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Northrop Grumman Systems Corporation

RW-21 AREA REMEDIAL DESIGN WORK PLAN

Operable Unit 3 (Former Grumman Settling Ponds)
Bethpage, New York
NYSDEC ID # 1-30-003A

June 3, 2016

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ACRONYMS AND ABBREVIATIONS

Arcadis	Arcadis of New York, Inc.
BWD	Bethpage Water District
Park	Bethpage Community Park
CAMP	Community Air Monitoring Plan
CERP	Community and Environmental Response Plan
ECL	Environmental Conservation Law
FER	Final Engineering Report
FS	Feasibility Study
Ft	Feet
GAC	Granular Activated Carbon
HASP	Health and Safety Plan
NCDOH	Nassau County Department of Health
Northrop Grumman	Northrop Grumman Systems Corporation
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
OM&M	Operation, Maintenance and Monitoring
OU	Operable Unit
Pre-Design Report	Pre-Design Report for the RW-21 Area
QAPP	Quality Assurance Project Plan
RAMP	Remedial Action Monitoring Plan
RI	Remedial Investigation
ROD	Record of Decision
RW	Remedial Well
SAP	Sampling and Analysis Plan
SCGs	Standards, Criteria and Guidelines
TVOC	Total Volatile Organic Compounds
VOC	Volatile Organic Compound
VPB	Vertical Profile Boring
Work Plan	Remedial Design Work Plan

1 INTRODUCTION

This Work Plan has been prepared by Arcadis, on behalf of Northrop Grumman, for remediation of the RW-21 Area groundwater and further investigation and remediation of groundwater hydraulically downgradient of the RW-21 Area in Bethpage, New York. The RW-21 Area is an area of elevated concentrations of VOCs in groundwater that is located hydraulically downgradient of the Park.

This Work Plan has been prepared in accordance with the OU3 ROD (NYSDEC 2013) and is consistent with the requirements of Section 5.2(b) of "DER-10 / Technical Guidance for Site Investigation and Remediation" (NYSDEC 2010) as the first step in preparing the design of the RW-21 Area groundwater remedy. **Figure 1** provides the location of the RW-21 Area in relation to the Park.

1.1 Background

As described in the Pre-Design Report (Arcadis 2016), groundwater in the RW-21 Area is impacted by VOCs in excess of NYSDEC groundwater quality criteria. The Pre-Design Report describes the distribution of VOCs in groundwater in the RW-21 Area and where 90 percent of the VOC mass discharge occurs along three groundwater plume transects (Cross Sections B-B', C-C', and D-D' in the Pre-Design Report). **Figure 2** depicts the distribution of TVOCs and lines of cross section. **Figures 3** through **5** depict the zones of 90 percent VOC mass discharge and the cumulative capture zone of the proposed remedial wells RW-20 and RW-21. The cumulative capture zone produced by RW-20, RW-21 and RW-22 will be determined following the design investigation for RW-22, as described in Section 2 below.

Two remedial wells, RW-20 and RW-21, were proposed in the Pre-Design Report for remediation of the RW-21 Area groundwater, and a third remedial well, RW-22, was proposed in the Preliminary Design Plan (Northrop Grumman 2016) to remediate groundwater hydraulically downgradient of the RW-21 Area. The precise location of RW-22 depicted in this Work Plan may change based on the outcome of the proposed design investigation described in Section 2.

The Pre-Design Report was approved by NYSDEC on March 17, 2016 and the Preliminary Design Plan was approved on April 28, 2016.

1.2 Objectives

The OU3 ROD states that the NYSDEC-selected groundwater remedy for the RW-21 Area will consist of:

> *"…One or more groundwater extraction well(s) along with the necessary treatment will be installed in the groundwater plume emanating from OU3 (the exact number to be determined during the design phase). The wells will be located downgradient of the area(s) of elevated contaminant levels identified upgradient of Bethpage Water District Plant 4. This system will be designed to capture and treat the "hot spot" area of the plume to the extent practicable, at a minimum, capturing and treating 90 percent of the mass of groundwater migrating from the elevated "hotspot area" (the recommendation by the Technical Team for Optimization of the Bethpage Plume Remedy in their June 15, 2011*

> *report prepared for the U.S. Navy). Considerations may be given to the use of Bethpage Water District facilities for all or part of treatment system."*

RW-20 and RW-21 will be installed to meet the OU3 ROD remedial design criterion of capturing 90 percent of the VOC mass discharge. The OU3 ROD also states that:

> *"Additional monitoring wells will also be installed and monitored to allow completion of a 3 dimensional delineation of the leading edge of the OU 3 plume and an assessment as to whether the remedy for the contaminated groundwater in this area needs to be further evaluated…"*

VPBs and monitoring wells will be completed in support of the investigation of the leading edge of the OU3 plume. RW-22 will be installed to capture additional VOC mass in groundwater hydraulically downgradient of the RW-21 Area. SCGs potentially applicable to the remedial design are summarized in **Table 1**.
The remedial action objective for the RW-21 Area is to achieve a 90 percent reduction in the baseline average TVOC concentration along Cross Section B-B' (Figures 2 and 4). The average baseline TVOC concentration along Cross Section B-B' is 3,300 µg/L, based on the analytical results obtained during the pre-design investigation. Accordingly, RW-21 can be shut down when the average TVOC concentration along Cross-Section B-B' reaches 330 µg/L and is maintained for a period of 6 months.

RW-20 and RW-22 may be shut down independent of RW-21 shut down and independent of each other, as follows:

- RW-20 can be shut down when a 90 percent reduction is achieved in the baseline average TVOC concentration along Cross Section D-D' (Figures 2 and 5). The average TVOC concentration along Cross Section D-D' is 1,110 µg/L based on analytical results obtained during the pre-design investigation. Accordingly, RW-20 can be shut down when the average TVOC concentration along transect D-D' reaches 110 µg/L and is maintained for a period of 6 months.

- RW-22 can be shut down 5 years after RW-20 is shut down or when RW-22 has reached asymptotic removal rates.

2 SCGS POTENTIALLY APPLICABLE TO THE REMEDIAL DESIGN ARE SUMMARIZED IN TABLE 1.DESIGN INVESTIGATION

This section provides details of the proposed design investigation, which will be completed to support the remedial design and remedial objectives.

2.1 Design Investigation

A focused groundwater investigation will be conducted with regard to RW-22 to: 1) determine groundwater quality south of the RW-21 area, 2) locate RW-22, and 3) finalize the design of RW-22. **Table 2** summarizes the proposed investigation, which includes drilling of four VPBs (VP-13 to VP-16) south of RW-20 as shown on **Figure 6**. The locations of the proposed VPBs have been determined by extrapolation of data collected and documented in the Pre-Design Report. Analytical data from the proposed VPBs will be used to determine the depths of each of the four monitoring wells (MW-13 to MW-16), to be installed in the VPB boreholes.

2.2 Project Controls

Field sampling methods (i.e., soil and groundwater), analytical protocols, and data validation procedures for the design investigation will be conducted in accordance with the QAPP (Arcadis 2016; **Appendix A**., following approval by NYSDEC.

The health and safety procedures detailed in the Site-Specific HASP (Arcadis 2016) will be followed for the design investigation and for the installation of Wells RW-20 and RW-21. Air monitoring for VOCs and particulates will be performed at designated work areas in accordance with the CAMP included in the NYSDEC-approved RI/FS Work Plan (Arcadis 2006). The HASP and associated CAMP are provided in **Appendix B**.

3 DESIGN SCOPE

This section provides details of the proposed remedial design.

3.1 Description of Remedial Action

The proposed remedial design consists of a pump-and-treat system that includes the following primary components:

- Three remedial wells designated as RW-20, RW-21, and RW-22;
- Extracted groundwater conveyance pipes;
- Groundwater treatment equipment consisting of two low-profile air strippers with GAC emission control units for vapor phase treatment, and;
- Existing treated water conveyance pipe which discharges to the Arthur Avenue recharge basin.

The proposed remedial well locations are shown on **Figure 6** which also provides the proposed conveyance pipe routes, the treatment system location, and existing treated water conveyance pipe and discharge location. The process flow diagram and groundwater pumping rates are shown on **Figure 7**. A description of the remedial system components is provided in **Table 3**. Additional treatment system components may be added based on results of analytical data obtained during well development and/or pumping tests.

3.2 Additional Requirements

Additional plans will be provided as part of the final design as it progresses, consistent with DER-10 Section 5, Subsection 5.1. The 50-75 percent design submittal will be prepared and provided to NYSDEC, and any comments received will be addressed in the 95 percent design submittal to be prepared and provided to NYSDEC. The design submittal dates are provided on **Figure 8.** A CERP will be included in the 95 percent design documents. A RAMP is not included in this remedial design, as such a plan is only potentially necessary for the following types of projects: dredging projects to include upstream and downstream water quality monitoring; sediment or sludge dewatering facilities; storm water management facility discharge monitoring; noise monitoring, and/or; monitoring of downstream or downgradient public water supplies.

4 PERMITS AND OTHER AUTHORIZATIONS

Table 4 identifies the required permits, exempted permits, entities which require access agreements, and other authorizations necessary for the construction of the remedial system. Applications will be completed and submitted for all permits, including those which are assumed to be exempt.

5 SCHEDULE

A schedule for the design investigation, as described in Section 2, and preparation and submittal of remedial design documents to NYSDEC, is provided on **Figure 8**.

