Work Plan for Supplemental Groundwater Characterization
Bethpage Park Groundwater Containment System

Operable Unit 3, Former Grumman Setting Ponds, Bethpage, New York

Prepared for:

NORTHROP GRUMMAN

Northrop Grumman Systems Corporation
Bethpage Facility

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1 Introduction

Environmental Management & Global Innovations, Inc. (EMAGIN) has prepared this Work Plan on behalf of Northrop Grumman Systems Corporation (Northrop Grumman) to address groundwater conditions in the vicinity of Bethpage Community Park (Park) in Bethpage, New York. This Work Plan describes the rationale and scope of work for drilling vertical profile borings (VPBs) and installing monitoring wells to assess previous groundwater sampling results and, if needed, to further delineate toluene in the deep aquifer in the vicinity of the Park. The proposed sampling locations and depths are based on the information provided in the *Bethpage Park Groundwater Containment System Hydraulic Effectiveness Evaluation Report* (Hydraulic Effectiveness Report; ERM, 2015), and the *Remedial Investigation Report (Site Area), Operable Unit 3 – Former Grumman Settling Ponds, Bethpage, New York* (ARCADIS, 2011).

2 Background

Northrop Grumman began operating the Bethpage Park Groundwater Containment System (BPGWCS) in 2009 to control off-site migration of volatile organic compounds (VOCs) in groundwater beneath the Park. The remedial system, which consists of four remedial wells situated along the southern Park boundary and an associated groundwater treatment system, has operated continuously since 2009. Pursuant to a May 2014 Operable Unit 3 (OU-3) Consent Order, Northrop Grumman conducted a hydraulic effectiveness evaluation to confirm that the BPGWCS was controlling VOC migration in groundwater. The work was conducted in accordance with the *Bethpage Park Containment System Pre-design Hydraulic Effectiveness Evaluation Work Plan* (Arcadis, 2014) and included drilling and sampling of four vertical profile borings (VPBs-207, -208, -300, and -301) and six monitoring wells (MWs-204, -205, -206, -207A, -207B, and -208) (**Figure 1**). Six piezometers (PZs-05C, -08A, -08B, -08C, -09A, and -10A) were also installed and sampled. The investigation findings were reported in the Hydraulic Effectiveness Report. The report concluded that the BPGWCS is effectively controlling VOCs in groundwater to an approximate depth of 175 feet below land surface (ft bls). The report also described findings related to the presence of toluene above the state groundwater quality standard (5 micrograms per liter (µg/L)) in VPBs at depths that had not previously been investigated (up to 400 ft bls). The report recommended consideration of supplemental characterization of the following areas:

- West of vertical profile boring VPB-207, downgradient of the Park, to define the western and vertical extent of toluene detected in groundwater at VPB-207 during the hydraulic effectiveness evaluation;
- In the former ball field area, to define the vertical extent of toluene where elevated toluene concentrations have historically been detected in groundwater; and
- At the northern property boundary of the Park, to investigate the potential for an upgradient, off-site source of toluene.

In its March 18, 2016 approval of the Hydraulic Effectiveness Report, the New York State Department of Environmental Conservation (NYSDEC) agreed that the BPGWCS is containing the OU-3 groundwater plume source and that selected additional testing is warranted in the deeper portion of the Magothy Aquifer (NYSDEC, 2016).

3 Objectives

The objectives of this investigation are:

- To assess toluene in deep groundwater (i.e., depths greater than 150 ft bls) downgradient of the Park and, if confirmed, define the western and vertical extent of that toluene;
- To assess toluene in deep groundwater (i.e., depths greater than 150 ft bls) at the southern boundary of the Park and, if confirmed, determine if there is a source in the former ball field area of the Park; and
- Further, if toluene is confirmed in deep groundwater at the southern boundary of the Park, determine if there is a source upgradient of the Park.

4 Scope of Work

The field work will be conducted in two phases, with Phase 2 contingent on the findings of Phase 1. The findings of Phase 1 and decisions regarding Phase 2 will be presented in a Phase 1 technical memo. Phase 2 will proceed if the Phase 1 results confirm the presence of deep toluene impacts in groundwater.

