New York State Department of Environmental Conservation Brownfield Cleanup Program

ALTERNATIVES ANALYSIS REPORT

BETHPAGE COMMUNITY PARK ICE RINK AREA
STEWART AVENUE
BETHPAGE
NASSAU, NEW YORK

NYSDEC SITE NO. C130212

H2M Project No.
TOBY 13-07

October 2016

Prepared for:

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October 2016

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TABLE OF ABBREVIATIONS AND ACRONYMS

µg/L	micrograms per liter
AAR	Alternatives Analysis Report
BCA	Brownfield Cleanup Agreement
BCP	Brownfield Cleanup Program
bgs	Below ground surface
BHS	Bethpage High School
bls	Below land surface
CFR	Code of Federal Regulations
cu yd	cubic yard
DAR	NYSDEC Division of Air Resources
December 2007 ARCADIS GW IRM WP	Groundwater Interim Remedial Measure Work Plan, Operable Unit 3, Former Grumman Settling Ponds, prepared by ARCADIS of New York, Inc. and (revision) dated December 12, 2007
DER	NYSDEC Division of Environmental Remediation
DER-10	NYSDEC DER-10 / Technical Guidance for Site Investigation and Remediation dated May 3, 2010
Draft BCP Guide	NYSDEC Draft Brownfield Cleanup Program Guide dated May 2004
ECL	Environmental Conservation Law
February 2008 ARCADIS RIR (Site Area)	Remedial Investigation Report (Site Area) prepared by ARCADIS of Melville, New York and dated February 1,2008
Freon-12™	Dichlorodifluoromethane
Freon-22™	Chlorodifluoromethane
H2M	H2M architects + engineers
IRM	Interim Remedial Measure
January 2009 ARCADIS Supplement to the RIR (Site Area)	Supplement to the Remedial Investigation Report (Site Area) prepared by ARCADIS of Melville, New York and dated January 2009
January 2014 H2M RIWP	Remedial Investigation Work Plan prepared by H2M and dated January 2014
January 2016 H2M RIR	Remedial Investigation Report prepared by H2M and dated January 2016
March 2013 NYSDEC OU3 ROD	ROD for Northrop Grumman Bethpage Facility – Operable Unit Number: 03 – State Superfund Project – Bethpage, Nassau County-Site No. 130003A, dated March 2013 and issued by the NYSDEC
MCL	Maximum Contaminant Level
msl	mean sea level

TABLE OF ABBREVIATIONS AND ACRONYMS

NGC	Northrop Grumman Corporation
NYCRR	Codes, Rules and Regulations of the State of New York
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
OTA	Town of Oyster Bay Office of the Town Attorney
OU3	Operable Unit 3
OU3 IRM	Groundwater pump and treat system south of the Park
Park	Bethpage Community Park
POC	Principal Organic Contaminant
RAO	Remedial Action Objective
RI	Remedial Investigation
ROD	Record of Decision
SCG	Standards Criteria and Guidance Values
SGV	NYSDEC Division of Water Technical and Operational Guidance Series (1.1.1) Class GA drinking water ambient standards and guidance values
Site	Bethpage Community Park Ice Rink Area in the Hamlet of Bethpage, TOB, Nassau County, New York
SPDES	State Pollutant Discharge Elimination System
SVE	Soil Vapor Extraction
SVI	Soil Vapor Intrusion
TCL	Target Compound List
TIC	Tentatively Identified Compound
TOB	Town of Oyster Bay
TOB Ice Skating Center	Two former ice skating rinks, now demolished and replaced by the current indoor ice skating center
TOGS	NYSDEC Technical & Operational Guidance series
Town	Town of Oyster Bay
TVOC	Total VOC
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VOC	Volatile Organic Compound

October 2016

1.0 INTRODUCTION

On behalf of the Town of Oyster Bay (TOB; Town) Office of the Town Attorney (OTA), H2M architects + engineers (H2M) has prepared this Alternatives Analysis Report (AAR) for the Bethpage Community Park Ice Rink Area in the Hamlet of Bethpage, TOB, Nassau County, New York (Site). The approximately 0.4-acre Site is situated within the northeast portion of the approximately 18-acre Bethpage Community Park (Park) and encompasses the footprint of two former ice skating rinks, now demolished and replaced by the current indoor ice skating center (TOB Ice Skating Center). United States Geological Survey (USGS) 7.5-minute topographic quadrangles including the Site and the surrounding area (within a minimum radius of 0.5 miles) are provided as Figure 1. A map showing the Park features and Site outline is provided as Figure 2.

The NYSDEC accepted the Site into the Brownfields Cleanup Program (BCP) in a letter dated January 19, 2012 and executed / entered into a Brownfield Cleanup Agreement (BCA) with the TOB on March 16, 2012. The TOB was tasked with investigating volatile organic compounds (VOC) and Tentatively Identified Compounds (TIC) impacts from the Site to groundwater and soil vapor. A Remedial Investigation (RI) was conducted in accordance with the NYSDEC-approved Remedial Investigation Work Plan prepared by H2M and dated January 2014 (January 2014 H2M RIWP). The RI included, but was not limited to groundwater and soil vapor sampling for Target Compound List (TCL) VOCs, VOC TICs, dichlorodifluoromethane (Freon-12™), and chlorodifluoromethane (Freon-22™) analysis.

The findings and conclusions of the RI were consistent with the Site being a former source of Freon-22™ impacts to groundwater as well as Freon-22™ and Freon-12™ impacts to soil vapor. Freon-22™-impacted groundwater was identified in the eastern portion of the Park (Figures 3 and 4). There is no indication that the Site contributed to existing or historical soil impacts nor to non-Freon™ impacts to groundwater and/or soil vapor. Freon-22™ and Freon-12™ impacts to soil vapor have been effectively reduced to a point where remediation was not recommended. The findings and conclusions were summarized in the RI Report prepared by H2M and dated January 2016 (January 2016 H2M RIR). The January 2016 H2M RIR was approved by the NYSDEC in a letter dated May 12, 2016. The NYSDEC also made a “significant threat” determination for the Site and required an alternatives analysis report for Freon-22™ in “on-site and off-site” groundwater. The determination by NYSDEC as to whether the Site poses a significant threat is a procedural step in the Brownfield Cleanup Program which triggers the potential availability of grant funding to qualifying community groups interested in independent technical analysis or review.

This AAR identifies, evaluates and proposes alternative remedies to address Freon-22™ in groundwater in the Site vicinity. This AAR has been prepared in accordance with the requirements of the New York State Department of Environmental Conservation (NYSDEC) Division of Environmental Remediation (DER) Technical Guidance for Site Investigation and Remediation dated May 2010 (NYSDEC DER-10) and NYSDEC DER Draft Brownfield Cleanup Program Guide dated May 2004 (NYSDEC Draft BCP Guide).

1.1 Site and Area Description

The Site is located on Stewart Avenue in the Hamlet of Bethpage, Town of Oyster Bay (TOB), Nassau County, New York. The Site location map is provided as Figures 1 and 2. The approximately 0.4-acre Site is situated within the northeast portion of the Park. The Site encompasses the footprint of two former ice skating rinks, now demolished and replaced by the current indoor TOB Ice Skating Center. The Site consists of one, one-story brick and concrete building. The Site is utilized for recreational purposes. Surrounding the Site is the approximately 18-acre Park, owned and operated by the TOB and containing a swimming pool, basketball court, baseball field, tennis courts, skate park, playground, picnic areas, a parking lot, and an indoor TOB Ice Skating Center. The Park is bordered by Cherry Avenue Extension to the north; Stewart Avenue to the east; Former NGC Plant 24 Access Road to the south; and the former NGC Plant 24 building and other Northrop Grumman Corporation (NGC) properties to the west. Bethpage High School (BHS) is located east of the Park, across Stewart Avenue and residential properties are located south of the Park, across the Former NGC Plant 24 Access Road. The area surrounding the Site contains a mix of land uses.

