

573 4TH AVENUE
BROOKLYN, NEW YORK

Remedial Action Work Plan

NYC BCP Number: 14CVCP17_8K
OER Project Number: 13EH-N282K

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REMEDIAL ACTION WORK PLAN

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LIST OF ACRONYMS

Acronym	Definition
AOC	Area of Concern
AS/SVE	Air Sparging/Soil Vapor Extraction
BOA	Brownfield Opportunity Area
CAMP	Community Air Monitoring Plan
C/D	Construction/Demolition
COC	Certificate of Completion
CQAP	Construction Quality Assurance Plan
CSOP	Contractors Site Operation Plan
DCR	Declaration of Covenants and Restrictions
ECs/ICs	Engineering and Institutional Controls
HASP	Health and Safety Plan
IRM	Interim Remedial Measure
BCA	Brownfield Cleanup Agreement
MNA	Monitored Natural Attenuation
NOC	Notice of Completion
NYC VCP	New York City Voluntary Cleanup Program
NYC DEP	New York City Department of Environmental Protection
NYC DOHMH	New York State Department of Health and Mental Hygiene
NYCRR	New York Codes Rules and Regulations
NYC OER	New York City Office of Environmental Remediation
NYS DEC	New York State Department of Environmental Conservation
NYS DEC DER	New York State Department of Environmental Conservation Division of Environmental Remediation
NYS DOH	New York State Department of Health
NYS DOT	New York State Department of Transportation
ORC	Oxygen-Release Compound
OSHA	United States Occupational Health and Safety Administration
PE	Professional Engineer

PID	Photo Ionization Detector
QEP	Qualified Environmental Professional
QHHEA	Qualitative Human Health Exposure Assessment
RAOs	Remedial Action Objectives
RAR	Remedial Action Report
RAWP	Remedial Action Work Plan or Plan
RCA	Recycled Concrete Aggregate
RD	Remedial Design
RI	Remedial Investigation
RMZ	Residual Management Zone
SCOs	Soil Cleanup Objectives
SCG	Standards, Criteria and Guidance
SMP	Site Management Plan
SPDES	State Pollutant Discharge Elimination System
SVOC	Semi-Volatile Organic Compound
USGS	United States Geological Survey
UST	Underground Storage Tank
VOC	Volatile Organic Compound

CERTIFICATION

I, Andrew L. Levenbaum, am a Professional Engineer licensed in the State of New York. I have primary direct responsibility for implementation of the remedial action for the 573 4th Avenue Site 13EH-N282K.

I, Paul P. Stewart am a Qualified Environmental Professional as defined in §43-140. I have primary direct responsibility for implementation of the remedial action for the 573 4th Avenue Site 13EH-N282K.

I certify that this Remedial Action Work Plan (RAWP) has a plan for handling, transport and disposal of soil, fill, fluids and other materials removed from the property in accordance with applicable City, State and Federal laws and regulations. Importation of all soil, fill and other material from off-Site will be in accordance with all applicable City, State and Federal laws and requirements. This RAWP has provisions to control nuisances during the remediation and all invasive work, including dust and odor suppression.

Name

NYS PE License Number

Signature

Date



QEP Name

QEP Signature

Date

EXECUTIVE SUMMARY

New Empire Builder Corp. has applied to enroll in the New York City Voluntary Cleanup Program (NYC VCP) to investigate and remediate a 2,107-square foot site located at 573 4th Avenue in Brooklyn, New York. A remedial investigation (RI) was performed to compile and evaluate data and information necessary to develop this Remedial Action Work Plan (RAWP). The remedial action described in this document provides for the protection of public health and the environment consistent with the intended property use, complies with applicable environmental standards, criteria and guidance and conforms with applicable laws and regulations.

Site Location and Current Usage

The Site is located at 573 4th Avenue in the Gowanus section of Brooklyn, New York and is identified as Block 1052, Lot 6 on the New York City Tax Map. Figure 1 shows the Site location. The Site is 2,107-square feet and is bounded by a two-story residential building to the north, an auto repair shop to the south, 16th Street, followed by multi-use buildings to the east, and 4th Avenue, followed by a twelve-story apartment building to the west. A map of the site boundary is shown in Figure 2. Currently, the Site is vacant but the most recent usage was an auto repair shop with residential space on the second floor. The eastern portion of the property is covered by a makeshift roof, built-out to cover the remaining area of the property. The concrete ground floor is covered with large metal plates. A concrete trench runs down the middle of the eastern portion of the building. Fill and vent pipes were noted on the sidewalk in front of the existing building.

Summary of Proposed Redevelopment Plan

The proposed future use of the Site will consist of a new multi-use ten-story building. Layout of the proposed site development is presented in Figure 3. The current zoning designation is C2-4/R8A for commercial and residential use. The proposed use is consistent with existing zoning for the property.

The proposed building for 573 4th Avenue will contain a partial 6-foot basement that will cover approximately 40% of the property and will contain utilities and the elevator vault, 69% of the building will be at-grade and will contain retail store, mechanical room and bicycle parking, and the remaining 31% of the property will contain outdoor recreational space. The foundation for the building basement and footings will be installed to a final depth of 8' bgs. The first floor will be for commercial usage with residences on the upper 9 floors. As part of development, the referenced lot is expected to remain exclusively on lot 6. The building will be constructed to a height of approximately 95 feet for the 9 floors and be approximately 9,521 gross square feet. The plan for development of the recreational space has not been finalized and may either be paved or contain landscaping. The slab-on-grade portion of the building and the rear yard recreational space will be excavated to a final depth of 2' bgs. The recreational space will either be developed as hardscape with a minimum six-inch top cover consisting of pavement and paver base or as a landscaped area consisting of a minimum of two feet of clean fill/topsoil. The water table is expected at approximately 49 feet bgs.

The remedial action contemplated under this RAWP may be implemented independently of the proposed redevelopment plan.

Summary of the Remedy

The proposed remedial action achieves protection of public health and the environment for the intended use of the property. The proposed remedial action achieves all of the remedial action objectives established for the project and addresses applicable standards, criterion, and guidance; is effective in both the short-term and long-term and reduces mobility, toxicity and volume of contaminants; is cost effective and implementable; and uses standards methods that are well established in the industry.

1. Preparation of a Community Protection Statement and implementation of all required NYC VCP Citizen Participation activities according to an approved Citizen Participation Plan.
2. Performance of a Community Air Monitoring Program for particulates and volatile organic carbon compounds.
3. Establishment of Track 4 Site Specific Soil Cleanup Objectives (SCOs).

4. Site mobilization involving Site security setup, equipment mobilization, utility mark outs and marking & staking excavation areas.
5. Installation of groundwater monitoring wells, collection and analyses of groundwater to determine groundwater quality beneath the site. Groundwater investigation will be conducted after building demolition.
6. Excavation and removal of soil/fill exceeding Track 4 SCOs. Excavation to 8 feet below grade for a basement that will cover approximately 40% of the building footprint and excavation to approximately 2 feet below grade for footings for the remainder of the building to be constructed at grade. While the area of the proposed building foundation footprint is known, hardscape and landscape area designs have not yet been finalized. In Site areas to be developed with hardscape, a minimum of six inches of top cover will be removed to accommodate a pavement and paver base. In Site areas to be landscaped, a minimum of two feet of top cover will be excavated. For the purposes of the cut and fill analysis provided in this RAWP, the removal of two feet of top cover from slab-on-grade foundation areas, hardscape and landscaped areas is assumed. All excavated soil/fill exceeding site-specific SCOs will be removed from the Site.
7. Screening of excavated soil/fill during intrusive work for indications of contamination by visual means, odor, and monitoring with a PID. Appropriate segregation of excavated media on-Site.
8. Removal of underground storage tanks (if encountered) and closure of petroleum spills (if evidence of a spill/leak is encountered during Site excavation) in compliance with applicable local, State and Federal laws and regulations.
9. Transportation and off-Site disposal of all soil/fill material at permitted facilities in accordance with applicable laws and regulations for handling, transport, and disposal, and this plan. Sampling and analysis of excavated media as required by disposal facilities. Appropriate segregation of excavated media on-Site.
10. Collection and analysis of end-point samples to determine the performance of the remedy with respect to attainment of SCOs.
11. Import of materials to be used for backfill and cover in compliance with this plan and in accordance with applicable laws and regulations.

12. Installation of a vapor barrier/waterproofing system below the concrete slab underneath the building, as well as behind foundation walls of the proposed building. The vapor barrier will consist of Herculine^{Sigma} Smooth 20 mil vapor barrier and will be laid down in sheets that will be overlapped and joined by single-sided tape.
13. Installation and operation of an active Sub slab Depressurization System. The system will be installed in the gravel layer beneath the new building.
14. Construction and maintenance of an engineered composite cover consisting of an 8" thick concrete slab across the footprint of the new building. In Site areas to be developed with hardscape, construction of a minimum six-inch top cover consisting of pavement and paver base. In Site areas to be landscaped, a minimum of two feet of clean fill/topsoil will be installed..
15. Implementation of storm-water pollution prevention measures in compliance with applicable laws and regulations.
16. Performance of all activities required for the remedial action, including permitting requirements and pretreatment requirements, in compliance with applicable laws and regulations.
17. Submission of a Remedial Action Report (RAR) that describes the remedial activities, certifies that the remedial requirements have been achieved, defines the Site boundaries, lists any changes from this RAWP, and describes all Engineering and Institutional Controls to be implemented at the Site.
18. Submission of an approved Site Management Plan (SMP) in the RAR for long-term management of residual contamination, including plans for operation, maintenance, monitoring, inspection and certification of Engineering and Institutional Controls and reporting at a specified frequency.
19. The property will continue to be registered with an E-Designation at the NYC Buildings Department. Establishment of Engineering Controls and Institutional Controls and a requirement that management of these controls must be in compliance with an approved SMP. Institutional Controls will include prohibition of the following: (1) vegetable gardening and farming; (2) use of groundwater without treatment rendering it safe for the

intended use; (3) disturbance of residual contaminated material unless it is conducted in accordance with the SMP; and (4) higher level of land usage without OER-approval.

COMMUNITY PROTECTION STATEMENT

The Office of Environmental Remediation created the New York City Voluntary Cleanup Program (NYC VCP) to provide governmental oversight for the cleanup of contaminated property in NYC. This Remedial Action Work Plan (“cleanup plan”) describes the findings of prior environmental studies that show the location of contamination at the site, and describes the plans to clean up the site to protect public health and the environment.

This cleanup plan provides a very high level of protection for neighboring communities and also includes many other elements that address common community concerns, such as community air monitoring, odor, dust and noise controls, hours of operation, good housekeeping and cleanliness, truck management and routing, and opportunities for community participation. The purpose of this Community Protection Statement is to explain these community protection measures in non-technical language to simplify community review.

Remedial Investigation and Cleanup Plan. Under the NYC VCP, a thorough cleanup study of this property (called a remedial investigation) has been performed to identify past property usage, to sample and test soils, groundwater and soil vapor, and identify contaminant sources present on the property. The cleanup plan has been designed to address all contaminant sources that have been identified during the study of this property.

Identification of Sensitive Land Uses. Prior to selecting a cleanup, the neighborhood was evaluated to identify sensitive land uses nearby, such as schools, day care facilities, hospitals and residential areas. The cleanup program was then tailored to address the special conditions of this community.

Qualitative Human Health Exposure Assessment. An important part of the cleanup planning for the Site is the performance of a study to find all of the ways that people might come in contact with contaminants at the Site now or in the future. This study is called a Qualitative Human Health Exposure Assessment (QHHEA). A QHHEA was performed for this project. This assessment has considered all known contamination at the Site and evaluated the potential for people to come in contact with this contamination. All identified public exposures will be addressed under this cleanup plan.

Health and Safety Plan. This cleanup plan includes a Construction Health and Safety Plan (CHASP) that is designed to protect community residents and on-Site workers. The elements of this plan are in compliance with safety requirements of the United States Occupational Safety and Health Administration (OSHA). This plan includes many protective elements including those discussed below.

Site Safety Coordinator. This project has a designated Site safety coordinator to implement the Health and Safety Plan. The safety coordinator maintains an emergency contact sheet and protocol for management of emergencies. The Site safety coordinator is Yisong Yang and can be reached at (Cell No. 718-508-2970).

Worker Training. Workers participating in cleanup of contaminated material on this project are required to be trained in a 40-hour hazardous waste operators training course and to take annual refresher training. This pertains to workers performing specific tasks including removing contaminated material and installing cleanup systems in contaminated areas.

Community Air Monitoring Plan. Community air monitoring will be performed during this cleanup project to ensure that the community is properly protected from contaminants, dust and odors. Air samples will be tested in accordance with a detailed plan called the Community Air Monitoring Plan or CAMP. Results will be regularly reported to the NYC OER. This cleanup plan also has a plan to address any unforeseen problems that might occur during the cleanup (called a 'Contingency Plan').

Odor, Dust and Noise Control. This cleanup plan includes actions for odor and dust control. These actions are designed to prevent off-Site odor and dust nuisances and includes steps to be taken if nuisances are detected. Generally, dust is managed by application of physical covers and by water sprays. Odors are controlled by limiting the area of open excavations, physical covers, spray foams and by a series of other actions (called operational measures). The project is also required to comply with NYC noise control standards. If you observe problems in these areas, please contact the onsite Project Manager Justin Zhang at 718-439-8588 or NYC Office of Environmental Remediation Project Manager Zach Schreiber at 212-788-3056.

Quality Assurance. This cleanup plan requires that evidence be provided to illustrate that all cleanup work required under the plan has been completed properly. This evidence will be

summarized in the final report, called the Remedial Action Report. This report will be submitted to the NYC OER and will be thoroughly reviewed.

Storm-Water Management. To limit the potential for soil erosion and discharge, this cleanup plan has provisions for storm-water management. The main elements of the storm water management include physical barriers such as tarp covers and erosion fencing, and a program for frequent inspection.

Hours of Operation. The hours for operation of cleanup will comply with the NYC Department of Buildings construction code requirements or according to specific variances issued by that agency.

Signage. While the cleanup is in progress, a placard will be prominently posted at the main entrance of the property with a laminated project Fact Sheet that states that the project is in the NYC Voluntary Cleanup Program, provides project contact names and numbers, and locations of project documents can be viewed.

Complaint Management. The contractor performing this cleanup is required to address all complaints. If you have any complaints, you can call the facility Project Manager Justin Zhang at 718-439-8588, the NYC Office of Environmental Remediation Project Manager Zach Schreiber at 212-788-3056, or call 311 and mention the Site is in the NYC Voluntary Cleanup Program.

Utility Mark-outs. To promote safety during excavation in this cleanup, the contractor is required to first identify all utilities and must perform all excavation and construction work in compliance with NYC Department of Buildings regulations.

Soil and Liquid Disposal. All soil and liquid material removed from the Site as part of the cleanup will be transported and disposed of in accordance with all applicable City, State and Federal regulations and required permits will be obtained.

Soil Chemical Testing and Screening. All excavations will be supervised by a trained and properly qualified environmental professional. In addition to extensive sampling and chemical testing of soils on the Site, excavated soil will be screened continuously using hand-held

instruments, by sight, and by smell to ensure proper material handling and management, and community protection.

Stockpile Management. Soil stockpiles will be kept covered with tarps to prevent dust, odors and erosion. Stockpiles will be frequently inspected. Damaged tarp covers will be promptly replaced. Stockpiles will be protected with silt fences. Hay bales will be used, as needed to protect storm water catch basins and other discharge points.

Trucks and Covers. Loaded trucks leaving the Site will be covered in compliance with applicable laws and regulations to prevent dust and odor. Trucks will be properly recorded in logs and records and placarded in compliance with applicable City, State and Federal laws, including those of the New York State Department of Transportation. If loads contain wet material that can leak, truck liners will be used. All transport of materials will be performed by licensed truckers and in compliance with all laws and regulations.

Imported Material. All fill materials proposed to be brought onto the Site will comply with rules outlined in this cleanup plan and will be inspected and approved by a qualified worker located on-Site. Waste materials will not be brought onto the Site. Trucks entering the Site with imported clean materials will be covered in compliance with applicable laws and regulations.

Equipment Decontamination. All equipment used for cleanup work will be inspected and washed, if needed, before it leaves the Site. Trucks will be cleaned at a truck inspection station on the property before leaving the Site.

Housekeeping. Locations where trucks enter or leave the Site will be inspected every day and cleaned regularly to ensure that they are free of dirt and other materials from the Site.

Truck Routing. Truck routes have been selected to: (a) limit transport through residential areas and past sensitive nearby properties; (b) maximize use of city-mapped truck routes; (c) limit total distance to major highways; (d) promote safety in entry to highways; (e) promote overall safety in trucking; and (f) minimize off-Site line-ups (queuing) of trucks entering the property. Operators of loaded trucks leaving the Site will be instructed not to stop or idle in the local neighborhood.

Final Report. The results of all cleanup work will be fully documented in a final report (called a Remedial Action Report) that will be available for you to review in the public document repositories located at the Park Slope branch of the Brooklyn Public Library.

Long-Term Site Management. To provide long-term protection after the cleanup is complete, the property owner will be required to comply with an ongoing Site Management Plan that calls for continued inspection of protective controls, such as Site covers. The Site Management Plan is evaluated and approved by the NYC OER. Requirements that the property owner must comply with are defined in the property's deed or established through a city environmental designation. A certification of continued protectiveness of the cleanup will be required from time to time to show that the approved cleanup is still effective.

REMEDIAL ACTION WORK PLAN

1.0 SITE BACKGROUND

New Empire Builder Corp. has enrolled in the New York City Voluntary Cleanup Program (NYC VCP) to investigate and remediate a property located at 573 4th Avenue in the Gowanus section of Brooklyn, New York (the “Site”). A Remedial Investigation (RI) was performed to compile and evaluate data and information necessary to develop this Remedial Action Work Plan (RAWP) in a manner that will render the Site protective of public health and the environment consistent with the contemplated end use. This RAWP establishes remedial action objectives, provides a remedial alternatives analysis that includes consideration of a permanent cleanup, and provides a description of the selected remedial action. The remedial action described in this document provides for the protection of public health and the environment, complies with applicable environmental standards, criteria and guidance and applicable laws and regulations.

1.1 SITE LOCATION AND CURRENT USAGE

The Site is located at 573 4th Avenue in the Gowanus section of Brooklyn, New York and is identified as Block 1052, Lot 6 on the New York City Tax Map. Figure 1 shows the Site location. The Site is 2,107-square feet and is bounded by a two-story residential building to the north, an auto repair shop to the south, 16th Street, followed by multi-use buildings to the east, and 4th Avenue, followed by a twelve-story apartment building to the west. A map of the site boundary is shown in Figure 2. Currently, the Site is vacant but the most recent usage was an auto repair shop with residential space on the second floor. The eastern portion of the property is covered by a makeshift roof, built-out to cover the remaining area of the property. The concrete ground floor is covered with large metal plates. A concrete trench runs down the middle of the eastern portion of the building. Fill and vent pipes were noted on the sidewalk in front of the existing building.

1.2 PROPOSED REDEVELOPMENT PLAN

The proposed future use of the Site will consist of a new multi-use ten-story building. Layout of the proposed site development is presented in Figure 3. The current zoning

designation is C2-4/R8A for commercial and residential use. The proposed use is consistent with existing zoning for the property.

The proposed building for 573 4th Avenue will contain a partial 6-foot basement that will cover approximately 40% of the property and will contain utilities and the elevator vault, 69% of the building will be at-grade and will contain a retail store, mechanical room and bicycle parking, and the remaining 31% of the property will contain outdoor recreational space. The foundation for the building basement and footings will be installed to a final depth of 8' bgs. The first floor will be for commercial usage with residences on the upper 9 floors. As part of development, the referenced lot is expected to remain exclusively on lot 6. The building will be constructed to a height of approximately 95 feet for the 9 floors and be approximately 9,521 gross square feet. The plan for development of the recreational space has not been finalized and may either be paved or contain landscaping. The slab-on-grade portion of the building and the rear yard recreational space will be excavated to a final depth of 2' bgs. The recreational space will either be developed as hardscape with a minimum six-inch top cover consisting of pavement and paver base or as a landscaped area consisting of a minimum of two feet of clean fill/topsoil. The water table is expected at approximately 49 feet bgs.

The remedial action contemplated under this RAWP may be implemented independently of the proposed redevelopment plan.

1.3 DESCRIPTION OF SURROUNDING PROPERTY

The site is located at 573 4th Avenue, and is in the Gowanus section of Brooklyn. It is predominantly multi-use buildings with commercial and residential uses. The site is zoned in a C2-4/R8A commercial and residential district. In addition the site was designated with "E" Designation (E-152) for Hazmat and Noise, by the NYC Department of City Planning in 2005 as part of the South Park Slope Rezoning and Text Resolution (CEQR number 06DCP014K).

An auto repair shop bounds the site to the south and the north side of the property is bounded by a 2-story residential building. To the west of the Site a 12-story mixed-use commercial/residential building follows 4th Avenue and the east is predominantly mixed-use residential buildings with commercial uses. There is one public school P.S. 124 Silas B. Dutcher

located approximately 528 feet North of the site at 515 4th Avenue, Brooklyn. There are no day care centers or hospitals within a 500-foot radius of the site.

1.4 REMEDIAL INVESTIGATION

A remedial investigation was performed and the results are documented in a companion document called “*Remedial Investigation Report, 573 4th Avenue*”, dated August, 2013 (RIR).