6 OPERATION, MAINTENANCE AND MONITORING PLAN

The RW-21 Area OM&M Plan will be developed in accordance with DER-10 Section 6, Subsection 2, Subparts 2 and 3. The OM&M Plan will provide a summary of: 1) the measures for monitoring the performance and effectiveness of the remedy, and 2) the measures necessary for operation and maintenance of the mechanical components of the remedy. In general, the OM&M Plan will include the following: a site description; a description of the remedy; a SAP and a QAPP; maintenance requirements; reporting requirements (i.e., periodic review reports); a citizen participation plan; a HASP; required records and forms; and, record drawings.

7 REFERENCES

Arcadis. 2006. Remedial Investigation/Feasibility Study Work Plan -- Former Grumman Settling Ponds, Operable Unit 3 -- Bethpage, New York. NYSDEC Site #1-30-003A, Revised March 8, 2006.

Arcadis. 2016. Pre-Design Report for the RW-21 Area, February 16, 2016.

Arcadis. 2016. Quality Assurance Project Plan – RW-21, May 2016.

Arcadis. 2016 Site-Specific Health and Safety Plan -- Operable Unit 2/Operable Unit 3 Onsite/Offsite Investigation & Groundwater Monitoring, May 2016.

Northrop Grumman. 2016. Preliminary Design Plan for the RW-21 Area, April 28, 2016.

NYSDEC. 2013. Record of Decision, Northrop Grumman – Bethpage Facility, Operable Unit Number: 03, State Superfund Project, Bethpage, Nassau County, Site No. 130003A, March 29, 2013.

NYSDEC. 2010. DER-10 / Technical Guidance for Site Investigation and Remediation, May 3, 2010.

TABLES

Table 1
Potentially Applicable Standards, Criteria and Guidelines (SCGs) for the RW-21 Area
Northrop Grumman Systems Corporation
Operable Unit 3 (Former Grumman Settling Ponds),
Bethpage, New York.

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Regulation	Citation	Standard (S) or Guidance (G)	Summary of Requirements	Applicability to the Remedial Action/Design
Potential Chemical-Specific SCGs				
National Primary Drinking Water Standards	40 CFR Part 141	S	Establishes maximum contaminant levels (MCLs) which are health-based standards for public water supply systems.	Applicable to treatment standards if used directly as drinking water.
RCRA-Regulated Levels for Toxic Characteristics Leaching Procedure (TCLP) Constituents	40 CFR Part 261	S	These regulations specify the TCLP constituent levels for identification of hazardous wastes that exhibit the characteristic of toxicity.	Applicable to remedial activities that generate waste materials that may require sampling/analysis for TCLP constituents to determine if the materials are hazardous (based on the characteristic of toxicity) prior to disposal.
Universal Treatment Standards/Land Disposal Restrictions (UTS/LDRs)	40 CFR Part 268	S	Identifies hazardous wastes for which land disposal is restricted and provides a set of numerical constituent concentration criteria at which hazardous waste is restricted from land disposal (without treatment).	Applicable if waste material is determined to be hazardous and is designated for off-site land disposal.
New York State Environmental Remediation Programs	6 NYCRR Part 375	S/G	Describes process for the development and execution of remedial programs in New York State (NYS), and provides soil cleanup objectives (SCOs) for various site usages.	Applicable for site investigation, remedy selection, and site remediation.
NYSDEC Ambient Water Quality Standards and Guidance Values	Division of Water Technical and Operational Guidance Series (TOGS) 1.1.1 (6/98, revised 4/00)	S/G	Provides a compilation of ambient water quality standards and guidance values for toxic and non-conventional pollutants for use in the NYSDEC programs.	These standards and guidance values are applicable to site remedial programs and should be considered in evaluating groundwater and surface water quality and remediation.

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Regulation	Citation	Standard (S) or Guidance (G)	Summary of Requirements	Applicability to the Remedial Action/Design
Potential Chemical-Specific SCGs				
Identification and Listing of Hazardous Wastes	6 NYCRR Part 371	S	Outlines criteria for determining if a solid waste is a hazardous waste and subject to regulation under 6 NYCRR Parts 370 thru 376.	Applicable for determining if waste material generated during implementation of remedial activities are hazardous wastes. These regulations do not set cleanup standards, but are considered when developing remedial alternatives.
New York State Surface Water and Groundwater Quality Standards	6 NYCRR Parts 700 thru 706	S	Establishes quality standards for surface water and groundwater.	Applicable for assessing water quality at the site during remedial activities.
New York Drinking Water Supplies	10 NYCRR Part 5	S	Establishes quality standards for drinking water.	Potentially applicable for assessing water quality at the site during remedial activities if used directly as drinking water.
Occupational Safety and Health Act (OSHA) - General Industry Standards	29 CFR Part 1910	S	These regulations specify the 8-hour time-weighted average concentration for worker exposure to various compounds. Training requirements for workers at hazardous waste operations are specified in 29 CFR 1910.120.	Applicable where on-site activities have the potential to expose workers to site-related contaminants.
OSHA - Safety and Health Standards	29 CFR Part 1926	S	These regulations specify the type of safety equipment and procedures to be followed during site remediation.	Applicable where on-site activities have the potential to expose workers to site-related contaminants.
OSHA - Record-keeping, Reporting and Related Regulations	29 CFR Part 1904	S	These regulations outline record-keeping and reporting requirements for an employer under OSHA, and apply to the company(s) contracted to install, operate, and maintain remedial actions at hazardous waste sites.	Applicable where on-site activities have the potential to expose workers to site-related contaminants.

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Regulation	Citation	Standard (S) or Guidance (G)	Summary of Requirements	Applicability to the Remedial Action/Design
Potential Action-Specific SCGs				
RCRA - Preparedness and Prevention	40 CFR Part 264.30 - 264.31	S	These regulations outline requirements for safety equipment and spill control when treating, handling and/or storing hazardous wastes.	Potentially applicable to remedial activities.
RCRA - Contingency Plan and Emergency Procedures	40 CFR Part 264.50 - 264.56	S	Provides requirements for emergency contingency planning and procedures to be used following explosions, fires, etc. when storing hazardous wastes.	Potentially applicable to remedial activities.
RCRA - General Standards	40 CFR Part 264.111	S	General performance standards requiring minimization of need for further maintenance and control; minimization or elimination of post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated runoff, or hazardous waste decomposition products. Also requires decontamination or disposal of contaminated equipment, structures and soils.	Potentially applicable to decontamination activities conducted for remedial activities.
Standards Applicable to Transporters of Applicable Hazardous Waste - RCRA Section 3003	40 CFR Parts 170-179, 262, and 263	S	Establishes the responsibility of off-site transporters of hazardous waste in the handling, transportation and management of the waste. Requires manifesting, recordkeeping and immediate action in the event of a discharge.	These requirements are applicable to any company(s) contracted to transport hazardous material from the site.

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Regulation	Citation	Standard (S) or Guidance (G)	Summary of Requirements	Applicability to the Remedial Action/Design
Potential Action-Specific SCGs				
United States Department of Transportation (USDOT) Rules for Transportation of Hazardous Materials	49 CFR Parts 107 and 171.1 - 172.558	S	Outlines procedures for the packaging, labeling, manifesting and transporting of hazardous materials.	These requirements are applicable to any company(s) contracted to transport hazardous material from the site.
Clean Air Act-National Ambient Air Quality Standards	40 CFR Part 50	S	Establishes ambient air quality standards for protection of public health.	Applicable to remedial systems that generate air emissions.
USEPA-Administered Permit Program: The Hazardous Waste Permit Program	RCRA Section 3005; 40 CFR Part 270.124	S	Covers the basic permitting, application, monitoring and reporting requirements for off-site hazardous waste management facilities.	Any off-site facility accepting hazardous waste from the site must be properly permitted.
New York Air Quality Classification System	6 NYCRR Part 256	S	Outlines the air quality classifications for different land uses and population densities.	Applicable to the treatment process as it will generate air emissions.
National Emission Standards for Hazardous Air Pollutants (NESHAP)	40 CFR Part 61	S	Provides air emission standards for hazardous air pollutants.	Applicable to the treatment process as it will generate air emissions. Treatment system design will consider appropriate air emissions controls to meet these regulations.
New York Permits and Certificates	6 NYCRR Part 201	S	Provides instructions and regulations for obtaining a permit to operate an air emission source. Also provides instructions on what to do in case of malfunction.	NYS permits may be waived for remedial actions implemented under Consent Order at NYS Inactive Hazardous Waste Disposal sites; however, documentation will be developed to assure relevant and appropriate permit conditions are complied with.

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Regulation	Citation	Standard (S) or Guidance (G)	Summary of Requirements	Applicability to the Remedial Action/Design
Potential Action-Specific SCGs				
New York Emissions Testing, Sampling, and Analytical Determinations	6 NYCRR Part 202	S	Outlines requirements for emissions testing for air emission sources. States that independent emissions testing can be ordered by the Commissioner of the NYSDEC.	Applicable to treatment system as emissions from treatment system must be analyzed.
New York Regulations for General Process Emissions	6 NYCRR Part 212	S	Outlines the procedure of environmental rating. The Commissioner determines a rating of emissions based on sampling.	Applicable to treatment system emissions for various constituents outlined.
Protection of Significant Deterioration of Air Quality (PSD)	40 CFR Part 51.2	S	New major stationary sources may be subject to PSD review [i.e., require best available control technology (BACT), lowest achievable detection limit (LAEL), and/or emission off-sets.	PSD procedures will be included in the remedial design/remedial action process. The procedures will be expanded to BACT and LAEL evaluations.
New York Air Quality Standards	6 NYCRR Part 257	S	Provides air quality standards for different chemicals (including those found at the site), particles, and processes.	Applicable to treatment system to ensure emissions will meet the air quality standards.
Land Disposal Restrictions	40 CFR Part 268	S	Restricts land disposal of hazardous wastes that exceed specific criteria. Establishes Universal Treatment Standards (UTSs) to which hazardous waste must be treated prior to land disposal.	Waste materials that display the characteristic of hazardous waste or that are re-characterized after generation must be treated to 90% constituent concentration reduction capped at 10 times the UTS.
RCRA Subtitle C	40 U.S.C. Section 6901 et seq.; 40 CFR Part 268	S	Restricts land disposal of hazardous wastes that exceed specific criteria. Establishes UTSs to which hazardous wastes must be treated prior to land disposal.	Potentially applicable to remedial activities that include disposal of generated waste material from the site (i.e. well drilling).