1.2 Topography and Hydrogeology

The Site is located in an area that is approximately 125 feet above mean sea level (msl) and is generally flat. The surrounding area land surface ranges from approximately 85 to 120 feet above msl and is generally flat. The depth to groundwater at the Site varied during the RI between approximately 52.95 feet below ground surface (bgs) to 53.61 feet bgs. The depth to groundwater at the Site varies seasonally from approximately 50 to 55 feet below land surface (bls). The depth to groundwater within the general area of the Site varies between 50 and 74 feet above msl. Groundwater flow at the Site and in the general area of the Site is in the south-southeasterly direction.

1.3 Environmental History

1.3.1 Site and Park

The Site is owned and operated by TOB and is a part of the Park. Historically, the Park area was first developed and utilized for farming activity. Grumman (predecessor to NGC) purchased the Park area property in 1941 and utilized the property as sludge settling beds (settling ponds) and recharge basins for waste disposal purposes (including Grumman manufacturing processes and industrial wastes, industrial wastewater treatment sludge, spent paint booth rags, and potential used oil and jet fuel). The Park was also utilized for fire control training. Grumman transferred ownership of the property to the TOB in 1962 for development as a public park. The TOB developed the Park with an ice skating rink (Site), a parking lot, basketball court, baseball field, stormwater recharge basin, paddleball, tennis and shuffleboard courts, picnic and playground areas, horseshoe pits, bicycle racks, swimming pools, and offices. The Park was partially redeveloped by the TOB in 2005. Redevelopment of the Site included demolition of the former ice skating rink and replacement with the current indoor TOB Ice Skating Center.

The former ice skating rinks that existed at the Park prior to installation of the currently existing Ice Skating Center were known to have utilized Freon-22™ in the facility's ice making system. In addition, based upon information from Town employees familiar with the system, the network of piping used to transport Freon-22™ through the system was known to have leaked. While the statement by the former employee clearly referenced vapor phase Freon leaks to air, the identification

of past Freon leaks and the presence of Freon in soil vapor and groundwater in the vicinity of the former ice rinks created a concern that the former ice rinks were a source.

1.3.2 Operable Units 2 and 3

The former United States Naval Weapons Industrial Reserve Plant (NWIRP) occupied approximately 105 acres of the Grumman Property, located west of the Site. The NWIRP was established in 1933 and included four plants, two warehouse complexes, a salvage storage area, water recharge basins, an Industrial Wastewater Treatment Plant (ITWP), and several support buildings. Operations at the NWIRP included research prototyping, testing, design engineering, fabrication, and primary assembly of military aircraft. Freon™ was utilized at the NWIRP.

Beginning in the 1940's, operations at the Grumman Property included chemical milling, plating, and degreasing. Chromic acid wastes were disposed in open seepage basins or directly on the ground and neutralized chromic acid wastes were dried in settling ponds and shipped off-site for disposal. Chromium contamination was identified in a public water supply well south of the Grumman Property in 1949. In 1976, trichlorethene (TCE) was detected in a Grumman Property-owned supply well and a Bethpage Water District (BWD) off-line well located south of the Grumman Property.

The approximately 17-acre former Occidental Chemical Corporation (formerly the Hooker Chemical Corporation) / RUCO Polymer Corporation (OCC / RUCO) site was located on New South Road, adjacent to and west of the Grumman Property, began operations in 1945 and included handling and storing natural rubber latex, production of plasticizers and polyvinyl chloride, and disposing manufacturing processes wastes (including glycols, alcohols, tetrachloroethene [PCE], methanol, and organic acids) and non-contact cooling water through sand sumps at the OCC / RUCO site.

The OU2 program was developed to investigate and remediate the groundwater impacts in and around the NWIRP, Grumman and/or OCC / RUCO sites. A groundwater containment and treatment system (Onsite Containment System [ONCT]) was installed in November 1997. As of February 2011, the maximum extent of the OU2 VOC-Plume was approximately 3.5 miles in length, 1.6 miles in width, 790 feet in depth, and 430 feet in thickness.

The OU3 program was developed to investigate and remediate source areas and groundwater at the Former Grumman Settling Ponds, portions of the Park and the Grumman Access Road. Effective July 4, 2005, the NYSDEC and NGC executed an Order on Consent (CO; Index Number W1-0018-04-01) for implementation of a groundwater pump-and-treat system IRM and a soil vapor IRM for OU3. Based on groundwater investigations conducted between June 2006 and July 2009, the OU3 / Study Area VOC-Plume was approximately 8,300 feet in length, 2,100 feet in width, 670 feet bls in depth, and 430 feet in thickness (as of February 2011).

In a letter dated May 26, 2010, the NYSDEC indicated that the "Freon-22™ groundwater contamination has been identified as a sub-plume within the overall OU3 Grumman groundwater contamination plume." The Freon-22™ groundwater sub-plume was identified in the eastern portion of the Park and delineated within the OU3 boundary.

1.3.3 RI and IRMs

To date, extensive environmental sampling of groundwater, soil and soil vapor at the Site and general area has been conducted by various entities. Groundwater, soil and soil vapor samples were analyzed for various constituents, including, but not limited to metals, pesticides, polychlorinated biphenyls (PCB), volatile organic compounds (VOCs) and semivolatile organic compounds (SVOC). The following are based on the Remedial Investigation Report (Site Area) prepared by ARCADIS for OU3 and dated February 1, 2008 (February 2008 ARCADIS RIR [Site Area]):

- Perched water in the southwest portion of the Park was impacted with VOCs;
- Groundwater impacted with VOCs was present at the Park and originates from the southwest portion of the Park. The southwest portion of the Park is a continuing source of VOCs impacts to groundwater. The groundwater plume contained VOCs at concentrations up to four orders of magnitude greater than applicable regulatory agency standards.
- Soil in the southwest portion of the Park was impacted with SVOCs and VOCs. Soil impacted with metals and PCB was identified at the Park.
- VOCs were identified in soil gas at the Park.

Remedies to the environmental impacts identified by numerous investigations were presented in several Records of Decisions (ROD) issued by the NYSDEC (130003A and 130003B [March 1995, March 2001 and May 1995]) and Operable Units (OU1, OU2 and OU3). According to the ROD for Northrop Grumman Bethpage Facility – Operable Unit Number: 03 – State Superfund Project – Bethpage, Nassau County- Site No. 130003A, dated March 2013 and issued by the NYSDEC (March 2013 NYSDEC OU3 ROD), the “Freon plume emanating from the ice rinks is comingled with OU3 related VOCs”.

Interim Remedial Measures (IRM) implemented at the Park included, but are not limited to the following:

1. Soil Excavation IRM – Approximately 173,000 tons of non-hazardous debris and soil impacted with VOCs, SVOCs, PCBs, metals, and cyanide were excavated from across 7 acres of the Park. The excavated soil was replaced with clean soils.
2. Soil Vapor Extraction System (SVE) IRM – An SVE system was installed along the southern boundary of the Park to “intercept/contain contamination in the soil vapor”. The SVE system has been operational since early 2008.
3. Groundwater Pump and Treat IRM (OU3 IRM) – A groundwater extraction and treatment system was installed along the southern boundary of the Park to address “contaminated groundwater”. The IRM includes four remedial wells, groundwater treatment via air stripping to reduce VOCs (including Freon-22™), groundwater filtration to remove oxidized metals, and (treated) groundwater return to the aquifer via a recharge basin. According to the Groundwater Interim Remedial Measure Work Plan, Operable Unit 3, Former Grumman Settling Ponds, prepared by ARCADIS of New York, Inc. and (revision) dated December 12, 2007 (December 2007 ARCADIS GW IRM WP), the groundwater pump-and-treat system was designed to provide a hydraulic barrier across the downgradient portion of the Park Area. Specifically, the OU3 IRM was

designed to prevent groundwater with a total VOC concentration greater than 5 micrograms per liter (µg/L) from migrating across the 1,200-foot wide lateral extent of the Park Area boundary. The Groundwater Pump and Treat system has been operational since July 2009.