Summary of Past Uses of Site and Areas of Concern

A Phase I investigation was conducted by Grant Engineering and completed in March 2012. The results of a review of fire insurance maps show the existing two-story building on the site was constructed in 1906 and was initially utilized as a blacksmith. The site is located in a commercial district and designated as C2-4/R8A. While the building is currently unoccupied the most recent use of the building was an auto repair shop on the first floor and residential living space on the second.

The AOCs identified for this site include:

1. Area where an historic underground fuel oil tank is located toward front of site.
2. Area where there may be potential impacts from former auto repair operations.
3. Existence of a concrete lined trench in the rear of the building.

Summary of the Work Performed under the Remedial Investigation

Advanced Cleanup Technologies performed the following scope of work:

1. Conducted a Site inspection to identify AOCs and physical obstructions (i.e. structures, buildings, etc.);
2. Performed ground penetrating radar to determine the existence and location of an historic underground storage tank in the vicinity of fill and vent pipes along the northwest side of the building;

3. Installed four soil borings across the entire project Site, and collected eight soil samples for chemical analysis from the soil borings to evaluate soil quality;
4. Attempted to install temporary ground water monitoring wells and collect ground water samples from 2 separate locations;
5. Installed three soil vapor probes around Site perimeter and collected three samples for chemical analysis;
6. Perform indoor air collection and sampling of one location inside the building.

Summary of Environmental Findings

1. Elevation of the property ranges from 53 to 56 feet.
2. Groundwater has not been encountered at the site. During the September 2012 subsurface investigation (SB-1 and SB-2), attempts to reach groundwater were met by refusal at 18' below ground surface. Standing water was encountered at approximately 4.5' below ground surface on the west side of the Site.
3. Groundwater flow is expected to flow from east to west toward the Upper Bay.
4. Bedrock was not encountered during the remedial investigation.
5. The stratigraphy of the site, from the surface down, consists of 10 feet of orange-brown silty sands underlain by 5 feet of orange, medium to very coarse-grained sands.
6. Soil/fill samples collected during investigations showed low level concentrations of VOCs, SVOCs or PCBs. No pesticides were detected in any soil samples. PCB (Arocolor 1260) was detected in one soil sample at a concentration of 42 mg/Kg, and below Unrestricted Use SCOs. Trace concentrations of petroleum VOCs (1,2,4,5-trimethylbenzene, naphthalene, p-diethylbenzene) and chlorinated VOCs (cis-1,2-dichloroethene, trichloroethene (1.4 ug/Kg) and tetrachloroethene (14 ug/Kg)) were detected in three of eight of the soil samples obtained. Acetone (23 ug/Kg) was detected in one soil sample and methylene chloride (max. of 16 ug/Kg) was detected in four of eight samples. However, none of the VOC compounds were detected above its

Unrestricted Use SCO (UUSCO). Several SVOC compounds were identified, but none of them exceeded their respective Unrestricted Use SCOs. Several metals were detected in soil samples, and of these, lead (at 2,360 mg/Kg and 98.8 mg/Kg in two soil samples) and mercury (max. of 2.67 mg/Kg in four soil samples), exceeded Restricted Residential SCOs. Lead was detected in two shallow soils sample(s), and one mercury sample exceeded its Unrestricted Use SCO in deep soils. Overall, findings were consistent with observations for historical fill sites in areas throughout NYC.

7. Groundwater samples were not obtained during this investigation. Groundwater wells will be attempted following the demolition of the building to allow better access for sampling equipment. Groundwater is expected to be found at 49' bgs.
8. Soil vapor samples collected during the RI showed petroleum and chlorinated VOCs at moderate concentrations. Most compounds were detected at concentrations less than 30 $\mu\text{g}/\text{m}^3$, except for ethanol at 99 $\mu\text{g}/\text{m}^3$, toluene at 55 $\mu\text{g}/\text{m}^3$ and xylenes at a maximum concentration of 68 $\mu\text{g}/\text{m}^3$. Total concentrations of approximately 14 total petroleum-related VOCs in soil vapor ranged from 187 $\mu\text{g}/\text{m}^3$ to 260 $\mu\text{g}/\text{m}^3$. Chlorinated VOCs including tetrachloroethylene (PCE) was identified in one of three soil vapor samples at a concentration of 1,830 $\mu\text{g}/\text{m}^3$, trichloroethylene (TCE) (max. of 2.26 $\mu\text{g}/\text{m}^3$) and carbon tetrachloride (max. of 4.47 $\mu\text{g}/\text{m}^3$). 1,1,1-trichloroethane was not detected in site soil vapor. Single detection of PCE was above guidance matrix established by the NYS DOH. PCE and TCE were identified in site soils at low concentrations. 1,1,1- TCA was not detected in site soils. For more detailed results, consult the RIR.

Based on an evaluation of the data and information from the RIR and this RAWP, disposal of significant amounts of hazardous waste is not suspected at this site.

2.0 REMEDIAL ACTION OBJECTIVES

Based on the results of the RI, the following Remedial Action Objectives (RAOs) have been identified for this Site:

Groundwater

- The existence of the auto repair shop building has prevented the mobilization of proper sampling equipment to reach groundwater. A supplemental groundwater investigation will be performed following the demolition of the building.

Soil

- Prevent direct contact with contaminated soil.
- Prevent exposure to contaminants volatilizing from contaminated soil.

Soil Vapor

- Prevent exposure to contaminants in soil vapor.
- Prevent migration of soil vapor into dwelling and other occupied structures.

A historic underground fuel oil storage tank was identified during the Remedial Investigation. This tank will be removed and disposed of in compliance with applicable local, State and Federal laws and regulations. Endpoint samples from the sidewalls and excavation bottom will be collected and submitted to a New York State ELAP certified laboratory. A tank closure report will be submitted to DEC and OER following the field activities.

3.0 REMEDIAL ALTERNATIVES ANALYSIS

The goal of the remedy selection process is to select a remedy that is protective of human health and the environment, taking into consideration the current, intended and reasonable anticipated future use of the property. The remedy selection process begins by establishing RAPs for media in which chemical constituents were found in exceedance of applicable standards, criteria and guidance values (SCGs). A remedy is then developed based on the following ten criteria:

- Protection of human health and the environment;
- Compliance with SCGs;
- Short-term effectiveness and impacts;
- Long-term effectiveness and permanence;
- Reduction of toxicity, mobility, or volume of contaminated material;
- Implementability;
- Cost effectiveness;
- Community Acceptance;
- Land use; and
- Sustainability.

The following is a detailed description of the alternatives analysis and remedy selection to address impacted media at the Site. As required, a minimum of two remedial alternatives (including a Track 1 scenario) are evaluated, as follows:

Alternative 1 involves:

- Establishment of Unrestricted Use (Track1) Soil Cleanup Objectives (SCOs);
- Removal of all soil/fill exceeding Track 1 Unrestricted Use SCOs and confirmation that Track 1 has been achieved with post-excavation endpoint sampling. Based on the results of the remedial investigation, it is expected that this alternative would require excavation to an approximate depth of 2' bgs across the entire property. However, if soil/fill containing chemical constituents at concentrations above Track 1 Unrestricted Use SCOs are still present at the base of the excavation after the

removal of all soil required for new construction, additional excavation would be performed to ensure complete removal of soil that does not meet Track 1 Unrestricted Use SCOs;

- No Engineering or Institutional Controls are required for a Track 1 cleanup, but a vapor and waterproof barrier would be installed beneath the basement foundation and behind foundation sidewalls of the new building as a part of development to prevent any potential future exposures from off-Site soil vapor.
- An Sub Slab Depressurization System would be installed as part of new development;

Alternative 2 involves:

- Establishment of Site-specific (Track 4) SCOs;
- Excavation and removal of all soil/fill exceeding Site-specific SCOs and confirmation that Track 4 has been achieved with post-excavation end-point sampling. Based on the results of the remedial investigation, it is expected that this alternative would require excavation to a depth of 8' bgs across 40% of the western portion of the property and 2' bgs across the eastern portion of the property;
- Placement of a engineered composite cover system over the Site, consisting of the concrete building slab and in the rear yard recreational space either a minimum six-inch top cover consisting of pavement and paver base or as a landscaped area consisting of a minimum of two feet of clean fill/topsoil, to prevent exposure to remaining soil/fill;
- Installation of a vapor barrier system beneath the entire new building floor slab and behind sub-grade foundation sidewalls to prevent exposure to soil vapor contaminants;
- Installation of an active Sub-Slab Depressurization System (SSDS) within a layer of crushed stone beneath the building slab;

- Establishment of use restrictions including prohibitions on the use of groundwater from the Site and prohibitions on sensitive site uses, such as farming or vegetable gardening, to eliminate future exposure pathways;
- Establishment of an approved Site Management Plan to ensure long-term management of these Engineering and Institutional Controls including the performance of periodic inspections and certification that the Controls are performing as they were intended; and
- Continued registration as an E-designated property to memorialize the remedial action and the Engineering and Institutional Controls required by this RAWP.

3.1 THRESHOLD CRITERIA

Protection of Public Health and the Environment

This criterion is an evaluation of the remedy's ability to protect public health and the environment, and an assessment of how risks posed through each existing or potential pathway of exposure are eliminated, reduced or controlled through removal, treatment, and implementation of Engineering Controls or Institutional Controls. Protection of public health and the environment must be achieved for all approved remedial actions.

Alternative 1 would be protective of human health and the environment by removing soil/fill exceeding Track 1 Unrestricted Use SCOs, thus eliminating potential for direct contact with contaminated soil/fill once construction is complete.

Alternative 2 would achieve comparable protections of human health and environment by excavating the historic fill at the Site and by ensuring that remaining soil/fill on-Site meets Track 4 Site-specific SCOs as well as by placement of Institutional and Engineering Controls, including installation of a composite cover system to prevent direct contact with any remaining on-Site soil/fill. Installation of a vapor barrier system and an active Sub-Slab Depressurization System (SSDS) beneath the entire new building floor slab and behind foundation sidewalls as part of construction would prevent exposures from potential soil vapor intrusion. Implementing

Institutional Controls and a Site Management Plan would ensure that the composite cover system, vapor barrier and SSDS remain intact and protective.

For both remedial Alternatives, potential exposure to contaminated soils during construction would be minimized by implementing a Construction Health and Safety Plan, an approved Soils/Materials Management Plan and a Community Air Monitoring Plan (CAMP). Potential contact with groundwater would be prevented as its use is prohibited by city laws and regulations. Potential future migration of off-Site soil vapors into the new building would be prevented by installing a vapor barrier below the new building's basement and at-grade slabs and continuing the vapor barrier around sub-grade foundation walls as well as by installing an active SSDS.

3.2. BALANCING CRITERIA

Compliance with Standards, Criteria and Guidance (SCGs)

This evaluation criterion assesses the ability of the alternative to achieve applicable standards, criteria and guidance.

The proposed remedy will achieve soil SCGs by the excavation of accessible impacted soil to UUSCO's and capping the entire Site with an impermeable surface.

Alternative 1 would achieve compliance with the remedial goals, chemical-specific SCGs and RAOs for soil through removal of soil to meet Track 1 Unrestricted Use SCOs. Compliance with SCGs for soil vapor would also be achieved by installing a vapor barrier/waterproofing system below the new building's basement and at-grade slabs and continuing the vapor barrier around sub-grade foundation walls, as well as by installing an SSDS, as part of new development.

Alternative 2 would achieve compliance with the remedial goals, chemical-specific SCGs and RAOs for soil through the removal of soil to meet Track 4 Site-specific SCOs. Compliance with SCGs for soil vapor would also be achieved by installation of a vapor barrier system beneath the entire floor slab and behind foundation sidewalls as part of construction and an SSDS beneath the building foundation. A Site Management Plan would ensure that these controls remained protective for the long term.

Health and safety measures contained in the CHASP and Community Air Monitoring Plan (CAMP) that comply with the applicable SCGs would be implemented during Site redevelopment under this RAWP. For both Alternatives, focused attention on means and methods employed during the remedial action would ensure that handling and management of contaminated material would be in compliance with applicable SCGs. These measures will protect on-site workers and the surrounding community from exposure to Site-related contaminants.

Short-term effectiveness and impacts

This evaluation criterion assesses the effects of the alternative during the construction and implementation phase until remedial action objectives are met. Under this criterion, alternatives are evaluated with respect to their effects on public health and the environment during implementation of the remedial action, including protection of the community, environmental impacts, time until remedial response objectives are achieved, and protection of workers during remedial actions.

Both Alternatives 1 and 2 have similar short-term effectiveness during their respective implementations, as each requires excavation of soil/fill material under the building footprint. Alternative 1 would eliminate and Alternative 2 would reduce exposure to contaminant sources. Alternatives 1 and 2 would both employ appropriate measures to prevent short-term impacts, including a Community Air Monitoring Plan (CAMP) and a Soil/Materials Management Plan (SMMP), during all on-Site soil disturbance activities and would effectively prevent the release of significant contaminants into the environment. Short term impacts could potentially be higher for Alternative 1 if excavation of greater amounts of historical fill material is encountered below the excavation depth in the rear parking areas.

An additional short-term adverse impact and risks to the community associated with both remedial alternatives is increased truck traffic. Approximately 22 25-ton capacity truck trips would be necessary to transport fill and soil excavated during Site development. Truck traffic will be routed on the most direct course using major thoroughfares where possible and flaggers will be used to protect pedestrians at Site entrances and exits.

Both alternatives would employ appropriate measures to prevent short term impacts, including a Construction Health and Safety Plan, a Community Air Monitoring Plan (CAMP) and a Soil/Materials Management Plan (SMMP), during all on-Site soil disturbance activities and would minimize the release of contaminants into the environment. Both alternatives provide short-term effectiveness in protecting the surrounding community by decreasing the risk of contact with on-Site contaminants. Construction workers operating under appropriate management procedures and a Construction Health and Safety Plan (CHASP) will be protected from on-Site contaminants (personal protective equipment would be worn consistent with the documented risks within the respective work zones).

Long-term effectiveness and permanence

This evaluation criterion addresses the results of a remedial action in terms of its permanence and quantity/nature of waste or residual contamination remaining at the Site after response objectives have been met, such as permanence of the remedial alternative, magnitude of remaining contamination, adequacy of controls including the adequacy and suitability of ECs/ICs that may be used to manage contaminant residuals that remain at the Site and assessment of containment systems and ICs that are designed to eliminate exposures to contaminants, and long-term reliability of Engineering Controls.

Alternative 1 would achieve long-term effectiveness and permanence related to on-Site contamination by permanently removing all impacted soil/fill and enabling unrestricted usage of the property. Potential sources of soil vapor contamination would also be eliminated as part of the Track 1 remedy.

Alternative 2 would provide long-term effectiveness by removing most on-Site contamination and attaining Track 4 Site-specific SCOs, establishing a composite cover system across the site, maintaining use restrictions and establishing a Site Management Plan (SMP) to ensure long-term management of Engineering Controls (ECs) and Institutional Controls (ICs). Establishment of a Site Management Plan will ensure that this protection remains effective for the long-term. The SMP will ensure long-term effectiveness of all Engineering and Institutional Controls by requiring periodic inspection and certification that these controls and use restrictions continue to be in place and are functioning as they were intended assuring that protections designed into the remedy will provide continued high level of protection in perpetuity.

Both alternatives would result in removal of soil contamination exceeding the SCOs providing the highest level, most effective and permanent remedy over the long-term with respect to a remedy for contaminated soil, which will eliminate any migration to groundwater. Potential sources of soil vapor and groundwater contamination will also be eliminated by the vapor barrier and SSDS as part of the remedy. If on-site sources are removed, soil vapor impacts would be expected to dissipate.

Reduction of toxicity, mobility, or volume of contaminated material

This evaluation criterion assesses the remedial alternative's use of remedial technologies that permanently and significantly reduce toxicity, mobility, or volume of contaminants as their principal element. The following is the hierarchy of source removal and control measures that are to be used to remediate a Site, ranked from most preferable to least preferable: removal and/or treatment, containment, elimination of exposure and treatment of source at the point of exposure. It is preferred to use treatment or removal to eliminate contaminants at a Site, reduce the total mass of toxic contaminants, cause irreversible reduction in contaminants mobility, or reduce of total volume of contaminated media.

Alternative 1 would permanently eliminate the toxicity, mobility, and volume of contaminants from on-Site soil by removing all soil in excess of Track 1 - Unrestricted Use SCOs.

Alternative 2 would remove most of the historic fill at the Site, and any remaining on-Site soil beneath the new building will meet Track 4 - Site-Specific SCOs. Alternative 1 would eliminate a greater total mass of contaminants on Site.

Implementability

This evaluation criterion addresses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during its implementation, including technical feasibility of construction and operation, reliability of the selected technology, ease of undertaking remedial action, monitoring considerations, administrative feasibility (e.g. obtaining permits for remedial activities), and availability of services and materials.

The techniques, materials and equipment to implement Alternatives 1 and 2 are readily available and have been proven effective in remediating the contaminants associated with the Site. They use standard materials and services that are well-established technology. The reliability of each remedy is also high. There are no special difficulties associated with any of the activities proposed.

Cost effectiveness

This evaluation criterion addresses the cost of alternatives, including capital costs (such as construction costs, equipment costs, and disposal costs, engineering expenses) and site management costs (costs incurred after remedial construction is complete) necessary to ensure the continued effectiveness of a remedial action.

The capital costs associated with the Alternative 1 are similar to the Alternative 2 in that soils will be excavated and transported to appropriate facilities. In both cases, appropriate public health and environmental protections are achieved. Costs associated with Alternative 1 could potentially be higher than Alternative 2 if soil with analytes above Unrestricted Use SCOs is encountered below the excavation depth required for development. Additional costs would include installation of additional shoring/underpinning, disposal of additional soil, and import of clean soil for backfill. However, long-term costs for Alternative 2 are marginally higher than alternative 1 based on implementation of a Site Management Plan as part of Alternative 2.

The remedial plan creates an approach that combines the remedial action with the redevelopment of the Site, including the construction of the building foundation and sub-grade structures. The remedial plan is also cost effective in that it will take into consideration the selection of the closest and most appropriate disposal facilities to reduce transportation and disposal costs during the excavation of historic fill and other soils during the redevelopment of the Site.

Community Acceptance

This evaluation criterion addresses community opinion and support for the remedial action. Observations here will be supplemented by public comment received on the RAWP.

Based on the overall goals of the remedial program and the intended Site use, it is anticipated that both Alternatives 1 and 2 for the Site would be acceptable to the community.

Both remedial actions provide protection of public health and the environment and minimize potential contaminant exposures. This RAWP will be subject to and undergo public review under the NYC VCP and will provide the opportunity for detailed public input on the remedial alternatives and the selected remedial action. This public comment will be considered by OER prior to approval of this plan. The Citizen Participation Plan for the project is provided in Attachment B.

Land use

This evaluation criterion addresses the proposed use of the property. This evaluation has considered reasonably anticipated future uses of the Site and takes into account: current use and historical and/or recent development patterns; applicable zoning laws and maps; NYS Department of State's Brownfield Opportunity Areas (BOA) pursuant to section 970-r of the general municipal law; applicable land use plans; proximity to real property currently used for residential use, and to commercial, industrial, agricultural, and/or recreational areas; environmental justice impacts, Federal or State land use designations; population growth patterns and projections; accessibility to existing infrastructure; proximity of the site to important cultural resources and natural resources, potential vulnerability of groundwater to contamination that might emanate from the site, proximity to flood plains, geography and geology; and current Institutional Controls applicable to the site.

The proposed redevelopment of the Site is compatible with its current zoning and it's consistent with recent development patterns. Following remediation, the Site will meet either Track 1 Unrestricted Use or Track 4 Site-specific SCOs, both of which are appropriate for its planned commercial and residential uses. Improvements in the current environmental condition of the property achieved by both alternatives are also consistent with the City's goals for cleanup of contaminated land and bringing such properties into productive reuse. Both alternatives are equally protective of natural resources and cultural resources.

Sustainability of the Remedial Action

This criterion evaluates the overall sustainability of the remedial action alternatives and the degree to which sustainable means are employed to implement the remedial action including those that take into consideration NYC's sustainability goals defined in *PlanNYC: A Greener*,

Greater New York. Sustainability goals may include: maximizing the recycling and reuse of non-virgin materials; reducing the consumption of virgin and non-renewable resources; minimizing energy consumption and greenhouse gas emissions; improving energy efficiency; and promotion of the use of native vegetation and enhancing biodiversity during landscaping associated with Site development.

While the Alternative 2 would potentially result in lower energy usage based on reducing the volume of material transported off-Site, both remedial alternatives are comparable with respect to the opportunity to achieve sustainable remedial action. A complete list of green remedial activities considered as part of the NYC VCP is included in the Sustainability Statement included as Appendix D.

4.0 REMEDIAL ACTION

4.1 SUMMARY OF PREFERRED REMEDIAL ACTION

The preferred remedial action alternative is Alternative 2, the Track 4 remedy. The preferred remedial action alternative achieves protection of public health and the environment for the intended use of the property. The preferred remedial action alternative will achieve all of the remedial action objectives established for the project and addresses applicable SCGs. The preferred remedial action alternative is effective in both the short-term and long-term and reduces mobility, toxicity and volume of contaminants. The preferred remedial action alternative is cost effective and implementable and uses standards methods that are well established in the industry.