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Regulation	Citation	Standard (S) or Guidance (G)	Summary of Requirements	Applicability to the Remedial Action/Design
Potential Action-Specific SCGs				
NYSDEC's Monitoring Well Decommissioning Guidelines	NPL Site Monitoring Well Decommissioning dated May 1995	G	This guidance presents procedure for abandonment of monitoring wells at remediation sites.	Applicable for the decommissioning of monitoring wells onsite.
Guidelines for the Control of Toxic Ambient Air Contaminants	DAR-1 (Air Guide 1)	G	Provides guidance for the control of toxic ambient air contaminants in New York State and outlines the procedures for evaluating sources of air pollution	Applicable for the treatment system for the emission of certain contaminants.
New York Hazardous Waste Management System - General	6 NYCRR Part 370	S	Provides definitions of terms and general instructions for the Part 370 series of hazardous waste management.	Applicable where hazardous waste is to be managed (i.e. well drilling).
Hazardous Waste Manifest System and Related Standards for Generators, Transporters, and Facilities	6 NYCRR Part 372	S	Provides guidelines relating to the use of the manifest system and its recordkeeping requirements. It applies to generators, transporters and facilities in New York State.	This regulation is applicable to any company(s) contracted to do treatment work at the site or to transport or manage hazardous material generated at the site.
New York Regulations for Transportation of Hazardous Waste	6 NYCRR Part 372.3 a-d	S	Outlines procedures for the packaging, labeling, manifesting and transporting of hazardous waste.	These requirements are applicable to any company(s) contracted to transport hazardous material from the site.
Waste Transporter Permits	6 NYCRR Part 364	S	Governs the collection, transport and delivery of regulated waste within New York State.	These requirements are applicable to any company(s) contracted to transport hazardous material from the site

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Regulation	Citation	Standard (S) or Guidance (G)	Summary of Requirements	Applicability to the Remedial Action/Design
Potential Action-Specific SCGs				
New York Regulations for Hazardous Waste Management Facilities	6 NYCRR Part 373.1.1 - 373.1.8	S	Provides requirements and procedures for obtaining a permit to operate a hazardous waste treatment, storage and disposal facility. Also lists contents and conditions of permits.	These requirements are applicable to any off-site facility accepting waste from the site.
National Pollutant Discharge Elimination System (NPDES) Program Requirements, Administered Under New York State Pollution Discharge Elimination System (SPDES)	40 CFR Parts 122 Subpart B, 125, 301, 303, and 307 (Administered under 6 NYCRR 750-758)	S	Establishes permitting requirements for point source discharges; regulates discharge of water including the quantity and quality of discharge.	Applicable to site remedial activities that involve treatment/disposal of water.
NYSDEC Division of Environmental Remediation (DER) Numbered Technical Guidance Series Documents	DER-10 (Technical Guidance for Site Investigation and Remediation); and other applicable documents.	G	DER-10: Provides guidance on NYSDEC-accepted site investigation and remediation processes.	Applicable to remedy evaluation process and site remedial activities.
National Electric Code	NFPA 70	S/G	Requirements for safe electrical design, installation and inspection.	Applicable to site remedial activities which have additional electrical requirements.
National Building Code	Building Officials Code Administrators (BOCA) International	G	Requirements for building design and construction.	Applicable to treatment system construction.

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Regulation	Citation	Standard (S) or Guidance (G)	Summary of Requirements	Applicability to the Remedial Action/Design
Potential Action-Specific SCGs				
New York State Building Code	NYSBC	G	Requirements for building design and construction.	Applicable to treatment system construction.
Potential Location-Specific SCGs				
Local Codes	N/A	S	Local authorities may require permits for a variety of functions, including buildings, electric, stormwater, treated water discharge, etc.	Substantive provisions are potentially applicable to remedial activities that require construction.

DEFINITIONS:

CFR	Code of Federal Regulations
DAR-1	NYSDEC Division of Air Resources Guidelines for the Control of Toxic Ambient Air Contaminants
DER	NYSDEC Division of Environmental Remediation
EPA	US Environmental Protection Agency
LDR	Land Disposal Restrictions
NFPA	National Fire Protection Association
NYCRR	Official Compilation of New York Code, Rules and Regulations
NYSDEC	New York State Department of Environmental Conservation
POTW	Publicly-Owned Treatment Works
NYS	New York State
NPL	National Priorities List
US DOT	United States Department of Transportation
N/A	Not Applicable
UTS	Universal Treatment Standards

Table 2
Design Investigation for the RW-21 Area
Northrop Grumman Systems Corporation
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VPB Identification	VPB Estimated Total Depth (ft bls)	VPB Groundwater/Soil Sampling Interval (ft bls)	Monitoring Well Identification	Monitoring Well Depth
Vertical Profile Borings (1,2,3,4,5)				
RW-21_VP-13	Drilled to raritan clay	300-850	RW-21_MW-13	To Be Determined
RW-21_VP-14	850	300-850	RW-21_MW-14	To Be Determined
RW-21_VP-15	850	300-850	RW-21_MW-15	To Be Determined
RW-21_VP-16	850	300-850	RW-21_MW-16	To Be Determined

Notes and Abbreviations:

(1) VPBs will be terminated following the collection of three consecutive groundwater samples with no exceedances of applicable standards. VPB locations are shown on **Figure 6**.

(2) The complete description of drilling, sampling, and logging methods is provided in the NYSDEC-approved Pre-Design Work Plan for Groundwater Hotspot (2014). VPBs to be drilled using the mud rotary method and soil samples to be collected using split spoons. Select additional soil samples will be collected for sieve analysis. Groundwater samples will be collected using Hydropunch Sampler.

(3) VPB groundwater and soil samples will be collected from approximately 300 ft bls to 850 ft bls at 20 foot intervals.

(4) VPB groundwater samples will be analyzed for the TCL VOCs using USEPA Method 8260C. Field parameters measured will consist of pH, specific conductance, and temperature.

(5) Monitoring wells to be installed in VPB boreholes. Terminal depth of monitoring wells to be determined based on results of VPBs. Monitoring wells to be sampled using non-dedicated SS bladder pump following the low flow sampling method. Monitoring well groundwater samples to be analyzed for the TCL VOCs using USEPA Method 8260C and 1,4-dioxane using USEPA Method 8270D-SIM. Field parameters measured will consist of pH, specific conductance, and temperature.

ft bls	feet below land surface
NYSDEC	New York State Department of Environmental Conservation
SIM	selected ion monitoring
SS	stainless steel
TCL	target compound list
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound
VPB	vertical profile boring

Table 3
Remedial System Components for the RW-21 Area
Northrop Grumman Systems Corporation
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Component	Description
Remedial Wells	Remedial wells RW-20, RW-21, and RW-22 would be installed with estimated screen intervals from 650 to 700 ft bgs, 550 to 600 ft bgs, and 700 to 750 ft bgs, respectively. Final screen intervals will be determined based on pilot borehole drilling. Remedial wellheads would be enclosed in below-grade, locked vaults (installed flush with existing grade and not readily observable) along with associated discharge piping, shut-off valves, electrical junction boxes and controls. Electric would be metered and supplied via underground conduit from a nearby electric pole. The electric meter would be installed above-grade, as per PSEGLI requirements. A submersible groundwater pump would be used to extract the groundwater from the remedial well.
Influent Conveyance Piping	Dual-walled HDPE piping to transfer influent groundwater to a treatment building. All piping would be installed below-grade via horizontal directional drilling technologies or trenching within the TOB and/or utility right-of-ways. Leak detection ports would be installed throughout the length of the conveyance piping, at distances of approximately 500 feet or as otherwise deemed appropriate based on local topography.
Air Stripper	A modular "sliding-tray-type" low-profile air stripping system to remove VOCs from the influent groundwater. The modular nature of this type of low-profile air stripping system is easily adaptable to changing influent VOC concentrations over time. Influent groundwater would be treated to comply with applicable NYSDEC Groundwater Quality Standards, as defined by 6 NYCRR Part 703. The air stripping system would consist of a process blower, transfer pump, and primary logic controls.
Emission Control Units	ECUs containing VPGAC to remove the VOCs from the air stripper effluent vapor. The system would be installed with two units that would be operated in a lead/lag configuration. Treated discharge vapor would comply with applicable NYSDEC Air Toxics Regulatory Standards, as defined by 6 NYCRR Part 212.
Effluent Conveyance Piping	Treated water conveyance consisting of existing single-walled underground piping to the existing Nassau County Storm Sewer, which ultimately discharges to the Arthur Avenue recharge basin. Effluent water would be discharged in accordance with a SPDES Equivalency Permit.

Notes and Abbreviations:

ECU	emission control unit
ft bgs	feet below ground surface
HDPE	high density polyethylene
NYCRR	New York Code of Rules and Regulations
NYSDEC	New York State Department of Environmental Conservation
PSEGLI	Public Service Electric and Gas of Long Island
SPDES	State Pollutant Discharge Elimination System
TOB	Town of Oyster Bay
VOC	volatile organic compound
VPGAC	vapor phase granular activated carbon

Table 4
Permits, Access Agreements, and Authorizations for the RW-21 Area
Northrop Grumman Systems Corporation
Operable Unit 3 (Former Grumman Settling Ponds),
Bethpage, New York.