1.4 Remedial Investigation

An RI was conducted in accordance with the Chapter 2 and Chapter 3 of the NYSDEC DER-10 and the NYSDOH Soil Vapor Intrusion (SVI) Guidance and in compliance with the NYSDEC-approved January 2014 H2M RIWP. The RI included the following:

- Records search;
- Utility mark-out;
- Geophysical survey;
- Site visit;
- Groundwater investigation;
- Soil vapor investigation;
- Human Exposure Assessment; and
- Data evaluation.

The RI field work was conducted between February 2014 and October 2014 and included groundwater and soil vapor sampling for TCL VOCs, VOC TICs, Freon-12™, and Freon-22™ analysis. The findings and conclusions were summarized in the January 2016 H2M RIR and included the following:

- Freon-22™-impacted groundwater was identified in the eastern portion of the Park. The Freon-22™-impacted groundwater was not identified downgradient of the OU3 groundwater IRM extraction wells (south of the Park and north of Sycamore Avenue). Based on the findings of the RI, the existing groundwater IRM is effectively controlling the migration of Freon-22™ from the Park area. The RI findings are consistent with the Site being a former source of Freon-22™ impacts to groundwater. Details are provided on Figures 3 and 4.
- Freon 12™ impacts were not identified in groundwater.
- Freon-22™ and Freon-12™ concentrations in the shallow and deep soil vapor in the Site vicinity were initially identified and delineated as part of remedial investigation activity reported in 2005 and 2008. Since that timeframe, concentrations have decreased significantly. Freon-22™ and Freon-12™ soil vapor concentrations have been effectively reduced to below applicable United States Environmental Protection Agency (USEPA) Soil Screening Levels and worker exposure limits. The RI findings are consistent with the Site being a former source of Freon-22™ and Freon-12™ impacts to soil vapor.
- An ongoing source of Freon-12™ and/or Freon-22™ impacts to groundwater or soil vapor was not identified.
- Potential exposure to Freon-impacted soil vapor and/or groundwater is limited to subsurface work in the Site and Park area that may create a situation where construction

workers are directly exposed to groundwater or soil vapor. However, the concentrations are low and with minimal hazard concern. Other exposure pathways are considered incomplete given the results presented in the RI and/or controls in place. There is no indication that the Site contributed to existing or historical soil impacts nor to non-Freon™ impacts to groundwater and/or soil vapor. While not attributed to the Site, non-Freon™ VOC impacts to soil vapor and groundwater identified in the vicinity of the Site are significant. Accordingly, the following additional recommendations were provided:

- Based upon the most recent available IRM monitoring report, Park Area VOC impacts identified as emanating from the former Grumman settling pond and rag pit area are still present at several orders of magnitude above groundwater standards. It is therefore anticipated that the OU3 groundwater IRM will continue to operate for an extensive period of time. Operation should be continued in accordance with NYSDEC requirements and directives.
- While not attributed to the subject site, non-Freon VOC impacts to soil vapor in the Site and Park area are still significant enough to warrant soil vapor intrusion mitigation to be considered on any new or modified buildings to be constructed in the Park area.

Based on the findings of the RI, it was recommended that an evaluation of remedial alternatives be conducted for Freon-22™ in groundwater in the Park area. Freon-22™ and Freon-12™ impacts to soil vapor have been effectively reduced to a point where remediation was not recommended. The January 2016 H2M RIR was approved by the NYSDEC in a letter dated May 12, 2016. The NYSDEC required an alternatives analysis report for the “on-site and off-site” groundwater.

2.0 CRITERIA, GOALS AND OBJECTIVES

2.1 Standards, Criteria and Guidance

The remedy evaluation will consider the following Standards Criteria and Guidance Values (SCG) for remediation of Freon-22™ in groundwater:

- 6 New York Codes, Rules and Regulations (NYCRR), Chapter III, Subchapter A – Prevention and Control of Air Contamination and Air Pollution (applicable parts)
- 6 NYCRR Part 364 – Waste Transporter Permits
- 6 NYCRR Part 375 - Environmental Remediation Programs
- 6 NYCRR Part 701 – Classifications – Surface Waters and Groundwater
- 6 NYCRR Part 703 - Surface Water and Groundwater Quality Standards and Groundwater Effluent Limitations
- 6 NYCRR Part 750 – NYSDEC State Pollutant Discharge Elimination System (SPDES) Permit Programs
- 40 Code of Federal Regulations (CFR) Part 50 – National Primary and Secondary Ambient Air Quality Standards
- 40 CFR Part 51 – Requirements for Preparation, Adoption, and Submittal of Implementation Plans
- 40 CFR Part 122 – EPA Administered Permit Programs: The National Pollutant Discharge Elimination System (NPDES)
- 40 CFR Part 131 – Water Quality Standards
- 40 CFR Part 136 – Guidelines Establishing Test Procedures for the Analysis of Pollutants
- 40 CFR Part 403 – General Pretreatment Regulations for Existing and New Sources of Pollution
- 29 CFR Part 1910 – Occupational Safety and Health Administration
- 29 CFR Part 1926 – Safety and Health Regulations for Construction
- New York Environmental Conservation Law (ECL) 15-3109 – Groundwater Remediation Strategy
- NYSDEC DAR-1: Guidelines for the Control of Toxic Ambient Air Contaminants
- NYSDEC Technical & Operational Guidance series (TOGS) 1.1.1 - Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations

Individual Freons™ (principal organic contaminant [POC]) not listed in the NYSDEC TOGS are classified as halogenated alkanes. The 6 NYCRR Part 703 and NYSDEC TOGS Class GA drinking water standard for individual POCs and the 10 NYCRR Part 5 maximum contaminant level (MCL) for POCs is 5 µg/L. Accordingly, the SCG utilized for Freon-22™ in groundwater is 5 µg/L.

2.2 Remedial Goals

The goals of the remedial program to address Freon-22™ in groundwater include:

- Restore the Site to pre-release conditions, to the extent feasible through attainment of applicable media cleanup standards.
- Eliminate or mitigate significant threats to the public health and environment.

2.3 Remedial Action Objectives

The following Remedial Action Objectives (RAO) have been developed for the Site based on the findings of the RI and in accordance with NYSDEC DER-10:

- RAOs for Public Health Protection
    - Prevent ingestion of Freon-22™-impacted groundwater attributed to the Site.
    - Prevent exposure (contact, inhalation) to Freon-22™ in groundwater attributed to the Site.
- RAOs for Environmental Protection
    - Restore the groundwater quality impacted by the Site, to meet the applicable groundwater SCG for Freon-22™, to the extent feasible.

2.4 Evaluation Criteria

The proposed remedial alternative evaluation criteria were developed based on the requirements set forth in 6 NYCRR 375-1.8(f) and NYSDEC DER-10 and are presented below. The first two evaluation criteria are “threshold criteria” and must be satisfied for an alternative to be considered for selection. The remaining applicable criteria are “primary balancing criteria” and are used to compare the positive and negative aspects of each remedial alternative.

Threshold Criteria

Protection of Public Health and the Environment

This criterion is an evaluation of the ability of each alternative or the remedy to protect public health and the environment.