The proposed remedial action will consist of:

1. Preparation of a Community Protection Statement and implementation of all required NYC VCP Citizen Participation activities according to an approved Citizen Participation Plan.
2. Performance of a Community Air Monitoring Program for particulates and volatile organic carbon compounds.
3. Establishment of Track 4 Site Specific Soil Cleanup Objectives (SCOs).
4. Site mobilization involving Site security setup, equipment mobilization, utility mark outs and marking & staking excavation areas.
5. Installation of groundwater monitoring wells, collection and analyses of groundwater to determine groundwater quality beneath the site. Groundwater investigation will be conducted after building demolition.
6. Excavation and removal of soil/fill exceeding Track 4 SCOs. Excavation to 8 feet below grade for a basement that will cover approximately 40% of the building footprint and excavation to approximately 2 feet below grade for footings for the remainder of the building to be constructed at grade. While the area of the proposed building foundation footprint is known, hardscape and landscape area designs have not yet been finalized. In

Site areas to be developed with hardscape, a minimum of six inches of top cover will be removed to accommodate a pavement and paver base. In Site areas to be landscaped, a minimum of two feet of top cover will be excavated. For the purposes of the cut and fill analysis provided in this RAWP, the removal of two feet of top cover from slab-on-grade foundation areas, hardscape and landscaped areas is assumed. All excavated soil/fill exceeding site-specific SCOs will be removed from the Site.

7. Screening of excavated soil/fill during intrusive work for indications of contamination by visual means, odor, and monitoring with a PID. Appropriate segregation of excavated media on-Site.
8. Removal of underground storage tanks (if encountered) and closure of petroleum spills (if evidence of a spill/leak is encountered during Site excavation) in compliance with applicable local, State and Federal laws and regulations.
9. Transportation and off-Site disposal of all soil/fill material at permitted facilities in accordance with applicable laws and regulations for handling, transport, and disposal, and this plan. Sampling and analysis of excavated media as required by disposal facilities. Appropriate segregation of excavated media on-Site.
10. Collection and analysis of end-point samples to determine the performance of the remedy with respect to attainment of SCOs.
11. Import of materials to be used for backfill and cover in compliance with this plan and in accordance with applicable laws and regulations.
12. Installation of a vapor barrier/waterproofing system below the concrete slab underneath the building, as well as behind foundation walls of the proposed building. The vapor barrier will consist of Herculine^{Sigma} Smooth 20 mil vapor barrier and will be laid down in sheets that will be overlapped and joined by single-sided tape.
13. Installation and operation of an active Sub slab Depressurization System. The system will be installed in the gravel layer beneath the new building.
14. Construction and maintenance of an engineered composite cover consisting of an 8" thick concrete slab across the footprint of the new building. In Site areas to be developed with

hardscape, construction of a minimum six-inch top cover consisting of pavement and paver base. In Site areas to be landscaped, a minimum of two feet of clean fill/topsoil will be installed.

15. Implementation of storm-water pollution prevention measures in compliance with applicable laws and regulations.
16. Performance of all activities required for the remedial action, including permitting requirements and pretreatment requirements, in compliance with applicable laws and regulations.
17. Submission of a Remedial Action Report (RAR) that describes the remedial activities, certifies that the remedial requirements have been achieved, defines the Site boundaries, lists any changes from this RAWP, and describes all Engineering and Institutional Controls to be implemented at the Site.
18. Submission of an approved Site Management Plan (SMP) in the RAR for long-term management of residual contamination, including plans for operation, maintenance, monitoring, inspection and certification of Engineering and Institutional Controls and reporting at a specified frequency.
19. The property will continue to be registered with an E-Designation at the NYC Buildings Department. Establishment of Engineering Controls and Institutional Controls and a requirement that management of these controls must be in compliance with an approved SMP. Institutional Controls will include prohibition of the following: (1) vegetable gardening and farming; (2) use of groundwater without treatment rendering it safe for the intended use; (3) disturbance of residual contaminated material unless it is conducted in accordance with the SMP; and (4) higher level of land usage without OER-approval.

4.2 SOIL CLEANUP OBJECTIVES AND SOIL/FILL MANAGEMENT

Track 4 – Unrestricted Use Soil Cleanup Objectives (SCOs) are proposed for this project. Track 4 will consist of Track 2 Commercial as amended by the following Site-specific SCOs:

<u>Contaminant</u>	<u>Track 4 SCOs</u>
Lead	1,000
Mercury	2.5

Discrete contaminant sources (such as hotspots) identified during the remedial action will be surveyed. This information will be provided in the Remedial Action Report.

Soil and materials management on-Site and off-Site, including excavation, handling and disposal, will be conducted in accordance with the Soil/Materials Management Plan in Attachment D.

Estimated Soil/Fill Removal Quantities

The total quantity of soil/fill expected to be excavated and disposed off-Site is 343 yd³ or approximately 515 tons.

Disposal facilities will be reported to OER when they are identified and prior to the start of remedial action.

End-Point Sampling

Removal actions for development purposes under this plan will be performed in conjunction with confirmation soil sampling. Confirmation samples will be collected from the base of the excavation at locations to be determined by OER. For Track 4 SCOs, analytes will only include trigger compounds and elements established on the Track 4 SCO list including metals and PCBs.

Hot-spot removal actions, whether established under this RAWP or identified during the remedial program, will be performed in conjunction with post remedial end-point samples to

ensure that hot-spots are fully removed. Analytes for end-point sampling will be those parameters that are driving the hot-spot removal action and will be approved by OER. Frequency for hot-spot end-point sample collection is as follows:

1. For excavations less than 20 feet in total perimeter, at least one bottom sample and one sidewall sample biased in the direction of surface runoff.
2. For excavations 20 to 300 feet in perimeter:
 - For surface removals, one sample from the top of each sidewall for every 30 linear feet of sidewall and one sample from the excavation bottom for every 900 square feet of bottom area.
 - For subsurface removals, one sample from each sidewall for every 30 linear feet of sidewall and one sample from the excavation bottom for every 900 square feet of bottom area.
3. For sampling of volatile organics, bottom samples should be taken within 24 hours of excavation, and should be taken from the zero to six-inch interval at the excavation floor. Samples taken after 24 hours should be taken at six to twelve inches.
4. For contaminated soil removal, post remediation soil samples for laboratory analysis should be taken immediately after contaminated soil removal. If the excavation is enlarged horizontally, additional soil samples will be taken pursuant to bullets 1-3 above.

Post-remediation end-point sample locations and depth will be biased towards the areas and depths of highest contamination identified during previous sampling episodes unless field indicators such as field instrument measurements or visual contamination identified during the remedial action indicate that other locations and depths may be more heavily contaminated. In all cases, post-remediation samples should be biased toward locations and depths of the highest expected contamination.

New York State ELAP certified labs will be used for all confirmation and end-point sample analyses. Labs performing confirmation and end-point sample analyses will be reported in the RAR. The RAR will provide a tabular and map summary of all confirmation and end-point sample results and will include all data including non-detects and applicable standards and/or

guidance values. End-point samples will be Confirmation samples will be analyzed for compounds and elements as described above utilizing the following methodology:

Soil analytical methods will include:

- Volatile organic compounds by EPA Method 8260;
- Semi-volatile organic compounds by EPA Method 8270;
- Target Analyte List metals; and
- Pesticides/PCBs by EPA Method 8081/8082.

If either LNAPL and/or DNAPL are detected, appropriate samples will be collected for characterization and “finger print analysis” and required regulatory reporting (i.e. spills hotline) will be performed.

Quality Assurance/Quality Control

The fundamental QA objective with respect to accuracy, precision, and sensitivity of analysis for laboratory analytical data is to achieve the QC acceptance of the analytical protocol. The accuracy, precision and completeness requirements will be addressed by the laboratory for all data generated.

Collected samples will be appropriately packaged, placed in coolers and shipped via overnight courier or delivered directly to the analytical laboratory by field personnel. Samples will be containerized in appropriate laboratory provided glassware and shipped in plastic coolers. Samples will be preserved through the use of ice or “cold-paks” to maintain a temperature of 4°C.

Dedicated disposable sampling materials will be used for the collection endpoint samples, eliminating the need to prepare field equipment (rinsate) blanks. However, if non-disposable equipment is used, (stainless steel scoop, etc.) field rinsate blanks will be prepared at the rate of 1 for every eight samples collected. Decontamination of non-dedicated sampling equipment will consist of the following:

- Gently tap or scrape to remove adhered soil

- Rinse with tap water
- Wash withalconox® detergent solution and scrub
- Rinse with tap water
- Rinse with distilled or deionized water

Prepare field blanks by pouring distilled or deionized water over decontaminated equipment and collecting the water in laboratory provided containers. Trip blanks will be used whenever samples are transported to the laboratory for analysis of VOCs. Trip blanks will not be used for samples to be analyzed for metals, SVOCs or pesticides. One blind duplicate sample will be prepared and submitted for analysis every 20 samples.

4.3 ENGINEERING CONTROLS

The following elements will be incorporated into the foundation design as part of the development: composite cover system including concrete covered sidewalks and building slab, soil vapor barrier and active SSDS. These three elements will constitute Engineering Controls that will be employed in the remedial action to address residual contamination remaining at the Site.

Composite Cover System

Exposure to residual soil/fill will be prevented by an engineered, composite cover system to be built on the Site. This cover system will be comprised of a 8-inch thick concrete-building slab beneath the area of the proposed building and cover corresponding to the final design of the proposed rear yard recreational space. This composite cover system is comprised of:

- Concrete covered hardscape or landscape capped with two feet of clean fill/topsoil;
- Concrete building slabs;

The composite cover system is a permanent engineering control for the Site. The system will be inspected and reported at specified intervals as required by this RAWP and the SMP. A Soil Management Plan will be included in the Site Management Plan and will outline the procedures to be followed in the event that the composite cover system and underlying residual

soil/fill is disturbed after the remedial action is complete. Maintenance of this composite cover system will be described in the Site Management Plan in the RAR.

Active Sub-Slab Depressurization System

Contaminated sub-slab soil vapor is present beneath the Site as a result of contaminated subsurface soils. Groundwater has not yet been characterized at the site, and may also be a source of soil vapor contaminants. Groundwater characterization will occur once the on-site building has been demolished. An active sub-slab depressurization system will be installed beneath the cellar concrete slab as well as the residential concrete slab at grade. The SSDS will be designed in conjunction with the vapor barrier to create a negative pressure beneath the entire Site and prevent the migration of fugitive soil vapors into the proposed building. The SSDS will consist of a network of horizontal perforated pipes installed within a minimum of 18-inch layer of crushed stone beneath the building's 8-inch foundation floor as well as the 8-inch cellar floor. The perforated piping will consist of 4-inch diameter scheduled 40 PVC perforated pipe. A minimum of 4 inches of crushed stone will be placed above and below the pipes.

The horizontal depressurization piping will be connected to one or more vertical header pipes that will discharge above the second floor. A wind-driven turbine fan will be installed on the exhaust pipe to maintain negative pressure beneath the building foundation. Following installation of the active SSDS, indoor air samples will be collected and analyzed to provide a basis for the operation of the SSDS to be operated as a passive wind-driven system. Design plans for the SSDS are provided in Figure 6.

Vapor Barrier

Migration of soil vapor will be mitigated with a combination of building slab and vapor barrier. A pre-applied integrally bonded sheet with a High Density Polyethylene (HPDE) film will be installed as an impermeable vapor barrier underneath the entire foundation of the proposed building and the sidewalls of the cellar level. Herculine^{Sigma} Smooth 20 mil vapor barrier will be laid down in sheets that will be overlapped and joined by single-sided tape. Photo documentation of the vapor barrier installation will be submitted as part of the Remedial Action Report. Vapor barrier specifications are provided in Figure 7.

The project's Professional Engineer licensed by the State of New York will have primary direct responsibility for overseeing the implementation of the vapor barrier. The Remedial

Action Report will include photographs (maximum of two photos per page) of the installation process, PE/RA certified letter (on company letterhead) from primary contractor responsible for installation oversight and field inspections, and a copy of the manufacturers certificate of warranty.

4.4 Institutional Controls

Institutional Controls (IC) have been incorporated in this remedial action to manage residual soil/fill and other media and render the Site protective of public health and the environment. Institutional Controls are listed below. Long-term employment of EC/ICs will be implemented under a site-specific Site Management Plan (SMP) that will be included in the RAR. The property will continue to be registered with an E-Designation by the NYC Buildings Department.

Institutional Controls for this remedial action are:

- The property will continue to be registered with an E-Designation at the NYC Buildings Department. This RAWP includes a description of all ECs and ICs and summarizes the requirements of the Site Management Plan which will note that the property owner and property owner's successors and assigns must comply with the approved SMP;
- Submittal of a Site Management Plan in the RAR for approval by OER that provides procedures for appropriate operation, maintenance, monitoring, inspection, reporting and certification of ECs. SMP will require that the property owner and property owner's successors and assigns will submit to OER a periodic written statement that certifies that: (1) controls employed at the Site are unchanged from the previous certification or that any changes to the controls were approved by OER; and, (2) nothing has occurred that impairs the ability of the controls to protect public health and environment or that constitute a violation or failure to comply with the SMP. OER retains the right to enter the Site in order to evaluate the continued maintenance of any controls. This certification shall be submitted at a frequency to be determine by OER in the SMP and will comply with RCNY §43-1407(1)(3).
- Vegetable gardens and farming on the Site are prohibited in contact with residual soil materials;

- Use of groundwater underlying the Site is prohibited without treatment rendering it safe for its intended use;
- All future activities on the Site that will disturb residual material must be conducted pursuant to the soil management provisions in an approved SMP;
- The Site will be used for residential and commercial use and will not be used for a higher level of use without prior approval by OER.

4.5 SITE MANAGEMENT PLAN

Site Management is the last phase of remediation and begins with the approval of the Remedial Action Report and issuance of the Notice of Completion (NOC) for the Remedial Action. The Site Management Plan (SMP) describes appropriate methods and procedures to ensure implementation of all ECs and ICs that are required by the DCR and this RAWP. The Site Management Plan is submitted as part of the RAR but will be written in a manner that allows its use as an independent document. Site Management continues until terminated in writing by OER. The property owner is responsible to ensure that all Site Management responsibilities defined in the DCR and the Site Management Plan are implemented.

4.6 QUALITATIVE HUMAN HEALTH EXPOSURE ASSESSMENT

The objective of the qualitative exposure assessment is to identify potential receptors and pathways for human exposure to the contaminants of concern (COC) that are present at, or migrating from, the Site. The identification of exposure pathways describes the route that the COC takes to travel from the source to the receptor. An identified pathway indicates that the potential for exposure exists; it does not imply that exposures actually occur.

Investigations reported in the Remedial Investigation Report (RIR) are sufficient to complete a Qualitative Human Health Exposure Assessment (QHHEA). As part of the VCP process, a QHHEA was performed to determine whether the Site poses an existing or future health hazard to the Site's exposed or potentially exposed population. The sampling data from the RI were evaluated to determine whether there is any health risk by characterizing the exposure setting, identifying exposure pathways, and evaluating contaminant fate and transport. This QHHEA was

prepared in accordance with Appendix 3B and Section 3.3 (b) 8 of the NYSDEC Draft DER-10 Technical Guidance for Site Investigation and Remediation.

Known and Potential Sources

Soil:

- Acetone and methylene chloride were detected, but none exceeded Unrestricted Use SCOs;
- Metals including lead and mercury exceeding Restricted Residential Use Soil Cleanup Objectives; and
- One PCB (Arochlor 1260) was identified but did not exceed Unrestricted Use SCOs.

Soil Vapor:

- Trace concentrations of petroleum related VOCs were identified; and
- Chlorinated VOCs, including Tetrachloroethene (PCE), were detected above the monitoring thresholds established by NYS DOH.

Groundwater:

- Due to the lack of groundwater information from the previous remedial investigation, it will be treated as a potential source of contamination until characterization can be completed.

Nature, Extent, Fate and Transport of Contaminants

Soil samples collected during the Remedial Investigation showed that no VOCs or SVOCs were detected above regulatory guidance values. Two metals including lead and mercury were detected exceeding Soil Cleanup Objectives in both the shallow and deep samples. One of the soil vapor samples identified PCE above guidance values. The chlorinated VOCs in soil vapor were detected above guidance issued by New York State DOH and were not found in any of the on-Site soil samples collected. Groundwater samples have not been obtained to date, limiting the information that would determine the transportation potential of contaminants.

Potential Routes of Exposure

The five elements of an exposure pathway are (1) a contaminant source, (2) contaminant release and transport mechanisms, (3) a point of exposure, (4) a route of exposure, and (5) a receptor population. An exposure pathway is considered complete when all five elements of an exposure pathway are documented. A potential exposure pathway exists when any one or more of the five elements comprising an exposure pathway cannot be documented. An exposure pathway may be eliminated from further evaluation when any one of the five elements comprising an exposure pathway has not existed in the past, does not exist in the present, and will never exist in the future. Three potential primary routes exist by which chemicals can enter the body:

- Ingestion of water, fill, or soil;
- Inhalation of vapors and particulates; and
- Dermal contact with water, fill, soil, or building materials.

Existence of Human Health Exposure

Current Conditions: The Site is occupied by a vacant two-story building. Exposure to fill is unlikely because the Site is capped with metal plates and a building slab. Groundwater is not accessible at the Site, and because the Site is served by the public water supply and groundwater use for potable supply is prohibited, groundwater is not used at the Site. As the site is currently capped, accumulation of soil vapor can pose an exposure threat.

Construction/ Remediation Activities: The potential exposure pathways to onsite contamination are by ingestion, dermal, or inhalation exposure by onsite workers during the remedial action. Similarly, off-Site receptors could be exposed to dust from onsite activities. Groundwater is not expected to be encountered during construction/ remediation, and there will be no structures on Site where soil vapor could accumulate. During the remedial action, on-site exposure pathways will be eliminated by preventing access to the site, through implementation of soil/ materials management, storm water pollution prevention, and dust controls, employment of a community air monitoring plan, and implementation of a Construction Health and Safety Plan.

Proposed Future Conditions: Under future remediated conditions, the site will be fully capped, limiting potential direct exposure to soil and groundwater remaining in place, and engineering controls will prevent potential for inhalation via soil vapor intrusion. Any on-Site exposures to vapors from off-site sources will be prevented by installation of a soil vapor membrane. Long-term assurance of these protections will be achieved by Site inspections and periodic certifications under an approved Site Management Plan. The site is served by the public water supply, groundwater is not used at the site. There are no plausible off-site pathways for oral, inhalation, or dermal exposure to contaminants derived from the site.

Receptor Populations

On-Site Receptors – The Site is currently developed with one building: a vacant 2-story commercial/residential building. Current potential on-Site receptors are Site representatives and trespassers and visitors granted access to the property. During redevelopment of the Site, the on-Site potential receptors will include construction workers, site representatives, and visitors. Once the Site is redeveloped, the on-Site potential sensitive receptors will include adult and child building residents and visitors.

Off-Site Receptors - Potential off-Site receptors within a 0.25-mile radius of the Site include: adult and child residents, and commercial and construction workers, pedestrians, trespassers, and cyclists, based on the following:

1. Commercial Businesses (up to 0.25 mile) – existing and future
2. Residential Buildings (up to 0.25 mile) – existing and future
3. Building Construction/Renovation (up to 0.25 mile) – existing and future
4. Pedestrians, Trespassers, Cyclists (up to .25 mile) – existing and future
5. Schools (up to .25 mile) – existing and future

Overall Human Health Exposure Assessment

There are potential complete exposure pathways for the current site condition. There is a potential complete exposure pathway that requires mitigation during implementation of the remedy. There is no complete exposure pathway under future conditions after the site is developed. This assessment takes into consideration the reasonably anticipated use of the site,

which includes a residential structure, site-wide surface cover cap, and a subsurface vapor barrier system and an SSD system for the building. Potential post-construction use of groundwater is not considered an option because groundwater in this area of New York City is not used as a potable water source. There are no surface waters in close proximity to the Site that could be impacted or threatened.

Based upon this analysis, complete on-Site exposure pathways appear to be present during the remedial action phase. Under current conditions, on-Site exposure pathways exist for contractors and others that may access the Site. During remedial construction, on-Site and off-Site exposures to contaminated dust from historic fill material will be addressed through dust controls, and through the implementation of the Community Air Monitoring Program, the Soil/Materials Management Plan, and a Construction Health and Safety Plan. After the remedial action is complete, there will be no remaining exposure pathways to on-Site soil/fill or groundwater, as all soil above Site-Specific SCOs will have been removed and a vapor barrier system and an active SSD system will have been installed as part of development.

5.0 REMEDIAL ACTION MANAGEMENT

5.1 PROJECT ORGANIZATION AND OVERSIGHT

The Professional Engineer (PE) is Andrew Levenbaum and Qualified Environmental Professionals (QEP) for this project is Paul P. Stewart ACT.

5.2 SITE SECURITY

A steel construction fence and a gated entrance along 4th Avenue will control site access.

5.3 WORK HOURS

The hours for operation of remedial construction will be from 7:00 am to 6:00 pm. These hours conform to the New York City Department of Buildings construction code requirements.

5.4 CONSTRUCTION HEALTH AND SAFETY PLAN

The Health and Safety Plan is included in Appendix 4. The Site Safety Coordinator will be Yisong Yang. Remedial work performed under this RAWP will be in full compliance with applicable health and safety laws and regulations, including Site and OSHA worker safety requirements and HAZWOPER requirements. Confined space entry, if any, will comply with OSHA requirements and industry standards and will address potential risks. The parties performing the remedial construction work will ensure that performance of work is in compliance with the HASP and applicable laws and regulations. The HASP pertains to remedial and invasive work performed at the Site until the issuance of the Notice of Completion.