4.1 Phase 1 Activities

4.1.1 Resampling of monitoring wells MW-207A-1 and MW-207B-1

Monitoring wells MW-207A-1 and MW-207B-1 (**Figure 1**) were installed and sampled during the hydraulic effectiveness evaluation to confirm toluene impacts that were reportedly present at depth based on VPB samples collected in VPB-207. Toluene was present in the groundwater sample collected in MW-207A-1 (screened from 120 to 130 ft bls) at a concentration of 0.54 µg/L, compared to concentrations ranging from 147 to 190 µg/L in VPB samples previously collected over that same depth interval in VPB-207. Similarly, toluene was present in the groundwater sample collected in MW-207B-1 (screened from 210 to 220 ft bls) at a concentration of 2.4 µg/L, compared to concentrations ranging from 75 to 119 µg/L in VPB samples previously collected over that same depth interval in VPB-207. Resampling of the two monitoring wells was attempted in December 2015; however, groundwater samples could not be obtained because the well screens were obstructed.

The scope of work will address the apparent inconsistency in the previous sampling results by sampling at the MW-207A-1 and MW-207B-1 locations as follows:

1. Northrop Grumman will attempt to rehabilitate the wells (e.g., acid washing, surging) as a maintenance activity and, if successfully rehabilitated, the wells will be sampled for VOCs. Sampling protocols are provided in **Table 1.**
2. If rehabilitation of the wells is unsuccessful, replacement wells will be installed, with screened intervals the same as the original wells, and then the wells will be sampled for VOCs. Sampling protocols are provided in **Table 1.**

3. If the sampling results for MW-207A-1 and/or MW-207B-1 (or replacement wells) confirm the presence of elevated toluene in deep groundwater, then VPB-209 will be drilled west of those monitoring wells (**Figure 1**) to further delineate toluene impacts, as described in Section 4.2.1.

4.1.2 Installation of monitoring wells at VPB-300 and 301 locations

Toluene was detected in deep VPB samples at the southern boundary of the Park during the hydraulic effectiveness evaluation (e.g., 130 µg/L at 360 ft bls in VP-300 and 87 µg/L at 280 ft bls in VP-301; **Figure 1**). Those findings formed the basis for the Hydraulic Effectiveness Report's recommendation to evaluate potential deep toluene impacts in the former ball field area and at the northern Park boundary.

The scope of work to assess deep groundwater impacts at the southern boundary of the Park will consist of:

1. Northrop Grumman will install a monitoring well (MW-300) adjacent to former VPB-300 to assess deep toluene impacts at that location (**Figure 1**). The well will be screened from approximately 355 to 365 ft bls, but the final well screen interval will be selected based on results of VOC groundwater screening samples collected at 10-foot intervals from 335 to 385 ft bls using a HydroPunch tool. Following well completion and development, MW-300 will be sampled for VOCs. Sampling protocols are provided in **Table 1.**

2. Northrop Grumman will install a monitoring well (MW-301) adjacent to former VPB-301 to assess deep toluene impacts at that location (**Figure 1**). The well will be screened from approximately 275 to 285 ft bls, but the final well screen interval will be selected based on results of VOC groundwater screening samples collected by HydroPunch at 10-foot intervals from 255 to 305 ft bls. Following well completion and development, MW-301 will be sampled for VOCs. Sampling protocols are provided in **Table 1.**

3. If the sampling results for MW-300 and/or MW-301 confirm the presence of elevated toluene in deep groundwater at the southern Park boundary, then two VPBs will be drilled, one in the former ball field area of the Park (VPB-400) and one at the upgradient boundary of the Park (VPB-500) (**Figure 1**) as described in Section 4.2.2.

4.2 Phase 2 Activities

4.2.1 Installation of VPB-209/MW-209 west of vertical profile boring VPB-207

1. If the Phase 1 sampling results for MW-207A-1 and/or MW-207B-1 (or replacement wells) confirm the presence of elevated toluene in deep groundwater at that location, then VPB-209 will be drilled at the approximate location shown on **Figure 1** to define the western and vertical extent of toluene. VPB depth, sampling intervals, and sampling protocols are provided in **Table 1.**

2. Appropriate access agreement(s) and permit(s) will be obtained prior to drilling.

3. The VOC analytical results and geophysical logs from the VPB will be used to determine the appropriate screened interval for a monitoring well, MW-209, that will be installed in the VPB

borehole. Monitoring well construction will be flush-mount, 4-inch diameter PVC casing, with a 10-foot well screen.

4.2.2 Installation of VPB-400 at former ball field and VPB-500 at Park upgradient boundary

1. If the Phase 1 sampling results for MW-300 and/or MW-301 confirm the presence of elevated toluene in deep groundwater at the downgradient Park boundary, then VPB-400 and VPB-500 will be drilled to define the vertical extent of toluene at the former ball field area and the upgradient Park boundary, respectively. The approximate VPB locations are shown on **Figure 1** and the VPB depths, sampling intervals, and sampling protocols are provided in **Table 1**.