SCGs

The remedy must conform to regulatory agency promulgated SCGs that are directly applicable or that are relevant and appropriate. The selection of a remedy must also take into consideration applicable guidance as appropriate.

Primary Balancing Criteria

Long-term Effectiveness and Permanence

This criterion is an evaluation of the long-term effectiveness and permanence of an alternative or remedy after implementation. Long-term effectiveness and permanence of an alternative or remedy after implementation is best accomplished by alternatives that include restoration of the aquifer, to the extent feasible.

Toxicity, Mobility or Volume of Contamination Reduction

This criterion is an evaluation of the ability of an alternative or remedy to reduce the toxicity, mobility and volume of site contamination. Preference is given to remedies that permanently or significantly reduce the toxicity, mobility or volume of the contamination at the site.

Short-term Impact and Effectiveness

This criterion is an evaluation of the potential short-term adverse environmental impacts and human exposures during the construction and/or implementation of an alternative or remedy.

Ability to be Implemented

This criterion is an evaluation of the technical and administrative feasibility of implementing an alternative or remedy.

Cost Effectiveness

This criterion is an evaluation of the overall cost effectiveness of an alternative or remedy.

Community Acceptance

This criterion is evaluated after the public review of the remedy selection process and close of the public comment period.

3.0 REMEDIAL ALTERNATIVES ANALYSIS

Based on the findings of the RI, it was recommended that an evaluation of remedial alternatives be conducted for Freon-22™ in groundwater in the Park area. In addition, the NYSDEC required an Alternatives Analysis Report (AAR). Accordingly, this AAR identifies, evaluates and proposes alternative remedies to address Freon-22™ in groundwater in the Park area.

3.1 Description and Evaluation of Remedial Alternatives

3.1.1 Alternative 1 – No Action

Alternative 1 acknowledges that VOC impacts to groundwater were investigated and remediated via several IRMs. This alternative does not include any additional remedial activities or institutional controls. The No Action Alternative assumes continued operation of the groundwater pump and treat system (OU3 IRM) at the Park, in accordance with NYSDEC requirements and directives. The potential remains for direct contact with Freon-22™-impacted groundwater (e.g., future Site workers may come in contact with impacted groundwater if their work includes subsurface activity conducted at a depth where groundwater is present).

3.1.2 Alternative 2 –Institutional Action

Alternative 2 acknowledges that VOC impacts to groundwater were investigated and remediated via several IRMs and assumes continued operation of the groundwater pump and treat system (OU3 IRM) at the Park area, for a period of time sufficient to reduce Freon-22™ impacts in the Park area below the applicable SCG. Institutional Action involves establishing institutional controls in the form an NYSDEC environmental easement that will include to the following:

- Develop and implement controls to limit exposure to impacted groundwater during intrusive work in the impacted area;
- Restrict use of the groundwater as a source of potable or process water;
- Implement a site management plan and health and safety plan (for subsurface activity conducted at a depth where groundwater is present);
- Provide periodic certification of institutional controls to the NYSDEC; and
- Provide Site access and appropriate notification to the NYSDEC.

3.1.3 Alternative 3 – Pump and Treat System

Alternative 3 includes establishing institutional controls identified in Alternative 2 and installing a pump and treat system in the southeastern portion of the Park (north of the existing OU3 IRM extraction wells). The groundwater pump and treat system would be designed and dedicated to address Freon-22™ impacts and would generally consist of the following:

- Installing groundwater extraction wells in the southeast portion of the Park.
- Transferring Freon-22™-impacted groundwater to an air stripper to treat the groundwater and reduce the concentration of Freon-22™ to below the SCG of 5 µg/L.
- Discharging the treated water to the subsurface via a recharge basin or injection well.
- Treating the air stripper off-gas, if required, prior to discharge to the atmosphere.

3.2 Comparative Analysis of Remedial Alternatives

Provided below is a comparison of the selected remedial alternatives including application of threshold and balancing criteria.

3.2.1 Threshold Criteria

Protection of Public Health and the Environment

Alternative 1 does not provide additional protection of public health because the potential remains for direct contact with Freon-22™-impacted groundwater. As such, Alternative 1 is not considered for selection (will not be carried forward in the comparative analysis). Alternative 2 provides additional protection of public health with the establishment of an environmental easement. Alternative 3 provides protection of public health and the environment, but is less protective than Alternative 2 because installation of an additional groundwater pump and treat system has the potential to expose workers to impacted groundwater and operation of a new groundwater pump and treat system may distort the VOC and Freon-22™ plume and disrupt the OU3 IRM groundwater treatment system that has been operational since July 2009.

Conclusion: Alternative 2 provides better protection of public health and the environment than Alternatives 1 and 3.

Compliance with New York State SCGs

Alternative 2 achieves compliance with the SCG of 5 µg/L for Freon-22™ in groundwater because the OU3 IRM extracts groundwater, reduces the TVOC concentration (including Freon-22™) to below 5 µg/L and discharges the treated water to a recharge basin. Alternative 3 achieves compliance with the SCG of 5 µg/L for Freon-22™ with the design, installation and operation of a groundwater pump and treat system that would extract groundwater from the southeast portion of the Park, reduce the Freon-22™ concentration to below the SCG of 5 µg/L via air stripper and discharge the treated water to the subsurface. However, implementation of Alternative 3 may have a negative impact on the OU3 groundwater IRM effectiveness.

Conclusion: Alternative 2 and Alternative 3 achieve compliance with the SCG of 5 µg/l for Freon-22™ in groundwater. There is a potential for Alternative 3 to negatively impact the OU3 groundwater IRM effectiveness.

3.2.2 Primary Balancing Criteria

Long-term Effectiveness and Permanence

Alternative 2 includes continued application of an existing operational groundwater pump and treat system (OU3 IRM) that extracts impacted groundwater and returns treated water (TVOC [including Freon-22™] concentration less than 5 µg/L) to the ground via a recharge basin. Alternative 3 includes construction and operation of a new groundwater pump and treat system that extracts impacted groundwater from the southeast portion of the Park and returns treated water (Freon-22™ concentration less than 5 µg/L) to the ground via a recharge basin. Implementation of Alternative 3 may have a negative impact on the OU3 IRM long-term effectiveness and permanence.

Conclusion: Alternative 2 and Alternative 3 have long-term effectiveness and permanence. However, there is a potential for Alternative 3 to negatively impact the OU3 IRM long-term effectiveness and permanence.

Toxicity, Mobility or Volume of Contamination Reduction

Alternative 2 and Alternative 3 each include a groundwater pump and treat system that mitigate migration of Freon-22™ downgradient of the southern Park boundary and southeast portion of the Park, respectively. Alternative 2 and Alternative 3 each include a groundwater pump and treat system that reduces Freon-22™ impacts to groundwater. Implementation of Alternative 3 may have a negative impact on the ability of the OU3 IRM to reduce mobility and/or volume of VOC contaminants.

Conclusion: Alternative 2 and Alternative 3 reduce mobility and concentration of Freon-22™ in groundwater. There is a potential for Alternative 3 to negatively impact the OU3 IRM ability to reduce mobility or concentration of the OU3 groundwater plume.

Short-term Impact and Effectiveness

Alternative 2 has potential for short term impacts to the environment (e.g., uncontrolled release of untreated groundwater during operation of the groundwater pump and treat system of the OU3 IRM). Alternative 3 has the potential for short-term impacts to the environment (e.g., uncontrolled release of untreated groundwater during construction and/or operation). Additionally, Alternative 3 has the potential for short-term impacts to the public and workers during construction of the groundwater pump and treat system. When combined with the operation of the OU3 IRM groundwater pump and treat system, Alternative 3 adds to the potential for short-term impacts to the environment (i.e., operation of two systems). Alternative 2 results in immediate effectiveness because the OU3 IRM groundwater pump and treat system has been operational since July 2009. The newly constructed groundwater pump and treat system described in Alternative 3 will not be effective until after installation.