All field personnel involved in remedial activities will participate in training required under 29 CFR 1910.120, including 40-hour hazardous waste operator training and annual 8-hour refresher training. Site Safety Officer will be responsible for maintaining workers training records.

Personnel entering any exclusion zone will be trained in the provisions of the HASP and be required to sign an HASP acknowledgment. Site-specific training will be provided to field personnel. Additional safety training may be added depending on the tasks performed.

Emergency telephone numbers will be posted at the site location before any remedial work begins. A safety meeting will be conducted before each shift begins. Topics to be discussed include task hazards and protective measures (physical, chemical, environmental); emergency procedures; PPE levels and other relevant safety topics. Meetings will be documented in a log book or specific form.

An emergency contact sheet with names and phone numbers is included in the HASP. That document will define the specific project contacts for use in case of emergency.

5.5 COMMUNITY AIR MONITORING PLAN

Real-time air monitoring for volatile organic compounds (VOCs) and particulate levels at the perimeter of the exclusion zone or work area will be performed. Continuous monitoring will be performed for all ground intrusive activities and during the handling of contaminated or potentially contaminated media. Ground intrusive activities include, but are not limited to, soil/waste excavation and handling, test pit excavation or trenching, and the installation of soil borings or monitoring wells.

Periodic monitoring for VOCs will be performed during non-intrusive activities such as the collection of soil and sediment samples or the collection of groundwater samples from existing monitoring wells. Periodic monitoring during sample collection, for instance, will consist of taking a reading upon arrival at a sample location, monitoring while opening a well cap or overturning soil, monitoring during well baling/purging, and taking a reading prior to leaving a sample location. Depending upon the proximity of potentially exposed individuals, continuous monitoring may be performed during sampling activities. Examples of such situations include groundwater sampling at wells on the curb of a busy urban street, in the midst of a public park, or adjacent to a school or residence. Exceedences of action levels observed during performance of the Community Air Monitoring Plan (CAMP) will be reported to the OER Project Manager and included in the Daily Report.

VOC Monitoring, Response Levels, and Actions

Volatile organic compounds (VOCs) will be monitored at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a continuous basis during invasive work.

Upwind concentrations will be measured at the start of each workday and periodically thereafter to establish background conditions. The monitoring work will be performed using equipment appropriate to measure the types of contaminants known or suspected to be present. The equipment will be calibrated at least daily for the contaminant(s) of concern or for an appropriate surrogate. The equipment will be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

- If the ambient air concentration of total organic vapors at the downwind perimeter of the work area or exclusion zone exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities will be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities will resume with continued monitoring.
- If total organic vapor levels at the downwind perimeter of the work area or exclusion zone persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities will be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities will resume provided that the total organic vapor level 200 feet downwind of the exclusion zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less - but in no case less than 20 feet, is below 5 ppm over background for the 15-minute average.
- If the organic vapor level is above 25 ppm at the perimeter of the work area, activities will be shutdown.

All 15-minute readings must be recorded and be available for OER personnel to review. Instantaneous readings, if any, used for decision purposes will also be recorded.

Particulate Monitoring, Response Levels, and Actions

Particulate concentrations will be monitored continuously at the upwind and downwind perimeters of the exclusion zone at temporary particulate monitoring stations. The particulate monitoring will be performed using real-time monitoring equipment capable of measuring particulate matter less than 10 micrometers in size (PM-10) and capable of integrating over a period of 15 minutes (or less) for comparison to the airborne particulate action level. The

equipment will be equipped with an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration should be visually assessed during all work activities.

- If the downwind PM-10 particulate level is 100 micrograms per cubic meter (mcg/m^3) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques will be employed. Work will continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed $150 \text{ mcg}/\text{m}^3$ above the upwind level and provided that no visible dust is migrating from the work area.
- If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than $150 \text{ mcg}/\text{m}^3$ above the upwind level, work will be stopped and a re-evaluation of activities initiated. Work will resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within $150 \text{ mcg}/\text{m}^3$ of the upwind level and in preventing visible dust migration.

All readings will be recorded and be available for OER personnel to review.

5.6 AGENCY APPROVALS

All permits or government approvals required for remedial construction have been or will be obtained prior to the start of remedial construction. Approval of this RAWP by OER does not constitute satisfaction of these requirements and will not be a substitute for any required permit.

5.7 SITE PREPARATION

Pre-Construction Meeting

OER will be invited to attend the pre-construction meeting at the Site with all parties involved in the remedial process prior to the start of remedial construction activities.

Mobilization

Mobilization will be conducted as necessary for each phase of work at the Site. Mobilization includes field personnel orientation, equipment mobilization (including securing all

sampling equipment needed for the field investigation), marking/staking sampling locations and utility mark-outs. Each field team member will attend an orientation meeting to become familiar with the general operation of the Site, health and safety requirements, and field procedures.

Utility Marker Layouts, Easement Layouts

The presence of utilities and easements on the Site will be fully investigated prior to the performance of invasive work such as excavation or drilling under this plan by using, at a minimum, the One-Call System (811). Underground utilities may pose an electrocution, explosion, or other hazard during excavation or drilling activities. All invasive activities will be performed in compliance with applicable laws and regulations to assure safety. Utility companies and other responsible authorities will be contacted to locate and mark the locations, and a copy of the Markout Ticket will be retained by the contractor prior to the start of drilling, excavation or other invasive subsurface operations. Overhead utilities may also be present within the anticipated work zones. Electrical hazards associated with drilling in the vicinity of overhead utilities will be prevented by maintaining a safe distance between overhead power lines and drill rig masts.

Proper safety and protective measures pertaining to utilities and easements, and compliance with all laws and regulations will be employed during invasive and other work contemplated under this RAWP. The integrity and safety of on-Site and off-Site structures will be maintained during all invasive, excavation or other remedial activity performed under the RAWP.

Dewatering

Dewatering is not anticipated at the site. The extent of the excavation for the cellar are will be 8 feet and groundwater is believed to be around 40 feet below ground surface.

Equipment and Material Staging

Equipment and materials will be stored and staged in a manner that complies with applicable laws and regulations.

Stabilized Construction Entrance

Steps will be taken to ensure that trucks departing the site will not track soil, fill or debris off-Site. Such actions may include use of cleaned asphalt or concrete roads or use of stone or other aggregate-based egress paths between the truck inspection station and the property exit. Measures will be taken to ensure that adjacent roadways will be kept clean of project related soils, fill and debris.

Truck Inspection Station

An outbound-truck inspection station will be set up close to the Site exit. Before exiting the NYC VCP Site, trucks will be required to stop at the truck inspection station and will be examined for evidence of contaminated soil on the undercarriage, body, and wheels. Soil and debris will be removed. Brooms, shovels and potable water will be utilized for the removal of soil from vehicles and equipment, as necessary.

Extreme Storm Preparedness and Response Contingency Plan

Damage from flooding or storm surge can include dislocation of soil and stockpiled materials, dislocation of site structures and construction materials and equipment, and dislocation of support of excavation structures. Damage from wind during an extreme storm event can create unsafe or unstable structures, damage safety structures and cause downed power lines creating dangerous site conditions and loss of power. In the event of emergency conditions caused by an extreme storm event, the enrollee will undertake the following steps for site preparedness prior to the event and response after the event.

Storm Preparedness

Preparations in advance of an extreme storm event will include the following: containerized hazardous materials and fuels will be removed from the property; loose materials will be secured to prevent dislocation and blowing by wind or water; heavy equipment such as excavators and generators will be removed from holes, trenches and depressions on the property to high ground or removed from the property; an inventory of the property with photographs will be performed to establish conditions for the site and equipment prior to the event; stockpile covers for soil and fill will be secured by adding weights such as sandbags for added security and worn or ripped

stockpile covers will be replaced with competent covers; stockpiled hazardous wastes will be removed from the property; stormwater management systems will be inspected and fortified, including, as necessary: clean and reposition silt fences, haybales; clean storm sewer filters and traps; and secure and protect pumps and hosing.

Storm Response

At the conclusion of an extreme storm event, as soon as it is safe to access the property, a complete inspection of the property will be performed. A site inspection report will be submitted to OER at the completion of site inspection and after the site security is assessed. Site conditions will be compared to the inventory of site conditions and material performed prior to the storm event and significant differences will be noted. Damage from storm conditions that result in acute public safety threats, such as downed power lines or imminent collapse of buildings, structures or equipment will be reported to public safety authorities via appropriate means such as calling 911. Petroleum spills will be reported to NYS DEC within 2 hours of identification and consistent with State regulations. Emergency and spill conditions will also be reported to OER. Public safety structures, such as construction security fences will be repaired promptly to eliminate public safety threats. Debris will be collected and removed. Dewatering will be performed in compliance with existing laws and regulations and consistent with emergency notifications, if any, from proper authorities. Eroded areas of soil including unsafe slopes will be stabilized and fortified. Dislocated materials will be collected and appropriately managed. Support of excavation structure will be inspected and fortified as necessary. Impacted stockpiles will be contained and damaged stockpile covers will be replaced. Storm-water control systems and structures will be inspected and maintained as necessary. If soil or fill materials are discharged off site to adjacent properties, property owners and OER will be notified and corrective measure plan designed to remove and clean dislocated material will be submitted to OER and implemented following approval by OER and granting of site access by the property owner. Impacted offsite areas may require characterization based on site conditions, at the discretion of OER. If onsite petroleum spills are identified, a qualified environmental professional will determine the nature and extent of the spill and report to NYS DEC's spill hotline at DEC 800-457-7362. If the source of the spill is ongoing and can be identified, it should be stopped if this can be done safely. Potential hazards will be addressed immediately, consistent with guidance issued by NYS DEC.

Storm Response Reporting

A site inspection report will be submitted to OER at the completion of site inspection. An inspection report established by OER is available on OER's website (www.nyc.gov/oer) and will be used for this purpose. Site conditions will be compared to the inventory of site conditions and material performed prior to the storm event and significant differences will be noted. The site inspection report will be sent to the OER project manager and will include the site name, address, tax block and lot, site primary and alternate contact name and phone number. Damage and soil release assessment will include: whether the project had stockpiles; whether stockpiles were damaged; photographs of damage and notice of plan for repair; report of whether soil from the site was dislocated and whether any of the soil left the site; estimates of the volume of soil that left the site, nature of impact, and photographs; description of erosion damage; description of equipment damage; description of damage to the remedial program or the construction program, such as damage to the support of excavation; presence of onsite or offsite exposure pathways caused by the storm; presence of petroleum or other spills and status of spill reporting to NYS DEC; description of corrective actions; schedule for corrective actions. This report should be completed and submitted to OER project manager with photographs within 24 hours of the time of safe entry to the property after the storm event.

5.8 TRAFFIC CONTROL

Drivers of trucks leaving the NYC VCP Site with soil/fill will be instructed to proceed without stopping in the vicinity of the site to prevent neighborhood impacts. The planned route on local roads for trucks leaving the site is going northeast on 4th Avenue to 15th Street, taking the first left onto 3rd avenue to merge onto I-278W to I-95S.

5.9 DEMOBILIZATION

Demobilization will include:

- As necessary, restoration of temporary access areas and areas that may have been disturbed to accommodate support areas (e.g., staging areas, decontamination areas, storage areas, temporary water management areas, and access area);

- Removal of sediment from erosion control measures and truck wash and disposal of materials in accordance with applicable laws and regulations;
- Equipment decontamination, and;
- General refuse disposal.

Equipment will be decontaminated and demobilized at the completion of all field activities. Investigation equipment and large equipment (*e.g.*, soil excavators) will be washed at the truck inspection station as necessary. In addition, all investigation and remediation derived waste will be appropriately disposed.

5.10 REPORTING AND RECORD KEEPING

Daily Reports

Daily reports providing a general summary of activities for each day of *active remedial work* will be emailed to the OER Project Manager by the end of the following day. Those reports will include:

- Project number and statement of the activities and an update of progress made and locations of work performed;
- Quantities of material imported and exported from the Site;
- Status of on-Site soil/fill stockpiles;
- A summary of all citizen complaints, with relevant details (basis of complaint; actions taken; etc.);
- A summary of CAMP excursions, if any;
- Photograph of notable Site conditions and activities.

The frequency of the reporting period may be revised in consultation with OER project manager based on planned project tasks. Daily email reports are not intended to be the primary mode of communication for notification to OER of emergencies (accidents, spills), requests for changes to the RAWP or other sensitive or time critical information. However, such information will be included in the daily reports. Emergency conditions and changes to the RAWP will be

communicated directly to the OER project manager by personal communication. Daily reports will be included as an Appendix in the Remedial Action Report.

Record Keeping and Photo-Documentation

Job-site record keeping for all remedial work will be performed. These records will be maintained on-Site during the project and will be available for inspection by OER staff. Representative photographs will be taken of the Site prior to any remedial activities and during major remedial activities to illustrate remedial program elements and contaminant source areas. Photographs will be submitted at the completion of the project in the RAR in digital format (i.e. jpeg files).

5.11 COMPLAINT MANAGEMENT

All complaints from citizens will be promptly reported to OER. Complaints will be addressed and outcomes will also be reported to OER in daily reports. Notices to OER will include the nature of the complaint, the party providing the complaint, and the actions taken to resolve any problems.

5.12 DEVIATIONS FROM THE REMEDIAL ACTION WORK PLAN

All changes to the RAWP will be reported to the OER Project Manager and will be documented in daily reports and reported in the Remedial Action Report. The process to be followed if there are any deviations from the RAWP will include a request for approval for the change from OER noting the following:

- Reasons for deviating from the approved RAWP;
- Effect of the deviations on overall remedy; and
- Determination that the remedial action with the deviation(s) is protective of public health and the environment.

6.0 REMEDIAL ACTION REPORT

A Remedial Action Report (RAR) will be submitted to OER following implementation of the remedial action defined in this RAWP. The RAR will document that the remedial work required under this RAWP has been completed and has been performed in compliance with this plan. The RAR will include:

- Information required by this RAWP;
- As-built drawings for all constructed remedial elements, required certifications, manifests and other written and photographic documentation of remedial work performed under this remedy;
- Site Management Plan (if Track 1 is not achieved);
- Description of any changes in the remedial action from the elements provided in this RAWP and associated design documents;
- Tabular summary of all end point sampling results and all material characterization results, QA/QC results for end-point sampling, and other sampling and chemical analysis performed as part of the remedial action and DUSR;
- Test results or other evidence demonstrating that remedial systems are functioning properly;
- Account of the source area locations and characteristics of all contaminated material removed from the Site including a map showing source areas;
- Account of the disposal destination of all contaminated material removed from the Site. Documentation associated with disposal of all material will include transportation and disposal records, and letters approving receipt of the material.
- Account of the origin and required chemical quality testing for material imported onto the Site.
- Continue registration of the property with an E-Designation at the NYC Department of Buildings.

- Reports and supporting material will be submitted in digital form.

Remedial Action Report Certification

The following certification will appear in front of the Executive Summary of the Remedial Action Report. The certification will include the following statements:

I, Andrew R. Levenbaum, am currently a professional engineer licensed by the State of New York. I had primary direct responsibility for implementation of the remedial program for the 573 4th Avenue Site 13EH-N282K.

I, Paul P. Stewart, am a qualified Environmental Professional. I had primary direct responsibility for implementation remedial program for the 573 4th Avenue Site 13EH-N282K.

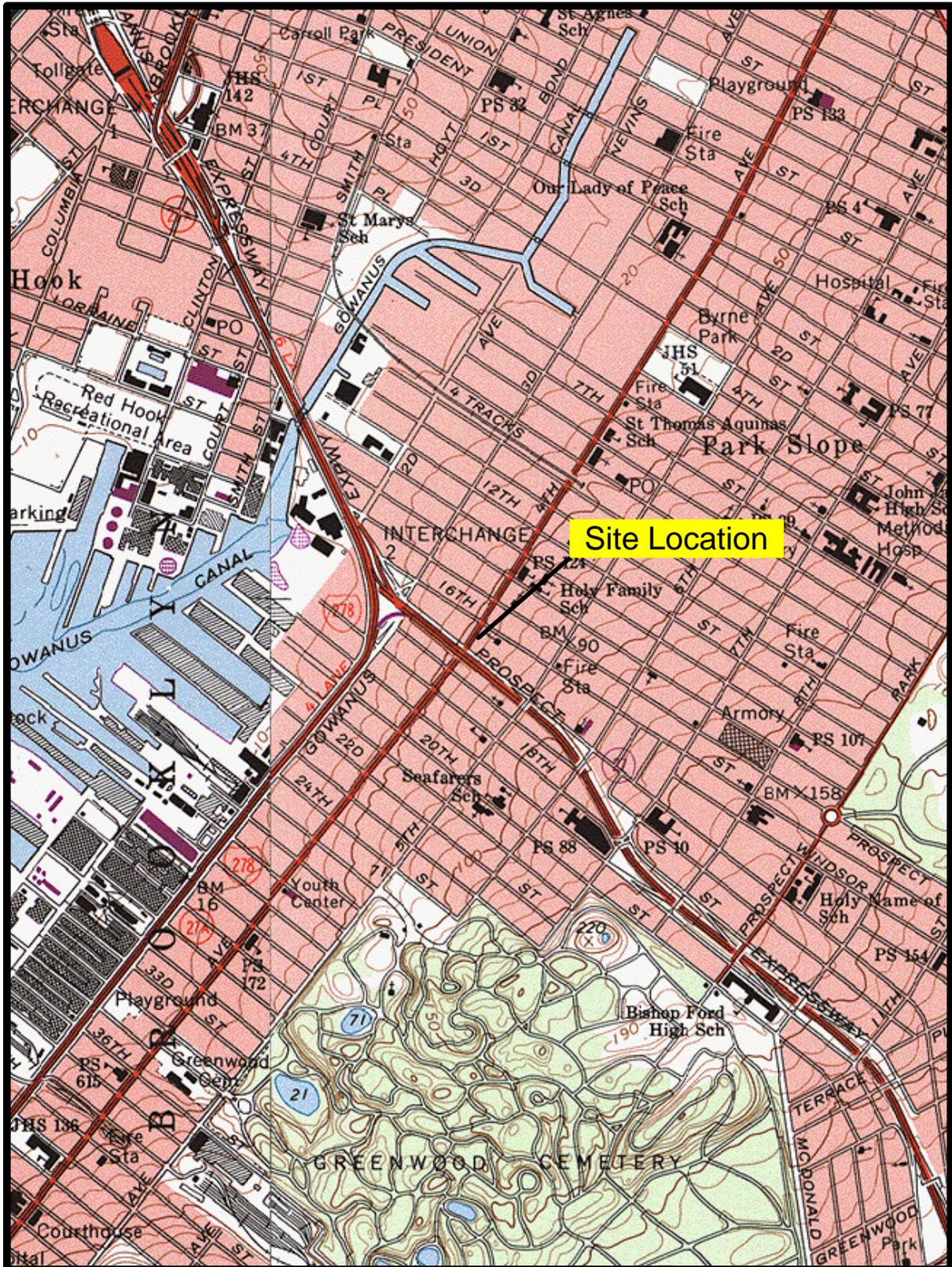
*I certify that the OER-approved Remedial Action Work Plan dated **month day year** and Stipulations in a letter dated **month day, year; if any** were implemented and that all requirements in those documents have been substantively complied with. I certify that contaminated soil, fill, liquids or other material from the property were taken to facilities licensed to accept this material in full compliance with applicable laws and regulations.*

7.0 SCHEDULE

The table below presents a schedule for the proposed remedial action and reporting. If the schedule for remediation and development activities changes, it will be updated and submitted to OER. Currently, a 4 month remediation period is anticipated.

