screen Interval (ft bmp): Top — Bottom —
Sounded Depth (ft bmp): Pump Intake Depth (ft bmp):
Depth to Water (ft bmp): 52.66 Purge time Start: 1220 Finish: 1500
Pump on 12:20

Field Parameter Measurements Taken During Purging

Time	Minutes Elapsed	Rate (mL/min)	Volume Purged	Temp (°C)	pH (SI Units)	Conductivity (mS/cm)	REDOX (mV)	DO (mg/L)	Turbidity (NTU)	Depth to Water (ft bmp)	Comments
12:20				16.27	5.52	0.002	329	10.65	1.5	52.70	
12:25				16.03	5.71	0.027	323	17.06	12.3		
12:30				16.25	5.49	0.100	348	19.99	24.2	52.75	
12:35				16.06	5.23	0.115	356	9.10	7.0		
12:40				16.10	5.22	0.115	356	9.11	6.0		
12:45				16.07	5.22	0.116	357	8.81	5.7		
12:50				16.15	5.22	0.116	363	8.55	5.4		
12:55				16.10	5.19	0.116	365	8.37	5.3		
1:00				16.19	5.21	0.116	368	8.35	5.3	52.72	
1:05				16.19	5.20	0.116	372	8.29	4.4		
1:10				16.19	5.20	0.116	373	8.29	4.3		
1:15				stopped Pumping (switch Compressors)							
~~1:20~~											
1430				16.14	5.21	.115	394	11.13	4.1	—	
1435				16.21	5.14	.115	385	8.56	21.3	52.72	
1440				16.21	5.14	.115	388	8.20	10.7		
1445				16.17	5.10	.115	392	8.14	6.7		
1450				16.22	5.10	.115	394	8.09	3.7		
1455				16.20	5.06	.114	395	7.99	2.9	52.70	

Sample Condition
Color: None Odor: None Appearance: Clear

Sample Collection

Parameter:	Container:	No.	Preservative:
VOC	40 ML VOA VIAL	2	None

PID Reading: 0.0

Comments: —

ARCADIS G&M, Inc.

Low-Flow Groundwater Sampling Log

Project Number: N40013478.0006 Task: 00002 Well ID: GM-730
Date: 11/25/02 Sampled By: SH/BH
Sampling Time: 10^30 - 1300 Recorded By: SH/BH
Weather: Clear, 60° Coded Replicate No.: Rep-1

Instrument Identification
Water Quality Meter(s): Mult. (In house Equipment) Serial #: —

Purging Information
Casing Material: PVC Purge Method: Low Flow / Non Ded. Bladder
Casing Diameter: 4" Screen Interval (ft bmp): Top 401 Bottom 411
Sounded Depth (ft bmp): 411 Pump Intake Depth (ft bmp): 406
Depth to Water (ft bmp): 50.~~87~~45 (SH) Purge time Start: 11:30 Finish: 1240

Field Parameter Measurements Taken During Purging

Time	Minutes Elapsed	Rate (mL/min)	Volume Purged	Temp (°C)	pH (SI Units)	Conductivity (mS/cm)	REDOX (mV)	DO (mg/L)	Turbidity (NTU)	Depth to Water (ft bmp)	Comments
11:30				13.4	7.65	459	125	—		50.~~87~~45	(SH)
11:35				14.4	6.94	381	209	—			
11:40				13.9	6.26	301	246	1.36			
11:45				13.9	5.93	354	259	1.40			
11:50				14.0	5.92	352	260	1.40			
11:55				14.0	5.86	359	260	1.40			
12:00				14.2	5.83	354	262	1.34		50.43	
12:05				14.3	5.70	355	269	1.38			
12:10				14.3	5.63	345	271	1.38			
12:15				14.3	5.61	346	275	1.37			
12:20				14.3	5.60	344	279	1.34			
12:25				14.4	5.54	345	280	1.35			
12:30				14.4	5.56	338	281	1.34	247	50.45	