Conclusion: Alternative 2 has less potential than Alternative 3 to have short-term impacts to the public health and the environment. Alternative 2 results in immediate effectiveness with no additional remedial construction. Alternative 3 increases the potential for short-term impacts to the public health and the environment due to the need to construct a new remedial system.

Ability to be Implemented

Alternative 2 and Alternative 3 are administratively feasible to implement by acquiring property owner and regulatory agency approval. Alternative 3 is technically feasible to implement and will require construction of a groundwater pump and treat system in the southeast portion of the Park. Alternative 2 is already in place and operational. As such, Alternative 2 is more readily implementable.

Conclusion: Alternative 2 and Alternative 3 are feasible to implement.

Cost Effectiveness

The costs of Alternative 2 and Alternative 3 vary significantly. Estimated costs for Alternative 2 and Alternative 3 are provided in Table 1 and details are provided in Attachment 1. Alternative 2 includes establishment of institutional controls in the form of an environmental easement. The present worth of implementing Alternative 2 is approximately $800,000 (Capital Cost: $97,000; and Annual Costs: $50,000). There would essentially be no cost associated with remediation of the Freon-22™ impacts to groundwater by the existing OU3 IRM as this system was designed and is currently operating to address other VOC impacts in the Park area that exist at much higher concentrations. As such, the system would have been installed and operated regardless of the presence of Freon-22™. In addition, given the higher total VOC impacts to groundwater and continued presence of a VOC source area in the Park, it is anticipated that the OU3 groundwater IRM will continue to operate for a period of time beyond that which will be required to reduce Freon-22™ levels below the applicable standard.

Alternative 3 includes costs for design, construction, operation and maintenance of a new groundwater pump and treat system in the southeast portion of the Park and establishing institutional controls in the form of an environmental easement. The present worth of implementing Alternative 3 is approximately $10,300,000 (Capital Cost: $1,500,000; and Annual Costs: $633,000).

Conclusion: Alternative 2 is more cost effective than Alternative 3.

3.3 Proposed Remedial Alternative

Based upon application of the threshold and balancing criteria identified above and the resulting conclusions, the proposed remedial alternative is Alternative 2 – Institutional Action. Alternative 2 includes the assumption that there will be continued operation of the existing groundwater pump and treat system (OU3 IRM) at the Park, in accordance with NYSDEC requirements and directives. Alternative 2 has been selected to address Freon-22™ impacts to “on-site and off-site” groundwater. Based upon the findings of the RI, current Freon-22™ impacts to groundwater that are attributed to the Site are limited to off-site impacts in the Park area. Freon-22™ impacts to groundwater do not appear to extend beyond the Park area boundary. The estimated present worth cost to implement Alternative 2 is $800,000.

The proposed remedy includes the following:

1. Continued operation of the existing OU3 IRM groundwater pump and treat system. The existing OU3 IRM groundwater pump and treat system will continue to operate and will be maintained in accordance with NYSDEC requirements and directives to treat the Freon-22™ plume (comingled with the with OU3-related VOCs) and minimize migration from the southern boundary of the Park. The OU3 IRM has been determined to be effective in controlling the migration of Freon-22™ from the Park area.
2. Establishment of institutional controls in the form of an environmental easement that will:
3. Control future intrusive work at a depth where groundwater is present to minimize exposure potential;

4. Restrict use of the groundwater as a source of potable or process water and implement a site management plan and health and safety plan (for subsurface activity conducted at a depth where groundwater is present);
5. Provide periodic certification of institutional controls to the NYSDEC; and
6. Provide Site access and appropriate notification to the NYSDEC.

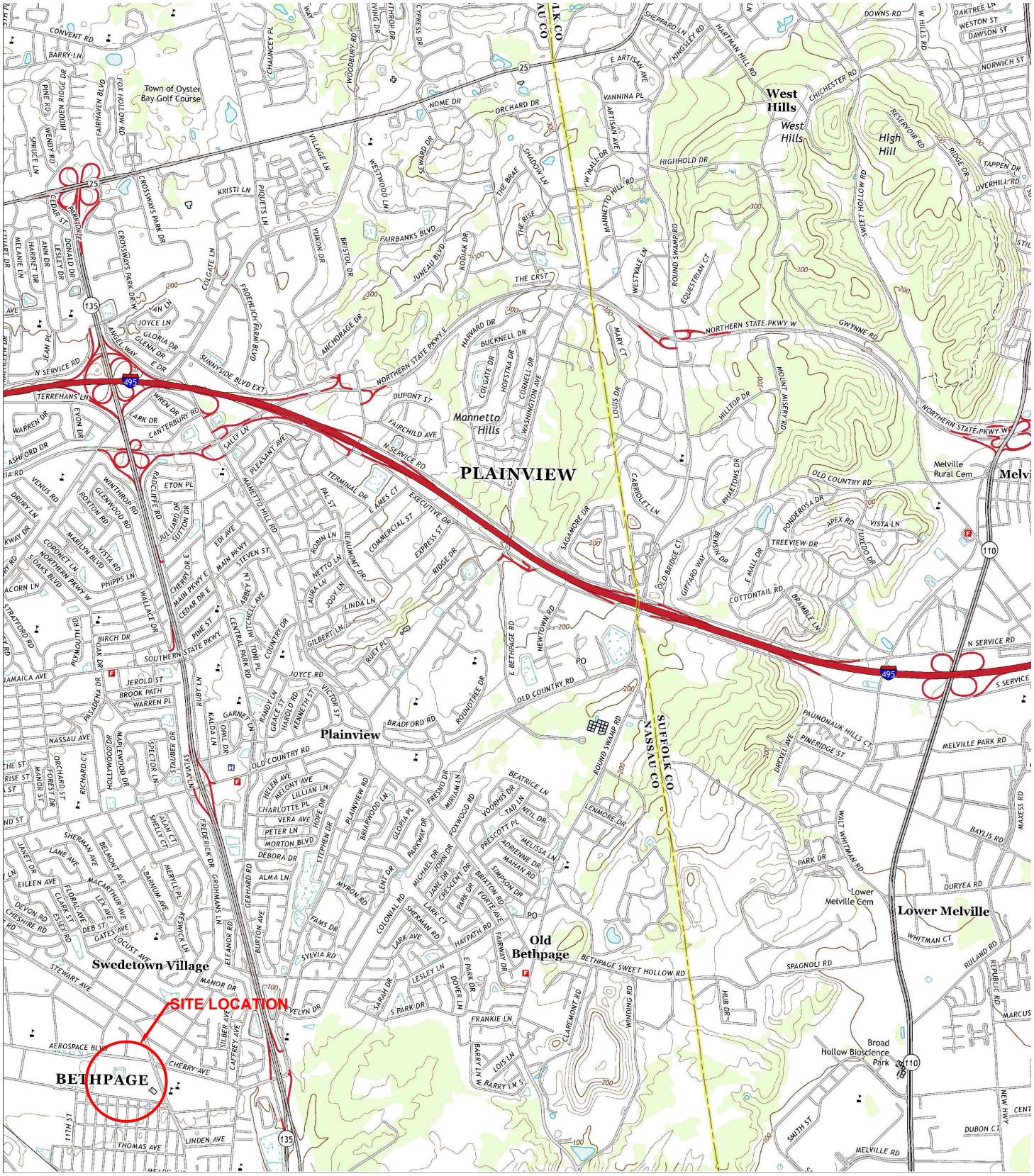
With the continued operation of the OU2 IRM groundwater pump and treat system and establishment of an environmental easement, Alternative 2 satisfies the two threshold criteria and is preferable to Alternative 3 when applying the primary balancing criteria. Implementation of Alternative 2 would achieve the remedial goals and meet the RAOs for the Site by the following:

- Minimize potential for migration of Freon-22™-impacted groundwater from the southern boundary of the Park area.
- Reduce Freon-22™ levels in groundwater in the Park area to below applicable SCGs.
- Establish an environmental easement (institutional control).