Schedule Milestone	Weeks from Remedial Action Start	Duration (weeks)
OER Approval of RAWP	0	-
Fact Sheet 2 announcing start of remedy	0	-
Mobilization	4	1
Remedial Excavation	5	8
Demobilization	13	1
Submit Remedial Action Report	16	4

**Figure 1:
Site Location Map**



From USGS 7.5 Minute Topographic Map Of Brooklyn, New York Quadrangle



Locational Diagram  Advanced Cleanup Technologies, Inc. ENVIRONMENTAL CONSULTANTS	
960 S. Broadway, Suite 100, Hicksville, New York 11801 Tel: 516-933-0655 Fax: 516-933-0659	
Project No.: 7115-BKNY	Figure No.: 1
Date: 10/19/2012	Scale: 1 inch = 2000 feet

**Figure 2:
Site Diagram**

4TH AVENUE

Possible UST

Fill

573 Roll up

SV-1

IA-1

SB-2

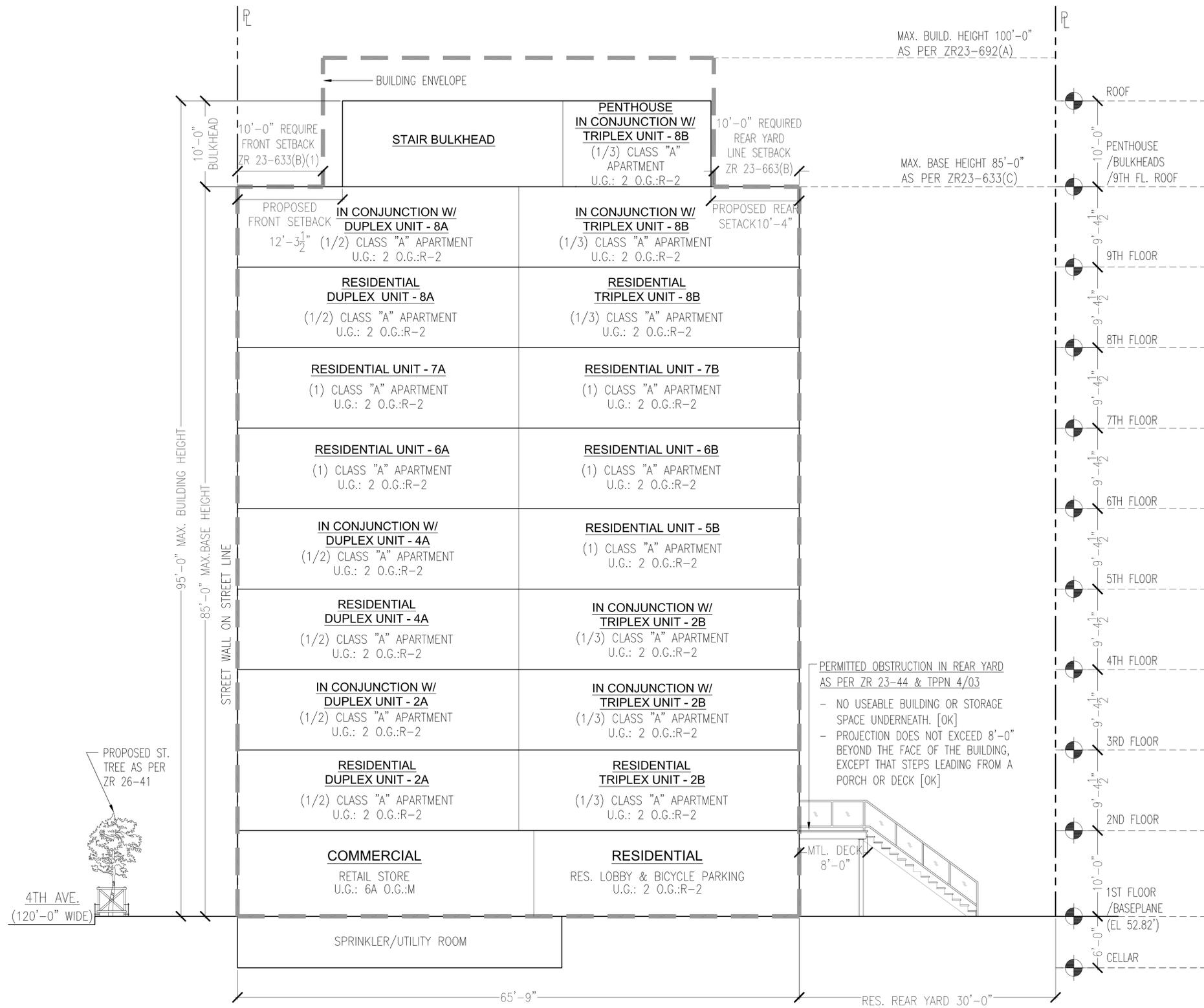
Concrete Lined Trench



Legend	
	Soil vapor point installed on September 25, 2012.
	Soil boring installed on September 25, 2012.
	Indoor air sampled on September 25, 2012.

Site Diagram	
960 S. Broadway, Suite 100, Hicksville, New York 11801 Tel: 516-933-0655 Fax: 516-933-0659	
Project No.: 7115-BKNY	Figure No.: 2
Date: 06/23/2013	Scale: Not To Scale

Figure 3: Redevelopment Plans



HEIGHT AND SETBACK REGULATION DIAGRAM

SCALE: NTS

CONDITION:

WITHIN 100'-0" OF STREET LINE
 STREET WALL HAS MINIMUM WIDTH OF 15'-0"
 BASEPLANE IS ANY LEVEL BETWEEN CURB LEVEL AND STREET WALL LINE LEVEL.
 CURB LEVEL = $(51.92' + 51.92') / 2 = 51.92'$
 STREET WALL LINE LEVEL = BASE PLAN LEVEL = $(52.82' + 52.82') / 2 = 52.82'$

NOTE:

ALL ELEVATIONS LEVEL REFER TO KINGS TOPOGRAPHICAL DATUM WHICH IS 2.560 FEET ABOVE NATION GEODETIC SURVEY DATUM AT SANDY HOOK NEW JERSEY.

DOB EMPLOYEE STAMP AND SIGNATURE (APPROVAL STAMP):

CLIENT:
CPCC MANAGEMENT LLC
WUJIE, ZHAO
 4920 3RD AVENUE
 BROOKLYN, NEW YORK 11220
 TEL.(718) 439-4688

REVISIONS:

REV. NO.	DATE	DESCRIPTION
NO. 1		
NO. 2		
NO. 3		
NO. 3		
NO. 2		
NO. 1		
ISSUE NO. DATE	ISSUED TO	

the reproduction of this drawing or the use of ideas and arrangements indicated on this drawing without the written approval of this office is prohibited. written dimensions take precedence over scaled dimensions. the contractor shall verify dimensions and conditions at the job and report discrepancies to the architect/ engineer prior to the start of the work.

PROJECT:
573 4TH AVENUE
BROOKLYN, NEW YORK 11215

DRAWING TITLE:
HEIGHT & SETBACK REGULATION DIAGRAM

ISSUED: 12.11.12	SEAL AND SIGNATURE:
PROJECT NO.:	
DRAWN BY: JE	
CHECK BY: TCO	
DWG NO.:	
Z-103.00	
FILE: 573 4TH AVENUE	SHEET: 09 OF
DOB JOB NO.:	

DOB EMPLOYEE STAMP AND SIGNATURE (APPROVAL STAMP):

CLIENT:
CPCC MANAGEMENT LLC
WUJIE, ZHAO
 4920 3RD AVENUE
 BROOKLYN, NEW YORK 11220
 TEL (718) 439-4688

REVISIONS:

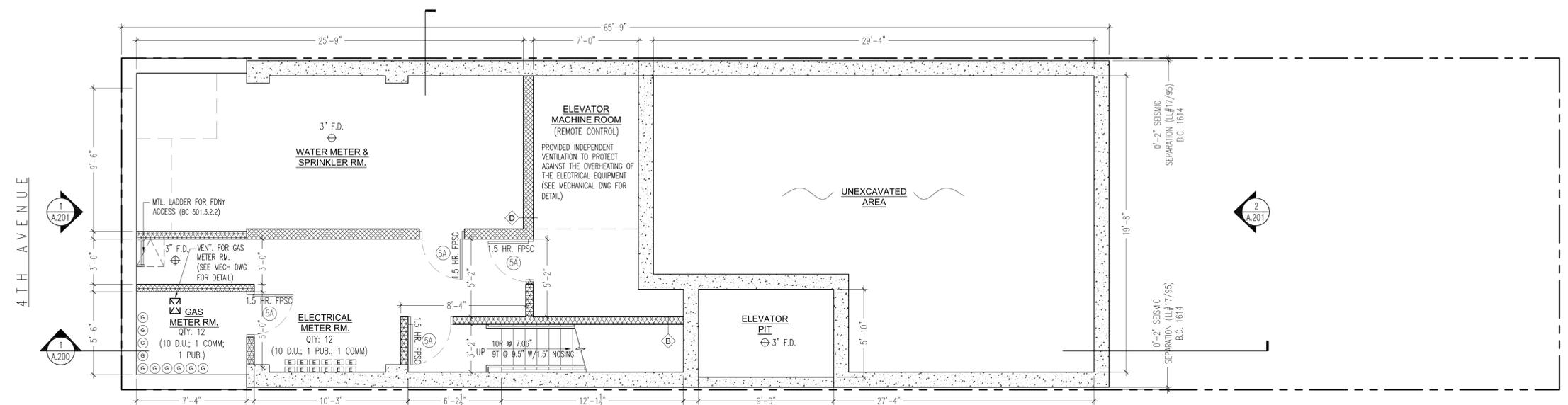
REV. NO.	DATE	DESCRIPTION
NO. 1		
NO. 2		
NO. 3		
NO. 3		
NO. 2		
NO. 1		
ISSUE NO.	DATE	ISSUED TO

and the reproduction of this drawing or the use of ideas and arrangements indicated on this drawing without the written approval of this office is prohibited. Written dimensions take precedence over scaled dimensions. The contractor shall verify dimensions and conditions at the job and report discrepancies to the architect/engineer prior to the start of the work.

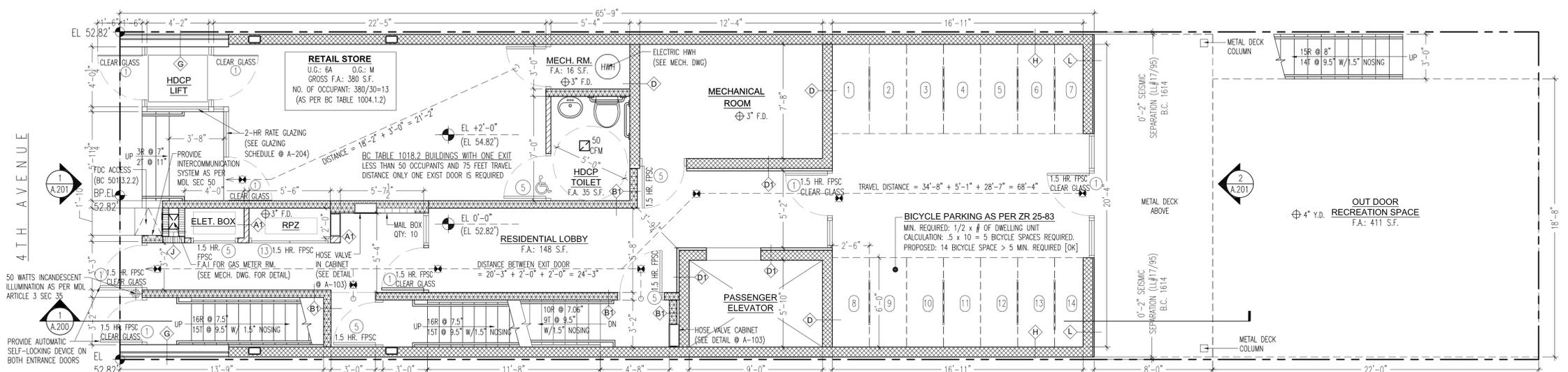
PROJECT:
573 4TH AVENUE
BROOKLYN, NEW YORK 11215

DRAWING TITLE:
PROPOSED CELLAR, 1ST & 2ND FLOOR PLAN

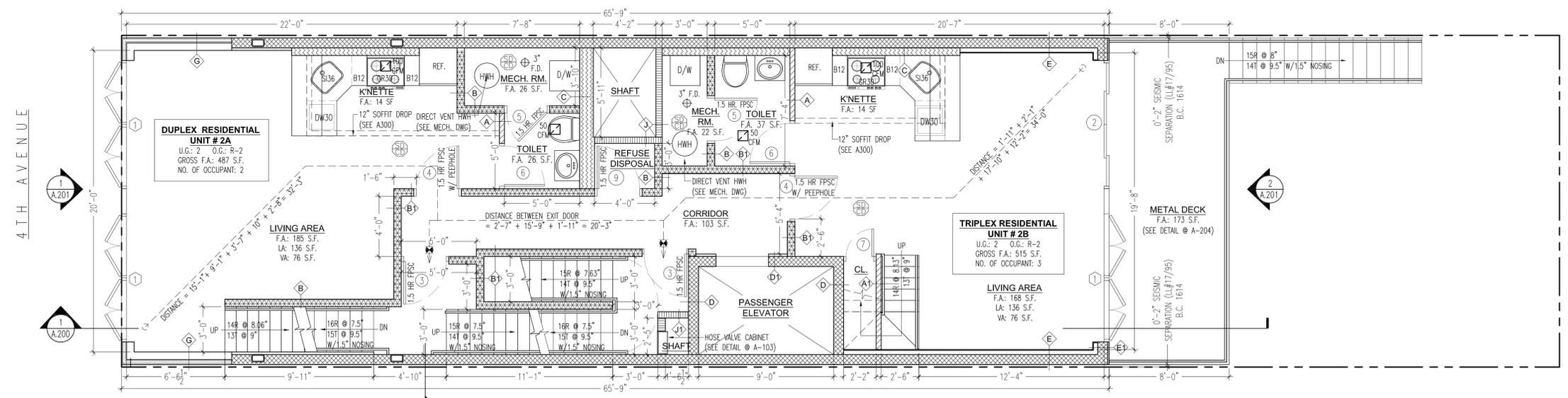
ISSUED: 12.11.12
 PROJECT NO:
 DRAWN BY: JZ
 CHECK BY: TCO
 DWG NO:
A-100.00
 SEAL AND SIGNATURE:
 FILE: 573 4TH AVENUE SHEET: 10 OF
 DOB JOB NO:



CELLAR PLAN
 SCALE: 1/4" = 1'-0"



1ST FLOOR PLAN
 SCALE: 1/4" = 1'-0"



2ND FLOOR PLAN
 SCALE: 1/4" = 1'-0"

DOB EMPLOYEE STAMP AND SIGNATURE (APPROVAL STAMP):

CLIENT:
CPCC MANAGEMENT LLC
WUJIE, ZHAO
 4920 3RD AVENUE
 BROOKLYN, NEW YORK 11220
 TEL (718) 439-4688

REVISIONS:

REV. NO.	DATE	DESCRIPTION
NO. 1		
NO. 2		
NO. 3		
NO. 3		
NO. 2		
NO. 1		
ISSUE NO.	DATE	ISSUED TO

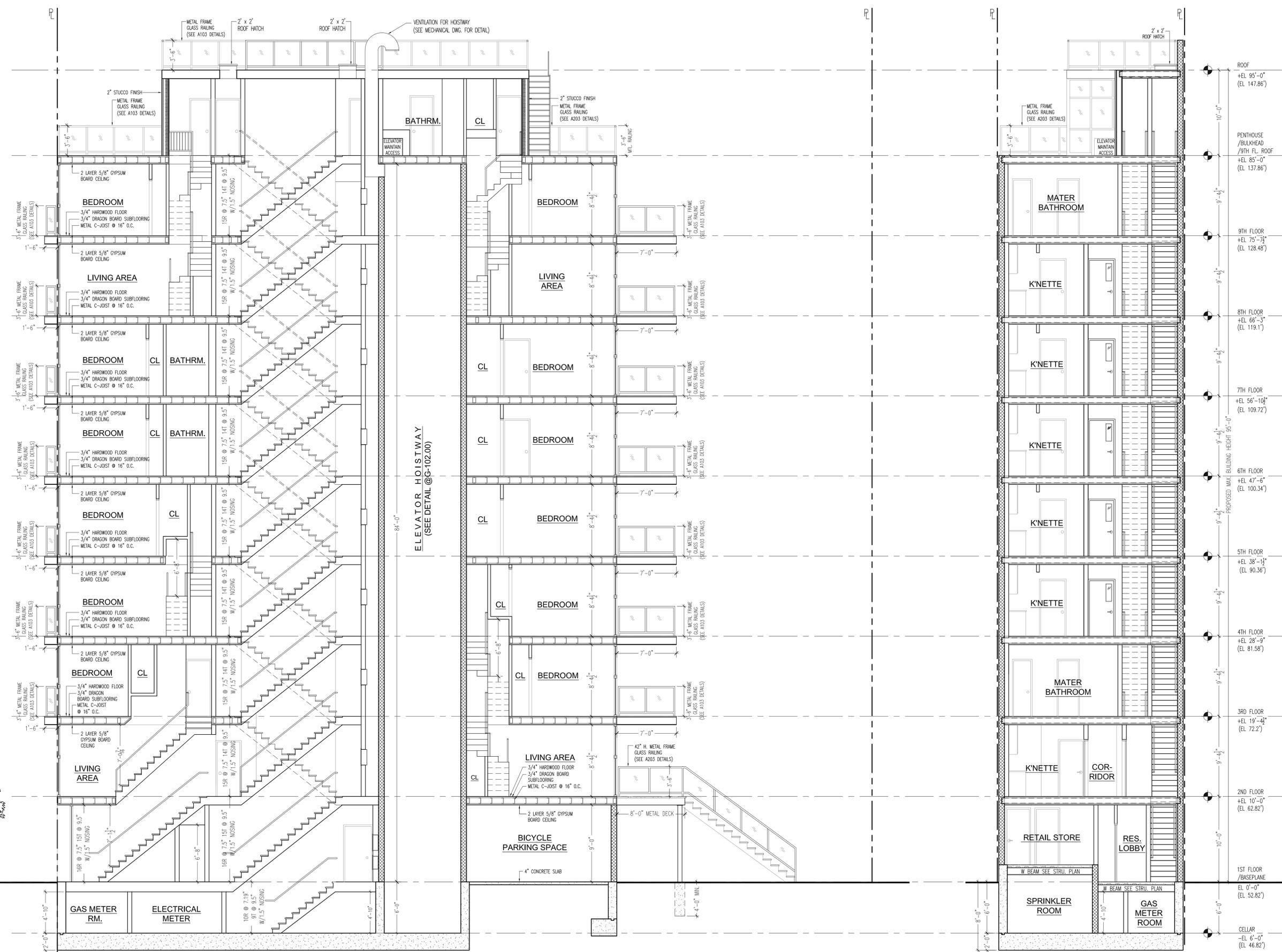
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PROJECT:
573 4TH AVENUE
BROOKLYN, NEW YORK 11215

DRAWING TITLE:

BUILDING SECTIONS

ISSUED: 12.11.12	SEAL AND SIGNATURE:
PROJECT NO:	
DRAWN BY: JC	
CHECK BY: TCO	
DWG NO:	
A-200.00	
FILE: 573 4TH AVENUE	SHEET: 14 OF
DOB JOB NO:	



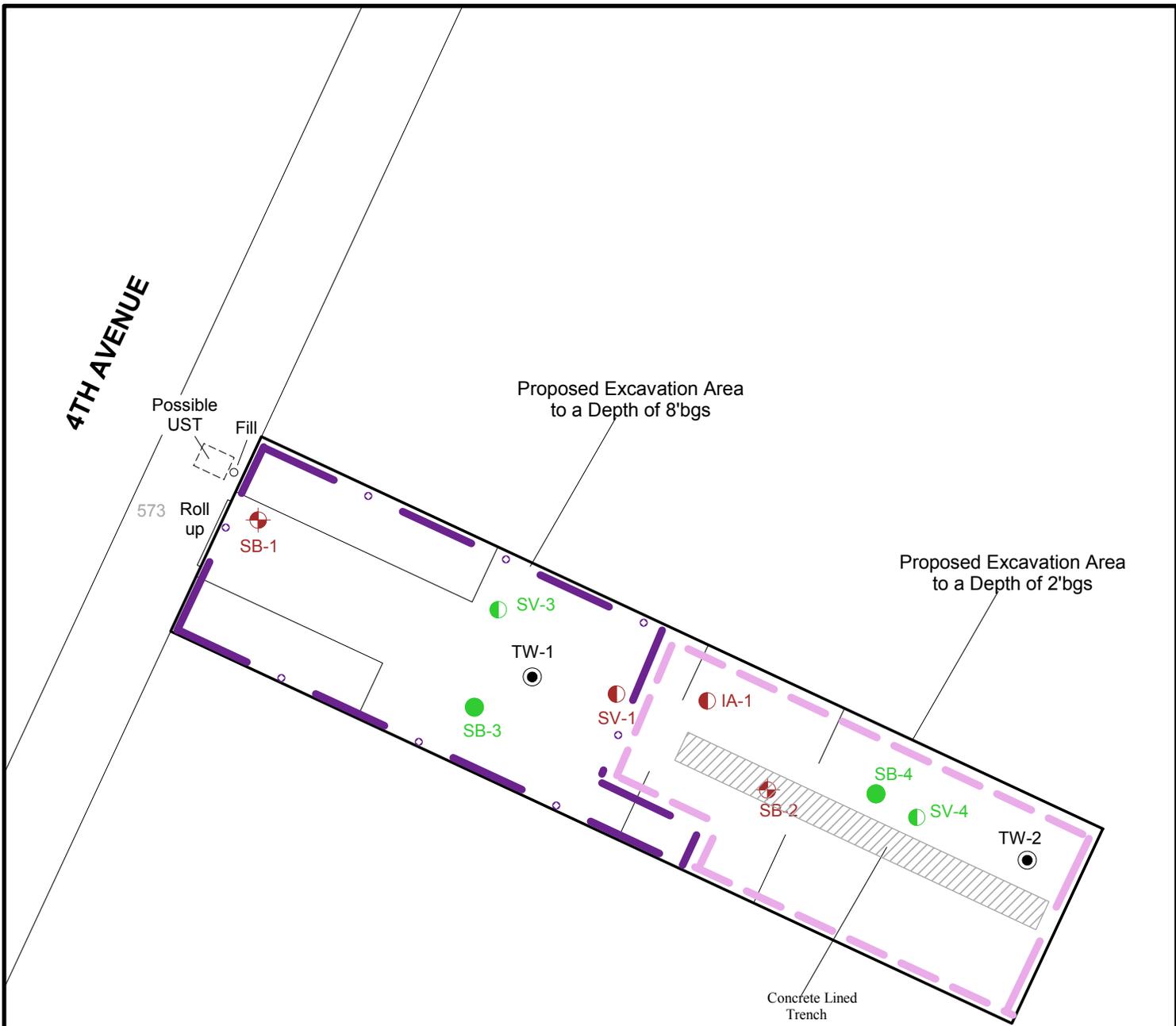
1 LONGITUDINAL SECTION
 SCALE: 1/4" = 1'-0"

2 TRANSVERSAL SECTION
 SCALE: 1/4" = 1'-0"



4TH AVE.