Sample Condition Color: None Odor: None Appearance: Turbid
Sample Collection

Parameter:	Container:	No.	Preservative:
VOC	40 ML VOA VIAL	2	None

PID Reading —

Comments # DO Meter not working Properly - Will be Used to just Show Stability #

ARCADIS GERAGHTY & MILLER

Laboratory Task Order No./P.O. No. _____

CHAIN-OF-CUSTODY RECORD

Page 1 of 1

Project Number/Name NY001348.0000.00002

Project Location Binghamton, NY

Laboratory STL

Project Manager David Shea

Sampler(s)/Affiliation SH/KS

Sample ID/Location	Matrix	Date/Time Sampled	Lab ID	40 ML VOA VIAL 1:1 HCl VOC ASP 95-1						Remarks	Total
				ANALYSIS / METHOD / SIZE							
CM-39D	L	11/26/02		2							2
TB 11/26/02	L	↓		2							2
FB 11/26/02	L	↓		2							2

Sample Matrix: L = Liquid; S = Solid; A = Air

Total No. of Bottles/ Containers: 6

				Seal Intact?
Relinquished by: [signature]	Organization: Arcadis G&M	Date 11/26/02	Time _____	
Received by: _____	Organization: _____	Date __/__/__	Time _____	Yes No N/A
Relinquished by: _____	Organization: _____	Date __/__/__	Time _____	Seal Intact?
Received by: _____	Organization: _____	Date __/__/__	Time _____	Yes No N/A

Special Instructions/Remarks: _____

Delivery Method: ☐ In Person ☒ Common Carrier FedEx (SPECIFY) ☐ Lab Courier ☐ Other _____ (SPECIFY)

AG 05-0597

ARCADIS GERAGHTY & MILLER

Laboratory Task Order No./P.O. No. _____

CHAIN-OF-CUSTODY RECORD

Page 1 of 1

Project Number/Name 14001348.0006.00002

Project Location Bethpage NY

Laboratory STL

Project Manager David Stern

Sampler(s)/Affiliation SH / BH

ANALYSIS / METHOD / SIZE

Sample ID/Location	Matrix	Date/Time Sampled	Lab ID	40 ML VOA VIAL (HYP) VOC (ASP-95-1)						Remarks	Total
GM 73D	L	11/25/02		2							2
GM 39D2				6 (4 + MS/MSD)							6
REP-1				2							2
TB 11/25/02				2							2
FB 11/25/02				2							2

Sample Matrix: L = Liquid; S = Solid; A = Air

Total No. of Bottles/ Containers 19

Relinquished by: Shawn Healy	Organization: Arcadis G&M	Date 11/25/02	Time _____	Seal Intact? Yes No N/A
Received by: _____	Organization: _____	Date / /	Time _____	
Relinquished by: _____	Organization: _____	Date / /	Time _____	Seal Intact? Yes No N/A
Received by: _____	Organization: _____	Date / /	Time _____	

Special Instructions/Remarks: _____

* Please Use GM 39D2 For A MS/MSD

Delivery Method: ☐ In Person ☒ Common Carrier Fed Ex (SPECIFY) ☐ Lab Courier ☐ Other _____ (SPECIFY)

AG 05-0597

ARCADIS GERAGHTY & MILLER

Laboratory Task Order No./P.O. No. _____

CHAIN-OF-CUSTODY RECORD

Page _____ of _____

Project Number/Name NY001348.0006.00002

Project Location Bethpage NY

Laboratory STL J

Project Manager David Stern

Sampler(s)/Affiliation SH / BH

Sample ID/Location	Matrix	Date/Time Sampled	Lab ID	ANALYSIS / METHOD / SIZE: 40 ML VOA VIAL (UNPJ VOC (ASP 95-1)						Remarks	Total
GM-73DZ	L	11/22/02		2							2
TB 11/22/02	L	↓		2							2

Sample Matrix: L = Liquid; S = Solid; A = Air

Total No. of Bottles/ Containers: 4

Relinquished by: Shawn Neely	Organization: Arcadis G&M	Date 11/22/02	Time _____	Seal Intact?	
Received by: _____	Organization: _____	Date / /	Time _____	Yes	No N/A
Relinquished by: _____	Organization: _____	Date / /	Time _____	Seal Intact?	
Received by: _____	Organization: _____	Date / /	Time _____	Yes	No N/A