4.0 CERTIFICATION

I, Philip J. Schade P.E. , certify that I am currently a NYS registered professional engineer and that this report (Alternatives Analysis Report) was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10) and that all activities were performed in accordance with the DER-approved work plan and any DER-approved modifications.

FIGURES



Notes:

1. Based map obtained from United States Geological Survey (USGS) Huntington Quadrangle, 7.5-Minute Series and dated 2013.

PROJECT: BROWNFIELD CLEANUP PROGRAM BETHPAGE COMMUNITY PARK ICE RINK AREA ALTERNATIVES ANALYSIS REPORT TOWN OF OYSTER BAY BETHPAGE, NEW YORK NYSDEC SITE NO.: C130212	DRAWING: Figure 1: Site Location Map	H2M PROJECT NO.: TOBY1307	H2M architects + engineers Melville, NY Albany, NY New City, NY Parsippany, NJ
	SCALE: Not to Scale	DATE: October 6, 2016	

C:\Users\sday\appdata\local\temp\AcPublish_12652\Figure 1 - Site Location.dwg Last Modified: Oct 06, 2016 - 3:34pm Plotted on: Oct 06, 2016 - 3:36pm By sday

NOTES:

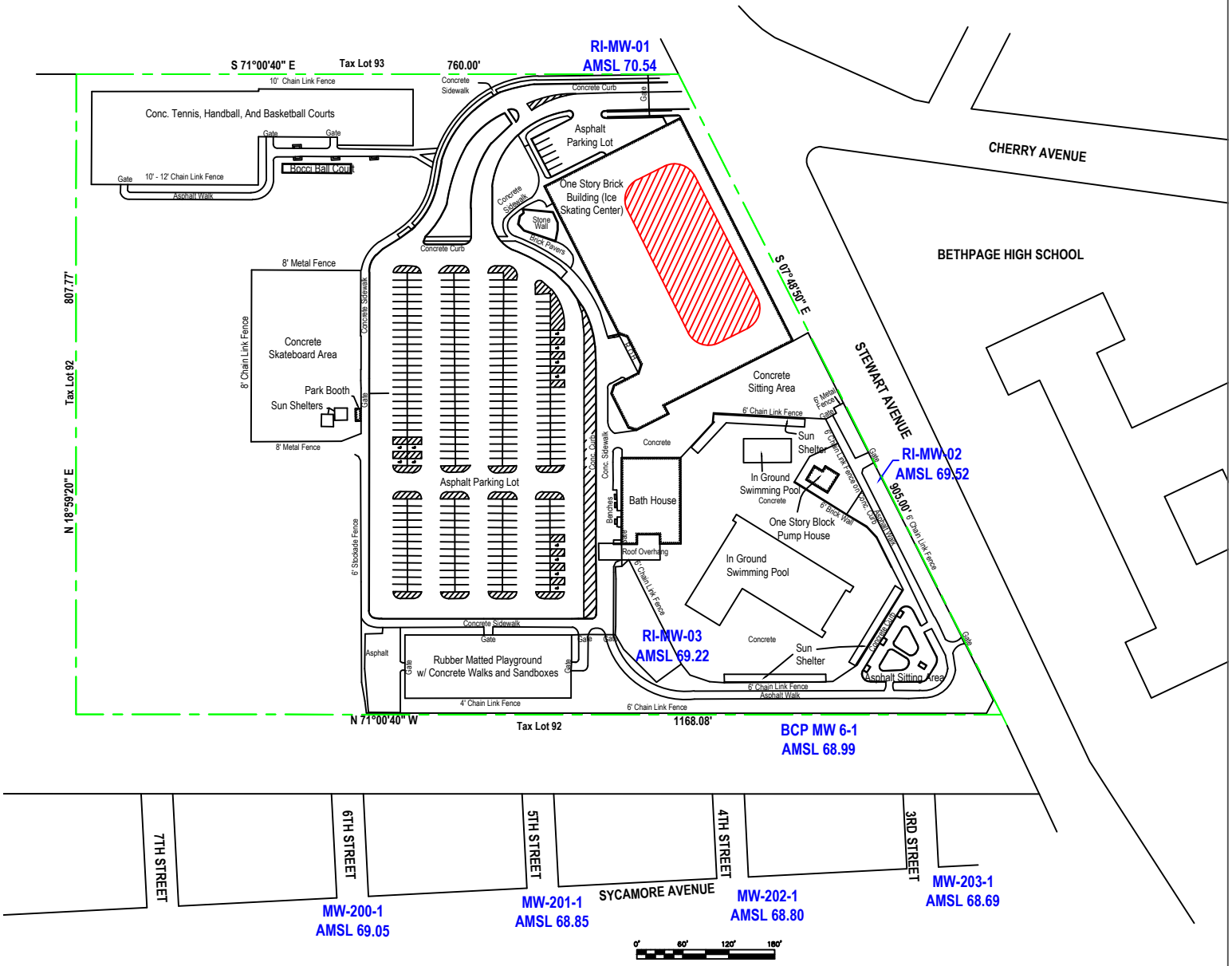
1. BASE MAP OBTAINED FROM FIGURE 8 NCTM: SECTION 46, BLOCK G, LOT 43, DATED OCTOBER 13, 2014.

2. PROPERTY LINE BASED ON MAP OF BOUNDARY OF REMEDIAL INVESTIGATION AREA AT BETHPAGE COMMUNITY PARK, PREPARED BY H2MGROUP, DATED NOVEMBER 15, 2004.

LEGEND:

BETHPAGE PARK PROPERTY LINE

BCP PROJECT SITE



PROJECT: BROWNFIELD CLEANUP PROGRAM BETHPAGE COMMUNITY PARK ICE RINK AREA ALTERNATIVES ANALYSIS REPORT TOWN OF OYSTER BAY BETHPAGE, NEW YORK NYSDEC SITE NO.: C130212	DRAWING: FIGURE 2: PARK AND SITE VICINITY SCALE: AS SHOWN	H2M PROJECT NO.: TOBY1307 DATE: OCTOBER 6, 2016	H2M architects + engineers Melville, NY New City, NY Albany, NY Parsippany, NJ