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Required Permits [1]	Authority	Reason
Well Permit	TOB	Permit required as per TOB Highway Department. Assumes permits will be required for all RWs.
Road Opening Permit	TOB	Permit required as per TOB Highway Department. Assumes permits will be required for all VPBs, MWs, RWs and for conveyance pipelines.
Building Permit	TOB	Assumes permits required as per TOB Building Department. Assumes required permits will include the well vaults, conveyance pipelines, and treatment system building.
Electrical Permit	TOB	Assumes permits required as per TOB Building Department. Assumes required permits will include the well vault and treatment system building.
Exempted Permits [2]	**Authority**	**Reason**
Air Discharge Permit	NYSDEC	Assumes Air Discharge Permit exempted for Equivalency as per statutes in DER-10 Section 1, Subsection 10.
SPDES Permit	NYSDEC	Assumes SPDES Permit exempted for Equivalency as per statutes in DER-10 Section 1, Subsection 10.
Water Withdrawal Permit	NYSDEC	Assumes Water Withdrawal Permit exempted as per statutes in DER-10 Section 1, Subsection 10.
Access Agreements [3]	**Authority**	**Reason**
VPBs and Monitoring Wells	TOB	Access agreements will need to be obtained for all VPBs and MWs.
Remedial Wells RW-20, RW-21, RW-22	TOB	Access agreements will need to be obtained for RW-20, RW-21, and RW-22. RW-20 is proposed to be installed in a TOB right-of-way, RW-21 is proposed to be installed in a TOB owned parking lot, and RW-22 is proposed to be installed in a TOB owned open lot.
Remedial Well RW-22	PSEGLI	Access agreement will need to be obtained for RW-22, which is proposed to be installed under PSEGLI owned overhead electric transmission lines.
Conveyance Pipelines	TOB	Access agreement will needed to be obtained for RW-20, RW-21 and RW-22 conveyance pipelines. Conveyance pipelines are proposed to be installed in TOB right-of-ways and/or crossing under TOB owned streets.
Conveyance Pipelines	NC	Access agreement will needed to be obtained for RW-20, RW-21 and RW-22 conveyance pipelines. Conveyance pipelines are proposed to be installed in NC owned property, specifically near the Arthur Avenue Basin.

Notes and abbreviations on last page.

Table 4
Permits, Access Agreements, and Authorizations for the RW-21 Area
Northrop Grumman Systems Corporation
Operable Unit 3 (Former Grumman Settling Ponds),
Bethpage, New York.

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Access Agreements [3]	Authority	Reason
Conveyance Pipelines	PSEGLI	Access agreement will needed to be obtained for RW-20, RW-21 and RW-22 conveyance pipelines. Conveyance pipelines are proposed to be installed under PSEGLI owned overhead electric transmission lines.
Conveyance Pipelines	Private Properties	Access agreements may be needed for the RW-20, RW-21 and RW-22 conveyance pipelines with applicable privately-owned properties.
Discharge Basin	NC	Access agreement will be needed for discharge of treated effluent to NC owned Arthur Avenue Basin.
Treatment System	TOB	Access agreement will be needed for the treatment system with TOB.
Treatment System	NC	Access agreement will be needed for the treatment system with NC.
Treatment System	Private Properties	Access agreement will be needed for the treatment system with applicable private property-owners.
Required Authorizations	**Authority**	**Reason**
Treatment System Construction	Navy	Authorization for addition to existing treatment system (GM-38) will be required from Navy. Proposed work in the area would include clearing, a building addition, and tie-in to existing discharge pipeline.
Discharge to NC POTW	NC	Authorization for discharge of groundwater generated during development of RWs and MWs to NC owned sanitary sewer system.
Discharge to Recharge Basin	NC	Authorization for discharge of treated effluent to NC owned Arthur Avenue Basin.

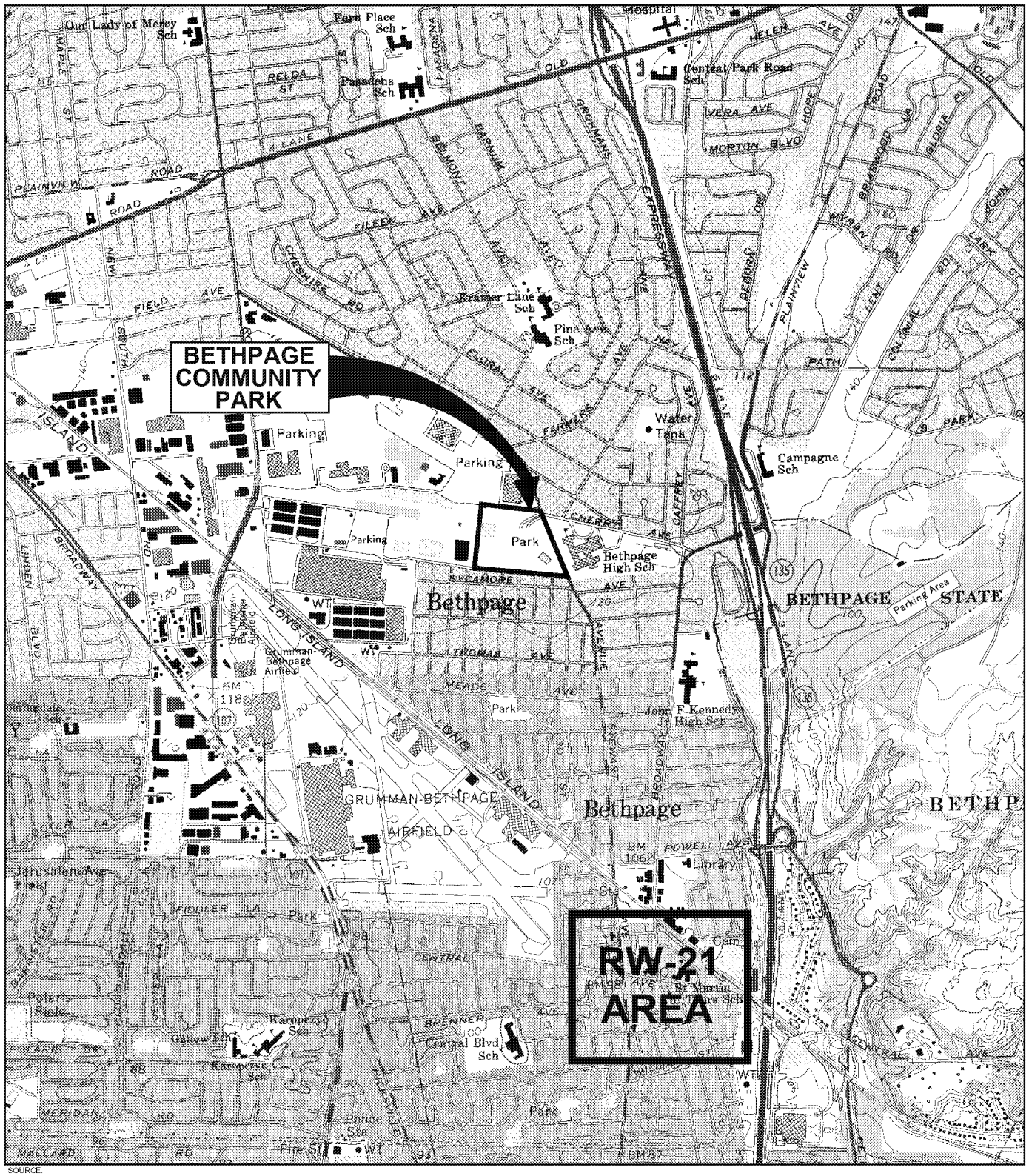
Notes and abbreviations on last page.

Notes and Abbreviations:

DER-10	NYSDEC Technical Guidance for Site Investigation and Remediation
MW	monitoring well
NC	Nassau County
NYSDEC	New York State Department of Environmental Conservation
POTW	Publicly Owned Treatment Works
PSEGLI	Public Service Electric and Gas of Long Island
RW	remedial well
TOB	Town of Oyster Bay
VPB	Vertical Profile Boring

1. NYSDEC may exempt these permits if the remedial program meets certain criteria as defined in DER-10 Section 1, Subsection 10.
2. NYSDEC may exempt these permits if the remedial program meets certain criteria as defined in DER-10 Section 1, Subsection 10 and it is assumed the permit exemptions will be granted.
3. An environmental easement will be required and will be coordinated with access agreements.