**Figure 4:
Planned Excavation Depths**



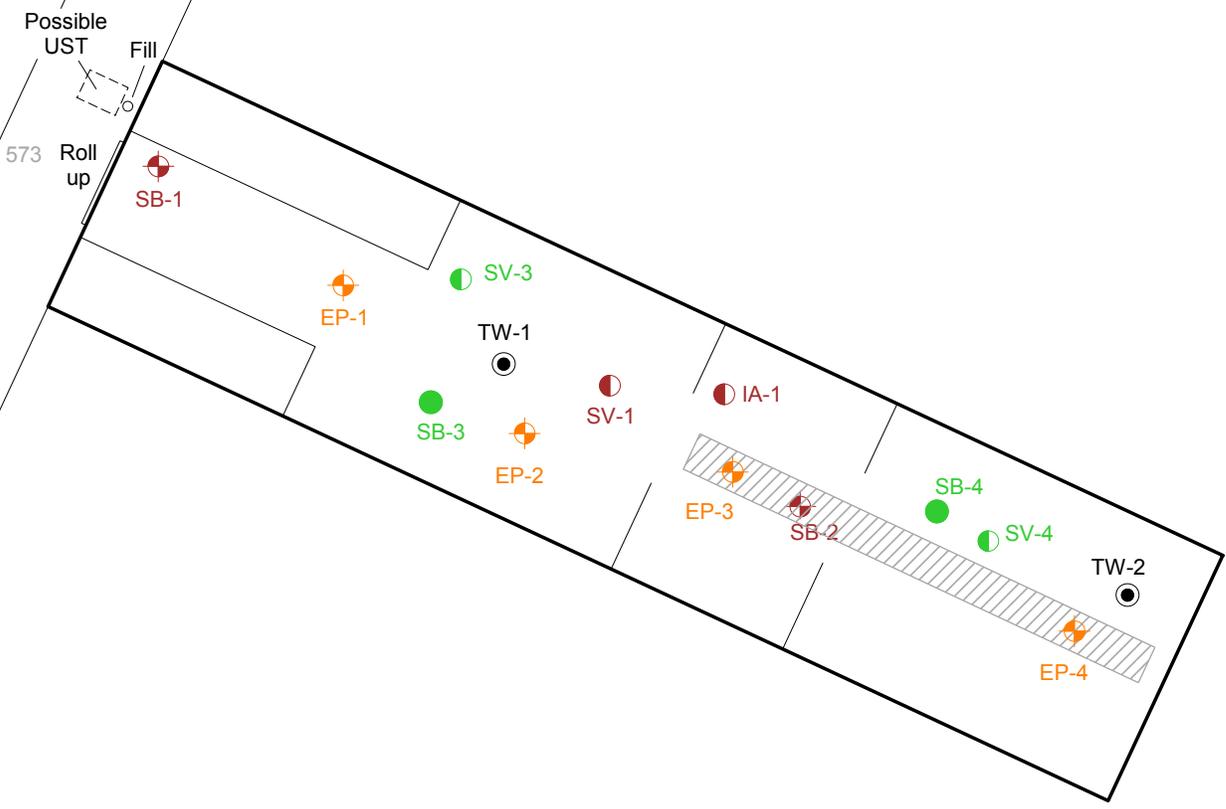
Legend	
 SV-1	Soil vapor point installed on September 25, 2012.
 SB-1	Soil boring installed on September 25, 2012.
 IA-1	Indoor air sampled on September 25, 2012.
 SB-3	Soil boring installed on June 20, 2013.
 SV-2	Soil vapor point installed on June 20, 2013.
 TW-1	Proposed sampling point for temporary well. (Pending access and building demo.)



Excavation Areas	
	
960 S. Broadway, Suite 100, Hicksville, New York 11801 Tel: 516-933-0655 Fax: 516-933-0659	
Project No.: 7115-BKNY	Figure No.: 4
Date: 06/23/2013	Scale: Not To Scale

**Figure 5:
Map of Endpoint Sample Locations**

4TH AVENUE



Legend	
	SV-1 Soil vapor point installed on September 25, 2012.
	SB-1 Soil boring installed on September 25, 2012.
	IA-1 Indoor air sampled on September 25, 2012.
	SB-3 Soil boring installed on June 20, 2013.
	SV-2 Soil vapor point installed on June 20, 2013.
	TW-1 Proposed sampling point for temporary well. (Pending access and building demo.)
	EP-1 Proposed sampling point for endpoint soil samples. (Pending Excavation area)



Endpoint Sampling Diagram



Advanced Cleanup Technologies, Inc.
ENVIRONMENTAL CONSULTANTS

960 S. Broadway, Suite 100, Hicksville, New York 11801
Tel: 516-933-0655 Fax: 516-933-0659

Project No.: 7115-BKNY	Figure No.: 5
Date: 10/08/2013	Scale: Not To Scale

Figure 6:
Sub-slab depressurization design diagram

**Figure 7:
Vapor barrier specifications**

Herculine^{Sigma} Smooth HDPE Product Specifications

Properties	Test Method	Minimum Average Values				
		12 mil	20 mil	30 mil	40 mil	60 mil
Thickness*, mil		12	20	30	40	60
Lowest individual reading	ASTM D 5199	10	18	27	36	54
Density, g/cm ³	ASTM D 1505	.940	.940	.940	.940	.940
Tensile Properties (Each Direction)	ASTM D 6693, Type IV					
Strength at Break, lb/in width (N/mm)		42 (7)	76 (13)	114 (20)	152 (27)	228 (40)
Strength at Yield, lb/in width (N/mm)		23 (4)	42 (7)	63 (11)	84 (15)	126 (22)
Elongation at Break, %		700	700	700	700	700
Elongation at Yield, %		12	12	12	12	12
Tear Resistance, lb. (N)	ASTM D 1004	7 (33)	13 (59)	21 (93)	28 (125)	42 (187)
Puncture Resistance, lb. (N)	ASTM D 4833	19 (86)	34 (152)	54 (240)	72 (320)	108 (480)
Carbon Black Content, % (minimum)	ASTM D 1603	2.0	2.0	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	Note ⁽¹⁾	Note ⁽¹⁾	Note ⁽¹⁾	Note ⁽¹⁾	Note ⁽¹⁾

⁽¹⁾ 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.

*Custom material thicknesses also available.

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Tables

Table 1
Volatile Organic Compounds in Soil (ug/kg)
EPA Method 8260
573 4th Avenue
Brooklyn, NY
ACT Project No.: 7115-BKNY

Sample ID Sample Date	UUSCO ¹	Standard RRSCO ²	CSCO ³	SB-1 (0-2') 9/25/12	SB-1 (10-12') 9/25/12	SB-2 (0-2') 9/25/12	SB-2 (10-12') 9/25/12
1,1,1-Trichloroethane	680	100,000	500,000	<2.4	<2.3	<2.3	<2.5
1,1,2,2-Tetrachloroethane	NS	NS	NS	<2.4	<2.3	<2.3	<2.5
1,1,2-Trichloro-1,2,2-trifluoroethane	NS	NS	NS	<2.4	<2.3	<2.3	<2.5
1,1,2-Trichloroethane	NS	NS	NS	<2.4	<2.3	<2.3	<2.5
1,1-Dichloroethane	270	26,000	240,000	<2.4	<2.3	<2.3	<2.5
1,1-Dichloroethene	330	100,000	500,000	<2.4	<2.3	<2.3	<2.5
1,2,4-Trichlorobenzene	NS	NS	NS	<2.4	<2.3	<2.3	<2.5
1,2-Dibromo-3-chloropropane	NS	NS	NS	<2.4	<2.3	<2.3	<2.5
1,2-Dibromoethane	NS	NS	NS	<2.4	<2.3	<2.3	<2.5
1,2-Dichlorobenzene	1,100	100,000	500,000	<2.4	<2.3	<2.3	<2.5
1,2-Dichloroethane	20	3,100	30,000	<2.4	<2.3	<2.3	<2.5
1,2-Dichloropropane	NS	NS	NS	<2.4	<2.3	<2.3	<2.5
1,3-Dichlorobenzene	2,400	49,000	280,000	<2.4	<2.3	<2.3	<2.5
1,4-Dichlorobenzene	1,800	13,000	130,000	<2.4	<2.3	<2.3	<2.5
2-Butanone	120	100,000	500,000	<6.0	<5.8	<5.8	<6.2
2-Hexanone	NS	NS	NS	<6.0	<5.8	<5.8	<6.2
4-Methyl-2-pentanone	NS	NS	NS	<6.0	<5.8	<5.8	<6.2
Acetone	50	100,000	500,000	23.0	<5.8	<5.8	<6.2
Benzene	60	4,800	44,000	<2.4	<2.3	<2.3	<2.5
Bromodichloromethane	NS	NS	NS	<2.4	<2.3	<2.3	<2.5
Bromoform	NS	NS	NS	<2.4	<2.3	<2.3	<2.5
Bromomethane	NS	NS	NS	<2.4	<2.3	<2.3	<2.5
Carbon disulfide	NS	NS	NS	<2.4	<2.3	<2.3	<2.5
Carbon tetrachloride	760	2,400	22,000	<2.4	<2.3	<2.3	<2.5
Chlorobenzene	1,100	100,000	500,000	<2.4	<2.3	<2.3	<2.5
Chloroethane	NS	NS	NS	<2.4	<2.3	<2.3	<2.5
Chloroform	370	49,000	350,000	<2.4	<2.3	<2.3	<2.5
Chloromethane	NS	NS	NS	<2.4	<2.3	<2.3	<2.5
cis-1,2-Dichloroethene	250	100,000	500,000	1.7	<2.3	<2.3	<2.5
cis-1,3-Dichloropropene	NS	NS	NS	<2.4	<2.3	<2.3	<2.5
Cyclohexane	NS	NS	NS	NA	NA	NA	NA
Dibromochloromethane	NS	NS	NS	<2.4	<2.3	<2.3	<2.5
Dichlorodifluoromethane	NS	NS	NS	<2.4	<2.3	<2.3	<2.5
Ethylbenzene	1,000	41,000	390,000	<2.4	<2.3	<2.3	<2.5
Isopropylbenzene	NS	NS	NS	<2.4	<2.3	<2.3	<2.5
Methyl Acetate	NS	NS	NS	<2.4	<2.3	<2.3	<2.5
Methyl tert-butyl ether	930	100,000	500,000	<2.4	<2.3	<2.3	<2.5
Methylcyclohexane	NS	NS	NS	NA	NA	NA	NA
Methylene chloride	50	100,000	500,000	16.0	6.3	7.7	6.0
Styrene	NS	NS	NS	<2.4	<2.3	<2.3	<2.5
Tetrachloroethene	1,300	19,000	150,000	14.0	1.9	5.4	<2.5
Toluene	700	100,000	500,000	<2.4	<2.3	<2.3	<2.5
trans-1,2-Dichloroethene	NS	NS	NS	<2.4	<2.3	<2.3	<2.5
trans-1,3-Dichloropropene	NS	NS	NS	<2.4	<2.3	<2.3	<2.5
Trichloroethene	470	21,000	200,000	1.4	<2.3	0.40	<2.5
Trichlorofluoromethane	NS	NS	NS	<2.4	<2.3	<2.3	<2.5
Vinyl chloride	20	900	13,000	<2.4	<2.3	<2.3	<2.5
Xylenes (Total)	260	100,000	500,000	<7.2	<6.9	<6.9	<7.4

¹ Unrestricted Use Soil Cleanup Objectives, Table 375-6.8(a), 6 NYCRR 375, NYSDEC 2006
² Restricted Residential Soil Cleanup Objectives, Table 375-6.8(b), 6 NYCRR 375, NYSDEC 2006
³ Commercial Soil Cleanup Objectives, Table 375-6.8(b), 6 NYCRR 375, NYSDEC 2006
 Bolded values signify detection above method detection limit
 NA = Not Analyzed
 NS = No Standard

Table 1 continued.

Volatile Organic Compounds in Soil (ug/kg)
EPA Method 8260
573 4th Avenue
Brooklyn, NY

ACT Project No.: 7115-BKNY

Sample ID Sample Date	UUSCO ¹	Standard RRSCO ²	CSCO ³	SB-3 (0-2') 6/20/13	SB-3 (8-10') 6/20/13	SB-4 (0-2') 6/20/13	SB-4 (3-5') 6/20/13
1,1,1-Trichloroethane	680	100,000	500,000	<13	<11	<11	<11
1,1,2,2-Tetrachloroethane	NS	NS	NS	<13	<11	<11	<11
1,1,2-Trichloro-1,2,2-trifluoroethane	NS	NS	NS	<13	<11	<11	<11
1,1,2-Trichloroethane	NS	NS	NS	<13	<11	<11	<11
1,1-Dichloroethane	270	26,000	240,000	<13	<11	<11	<11
1,1-Dichloroethene	330	100,000	500,000	<13	<11	<11	<11
1,2,4-Trichlorobenzene	NS	NS	NS	<13	<11	<11	<11
1,2-Dibromo-3-chloropropane	NS	NS	NS	<13	<11	<11	<11
1,2-Dibromoethane	NS	NS	NS	<13	<11	<11	<11
1,2-Dichlorobenzene	1,100	100,000	500,000	<13	<11	<11	<11
1,2-Dichloroethane	20	3,100	30,000	<13	<11	<11	<11
1,2-Dichloropropane	NS	NS	NS	<13	<11	<11	<11
1,3-Dichlorobenzene	2,400	49,000	280,000	<13	<11	<11	<11
1,4-Dichlorobenzene	1,800	13,000	130,000	<13	<11	<11	<11
2-Butanone	120	100,000	500,000	<13	<11	<11	<11
2-Hexanone	NS	NS	NS	<13	<11	<11	<11
4-Methyl-2-pentanone	NS	NS	NS	<13	<11	<11	<11
Acetone	50	100,000	500,000	<13	<11	<11	<11
Benzene	60	4,800	44,000	<13	<11	<11	<11
Bromodichloromethane	NS	NS	NS	<13	<11	<11	<11
Bromoform	NS	NS	NS	<13	<11	<11	<11
Bromomethane	NS	NS	NS	<13	<11	<11	<11
Carbon disulfide	NS	NS	NS	<13	<11	<11	<11
Carbon tetrachloride	760	2,400	22,000	<13	<11	<11	<11
Chlorobenzene	1,100	100,000	500,000	<13	<11	<11	<11
Chloroethane	NS	NS	NS	<13	<11	<11	<11
Chloroform	370	49,000	350,000	<13	<11	<11	<11
Chloromethane	NS	NS	NS	<13	<11	<11	<11
cis-1,2-Dichloroethene	250	100,000	500,000	<13	<11	<11	<11
cis-1,3-Dichloropropene	NS	NS	NS	<13	<11	<11	<11
Cyclohexane	NS	NS	NS	<13	<11	<11	<11
Dibromochloromethane	NS	NS	NS	<13	<11	<11	<11
Dichlorodifluoromethane	NS	NS	NS	<13	<11	<11	<11
Ethylbenzene	1,000	41,000	390,000	<13	<11	<11	<11
Isopropylbenzene	NS	NS	NS	<13	<11	<11	<11
Methyl Acetate	NS	NS	NS	<13	<11	<11	<11
Methyl tert-butyl ether	930	100,000	500,000	<13	<11	<11	<11
Methylcyclohexane	NS	NS	NS	<13	<11	<11	<11
Methylene chloride	50	100,000	500,000	<13	<11	<11	<11
Styrene	NS	NS	NS	<13	<11	<11	<11
Tetrachloroethene	1,300	19,000	150,000	<13	<11	<11	<11
Toluene	700	100,000	500,000	<13	<11	<11	<11
trans-1,2-Dichloroethene	NS	NS	NS	<13	<11	<11	<11
trans-1,3-Dichloropropene	NS	NS	NS	<13	<11	<11	<11
Trichloroethene	470	21,000	200,000	<13	<11	<11	<11
Trichlorofluoromethane	NS	NS	NS	<13	<11	<11	<11
Vinyl chloride	20	900	13,000	<13	<11	<11	<11
Xylenes (Total)	260	100,000	500,000	<13	<11	<11	<11

¹ Unrestricted Use Soil Cleanup Objectives, Table 375-6.8(a), 6 NYCRR 375, NYSDEC 2006² Restricted Residential Soil Cleanup Objectives, Table 375-6.8(b), 6 NYCRR 375, NYSDEC 2006³ Commercial Soil Cleanup Objectives, Table 375-6.8(b), 6 NYCRR 375, NYSDEC 2006

Bolded values signify detection above method detection limit

NA = Not Analyzed

NS = No Standard

Table 2
Semi Volatile Organic Compounds in Soil (ug/kg)
EPA Method 8270
573 4th Avenue
Brooklyn, NY

ACT Project No.: 7115-BKNY

Sample ID Sample Date	UUSCO ¹	Standard RRSCO ²	CSCO ³	SB-1 (0-2') 9/25/12	SB-1 (10-12') 9/25/12	SB-2 (0-2') 9/25/12	SB-2 (10-12') 9/25/12
1,1'-Biphenyl	NS	NS	NS	NA	NA	NA	NA
2,2'-oxybis(1-chloropropane)	NS	NS	NS	NA	NA	NA	NA
2,4,5-Trichlorophenol	NS	NS	NS	<290	<280	<290	<310
2,4,6-Trichlorophenol	NS	NS	NS	<290	<280	<290	<310
2,4-Dichlorophenol	NS	NS	NS	<290	<280	<290	<310
2,4-Dimethylphenol	NS	NS	NS	<290	<280	<290	<310
2,4-Dinitrophenol	NS	NS	NS	<290	<280	<290	<310
2,4-Dinitrotoluene	NS	NS	NS	<290	<280	<290	<310
2,6-Dinitrotoluene	NS	NS	NS	<290	<280	<290	<310
2-Chloronaphthalene	NS	NS	NS	<290	<280	<290	<310
2-Chlorophenol	NS	NS	NS	<290	<280	<290	<310
2-Methylnaphthalene	NS	NS	NS	<290	<280	<290	<310
2-Methylphenol	330	100,000	500,000	<290	<280	<290	<310
2-Nitroaniline	NS	NS	NS	<290	<280	<290	<310
2-Nitrophenol	NS	NS	NS	<290	<280	<290	<310
3,3'-Dichlorobenzidine	NS	NS	NS	<290	<280	<290	<310
3-Nitroaniline	NS	NS	NS	<290	<280	<290	<310
4,6-Dinitro-2-methylphenol	NS	NS	NS	<290	<280	<290	<310
4-Bromophenyl-phenylether	NS	NS	NS	<290	<280	<290	<310
4-Chloro-3-methylphenol	NS	NS	NS	<290	<280	<290	<310
4-Chloroaniline	NS	NS	NS	<290	<280	<290	<310
4-Chlorophenyl phenyl ether	NS	NS	NS	<290	<280	<290	<310
4-Methylphenol	NS	NS	NS	NA	NA	NA	NA
4-Nitroaniline	NS	NS	NS	<290	<280	<290	<310
4-Nitrophenol	NS	NS	NS	<290	<280	<290	<310
Acenaphthene	20,000	100,000	500,000	<290	<280	95.0	<310
Acenaphthylene	100,000	100,000	500,000	<290	<280	34.0	<310
Acetophenone	NS	NS	NS	<290	<280	<290	<310
Anthracene	100,000	100,000	500,000	44.0	<280	270	<310
Atrazine	NS	NS	NS	<290	<280	<290	<310
Benzaldehyde	NS	NS	NS	<290	<280	<290	<310
Benzo(a)anthracene	1,000	1,000	5,600	170	<280	670	<310
Benzo(a)pyrene	1,000	1,000	1,000	170	<280	560	<310
Benzo(b)fluoranthene	1,000	1,000	5,600	150	<280	480	<310
Benzo(g,h,i)perylene	100,000	100,000	500,000	100	<280	370	<310
Benzo(k)fluoranthene	800	3,900	56,000	130	<280	510	<310
Bis(2-chloroethoxy)methane	NS	NS	NS	<290	<280	<290	<310
Bis(2-chloroethyl)ether	NS	NS	NS	<290	<280	<290	<310
Bis(2-ethylhexyl)phthalate	NS	NS	NS	400	120	180	150
Butyl benzyl phthalate	NS	NS	NS	52.0	<280	<290	<310
Caprolactam	NS	NS	NS	<290	<280	<290	<310
Carbazole	NS	NS	NS	<290	<280	75.0	<310
Chrysene	1,000	3,900	56,000	230	<280	690	<310
Dibenzo(a,h)anthracene	330	330	560	37.0	<280	<290	<310
Dibenzofuran	NS	NS	NS	<290	<280	54.0	<310
Diethyl phthalate	NS	NS	NS	<290	<280	<290	<310
Dimethyl phthalate	NS	NS	NS	<290	<280	<290	<310
Di-n-butyl phthalate	NS	NS	NS	780	480	640	740
Di-n-octyl phthalate	NS	NS	NS	<290	<280	<290	<310
Fluoranthene	100,000	100,000	500,000	330	<280	1,900	33.0
Fluorene	30,000	100,000	500,000	<290	<280	93.0	<310
Hexachlorobenzene	NS	NS	NS	<290	<280	<290	<310
Hexachlorobutadiene	NS	NS	NS	<290	<280	<290	<310
Hexachlorocyclopentadiene	NS	NS	NS	<290	<280	<290	<310
Hexachloroethane	NS	NS	NS	<290	<280	<290	<310
Indeno(1,2,3-c,d)pyrene	500	500	5,600	100	<280	400	<310
Isophorone	NS	NS	NS	<290	<280	<290	<310
Naphthalene	12,000	100,000	500,000	<290	<280	<290	<310
Nitrobenzene	NS	NS	NS	<290	<280	<290	<310
N-Nitrosodi-n-propylamine	NS	NS	NS	<290	<280	<290	<310
N-Nitrosodiphenylamine	NS	NS	NS	<290	<280	<290	<310
Pentachlorophenol	800	6,700	6,700	<290	<280	<290	<310
Phenanthrene	100,000	100,000	500,000	220	<280	1,500	<310
Phenol	330	100,000	500,000	<290	<280	<290	<310
Pyrene	100,000	100,000	500,000	310	<280	1,500	<310

¹ Unrestricted Use Soil Cleanup Objectives, Table 375-6.8(a), 6 NYCRR 375, NYSDEC 2006

² Restricted Residential Soil Cleanup Objectives, Table 375-6.8(b), 6 NYCRR 375, NYSDEC 2006

³ Commercial Soil Cleanup Objectives, Table 375-6.8(b), 6 NYCRR 375, NYSDEC 2006

Bolded values signify detection above method detection limit

Highlighted values signify exceedance of regulatory guidance

NA = Not Analyzed

NS = No Standard

Table 2 continued.