2. Appropriate access agreement(s) and permit(s) will be obtained prior to drilling.

3. Installation of permanent monitoring wells in the VPB-400 and VPB-500 boreholes will be contingent on the VPB sampling results. If VOCs are found at depth in a VPB above the applicable groundwater quality criteria, then a monitoring well will be installed in the borehole to confirm the VPB results and to provide a means for future groundwater monitoring. If constructed, monitoring wells will be flush-mount, 4-inch diameter PVC casing, with 10-foot well screens.

4.3 Health and Safety

The health and safety procedures detailed in the *Site-Specific Health and Safety Plan* (HASP; Arcadis, 2016a) will be followed for work carried out according to this Work Plan. Air monitoring for VOCs and particulates will be performed at designated work areas in accordance with the *Community Air Monitoring Plan* included in the HASP.

4.4 Decontamination

A decontamination pad will be constructed for equipment decontamination during implementation of the Work Plan. Decontamination fluids will be collected, containerized in 55-gallon drums, and temporarily stored at the Northrop Grumman facility before being characterized and either treated on site or disposed at a permitted off-site facility.

4.5 Investigation Derived Waste

Investigation derived waste produced during VPB and monitoring well installation and sampling activities will be collected, containerized in 55-gallon drums, and temporarily stored at the Northrop Grumman facility before being characterized and either treated on site or disposed at a permitted off-site facility.

5 Reporting

A Phase 1 technical memo will be prepared to present the results of the Phase 1 activities and to support decisions regarding the scope of, or need for, Phase 2 activities. The memo will include information, findings, and conclusions of the Phase 1 investigation regarding the presence of toluene in deep groundwater.

If Phase 2 activities are implemented, an assessment report will be prepared following completion of the field work. The report will include findings, conclusions, and recommendations for additional VPBs and/or monitoring wells, if needed to further delineate toluene in the deep groundwater in the vicinity of the Park.

A *Data Usability Summary Report* (DUSR) will be prepared in accordance with Section 17.1 of the *Quality Assurance Project Plan* (Arcadis, 2016b) and appended to the report. The DUSR will provide an evaluation of the analytical data to determine whether it meets the site-specific criteria for data quality and use.

6 Schedule

A proposed schedule for implementing this Work Plan is presented as **Figure 2.**

7 References

Arcadis, 2011. Remedial Investigation Report (Site Area), Operable Unit 3. February 2011.

Arcadis, 2014. Bethpage Park Containment System, Pre-Design Hydraulic Effectiveness Evaluation Work Plan. May 1, 2014.

Arcadis, 2016a. Site Specific Health and Safety Plan. May 2016.

Arcadis, 2016b. Quality Assurance Project Plan, Operable Units 2 and 3. June 2016.

ERM, 2015. ERM Consulting and Engineering, Inc. (ERM). Bethpage Park Groundwater Containment System Hydraulic Effectiveness Evaluation Report. July 2015.

NYSDEC, 2016. Approval letter for Bethpage Park Groundwater Containment System Hydraulic Effectiveness Evaluation Report. March 18, 2016.

Tables

Table 1. Sampling Plan
Work Plan for Supplemental Groundwater Characterization, Bethpage Park Groundwater Containment System

Boring/Well ID	Sampling Interval (ft bls)	Discrete Groundwater Sampling Frequency (ft)	Groundwater Laboratory Analysis[4]	Geophysical Logging	Split Spoons[5]	Purpose
Phase 1						
MW-207A-1	120-130	10	VOCs	NA	NA	Assess deep toluene impacts estimated by VPB-207.
MW-207B-1	210-220					Assess deep toluene impacts estimated by VPB-207.
MW-300	355-365	VOC samples will be collected at 10-foot intervals using HydroPunch method during well drilling, from 20 ft above to 20 ft below estimated screened zone.[1]				Assess deep toluene impacts estimated by VPB-300.
MW-301	275-285					Assess deep toluene impacts estimated by VPB-301.
Phase 2 (contingent on Phase 1 results)						
VPB-209	Water table[2] to 400[3]	10	VOCs	Continuous gamma, resistivity, and spontaneous potential logging	Split spoon samples will be collected at 150, 250, and 350 ft bls in each VPB	Determine the total depth and likely western extent of toluene immediately downgradient of the Park.
VPB-400	150 - 400[3]					Determine if deep groundwater (greater than 150 ft bls) in the former ball field area in the Park is impacted by toluene.
VPB-500	150 - 400[3]					Determine if deep groundwater (greater than 150 ft bls) at the upgradient boundary of the Park is impacted by toluene.