FIGURES



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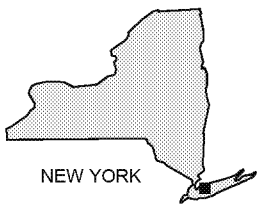

0 2000' 4000'
SCALE IN FEET

NORTHROP GRUMMAN SYSTEMS CORPORATION
OPERABLE UNIT 3
(FORMER GRUMMAN SETTLING PONDS)
BETHPAGE, NEW YORK

RW-21 AREA LOCATION

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FIGURE
1

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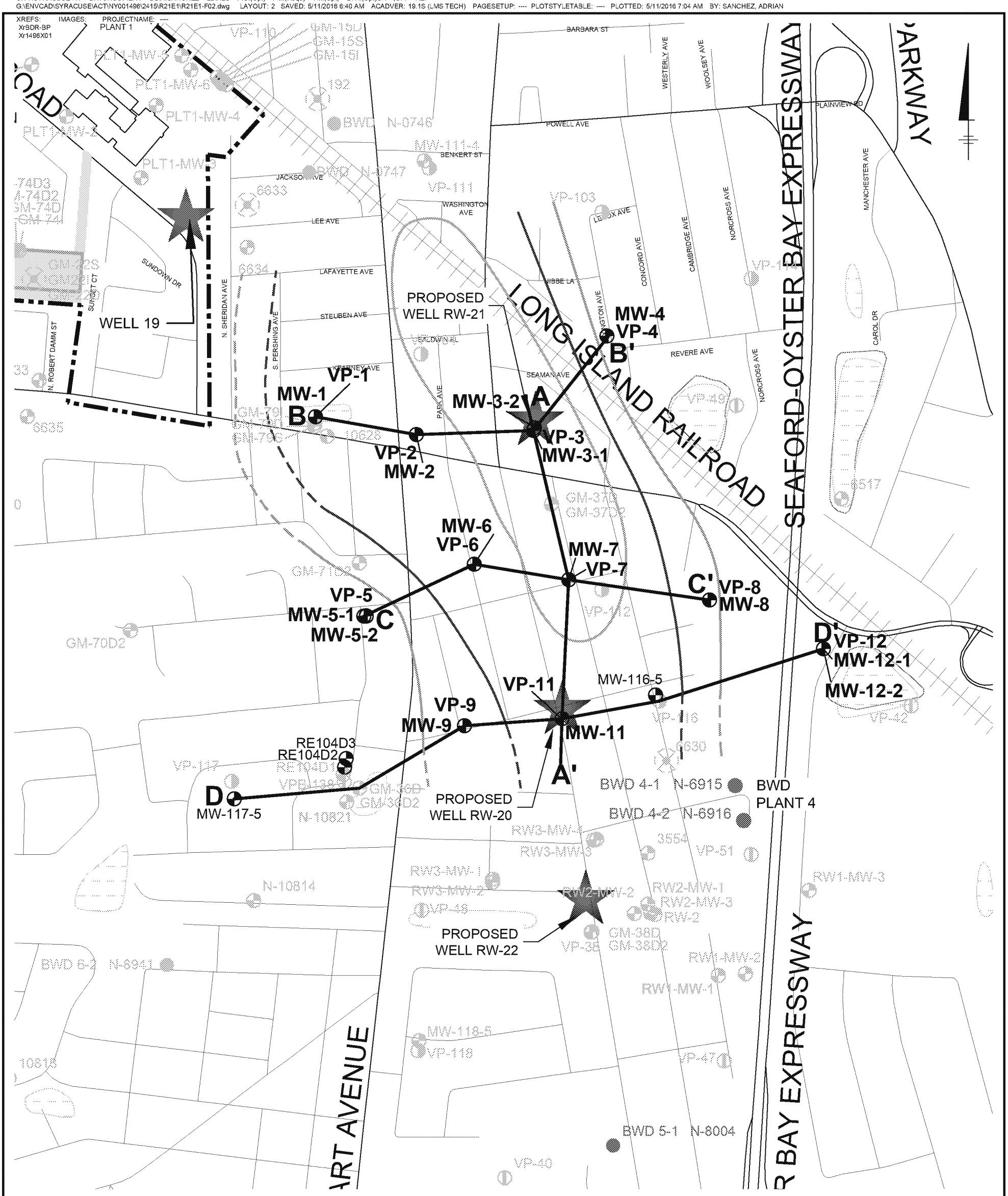

LEGEND:

- PROPERTY BOUNDARY OF THE FORMER GRUMMAN AEROSPACE CORPORATION SITE
- LONG ISLAND RAILROAD
- RECHARGE BASIN
- PUBLIC SUPPLY WELL
- EXISTING OU2 REMEDIAL WELL
- VERTICAL PROFILE BORING AND MONITORING WELL INSTALLED FOR RW-21 AREA PROGRAM (OTHER WELLS OWNED BY NAVY, NORTHROP GRUMMAN OR OTHERS SHOWN IN GRAY FOR REFERENCE ONLY)
- BWD — BETHPAGE WATER DISTRICT
- A—A' LINE OF CROSS SECTION
- PROPOSED REMEDIAL WELL

TVOC CONCENTRATION CONTOURS IN GROUNDWATER IN µg/L (DASHED WHERE APPROXIMATE)

500
1000
5000

TVOC DATA DISPLAYED CONSISTS OF MONITORING WELL RESULTS.

NOTES:

1. TVOC PLUME EXTENT LIMITED TO RW-21 AREA FOR THE PURPOSE OF DEPICTING THE LINES OF CROSS SECTION.
2. CONTOURING BASED ON TVOC CONCENTRATIONS FROM NEWLY INSTALLED MONITORING WELLS LOCATED WITHIN THE RW-21 AREA, PLUS SELECTED OTHER WELLS WITHIN AND NEAR THE RW-21 AREA SCREENED AT A SIMILAR DEPTH.

0 500' 1000'
APPROXIMATE SCALE IN FEET

NORTHROP GRUMMAN SYSTEMS CORPORATION
OPERABLE UNIT 3
(FORMER GRUMMAN SETTLING PONDS)
BETHPAGE, NEW YORK

RW-21 AREA TVOC DISTRIBUTION AND LINES OF CROSS SECTION

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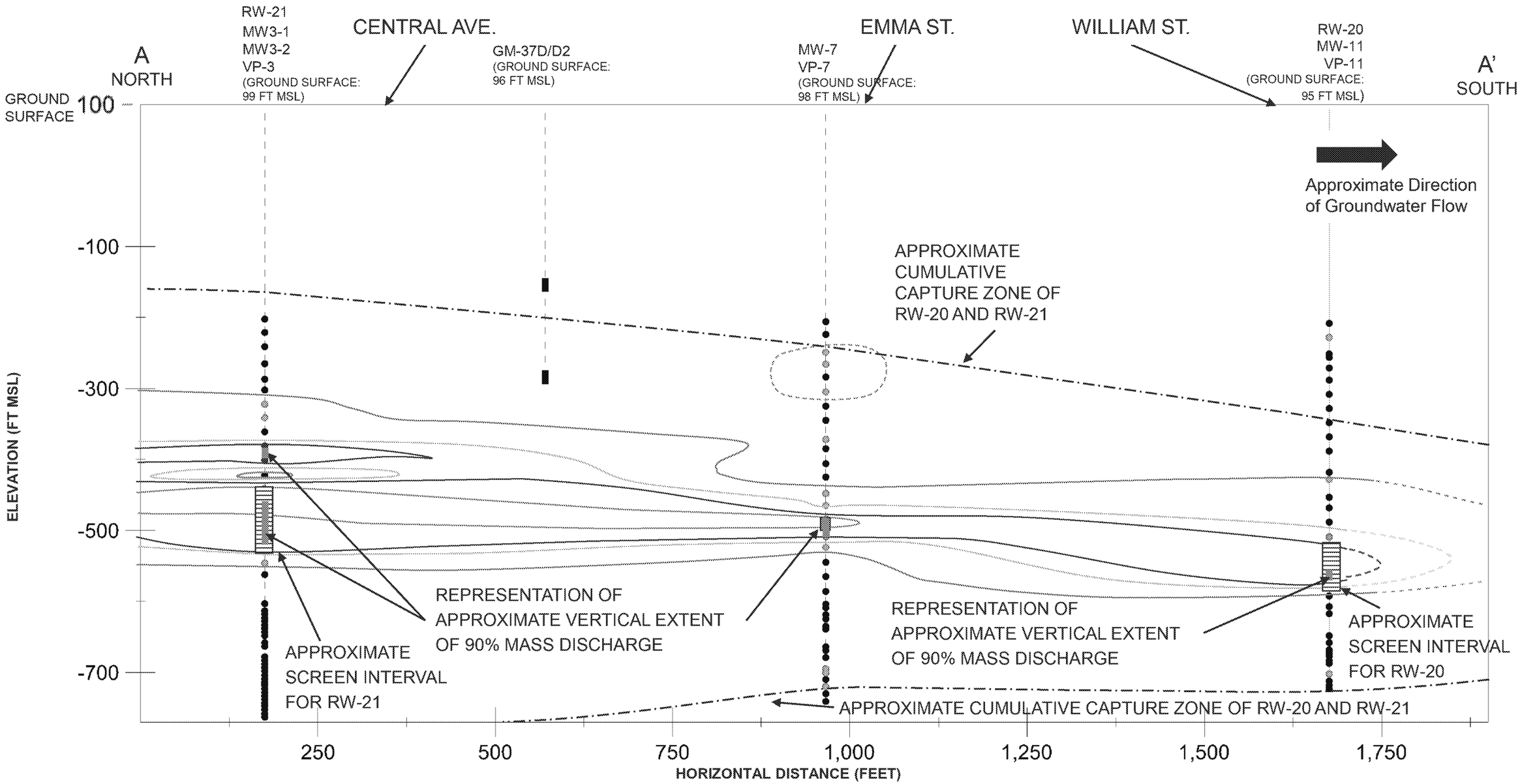
FIGURE
2



Hydropunch/Monitoring Well TVOC Concentrations (SEE NOTE 6)

- > 5,000 µg/L
- 1,000 - 5,000 µg/L
- 500 - 1,000 µg/L
- 50 - 500 µg/L
- < 50 µg/L

TVOC Concentration Contours in Groundwater (SEE NOTES 4 & 5)

- 5,000 µg/L
- 1,000 µg/L
- 500 µg/L
- 50 µg/L

Notes:

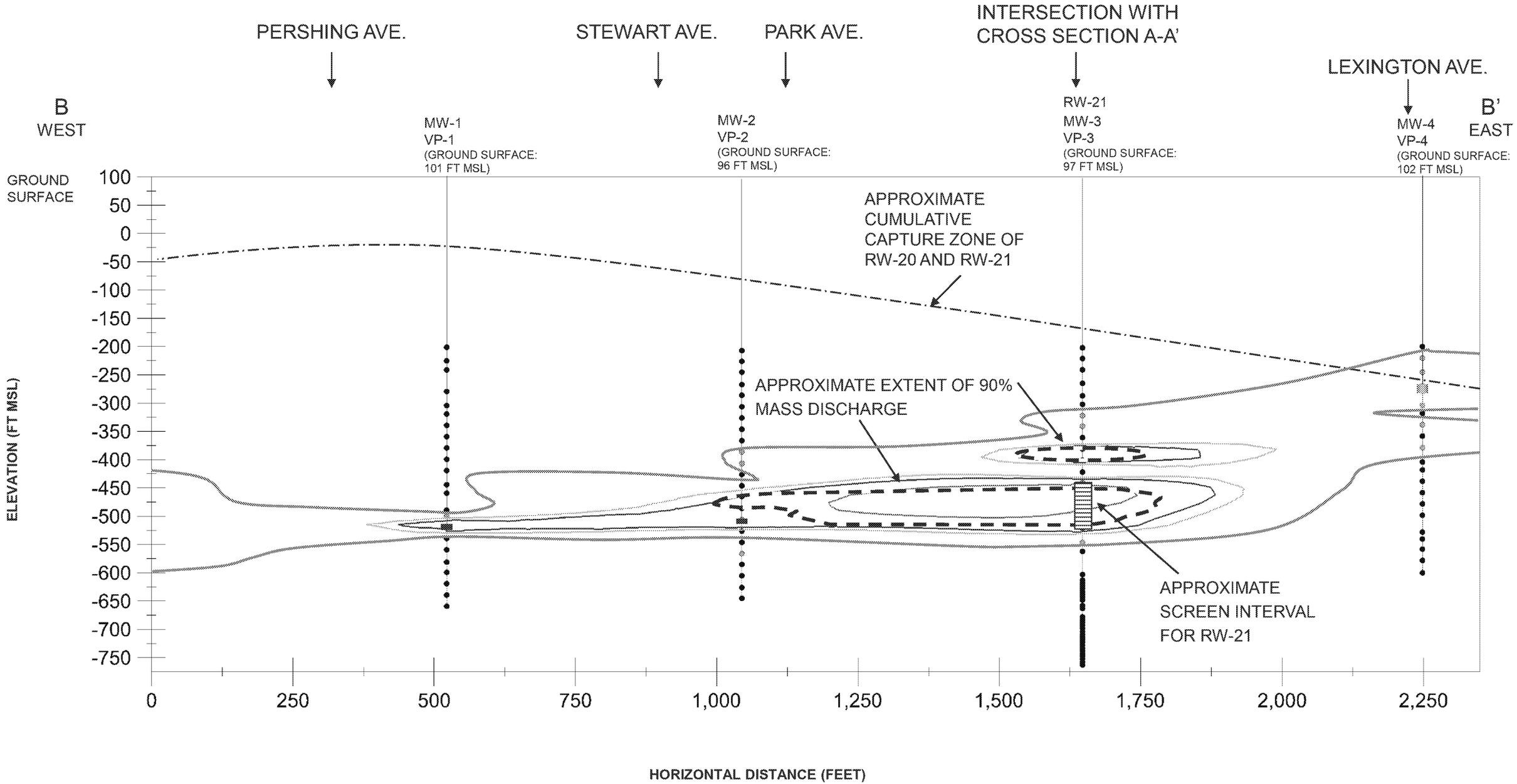
1. TVOC: Total Volatile Organic Compound
2. µg/L: micrograms per liter
3. No Vertical Exaggeration
4. TVOC contours on the cross section represent a two-dimensional slice of three-dimensional TVOC plumes contoured in the 3D model.
5. Contours based on collective interpretation of monitoring well and screening-level VPB data. Historical VPB data (prior to 2014) provided for completeness of contouring; however, contours based on historical data are dashed unless confirmed by recent monitoring well sampling results.
6. Hydropunch data shown as circles; Monitoring Well data shown as rectangles.
7. Approximate groundwater flow direction is to the South/Southeast.
8. Approximate cumulative extent of capture zone is estimated based on proposed recovery wells RW- 20 and RW-21 each pumping at 500 GPM. Cumulative capture zone extends beyond the limits of the cross section to the north and south. Cumulative capture zone will be updated following design investigation and subsequent modeling for RW-22.

NORTHROP GRUMMAN SYSTEMS CORPORATION
OPERABLE UNIT 3
(FORMER GRUMMAN SETTLING PONDS)
BETHPAGE, NEW YORK

Cross Section A-A' – Approximate Cumulative Capture Zone and 90 Percent Mass Discharge Area within the 500 µg/L TVOC Contour

ARCADIS

FIGURE 3



Hydropunch/Monitoring Well TVOC Concentrations (SEE NOTE 6)

- > 5,000 µg/L
- 1,000 - 5,000 µg/L
- 500 - 1,000 µg/L
- 50 - 500 µg/L
- < 50 µg/L

TVOC Concentration Contours in Groundwater (SEE NOTES 4 & 5)

- 5,000 µg/L
- 1,000 µg/L
- 500 µg/L
- 50 µg/L

Notes:

1. TVOC: Total Volatile Organic Compound
2. µg/L: micrograms per liter
3. No Vertical Exaggeration
4. TVOC contours on the cross section represent a two-dimensional slice of three-dimensional TVOC plumes contoured in the 3D model.
5. Contours based on collective interpretation of monitoring well and screening-level VPB data. Historical VPB data (prior to 2014) provided for completeness of contouring; however, contours based on historical data are dashed unless confirmed by recent monitoring well sampling results.
6. Hydropunch data shown as circles; Monitoring Well data shown as rectangles.
7. Approximate groundwater flow direction is to the South/Southeast.
8. Approximate cumulative extent of capture zone is estimated based on proposed recovery wells RW-20 and RW-21 each pumping at 500 GPM. Cumulative capture zone extends beyond the limits of the cross section to the west and east. Cumulative capture zone will be updated following design investigation and subsequent modeling for RW-22.

NORTHROP GRUMMAN SYSTEMS CORPORATION
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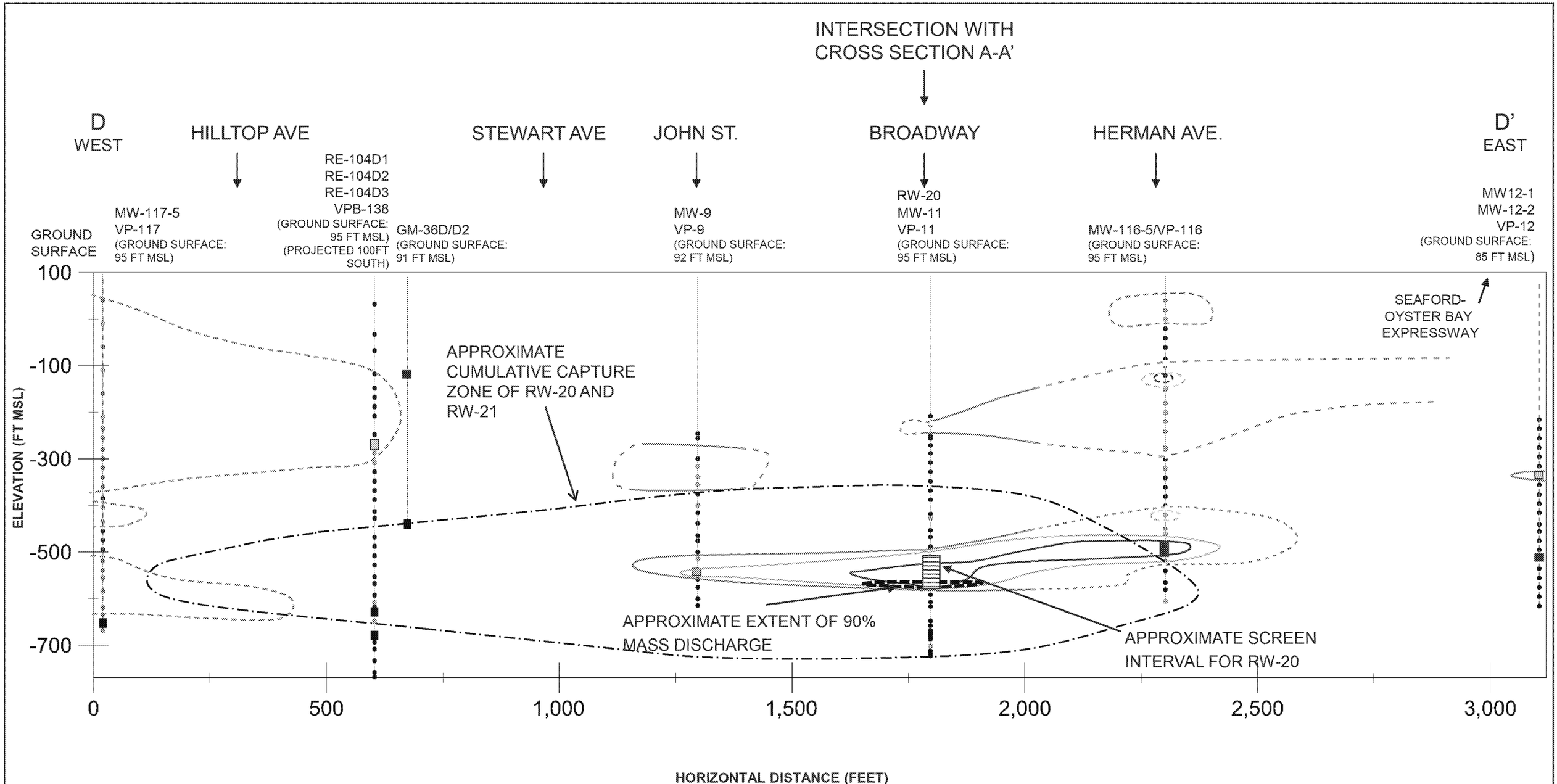
(FORMER GRUMMAN SETTLING PONDS)
BETHPAGE, NEW YORK