Special Instructions/Remarks: E-Post to David Stern

Delivery Method: ☐ In Person ☑ Common Carrier FED-EX (SPECIFY) ☐ Lab Courier ☐ Other _____ (SPECIFY)

AG 05-0597

New York State Department of Environmental Conservation
Division of Environmental Remediation
Bureau of Eastern Remedial Action, 11th Floor
625 Broadway, Albany, New York 12233-7015
Phone: (518) 402-9620 FAX: (518) 402-9022

Erin M. Crotty
Commissioner

July 29, 2002

David Stern
ARCADIS Geraghty and Miller Inc.
88 Duryea Road
Melville, New York 11747

RE: Northrop Grumman, Naval Weapons Industrial Research Plant (NWIRP) Bethpage and Grumman Steel Los Sites, Nassau County Sites No. 1-30-003A, B &C.

Dear Mr. Stern:

ARCADIS Geragthy and Miller Inc., on behalf of the Northrop Grumman Corporation, has submitted the Hydraulic Effectiveness Work Plan for the On-Site Containment (ONCT) system. This ONCT system Hydraulic Effectiveness work plan is being submitted as part of the implementation of the Northrop Grumman and Naval Weapons Industrial Reserve Plant (NWIRP) Sites Operable Unit 2 Record of Decision (ROD).

1. Page 1, First Bullet: This statement acknowledges that, as further detailed in the comments below, that this work plan is only a partial evaluation towards the overall evaluation of the hydraulic effectiveness of the on-site containment (ONCT) system.

2. Page 1, Section 2, Scope of Work: The Site Plan referenced as figure 1 fails to show the location of GP1, GP3 and most of the western recharge basins adjacent to Plant 5. Please revise the figure accordingly.

3. Page 2, Section 2.1, Vertical Profile Borings:

A. Why is eastern and central portion but not the western portion of the of the ONCT system being evaluated for hydraulic effectiveness under the current plan?

B. the analytical results of GM-75 D2 indicate that there is a source of VOCs somewhere to the north of 75 D2 and to the west of GM 20. Unless the source of volatile organic contamination in 75 D2 can be shown otherwise, the GM 75D2 contamination is from Plant 2 contamination that is potentially circumventing the ONCT system somewhere between GM-20 and GM 33. Accordingly, vertical profile borings, if not now, at some point in this program, need to be added on the south side of the ONCT system and at least one specifically to the west of monitoring well GM 20 to determine if contaminants are by-passing the ONCT system in this area.

4. Section 2.5 Data Evaluation and Reporting: A geologic cross-section figure that details currently known low permeability layers should be included with this work plan. The established lithography should then be compared with that identified by this latest round of vertical profile borings and the figure revised accordingly.

5. Page 6, Section 3.1, First Two Bullets: These bullets must be corrected to state that the monitoring wells at VP-39 and VPB-73 will be installed but that the screen zone may be modified depending on the analytical results of the vertical profile for VOCs. The work plan needs to be revised accordingly.

6. Page 6, Section 3.1 and Appendix A: The number of wells proposed in section 3.1 should also be included in Appendix A and Appendix A should discuss that up to five permament wells may be constructed as part of this remedial program rather than the three wells. In addition, the two additional wells that may be constructed GM-39D3 and GM-73D3 should be added to Table 1 of Appendix A.

Appendix A:

7. Page 1-2: States that the wells "will be installed at different depths, which are classified as deep and D2..." Then describes the well depths as Deep (D), deep 2 (D2) and dep 3 D3). This should be clarified.

Overall, the Department of the Navy can proceed with the two proposed vertical profile borings with the understanding that this is only part of the information required to determine the overall effectiveness of the ONCT system. In addition, any final report regarding the ONCT system can only be accepted if orders on consent for the RD/RA work on these sites have been entered into and executed by all parties.

Thank you for the opportunity to review the Hydraulic Effectiveness Evaluation Work Plan. If you have any questions, please contact me at (518)402-9620.

Sincerely,

Steven M. Scharf, P.E.
Project Engineer
Bureau of Eastern Remedial Action
Division of Environmental Remediation

(ONCTEFF.wpd)

c: J. Molloy, H2M/G. Loesch, H2M
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J. Lovejoy, NCDH
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