Semi Volatile Organic Compounds in Soil (ug/kg)
EPA Method 8270
573 4th Avenue
Brooklyn, NY

ACT Project No.: 7115-BKNY

Sample ID Sample Date	UUSCO ¹	Standard RRSCO ²	CSCO ³	SB-3 (0-2') 6/20/13	SB-3 (8-10') 6/20/13	SB-4 (0-2') 6/20/13	SB-4 (3-5') 6/20/13
1,1'-Biphenyl	NS	NS	NS	<380	<400	<370	<370
2,2'-oxybis(1-chloropropane)	NS	NS	NS	<380	<400	<370	<370
2,4,5-Trichlorophenol	NS	NS	NS	<960	<1,000	<920	<920
2,4,6-Trichlorophenol	NS	NS	NS	<380	<400	<370	<370
2,4-Dichlorophenol	NS	NS	NS	<380	<400	<370	<370
2,4-Dimethylphenol	NS	NS	NS	<380	<400	<370	<370
2,4-Dinitrophenol	NS	NS	NS	<960	<1,000	<920	<920
2,4-Dinitrotoluene	NS	NS	NS	<380	<400	<370	<370
2,6-Dinitrotoluene	NS	NS	NS	<380	<400	<370	<370
2-Chloronaphthalene	NS	NS	NS	<380	<400	<370	<370
2-Chlorophenol	NS	NS	NS	<380	<400	<370	<370
2-Methylnaphthalene	NS	NS	NS	<380	<400	<370	<370
2-Methylphenol	330	100,000	500,000	<380	<400	<370	<370
2-Nitroaniline	NS	NS	NS	<960	<1,000	<920	<920
2-Nitrophenol	NS	NS	NS	<380	<400	<370	<370
3,3'-Dichlorobenzidine	NS	NS	NS	<380	<400	<370	<370
3-Nitroaniline	NS	NS	NS	<380	<1,000	<370	<370
4,6-Dinitro-2-methylphenol	NS	NS	NS	<380	<1,000	<370	<370
4-Bromophenyl-phenylether	NS	NS	NS	<380	<400	<370	<370
4-Chloro-3-methylphenol	NS	NS	NS	<380	<400	<370	<370
4-Chloroaniline	NS	NS	NS	<380	<400	<370	<370
4-Chlorophenyl phenyl ether	NS	NS	NS	<380	<400	<370	<370
4-Methylphenol	NS	NS	NS	<380	<400	<370	<370
4-Nitroaniline	NS	NS	NS	<960	<1,000	<920	<920
4-Nitrophenol	NS	NS	NS	<960	<1,000	<920	<920
Acenaphthene	20,000	100,000	500,000	<380	<400	<370	<370
Acenaphthylene	100,000	100,000	500,000	<380	<400	<370	<370
Acetophenone	NS	NS	NS	<380	<400	<370	<370
Anthracene	100,000	100,000	500,000	<380	<400	<370	<370
Atrazine	NS	NS	NS	<380	<400	<370	<370
Benzaldehyde	NS	NS	NS	<380	<400	<370	<370
Benzo(a)anthracene	1,000	1,000	5,600	<380	<400	<370	<370
Benzo(a)pyrene	1,000	1,000	1,000	<380	<400	<370	<370
Benzo(b)fluoranthene	1,000	1,000	5,600	<380	<400	<370	<370
Benzo(g,h,i)perylene	100,000	100,000	500,000	<380	<400	<370	<370
Benzo(k)fluoranthene	800	3,900	56,000	<380	<400	<370	<370
Bis(2-chloroethoxy)methane	NS	NS	NS	<380	<400	<370	<370
Bis(2-chloroethyl)ether	NS	NS	NS	<380	<400	<370	<370
Bis(2-ethylhexyl)phthalate	NS	NS	NS	<380	<400	<370	<370
Butyl benzyl phthalate	NS	NS	NS	<380	<400	<370	<370
Caprolactam	NS	NS	NS	<380	<400	<370	<370
Carbazole	NS	NS	NS	<380	<400	<370	<370
Chrysene	1,000	3,900	56,000	<380	<400	<370	<370
Dibenzo(a,h)anthracene	330	330	560	<380	<400	<370	<370
Dibenzofuran	NS	NS	NS	<380	<400	<370	<370
Diethyl phthalate	NS	NS	NS	<380	<400	<370	<370
Dimethyl phthalate	NS	NS	NS	<380	<400	<370	<370
Di-n-butyl phthalate	NS	NS	NS	<380	<400	<370	<370
Di-n-octyl phthalate	NS	NS	NS	<380	<400	<370	<370
Fluoranthene	100,000	100,000	500,000	<380	<400	<370	<370
Fluorene	30,000	100,000	500,000	<380	<400	<370	<370
Hexachlorobenzene	NS	NS	NS	<380	<400	<370	<370
Hexachlorobutadiene	NS	NS	NS	<380	<400	<370	<370
Hexachlorocyclopentadiene	NS	NS	NS	<380	<400	<370	<370
Hexachloroethane	NS	NS	NS	<380	<400	<370	<370
Indeno(1,2,3-c,d)pyrene	500	500	5,600	<380	<400	<370	<370
Isophorone	NS	NS	NS	<380	<400	<370	<370
Naphthalene	12,000	100,000	500,000	<380	<400	<370	<370
Nitrobenzene	NS	NS	NS	<380	<400	<370	<370
N-Nitrosodi-n-propylamine	NS	NS	NS	<380	<400	<370	<370
N-Nitrosodiphenylamine	NS	NS	NS	<380	<400	<370	<370
Pentachlorophenol	800	6,700	6,700	<960	<1,000	<920	<920
Phenanthrene	100,000	100,000	500,000	<380	<400	<370	<370
Phenol	330	100,000	500,000	<380	<400	<370	<370
Pyrene	100,000	100,000	500,000	<380	<400	<370	<370

¹ Unrestricted Use Soil Cleanup Objectives, Table 375-6.8(a), 6 NYCRR 375, NYSDEC 2006

² Restricted Residential Soil Cleanup Objectives, Table 375-6.8(b), 6 NYCRR 375, NYSDEC 2006

³ Commercial Soil Cleanup Objectives, Table 375-6.8(b), 6 NYCRR 375, NYSDEC 2006

Bolded values signify detection above method detection limit

Highlighted values signify exceedance of regulatory guidance

NA = Not Analyzed

NS = No Standard

Table 3

Metals in Soil (mg/kg)
EPA Method 6010 and 7471
573 4th Avenue
Brooklyn, NY

ACT Project No.: 7115-BKNY

Sample ID Sample Date	UUSCO ¹	Standard RRSCO ²	CSCO ³	SB-1 (0-2')	SB-1 (10-12')	SB-2 (0-2')	SB-2 (10-12')
				9/25/12	9/25/12	9/25/12	9/25/12
Aluminum	NS	NS	NS	NA	NA	NA	NA
Antimony	NS	NS	NS	NA	NA	NA	NA
Arsenic	13	16	16	4.1	4.5	4.1	4.3
Barium	350	400	400	67.2	21.2	72.2	61.3
Beryllium	7.2	72	590	NA	NA	NA	NA
Cadmium	2.5	4.3	9.3	0.451	<0.458	2.4	<0.488
Calcium	NS	NS	NS	NA	NA	NA	NA
Chromium	30	180	1,500	10.5	8.62	21.5	19.0
Cobalt	NS	NS	NS	NA	NA	NA	NA
Copper	50	270	270	NA	NA	NA	NA
Iron	NS	NS	NS	NA	NA	NA	NA
Lead	63	400	1,000	34.9	7.49	2,360	28.6
Magnesium	NS	NS	NS	NA	NA	NA	NA
Manganese	1,600	2,000	10,000	NA	NA	NA	NA
Mercury	0.18	0.81	2.8	0.429	0.0349	2.67	0.232
Nickel	30	310	310	NA	NA	NA	NA
Potassium	NS	NS	NS	NA	NA	NA	NA
Selenium	3.9	180	1,500	0.329	<0.572	<0.569	<0.610
Silver	2	180	1,500	0.123	<0.458	0.723	<0.488
Sodium	NS	NS	NS	NA	NA	NA	NA
Thallium	NS	NS	NS	NA	NA	NA	NA
Vanadium	NS	NS	NS	NA	NA	NA	NA
Zinc	109	10,000	10,000	NA	NA	NA	NA

¹ Unrestricted Use Soil Cleanup Objectives, Table 375-6.8(a), 6 NYCRR 375, NYSDEC 2006

² Restricted Residential Soil Cleanup Objectives, Table 375-6.8(b), 6 NYCRR 375, NYSDEC 2006

³ Commercial Soil Cleanup Objectives, Table 375-6.8(b), 6 NYCRR 375, NYSDEC 2006

Bolded values signify detection above method detection limit

Highlighted values signify exceedance of regulatory guidance

NA = Not Analyzed

Table 3 continued.

Metals in Soil (mg/kg)
EPA Method 6010 and 7471
573 4th Avenue
Brooklyn, NY

ACT Project No.: 7115-BKNY

Sample ID Sample Date	UUSCO ¹	Standard RRSCO ²	CSCO ³	SB-3 (0-2')	SB-3 (8-10')	SB-4 (0-2')	SB-4 (3-5')
				6/20/13	6/20/13	6/20/13	6/20/13
Aluminum	NS	NS	NS	4,490	4,480	10,000	4,760
Antimony	NS	NS	NS	<6.93	<7.27	<6.66	<6.66
Arsenic	13	16	16	7.2	2.1	3.8	2.6
Barium	350	400	400	41.3	34.8	48.6	37.7
Beryllium	7.2	72	590	<0.58	<0.61	<0.55	<0.55
Cadmium	2.5	4.3	9.3	<0.58	<0.61	<0.55	<0.55
Calcium	NS	NS	NS	1,440	1,080	2,720	1,070
Chromium	30	180	1,500	15.2	14.1	17.7	15.9
Cobalt	NS	NS	NS	<5.78	<6.06	6.44	<5.55
Copper	50	270	270	12.7	10.2	9.1	9.2
Iron	NS	NS	NS	15,100	10,100	15,400	13,000
Lead	63	400	1,000	98.8	3.6	33.5	4.7
Magnesium	NS	NS	NS	1,760	1,850	2,020	1,900
Manganese	1,600	2,000	10,000	148	190	304	190
Mercury	0.18	0.81	2.8	0.44	<0.24	<0.22	<0.22
Nickel	30	310	310	11.3	11.6	10.3	8.8
Potassium	NS	NS	NS	1,050	1,110	1,020	1,160
Selenium	3.9	180	1,500	<0.58	<0.61	<0.55	<0.55
Silver	2	180	1,500	<1.16	<1.21	<1.11	<1.11
Sodium	NS	NS	NS	53.6	38.1	43.0	34.5
Thallium	NS	NS	NS	<1.16	<1.21	<1.11	<1.11
Vanadium	NS	NS	NS	26.3	19.1	20.9	24.1
Zinc	109	10,000	10,000	51.5	24.6	42.2	24.5

¹ Unrestricted Use Soil Cleanup Objectives, Table 375-6.8(a), 6 NYCRR 375, NYSDEC 2006

² Restricted Residential Soil Cleanup Objectives, Table 375-6.8(b), 6 NYCRR 375, NYSDEC 2006

³ Commercial Soil Cleanup Objectives, Table 375-6.8(b), 6 NYCRR 375, NYSDEC 2006

Bolded values signify detection above method detection limit

Highlighted values signify exceedance of regulatory guidance

NA = Not Analyzed

Table 4
PCBs and Pesticides in Soil (ug/kg)
EPA Method 8081/8082
573 4th Avenue
Brooklyn, NY
ACT Project No.: 7115-BKNY

Sample ID Sample Date	UUSCO ¹	Standard RRSCO ²	CSCO ³	SB-3 (0-2') 6/20/13	SB-3 (8-10') 6/20/13	SB-4 (0-2') 6/20/13	SB-4 (3-5') 6/20/13
4,4'-DDD	3.3	2,600	92,000	<3.8	<4.0	<11	<3.6
4,4'-DDE	3.3	1,800	62,000	<3.8	<4.0	<11	<3.6
4,4'-DDT	3.3	1,700	47,000	<3.8	<4.0	<11	<3.6
Aldrin	5	19	680	<2.0	<2.1	<5.6	<1.9
alpha-BHC	20	97	3,400	<2.0	<2.1	<5.6	<1.9
alpha-Chlordane	94	4,200	24,000	<2.0	<2.1	<5.6	<1.9
Aroclor 1016	100	1,000	1,000	<38	<40	<110	<36
Aroclor 1221	100	1,000	1,000	<77	<81	<220	<74
Aroclor 1232	100	1,000	1,000	<38	<40	<110	<36
Aroclor 1242	100	1,000	1,000	<38	<40	<110	<36
Aroclor 1248	100	1,000	1,000	<38	<40	<110	<36
Aroclor 1254	100	1,000	1,000	<38	<40	<110	<36
Aroclor 1260	100	1,000	1,000	<38	<40	<110	42
beta-BHC	36	72	3,000	<2.0	<2.1	<5.6	<1.9
delta-BHC	40	100,000	500,000	<2.0	<2.1	<5.6	<1.9
Dieldrin	5	39	1,400	<3.8	<4.0	<11	<3.6
Endosulfan I	2,400	4,800	200,000	<2.0	<2.1	<5.6	<1.9
Endosulfan II	2,400	4,800	200,000	<3.8	<4.0	<11	<3.6
Endosulfan sulfate	2,400	4,800	200,000	<3.8	<4.0	<11	<3.6
Endrin	14	2,200	89,000	<3.8	<4.0	<11	<3.6
Endrin aldehyde	NS	NS	NS	<3.8	<4.0	<11	<3.6
Endrin ketone	NS	NS	NS	<3.8	<4.0	<5.6	<3.6
gamma-BHC	100	280	9,200	<2.0	<2.1	<5.6	<1.9
gamma-Chlordane	NS	NS	NS	<2.0	<2.1	<5.6	<1.9
Heptachlor	42	420	15,000	<2.0	<2.1	<5.6	<1.9
Heptachlor epoxide	NS	NS	NS	<2.0	<2.1	<5.6	<1.9
Methoxychlor	NS	NS	NS	<20	<21	<56	<19
Toxaphene	NS	NS	NS	<200	<210	<560	<190

¹ Unrestricted Use Soil Cleanup Objectives, Table 375-6.8(a), 6 NYCRR 375, NYSDEC 2006

² Restricted Residential Soil Cleanup Objectives, Table 375-6.8(b), 6 NYCRR 375, NYSDEC 2006

³ Commercial Soil Cleanup Objectives, Table 375-6.8(b), 6 NYCRR 375, NYSDEC 2006

Bolded values signify detection above method detection limit

Highlighted values signify exceedance of regulatory standard

Table 5

Volatile Organic Compounds in Sub-Slab Vapor (ug/m3)
EPA Method TO-15
573 4th Avenue
Brooklyn, NY

ACT Project No.: 6533-JANY

Sample ID Sample Date	NYSDOH Guideline ¹	Background Value ²	IA-1 9/13/12	SV-1 (6") 9/13/12	SV-3 (4') 6/20/13	SV-4 (5') 6/20/13
1,1,1-Trichloroethane	NA	11	<1.09	<1.09	<1.09	<1.09
1,1,2,2-Tetrachloroethane	NA	NS	<1.37	<1.37	<1.37	<1.37
1,1,2-Trichloro-1,2,2-trifluoroethane	NA	NS	<0.766	<0.766	<0.77	<0.77
1,1,2-Trichloroethane	NA	<1.4	<1.09	<1.09	<1.09	<1.09
1,1-Dichloroethane	NA	<0.5	<0.809	<0.809	<0.81	<0.81
1,1-Dichloroethene	NA	<1.2	<0.793	<0.793	<0.79	<0.79
1,2,4-Trichlorobenzene	NA	<1.2	<1.48	<1.48	<1.48	<1.48
1,2,4-Trimethylbenzene	NA	5	11.2	29.2	10.3	9.5
1,2-Dibromoethane	NA	<1.4	<1.54	<1.54	<1.54	<1.54
1,2-Dichlorobenzene	NA	<1.0	<1.20	<1.20	<1.20	<1.20
1,2-Dichloroethane	NA	<0.7	<0.809	<0.809	<0.81	<0.81
1,2-Dichloroethene (cis)	NA	<1.2	<0.793	<0.793	<0.79	<0.79
1,2-Dichloroethene (trans)	NA	NS	<0.793	<0.793	<0.79	<0.79
1,2-Dichloropropane	NA	<1.6	<0.924	<0.924	<0.92	<0.92
1,2-Dichlorotetrafluoroethane	NA	NS	<1.40	<1.40	<1.40	<1.40
1,3,5-Trimethylbenzene	NA	<4.6	3.6	8.6	3.2	2.9
1,3-Butadiene	NA	<2.7	<0.442	<0.442	<0.44	<0.44
1,3-Dichlorobenzene	NA	<1.1	<1.20	<1.20	<1.20	<1.02
1,3-Dichloropropene (cis)	NA	<2.0	<0.908	<0.908	<0.91	<0.91
1,3-Dichloropropene (trans)	NA	<1.2	<0.908	<0.908	<0.91	<0.91
1,3-Hexachlorobutadiene	NA	NS	<2.13	<2.13	<2.13	<2.13
1,4-Dichlorobenzene	NA	1	<1.20	<1.20	<1.20	<1.2
1,4-Dioxane	NA	NS	<0.721	<0.721	<0.72	<0.72
2,2,4-Trimethylpentane	NA	NS	21.0	6.9	29.9	24.0
4-Ethyltoluene	NA	<3.1	2.9	7.4	3.1	2.8
Acetone	NA	60	<0.475	34.1	13.4	10.9
Benzene	NA	5	12.5	4.4	16.0	15.8
Bromodichloromethane	NA	NS	<1.34	<1.34	<1.34	<1.34
Bromoform	NA	NS	<2.07	<2.07	<2.07	<2.07
Bromomethane	NA	<1.1	<0.777	<0.777	<0.78	<0.78
Carbon disulfide	NA	2	<0.623	0.903	<0.62	<0.62
Carbon tetrachloride	NA	<1.1	<1.26	4.5	<1.26	<1.26
Chlorobenzene	NA	<0.8	<0.921	<0.921	<0.92	<0.92
Chloroethane	NA	<1.0	<0.528	<0.528	<0.53	<0.53
Chloroform	NA	<1.2	<0.977	1.1	1.1	<0.98
Chloromethane	NA	3	0.950	<0.413	1.1	1.1
Cyclohexane	NA	NS	4.5	2.68	6.3	5.1
Dibromochloromethane	NA	NS	<1.70	<1.70	<1.70	<1.70
Dichlorodifluoromethane	NA	11	2.3	2.0	2.4	2.4
Ethanol	NA	140	67.4	9.0	99.9	68.2
Ethyl acetate	NA	3	<0.721	<0.721	<0.72	<0.72
Ethylbenzene	NA	3	8.0	18.2	7.6	6.3
Isopropanol	NA	NS	2.2	1.3	2.5	1.6
Methyl butyl ketone	NA	NS	<0.819	<0.819	<0.82	<0.82
Methyl ethyl ketone	NA	8	2.5	9.8	3.0	2.5
Methyl isobutyl ketone	NA	3	<0.820	<0.820	<0.82	<0.82
Methyl tert-butyl ether	NA	<6.4	<0.721	<0.721	<0.72	<0.72
Methylene chloride	60	5	1.8	1.9	4.8	3.3
n-Heptane	NA	<1.6	7.9	11.0	10.6	8.0
n-Hexane	NA	6	13.8	9.2	17.7	13.0
Propylene	NA	NS	18.2	4.5	20.1	29.1
Styrene	NA	<2.3	3.5	0.980	1.5	1.6
tert-Butyl Alcohol	NA	NS	<0.606	3.0	6.0	6.6
Tetrachloroethene	100	6	<1.36	1,830	<1.36	<1.36
Tetrahydrofuran	NA	NS	<0.590	37.9	1.2	0.9
Toluene	NA	26	33.1	55.4	44.3	38.7
Trichloroethene	5	1.2	<1.07	2.3	<1.07	<1.07
Trichlorofluoromethane	NA	7	1.4	1.6	1.5	1.4
Vinyl acetate	NA	NS	<0.704	<0.704	<0.70	<0.70
Vinyl bromide	NA	NS	<0.874	<0.874	<0.87	<0.87
Vinyl chloride	NA	<1.0	<0.511	<0.511	<0.51	<0.51
Xylenes (m&p)	NA	12	25.8	68.1	26.4	21.4
Xylenes (o)	NA	4	10.2	25.6	9.4	8.1

¹ Table 3.1, NYSDOH "Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York", October 2006.² Background values are derived from EPA 2001 Building Assessment and Survey Evaluation (BASE) Database, 75th Percentile of

Bolted values signify detection above method detection limit

NA = Not Available

APPENDIX 1

CITIZEN PARTICIPATION PLAN

The NYC Office of Environmental Remediation and New Empire Builder Corp., have established this Citizen Participation Plan because the opportunity for citizen participation is an important component of the NYC Voluntary Cleanup Program. This Citizen Participation Plan describes how information about the project will be disseminated to the Community during the remedial process. As part of its obligations under the NYC VCP, New Empire Builder Corp. will maintain a repository for project documents and provide public notice at specified times throughout the remedial program. This Plan also takes into account potential environmental justice concerns in the community that surrounds the project Site. Under this Citizen Participation Plan, project documents and work plans are made available to the public in a timely manner. Public comment on work plans is strongly encouraged during public comment periods. Work plans are not approved by the NYC Office of Environmental Remediation (OER) until public comment periods have expired and all comments are formally reviewed. An explanation of cleanup plans in the form of a public meeting or informational session is available upon request to OER's project manager assigned to this Site, Zach Schreiber, who can be contacted about these issues or any others questions, comments or concerns that arise during the remedial process at (212) 788-8841

Project Contact List. OER has established a Site Contact List for this project to provide public notices in the form of fact sheets to interested members of the Community. Communications will include updates on important information relating to the progress of the cleanup program at the Site as well as to request public comments on the cleanup plan. The Project Contact List includes owners and occupants of adjacent buildings and homes, principal administrators of nearby schools, hospitals and day care centers, the public water supplier that serves the area, established document repositories, the representative Community Board, City Council members, other elected representatives and any local Brownfield Opportunity Area (BOA) grantee organizations. Any member of the public or organization will be added to the Site Contact List on request. A copy of the Site Contact List is maintained by OER's project

manager. If you would like to be added to the Project Contact List, contact NYC OER at (212) 788-8841 or by email at brownfields@cityhall.nyc.gov.