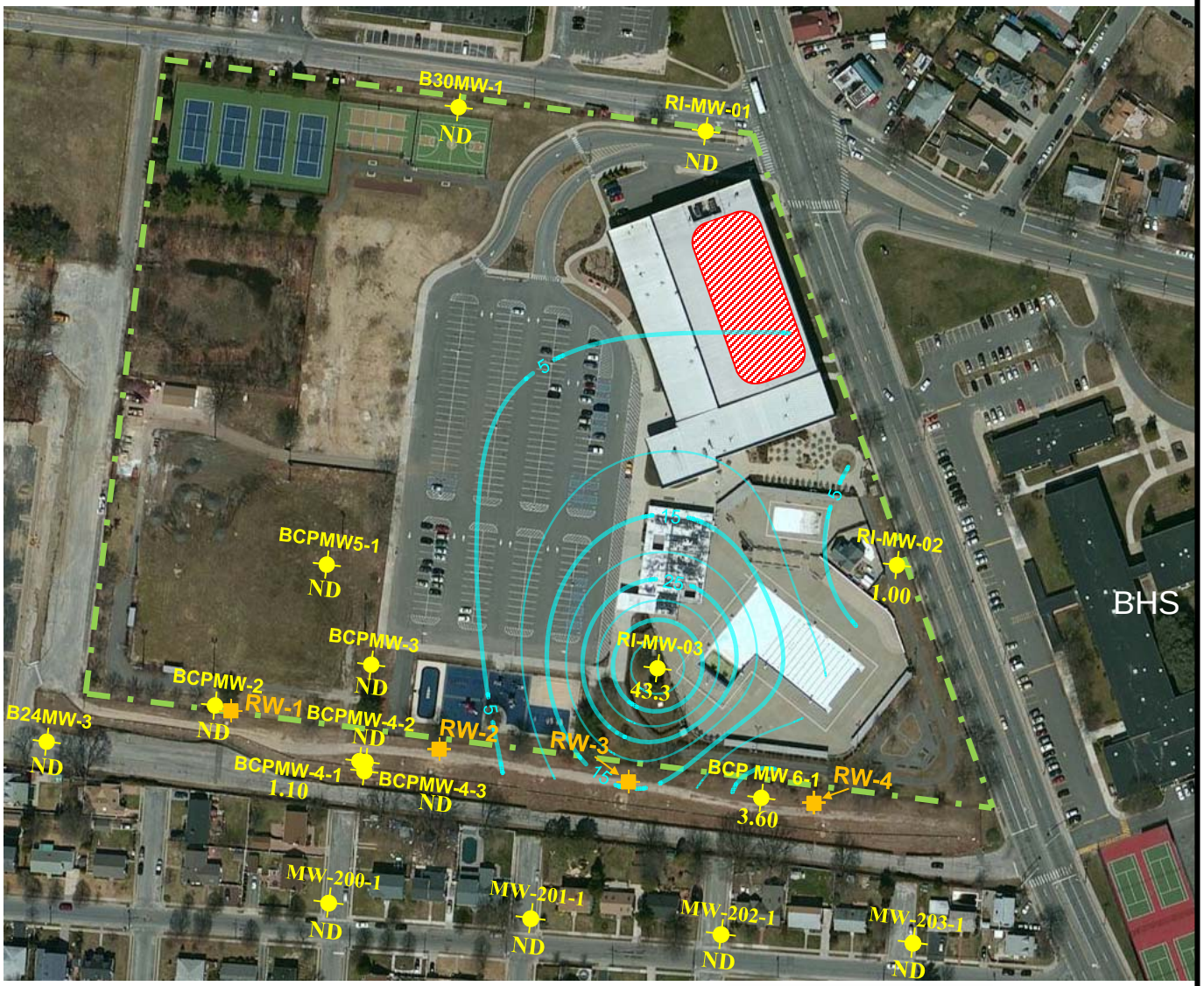
Notes:

1. Aerial image obtained from Bing Maps (http://www.bing.com/maps/) on March 20, 2015.
2. Bethpage Park property line based on drawing titled "Boundary of Remedial Investigation Area at Bethpage Community Park," prepared by H2MGROUP and dated November 15, 2004.
3. Monitoring well locations are based on two figures:
   a. Figure 8 NCTM: Section 46, Block G, Lot 43, prepared by H2M architects + engineers and dated October 13, 2014.
   b. Figure 4 in "Quarterly Operation, Maintenance, and Monitoring Report for the Bethpage Park Groundwater Containment System." prepared by ARCADIS dated June 2014.
4. Isoconcentration contours are in µg/L and at intervals of 5 µg/L. Isoconcentration contours between 5 and 40 are shown in this drawing.
5. Isoconcentration contours obtained from Surfer and based on monitoring well sampling data obtained from this RI and from "Quarterly Operation, Maintenance, and Monitoring Report for the Bethpage Park Groundwater Containment System." prepared by ARCADIS dated June 2014.
6. NGC remedial well locations approximated from Figure 4 in "Operation, Maintenance, and Monitoring Report for the Bethpage Park Groundwater Containment System," prepared by ARCADIS and dated June 2014.
7. Data obtained from the 200-series monitoring wells were not utilized in generating this contour map.
8. Duplicate samples were collected at RI-MW-02 and MW-202-1. The concentrations depicted are the higher concentrations between the parent and duplicate samples.

Legend:

- Property Line
- SV-7 / 1.38 — Monitoring Well ID; Groundwater Sampling Location; Freon-22™ Concentration (µg/L)
- RW-1 — Remedial Well ID; Remedial Well Location
- BCP Project Site
- Groundwater Freon-22™ Isoconcentration Contour

NGC	Northrup Grumman Corporation
BHS	Bethpage High School
µg/L	Micrograms per Liter
bgs	Below Grade Surface



PROJECT:

Brownfield Cleanup Program
Bethpage Community Park Ice Rink Area
Alternatives Analysis Report

Town of Oyster Bay
Bethpage, New York
NYSDEC Site No.: C130212

DRAWING:

Figure 3: Freon-22™ in Groundwater Including Historic Data

SCALE:

1" = 200'

H2M PROJECT NO.:

TOBY1307

DATE:

10/06/2016

H2M architects + engineers

Melville, NY
New City, NY
Albany, NY
Parsippany, NY

Notes:

1. Aerial image obtained from Bing Maps (http://www.bing.com/maps/) on March 20, 2015.
2. Bethpage Park property line based on drawing titled "Boundary of Remedial Investigation Area at Bethpage Community Park," prepared by H2MGROUP and dated November 15, 2004.
3. Monitoring well locations are based on field notes from H2M architects + engineers and two figures:
   a. Figure 8 NCTM: Section 46, Block G, Lot 43, prepared by H2M architects + engineers and dated October 13, 2014.
   b. Figure 4 in "Quarterly Operation, Maintenance, and Monitoring Report for the Bethpage Park Groundwater Containment System." prepared by ARCADIS dated June 2014.
4. Isoconcentration contours are in µg/L and at intervals of 25 µg/L. Isoconcentration contours between 25 and 200 are shown in this drawing.
5. Isoconcentration contours obtained from Surfer and based on monitoring well sampling data obtained from this RI and from "Quarterly Operation, Maintenance, and Monitoring Report for the Bethpage Park Groundwater Containment System." prepared by ARCADIS dated June 2014.
6. NGC remedial well locations approximated from Figure 4 in "Operation, Maintenance, and Monitoring Report for the Bethpage Park Groundwater Containment System," prepared by ARCADIS and dated June 2014.
7. Data obtained from the 200-series monitoring wells were not utilized in generating this contour map.
8. Temporary monitoring well concentrations obtained from sampling event performed by H2M architects + engineers between February 19, 2014 and March 12, 2014. Sample depths for RI-TMW-02, RI-TMW-03, and RI-TMW-04 are 65, 55. and 95 feet bgs

Legend:

- Property Line
- SV-7 / 1.38 — Monitoring Well ID, Groundwater Sampling Location, Freon-22™ Concentration (µg/L)
- RW-1 — Remedial Well ID, Remedial Well Location
- BCP Project Site
- Groundwater Freon-22™ Isoconcentration Contour

NGC	Northrup Grumman Corporation
BHS	Bethpage High School
µg/L	Micrograms per Liter
bgs	Below Grade Surface

PROJECT:

Brownfield Cleanup Program
Bethpage Community Park Ice Rink Area
Alternatives Analysis Report

Town of Oyster Bay
Bethpage, New York
NYSDEC Site No.: C130212

DRAWING:
Figure 4: Freon-22™ in Groundwater Including Historic and Temporary Monitoring Well Data