Cross Section B-B' – Approximate Cumulative Capture Zone and 90 Percent Mass Discharge Area within the 500 µg/L TVOC Contour

ARCADIS

FIGURE
4



Hydropunch/Monitoring Well TVOC Concentrations (SEE NOTE 6)

- 1,000 - 5,000 µg/L
- 500 - 1,000 µg/L
- 50 - 500 µg/L
- < 50 µg/L

TVOC Concentration Contours in Groundwater (SEE NOTES 4 & 5)

- 1,000 µg/L
- 500 µg/L
- 50 µg/L

Notes:

1. TVOC: Total Volatile Organic Compound
2. µg/L: micrograms per liter
3. No Vertical Exaggeration
4. TVOC contours on the cross section represent a two-dimensional slice of three-dimensional TVOC plumes contoured in the 3D model.
5. Contours based on collective interpretation of monitoring well and screening-level VPB data. Historical VPB data (prior to 2014) provided for completeness of contouring; however, contours based on historical data are dashed unless confirmed by recent monitoring well sampling results.
6. Hydropunch data shown as circles; Monitoring Well data shown as rectangles.
7. Approximate groundwater flow direction is to the South/Southeast.
8. Capture zone is estimated based on proposed recovery wells RW-20 and RW-21 each pumping at 500 GPM. Cumulative capture zone will be updated following design investigation and subsequent modeling for RW-22.

NORTHROP GRUMMAN SYSTEMS CORPORATION
OPERABLE UNIT 3
(FORMER GRUMMAN SETTLING PONDS)
BETHPAGE, NEW YORK

Cross Section D-D' – Approximate Cumulative Capture Zone and 90 Percent Mass Discharge Area within the 500 µg/L TVOC Contour

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FIGURE
5

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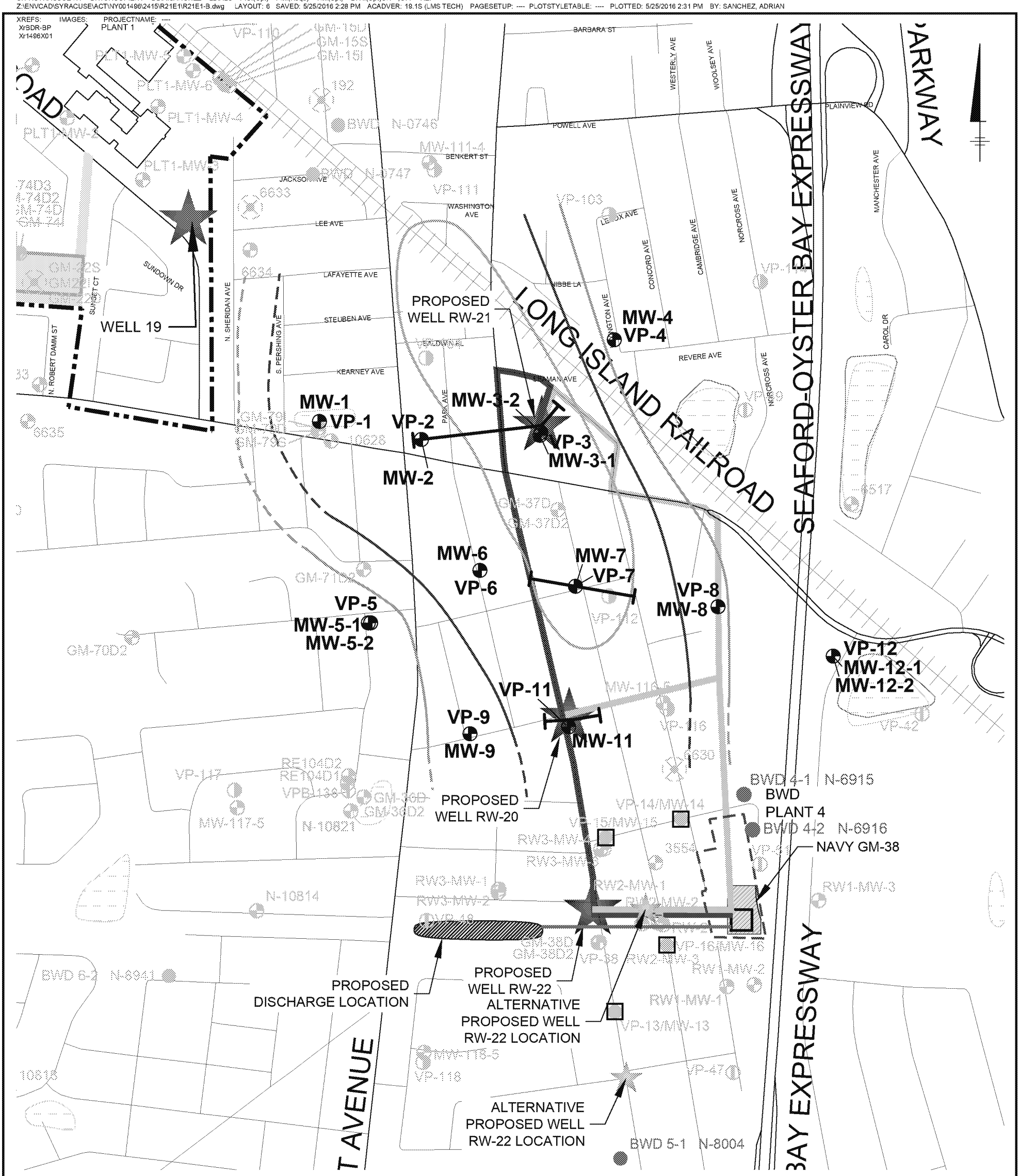

LEGEND:

- PROPERTY BOUNDARY OF THE FORMER GRUMMAN AEROSPACE CORPORATION SITE
- LONG ISLAND RAILROAD
- RECHARGE BASIN
- PUBLIC SUPPLY WELL
- EXISTING OU2 REMEDIAL WELL
- VERTICAL PROFILE BORING AND MONITORING WELL INSTALLED FOR RW-21 AREA PRE-DESIGN INVESTIGATION (OTHER WELLS OWNED BY NAVY, NORTHROP GRUMMAN OR OTHERS SHOWN IN GRAY FOR REFERENCE ONLY)
- VP-13/MW-13 PROPOSED VERTICAL PROFILE BORING/MONITORING WELL
- BWD BETHPAGE WATER DISTRICT
- APPROXIMATE PROPERTY BOUNDARY FOR POTENTIAL TREATMENT SYSTEM
- PROPOSED REMEDIAL WELL
- LATERAL EXTENT OF 90% OF VOC MASS DISCHARGE
- EXISTING EFFLUENT CONVEYANCE PIPE
- PROPOSED INFLUENT CONVEYANCE PIPE, ALTERNATIVE A
- PROPOSED INFLUENT CONVEYANCE PIPE, ALTERNATIVE B

TVOC CONCENTRATION CONTOURS IN GROUNDWATER IN µg/L (DASHED WHERE APPROXIMATE)

- 500
- 1000
- 5000

NOTE:

1. TVOC PLUME EXTENT LIMITED TO RW-21 AREA.
2. RW-22 LOCATION WILL BE FINALIZED FOLLOWING DESIGN INVESTIGATION.
3. FINAL INFLUENT CONVEYANCE PIPE ROUTE WILL BE DETERMINED BASED ON ACCESS AND APPROVAL.