Notes:

1 Final well screen intervals will be selected based on VOC results from HydroPunch samples.

2 Water table is approximately 50 ft bls.

3 If VOCs detected above groundwater quality standard at 400 ft bls, boring will be continued until VPB results show 3 consecutive samples below the standard.

4 Groundwater samples will be analyzed for VOCs by EPA Method 8260. Analytical results will be obtained on a 24-hour turn-around.

5 Split spoon samples will be used to check borehole geophysical results and to provide hydrogelogic information.

Definitions:

ft feet
ft bls feet below land surface
VPB vertical profile boring
VOCs volatile organic compounds

Figures

Work Plan for
Supplemental Groundwater Characterization
Northrop Grumman, Bethpage, NY

Figure 1
Current and Proposed VPB
and Monitoring Well Locations

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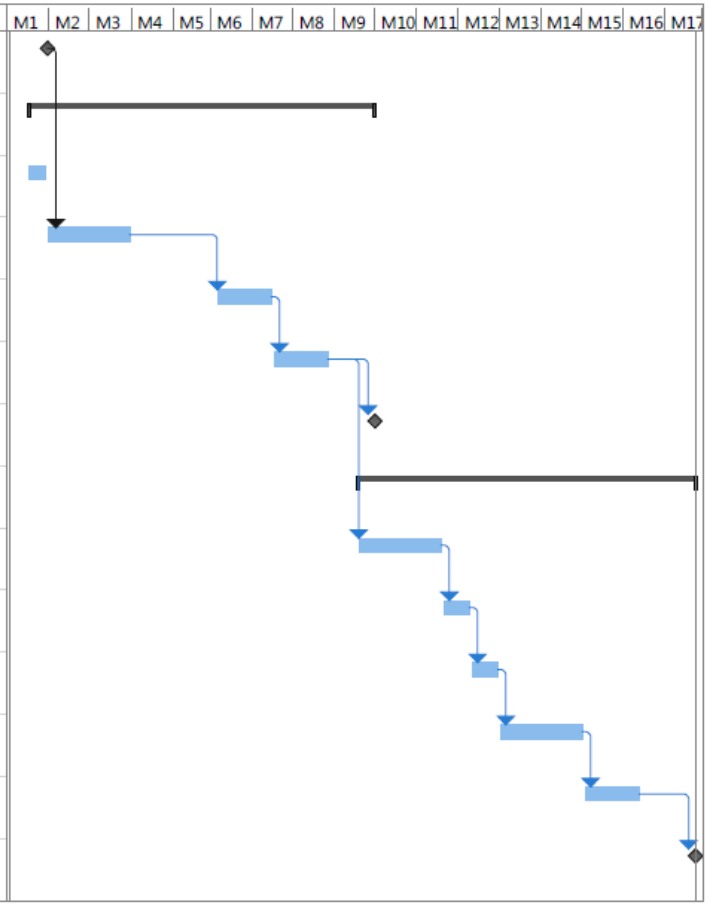
Task Name	Duration
DEC Approval of Work Plan	0 days
Phase 1 Tasks	**185 days**
Rehabilitate / sample MW-207A-1 and MW-207B-1 (work to be initiated before DEC approval of Work Plan)	10 days
Permitting, contracting, notices for well installation	45 days
Install / sample replacement wells for MW-207A-1 and MW207B-1 (Contingent task)	30 days
Install / sample MW-300 and MW-301	30 days
Submit Phase 1 technical memo to DEC	0 days
Phase 2 Tasks (Contingent on Phase 1 Results)	**180 days**
Permitting, contracting, notices for VPB/well installation	45 days
Drill VPB-209	15 days
Install / sample MW-209	15 days
Drill VPB-400 and VPB-500	45 days
Install / sample MW-400 and/or MW-500	30 days
Submit final report to DEC	0 days



Schedule assumes no delays in task implementation caused by:

- Obtaining site access agreements
- Obtaining drilling and other required permits
- NYSDEC/NYSDOH/NCDOH/TOB work plan reviews and 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 involvements of regulatory/government agencies other than NYSDEC, NYSDOH, NCDOH, or TOB
- 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

Work Plan for
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Figure 2
Schedule

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