SCALE:
1" = 200'

H2M PROJECT NO.:
TOBY1307

DATE:
10/06/2016

H2M architects + engineers
Melville, NY
New City, NY
Albany, NY
Parsippany, NY

TABLES

TABLE 1
Remedial Alternatives Cost Estimates
Brownfield Cleanup Program
Bethpage Community Park Ice Rink Area
Alternatives Analysis Report
Town of Oyster Bay, Bethpage, New York
NYSDEC Site No.: C130212
H2M Project No.: TOBY1307

ALTERNATIVE 2 DESCRIPTION	ESTIMATED COST	NOTES
Site Management Plan	$8,000	
Final Engineering Report	$15,000	
Survey	$15,000	
Legal Fees	$50,000	
Contingency	10%	
TOTAL CAPITAL COSTS:	$97,000	Estimate is rounded to the nearest $1,000
ANNUAL COSTS		
Annual Costs	$50,000	Maintaining the environmental easement
Present Worth of Annual Costs	$700,000	Estimate is the 30-year present value with a rate of 6%. Estimate is rounded to the nearest $100,000.
TOTAL COST OF ALTERNATIVE 2:	**$800,000**	Estimate is rounded to the nearest $100,000

ALTERNATIVE 3 DESCRIPTION	ESTIMATED COST	NOTES
CAPITAL COSTS		
Aquifer Pumping Test	$165,000	Includes a geophysical survey, one pumping well, three monitoring wells, well development, decontamination pad, pump, data logging water level meter, groundwater sampling and laboratory analysis, waste disposal (soil cuttings), and groundwater treatment via liquid phase carbon units prior to discharge to subsurface, site surface repair).
Remedial System Design	$105,000	Includes analysis of aquifer pumping test data, groundwater modeling, and remedial system design.
Groundwater Pump & Treat System	$425,000	Includes three extraction wells, treatment building with air stripper, discharge to subsurface via recharge basin, injection well and associated piping or similar, electrical components, system controls, alarms, well and piping installation, construction waste management, and professional fees.
Site Management	$530,000	Includes development of a groundwater pump and treat remediation system site management plan.
Institutional Control Implementation	$115,000	Includes legal consultation and fees to prepare and implement an environmental easement.
Contingency	10%	
TOTAL CAPITAL COSTS:	$1,500,000	Estimate is rounded to the nearest $100,000
ANNUAL COSTS		
Annual Costs	$633,000	Site Management Plan (plus 10% contingency) and Environmental Easement maintenance.
Present Worth of Annual Costs	$8,800,000	Estimate is the 30-year present value with a rate of 6%. Estimate is rounded to the nearest $100,000.
TOTAL COST OF ALTERNATIVE 3:	**$10,300,000**	

ATTACHMENT 1

ATTACHMENT 1
Remedial Alternatives Cost Estimates
Brownfield Cleanup Program
Bethpage Community Park Ice Rink Area
Alternatives Analysis Report
Town of Oyster Bay, Bethpage, New York
NYSDEC Site No.: C130212
H2M Project No.: TOBY1307

Aquifer Pumping Test	Rate	Unit	Est Quant	Cost Est
Geophysical Survey	$1,995.00 /	day	1	$1,995.00
Well Installation	$3,700.00 /	day	10	$37,000.00
Well Materials (6-in)	$35.00 /	foot	100	$3,500.00
Well Materials (2-in)	$17.00 /	foot	300	$5,100.00
Well Covers	$275.00	each	4	$1,100.00
Decon Pad	$500.00	each	1	$500.00
Permits	$250.00 /	each	3	$750.00
Well Development	$2,200.00 /	day	2	$4,400.00
Pump	$1,950.00	each	1	$1,950.00
Water Level Meter	$240.00 /	week	2	$480.00
Sampling	$450.00 /	sample	1	$450.00
Analysis for F-22	$55.00 /	sample	4	$220.00
Pre-Treatment of Waste	$55,000.00 /	week	1	$55,000.00
Piping	$3,500.00	system	1	$3,500.00
Crane	$2,400.00 /	mobe	2	$4,800.00
Power	$0.25 /	kWh	3500	$875.00
Waste Disposal	$16,362.00		1	$16,362.00
H2M Fees	$23,000.00		1	$23,000.00
			SUM:	$160,982.00

ATTACHMENT 1
Remedial Alternatives Cost Estimates
Brownfield Cleanup Program
Bethpage Community Park Ice Rink Area
Alternatives Analysis Report
Town of Oyster Bay, Bethpage, New York
NYSDEC Site No.: C130212
H2M Project No.: TOBY1307

DESIGN:				
	Rate	Unit	Est Quant	Cost Est
H2M Design	$422,545.00		10%	$50,000.00
H2M CM + PM	$ 35,000.00		1	$35,000.00
H2M SMP	$16,500.00	Lump Sum	1	$16,500.00
			SUM:	$101,500.00
INSTALL:				
	Rate	Unit	Est Quant	Cost Est
Geophysical Survey	$1,995.00 /	day	2	$3,990.00
Survey	$10,000.00	Lump Sum	1	$10,000.00
Diller	$3,700.00 /	day	21	$77,700.00
Well Development	$2,200.00 /	day	15	$33,000.00
Well pumps	$5,000.00 /	each	3	$15,000.00
Well Materials (6-in)	$35.00 /	foot	300	$10,500.00
Well Covers	$275.00	each	6	$1,650.00
Well Head Vault	$650.00	each	6	$3,900.00
Flow Meters	$500.00	each	6	$3,000.00
Piping, Valves, Fittings, Misc.	$6.00 /	foot	1,300	$7,800.00
Treatment Building	$15,000.00	each	1	$15,000.00
Treatment System	$75,000.00	lump sum	1	$75,000.00
Injection Wells	$35.00 /	foot	300	$10,500.00
Crane	$2,400.00 /	mobe	2	$4,800.00
Trenching/Labor	$50,000.00	lump sum	1	$50,000.00
Liner	$1.75 /	foot	1,300	$2,275.00
Pea Gravel	$59.00 /	cu yd	20	$1,180.00
Electrician	$2,500.00	lump sum	1	$2,500.00
Backfill	$49.00 /	cu yd	1,500	$73,500.00
Decon Pad	$500.00	each	1	$500.00
Waste Disposal	$20,000.00	lump sum	1	$20,000.00
Permits	$250.00 /	each	3	$750.00
			SUM:	$422,545.00

ATTACHMENT 1
Remedial Alternatives Cost Estimates
Brownfield Cleanup Program
Bethpage Community Park Ice Rink Area
Alternatives Analysis Report
Town of Oyster Bay, Bethpage, New York
NYSDEC Site No.: C130212
H2M Project No.: TOBY1307

	Rate	Unit	Est Quant	Cost Est
Site Management				
Sampling & Reporting	$99,000.00	Lump Sum	1	$99,000.00
Field Equipment	$12,588.00	Lump Sum	1	$12,588.00
Laboratory (F-22)	$55.00 /	sample	72	$3,960.00
Treatment System	$5,000.00 /	week	52	$260,000.00
Bag Filters	$500.00 /	3 month	4	$2,000.00
Carbon Changeouts	$7,000.00 /	3 months	4	$28,000.00
Power	$0.25 /	kWh	403,000.00	$100,750.00
Waste Management	$20,000.00	Lump Sum	1	$20,000.00
			SUM:	$526,298.00

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Remedial Alternatives Cost Estimates
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NYSDEC Site No.: C130212
H2M Project No.: TOBY1307

	Cost Estimate
Legal Fees	$50,000.00
Site Management Plan	$15,800.00
Final Engineering Report	$33,000.00
Survey	$15,000.00
SUM:	$113,800.00