0 500' 1000'
APPROXIMATE SCALE IN FEET

NORTHROP GRUMMAN SYSTEMS CORPORATION
OPERABLE UNIT 3
(FORMER GRUMMAN SETTLING PONDS)
BETHPAGE, NEW YORK

RW-21 AREA MASS DISCHARGE TRANSECTS, TREATMENT SYSTEM LAYOUT, AND DESIGN INVESTIGATION LOCATION

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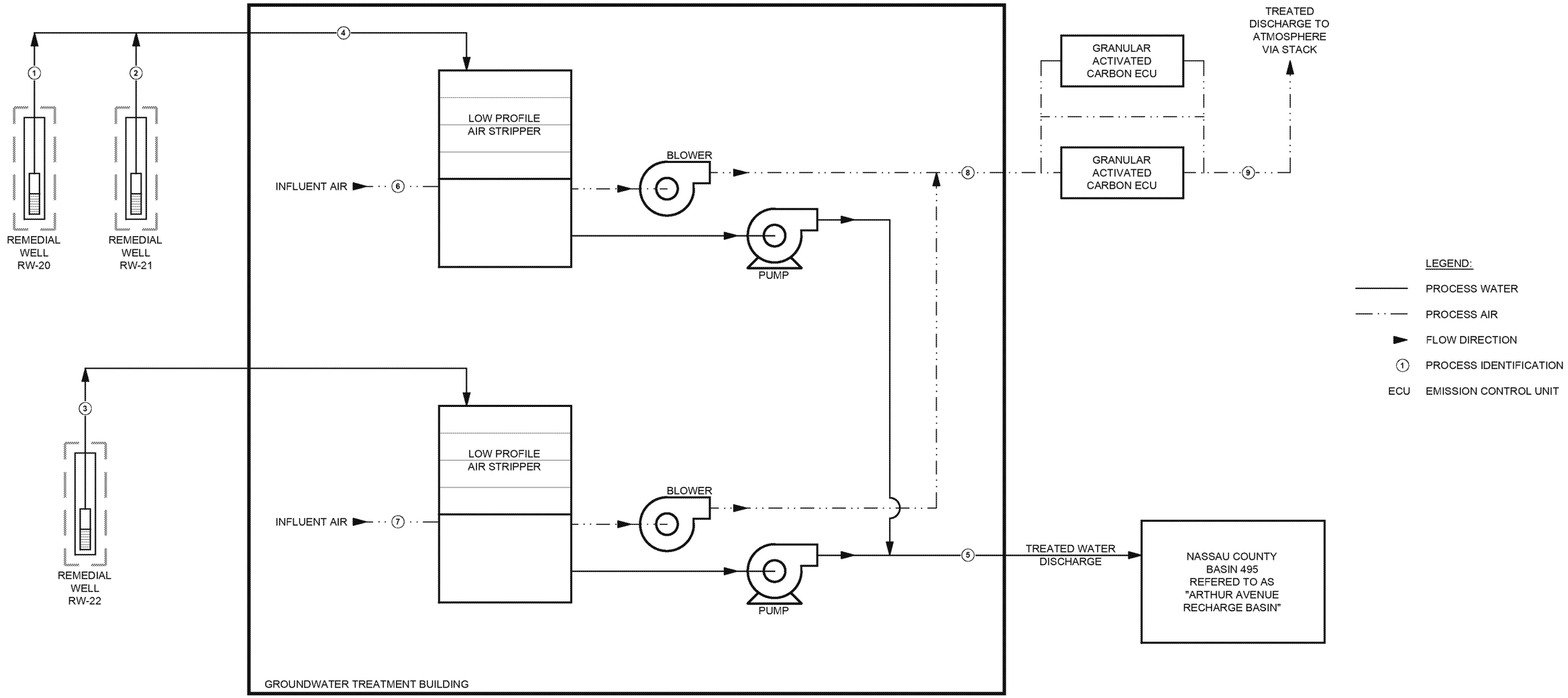
FIGURE 6



PROCESS IDENTIFICATION	1	2	3	4	5	6	7	8	9
Concentration (ppb)									
Trichloroethene	2,187	6,075	2,184	4,130	<1	0	0	15,978	<160
cis-1,2 Dichloroethene	194	405	194	300	<1	0	0	1,546	<15.5
Mass Loading (lbs/day)									
Trichloroethene	13.1	36.5	13.1	49.6	<0.018	0	0	60.2	<0.60
cis-1,2 Dichloroethene	1.2	2.4	1.2	3.6	<0.018	0	0	4.3	<0.043
Flow Rate (gpm)	500	500	500	1,000	1,500	---	---	---	---
Flow Rate (SCFM)	---	---	---	---	---	5,200	2,600	7,800	5,200

NOTE:

1. ALL PROCESS DATA REPRESENTS DESIGN VALUES FOR THE PURPOSE OF SIZING THE TREATMENT SYSTEM EQUIPMENT.
2. CONCENTRATIONS SHOWN IN PROCESS TABLE ARE BASED ON MODELED GROUNDWATER TOTAL VOLATILE ORGANIC COMPOUND CONCENTRATIONS.

NORTHROP GRUMMAN SYSTEMS CORPORATION
OPERABLE UNIT 3
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BETHPAGE, NEW YORK

PROPOSED RW-21 AREA TREATMENT SYSTEM FLOW DIAGRAM

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FIGURE 7

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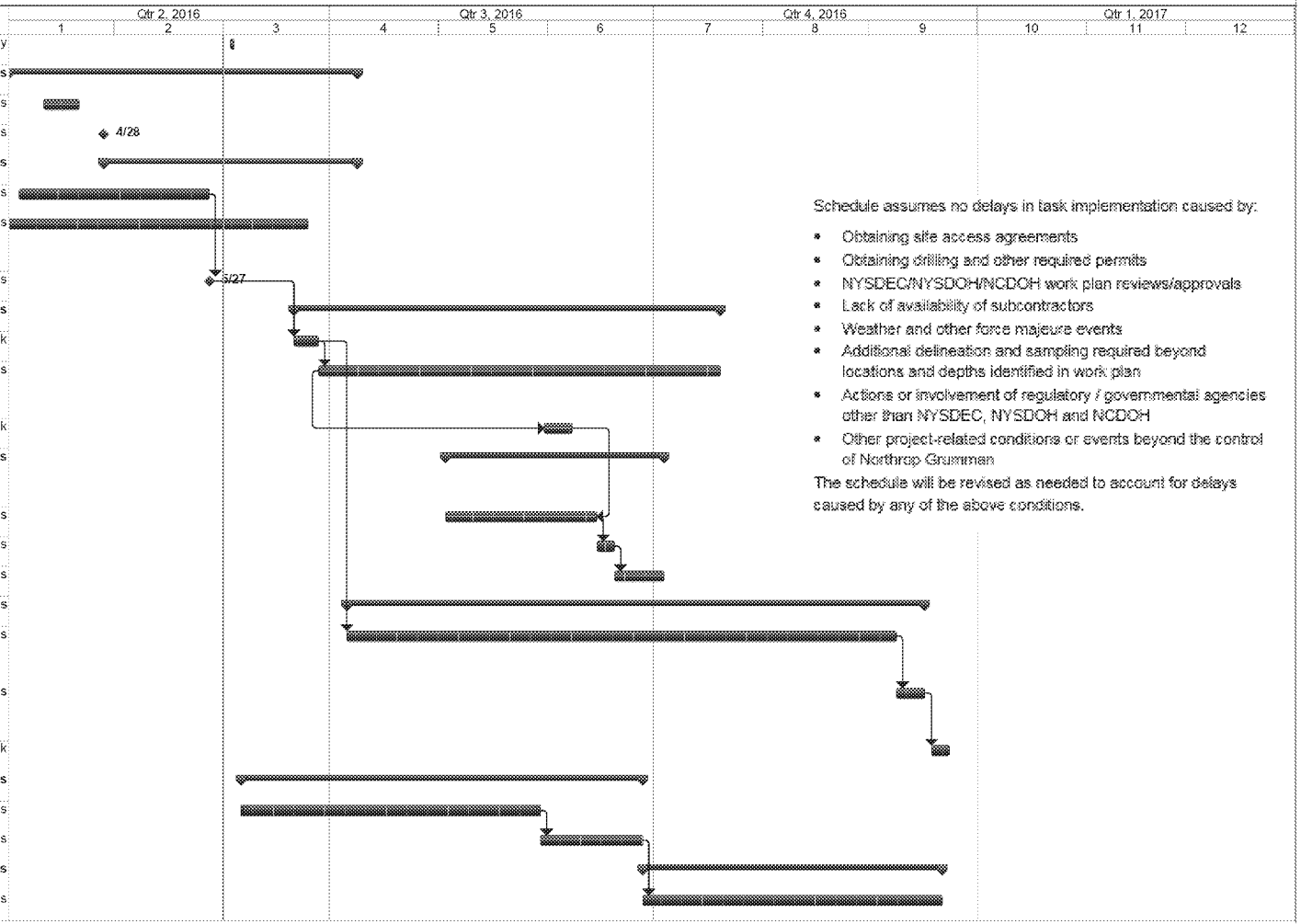
Figure 8: Project Schedule; RW-21 Area Remedial Design Work Plan, Northrop Grumman Systems Corporation, Operable Unit 3 (Former Grumman Settlings Ponds), Bethpage, New York.

ID	Task Name	Duration
1	Submit Remedial Design Work Plan to NYSDEC	1 day
2	**Planning and Coordination**	**69 days**
3	Preliminary RW-20, 21, & 22 Design Plan to NYSDEC	8 days
4	NYSDEC Approval	0 days
5	**Availability Sessions**	**50 days**
9	Recovery Well Bid Process	8 wks
10	Finalize Drill Sites, Permits, Access and Public Notification	12 wks
11	NG Notice to Proceed	0 days
12	**RW-22 Design Investigation**	**85 days**
13	Utility Clearance and Mobilization	1 wk
14	VPB and Monitoring Well Drilling, Development, Surveying, Waste Management	4 mons
15	Monitoring Well Sampling	1 wk
16	**Laboratory Analysis, Data Validation, Modeling, and Reporting**	**43 days**
17	Lab Analysis and Data Validation	6 wks
18	Groundwater Modeling	3 days
19	RW-22 Technical Report	2 wks
20	**Remedial Well RW-20, 21, and 22 Drilling**	**116 days**
21	Remedial Well Drilling, Installation, and Preliminary Development	22 wks
22	Remedial Well Surveying Temporary Vaults and Site Restoration	6 days
23	Final Well Construction Report	1 wk
24	**Remedial Design**	**80 days**
25	50-75% Engineering Design to NYSDEC	60 days
26	95% Engineering Design to NYSDEC	20 days
27	**Remedial Construction Bidding**	**60 days**
28	Bidding and Contracting	3 mons



Schedule assumes no delays in task implementation caused by:

- Obtaining site access agreements
- Obtaining drilling and other required permits
- NYSDEC/NYSDOH/NCDOH work plan reviews/approvals
- Lack of availability of subcontractors
- Weather and other force majeure events
- Additional delineation and sampling required beyond locations and depths identified in work plan
- Actions or involvement of regulatory / governmental agencies other than NYSDEC, NYSDOH and NCDOH
- Other project-related conditions or events beyond the control of Northrop Grumman

The schedule will be revised as needed to account for delays caused by any of the above conditions.

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

APPENDIX A

Quality Assurance Project Plan

APPENDIX B

Health and Safety Plan and Community Air Monitoring Plan

ARCADIS Design & Consultancy for natural and built assets

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