Repositories. A document repository is maintained in the nearest public library that maintains evening and weekend hours. This document repository is intended to house, for community review, all principal documents generated during the cleanup program including Remedial Investigation plans and reports, Remedial Action work plans and reports, and all public notices and fact sheets produced during the lifetime of the remedial project. New Empire Builder Corp. will inspect the repositories to ensure that they are fully populated with project information. The repository for this project is:

Park Slope Branch

Brooklyn Public Library

431 6th Ave. at 9th St.

Brooklyn, NY 11215

718-832-1853

Monday, Wednesday, Friday: 10:00 am – 9:00 pm

Tuesday, Thursday: 1:00 pm – 8:00 pm

Saturday: 10:00 am – 5:00 pm

Sunday: closed

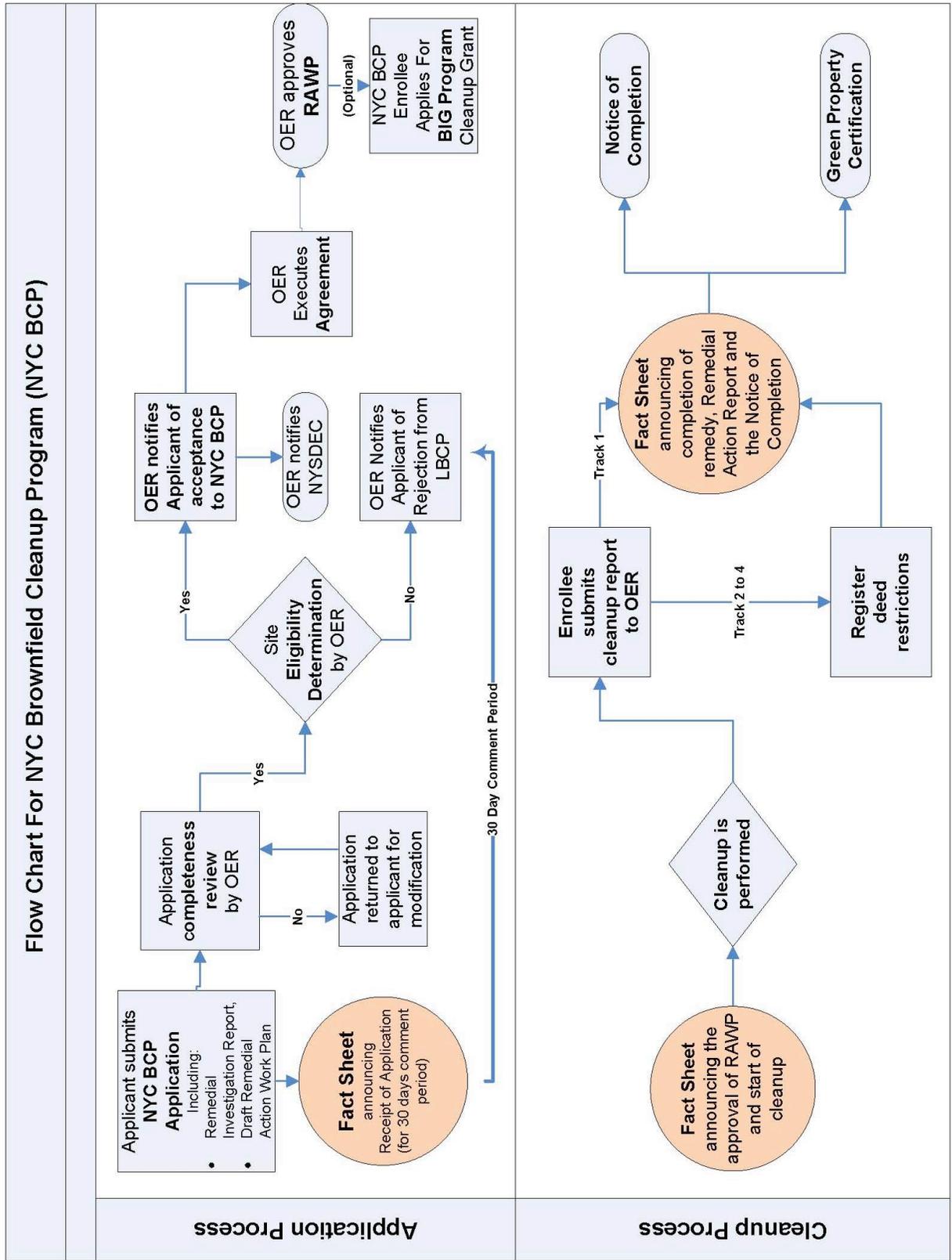
Digital Documentation. NYC OER strongly encourages the use of digital documents in repositories as a means of minimizing paper use while also increasing convenience in access and ease of use.

Identify Issues of Public Concern.

New Empire Builder Corp. is unaware of any specific issues of concern to stakeholders proximate to the Site. A major issue of concern to the public will be potential impacts of nuisance odors and dust during the disturbance of historic fill soils at the Site. This work will be performed in accordance with procedures, which will be specified under a detailed Remedial Program, which considers and takes preventive measures for exposures to future residents of the

property and those on adjacent properties during construction. Detailed plans to monitor the potential for exposure including a Construction Health and Safety Plan and a Community Air Monitoring Plan are required components of the remedial program. Implementation of these plans will be under the direct oversight of the New York City Office of Environmental Remediation (NYCOER).

Public Notice and Public Comment. Public notice to all members of the Project Contact List is required at three major steps during the performance of the cleanup program (listed below) and at other points that may be required by OER. Notices will include Fact Sheets with descriptive project summaries, updates on recent and upcoming project activities, repository information, and important phone and email contact information. All notices will be prepared by New Empire Builder Corp., reviewed and approved by OER prior to distribution and mailed by New Empire Builder Corp. Public comment is solicited in public notices for all work plans developed under the NYC Voluntary Cleanup Program. Final review of all work plans by OER will consider all public comments. Approval will not be granted until the public comment period has been completed.



Citizen Participation Milestones. Public notice and public comment activities occur at several

steps during a typical NYC VCP project. See flow chart on the following page, which identifies when during the NYC VCP public notices are issued: These steps include:

- **Public Notice of the availability of the Remedial Investigation Report and Remedial Action Work Plan and a 30-day public comment period on the Remedial Action Work Plan.**

Public notice in the form of a Fact Sheet is sent to all parties listed on the Site Contact List announcing the availability of the Remedial Investigation Report and Remedial Action Work Plan and the initiation of a 30-day public comment period on the Remedial Action Work Plan. The Fact Sheet summarizes the findings of the RIR and provides details of the RAWP. The public comment period will be extended an additional 15 days upon public request. A public meeting or informational session will be conducted by OER upon request.

- **Public Notice announcing the approval of the RAWP and the start of remediation**

Public notice in the form of a Fact Sheet is sent to all parties listed on the Site Contact List announcing the approval of the RAWP and the start of remediation.

- Public Notice announcing the completion of remediation, designation of Institutional and Engineering Controls and issuance of the Notice of Completion
- Public notice in the form of a Fact Sheet is sent to all parties listed on the Site Contact List announcing the completion of remediation, providing a list of all Institutional and Engineering Controls implemented for to the Site and announcing the issuance of the Notice of Completion.

APPENDIX 2

SUSTAINABILITY STATEMENT

This Sustainability Statement documents sustainable activities and green remediation efforts planned under this remedial action.

Reuse of Clean, Recyclable Materials. Reuse of clean, locally-derived recyclable materials reduces consumption of non-renewable virgin resources and can provide energy savings and greenhouse gas reduction.

An estimate of the quantity (in tons) of clean, non-virgin materials (reported by type of material) reused under this plan will be quantified and reported in the RAR.

Reduce Consumption of Virgin and Non-Renewable Resources. Reduced consumption of virgin and non-renewable resources lowers the overall environmental impact of the project on the region by conserving these resources.

An estimate of the quantity (in tons) of virgin and non-renewable resources, the use of which will be avoided under this plan, will be quantified and reported in the RAR.

Reduced Energy Consumption and Promotion of Greater Energy Efficiency. Reduced energy consumption lowers greenhouse gas emissions, improves local air quality, lessens in-city power generation requirements, can lower traffic congestion, and provides substantial cost savings.

Best efforts will be made to quantify energy efficiencies achieved during the remediation and will be reported in the Remedial Action Report (RAR). Where energy savings cannot be easily quantified, a gross indicator of the amount of energy saved or the means by which energy savings was achieved will be reported.

Conversion to Clean Fuels. Use of clean fuel improves NYC's air quality by reducing harmful emissions.

An estimate of the volume of clean fuels used during remedial activities will be quantified and reported in the RAR.

Recontamination Control. Recontamination after cleanup and redevelopment is completed undermines the value of work performed, may result in a property that is less protective of public health or the environment, and may necessitate additional cleanup work later or impede future redevelopment. Recontamination can arise from future releases that occur within the property or by influx of contamination from off-Site.

An estimate of the area of the Site that utilizes recontamination controls under this plan will be reported in the RAR in square feet.

Storm-water Retention. Storm-water retention improves water quality by lowering the rate of combined storm-water and sewer discharges to NYC's sewage treatment plants during periods of precipitation, and reduces the volume of untreated influent to local surface waters.

An estimate of the enhanced storm-water retention capability of the redevelopment project will be included in the RAR.

Linkage with Green Building. Green buildings provide a multitude of benefits to the city across a broad range of areas, such as reduction of energy consumption, conservation of resources, and reduction in toxic materials use.

The number of Green Buildings that are associated with this brownfield redevelopment property will be reported in the RAR. The total square footage of green building space created as a function of this brownfield redevelopment will be quantified for residential, commercial and industrial/manufacturing uses.

Paperless Brownfield Cleanup Program. New Empire Builder Corp. is participating in OER's Paperless Brownfield Cleanup Program. Under this program, submission of electronic documents will replace submission of hard copies for the review of project documents, communications and milestone reports.

Low-Energy Project Management Program. New Empire Builder Corp. is participating in OER's low-energy project management program. Under this program, whenever possible, meetings are held using remote communication technologies, such as videoconferencing and teleconferencing to reduce energy consumption and traffic congestion associated with personal transportation.

Trees and Plantings. Trees and other plantings provide habitat and add to NYC's environmental quality in a wide variety of ways. Native plant species and native habitat provide optimal support to local fauna, promote local biodiversity, and require less maintenance.

An estimate of the land area that will be vegetated, including the number of trees planted or preserved, will be reported in square feet in the RAR.

APPENDIX 3

SOIL/MATERIALS MANAGEMENT PLAN

1.1 SOIL SCREENING METHODS

Visual, olfactory and PID soil screening and assessment will be performed under the supervision of a Qualified Environmental Professional and will be reported in the RAR. Soil screening will be performed during invasive work performed during the remedy and development phases prior to issuance of the Notice of Completion.

1.2 STOCKPILE METHODS

Excavated soil from suspected areas of contamination (e.g., hot spots, USTs, drains, etc.) will be stockpiled separately and will be segregated from clean soil and construction materials. Stockpiles will be used only when necessary and will be removed as soon as practicable. While stockpiles are in place, they will be inspected daily, and before and after every storm event. Results of inspections will be recorded in a logbook and maintained at the Site and available for inspection by OER. Excavated soils will be stockpiled on, at minimum, double layers of 8-mil minimum sheeting, will be kept covered at all times with appropriately anchored plastic tarps, and will be routinely inspected. Broken or ripped tarps will be promptly replaced.

All stockpile activities will be compliant with applicable laws and regulations. Soil stockpile areas will be appropriately graded to control run-off in accordance with applicable laws and regulations. Stockpiles of excavated soils and other materials shall be located at least of 50 feet from the property boundaries, where possible. Hay bales or equivalent will surround soil stockpiles except for areas where access by equipment is required. Silt fencing and hay bales will be used as needed near catch basins, surface waters and other discharge points.

1.3 CHARACTERIZATION OF EXCAVATED MATERIALS

Soil/fill or other excavated media that is transported off-Site for disposal will be sampled in a manner required by the receiving facility, and in compliance with applicable laws and regulations. Soils proposed for reuse on-Site will be managed as defined in this plan.

1.4 MATERIALS EXCAVATION, LOAD-OUT AND DEPARTURE

The PE/QEP overseeing the remedial action will:

- oversee remedial work and the excavation and load-out of excavated material;
- ensure that there is a party responsible for the safe execution of invasive and other work performed under this work plan;
- ensure that Site development activities and development-related grading cuts will not interfere with, or otherwise impair or compromise the remedial activities proposed in this RAWP;
- ensure that the presence of utilities and easements on the Site has been investigated and that any identified risks from work proposed under this plan are properly addressed by appropriate parties;
- ensure that all loaded outbound trucks are inspected and cleaned if necessary before leaving the Site;
- ensure that all egress points for truck and equipment transport from the Site will be kept clean of Site-derived materials during Site remediation.

Locations where vehicles exit the Site shall be inspected daily for evidence of soil tracking off premises. Cleaning of the adjacent streets will be performed as needed to maintain a clean condition with respect to Site-derived materials.

Open and uncontrolled mechanical processing of historical fill and contaminated soil on-Site will not be performed without prior OER approval.

1.5 OFF-SITE MATERIALS TRANSPORT

Loaded vehicles leaving the Site will comply with all applicable materials transportation requirements (including appropriate covering, manifests, and placards) in accordance with applicable laws and regulations, including use of licensed haulers in accordance with 6 NYCRR Part 364. If loads contain wet material capable of causing leakage from trucks, truck liners will be used. Queuing of trucks will be performed on-Site, when possible in order to minimize off Site disturbance. Off-Site queuing will be minimized.

Outbound truck transport routes are likely to include 4th Avenue to 15th Street, taking the first left onto 3rd avenue to merge onto I-278W to I-95S. This routing takes into account the following factors: (a) limiting transport through residential areas and past sensitive sites; (b) use of mapped truck routes; (c) minimizing off-Site queuing of trucks entering the facility; (d) limiting total distance to major highways; (e) promoting safety in access to highways; and (f) overall safety in transport. To the extent possible, all trucks loaded with Site materials will travel from the Site using these truck routes. Trucks will not stop or idle in the neighborhood after leaving the project Site.

1.6 MATERIALS DISPOSAL OFF-SITE

The following documentation will be established and reported by the PE/QEP for each disposal destination used in this project to document that the disposal of regulated material exported from the Site conforms with applicable laws and regulations: (1) a letter from the PE/QEP or Enrollee to each disposal facility describing the material to be disposed and requesting written acceptance of the material. This letter will state that material to be disposed is regulated material generated at an environmental remediation Site in Brooklyn, New York under a governmental remediation program. The letter will provide the project identity and the name and phone number of the PE/QEP or Enrollee. The letter will include as an attachment a summary of all chemical data for the material being transported; and (2) a letter from each disposal facility stating it is in receipt of the correspondence (1, above) and is approved to accept the material. These documents will be included in the RAR.

The Remedial Action Report will include an itemized account of the destination of all material removed from the Site during this remedial action. Documentation associated with disposal of all material will include records and approvals for receipt of the material. This information will be presented in the RAR.

All impacted soil/fill or other waste excavated and removed from the Site will be managed as regulated material and will be disposed in accordance with applicable laws and regulations. Historic fill and contaminated soils taken off-Site will be handled as solid waste and will not be disposed at a Part 360-16 Registration Facility (also known as a Soil Recycling Facility).

Waste characterization will be performed for off-Site disposal in a manner required by the receiving facility and in conformance with its applicable permits. Waste characterization sampling and analytical methods, sampling frequency, analytical results and QA/QC will be reported in the RAR. A manifest system for off-Site transportation of exported materials will be employed. Manifest information will be reported in the RAR. Hazardous wastes derived from on-Site will be stored, transported, and disposed of in compliance with applicable laws and regulations.

1.7 MATERIALS REUSE ON-SITE

Soil and fill that is derived from the property that meets the soil cleanup objectives established in this plan may be reused on-Site. The soil cleanup objectives for on-Site reuse are listed in Table 1. ‘Reuse on-Site’ means material that is excavated during the remedy or development, does not leave the property, and is relocated within the same property and on comparable soil/fill material, and addressed pursuant to the NYC VCP agreement subject to Engineering and Institutional Controls. The PE/QEP will ensure that reused materials are segregated from other materials to be exported from the Site and that procedures defined for material reuse in this RAWP are followed. No material excavated from the Site will be reused on-site.

Organic matter (wood, roots, stumps, etc.) or other waste derived from clearing and grubbing of the Site will not be buried on-Site. Soil or fill excavated from the site for grading or other purposes will not be reused within a cover soil layer or within landscaping berms.

1.8 DEMARCATION

After completion of hotspot removal and any other invasive remedial activities, and prior to backfilling, the top of the residual soil/fill will be defined by one of three methods: (1) placement of a demarcation layer. The demarcation layer will consist of geosynthetic fencing or equivalent material to be placed on the surface of residual soil/fill to provide an observable reference layer. A description or map of the approximate depth of the demarcation layer will be provided in the SMP; or (2) a land survey of the top elevation of residual soil/fill before the placement of cover soils, pavement and associated sub-soils, or other materials or structures or, (3) all materials

beneath the approved cover will be considered impacted and subject to site management after the remedy is complete. Demarcation may be established by one or any combination of these three methods. As appropriate, a map showing the method of demarcation for the Site and all associated documentation will be presented in the RAR.

This demarcation will constitute the top of the site management horizon. Materials within this horizon require adherence to special conditions during future invasive activities as defined in the Site Management Plan.

1.9 IMPORT OF BACKFILL SOIL FROM OFF-SITE SOURCES

This Section presents the requirements for imported fill materials to be used below the cover layer and within the clean soil cover layer. All imported soils will meet OER-approved backfill and cover soil quality objectives for this Site. The backfill and cover soil quality objectives are listed in Table 1.

A process will be established to evaluate sources of backfill and cover soil to be imported to the Site, and will include an examination of source location, current and historical use(s), and any applicable documentation. Material from industrial sites, spill sites, environmental remediation sites or other potentially contaminated sites will not be imported to the Site.

The following potential sources may be used pending attainment of backfill and cover soil quality objectives:

- Clean soil from construction projects at non-industrial sites in compliance with applicable laws and regulations;
- Clean soil from roadway or other transportation-related projects in compliance with applicable laws and regulations;
- Clean recycled concrete aggregate (RCA) from facilities permitted or registered by the regulations of NYS DEC.

All materials received for import to the Site will be approved by a PE/QEP and will be in compliance with provisions in this RAWP. The RAR will report the source of the fill, evidence

that an inspection was performed on the source, chemical sampling results, frequency of testing, and a Site map indicating the locations where backfill or soil cover was placed.

Source Screening and Testing

Inspection of imported fill material will include visual, olfactory and PID screening for evidence of contamination. Materials imported to the Site will be subject to inspection, as follows:

- Trucks with imported fill material will be in compliance with applicable laws and regulations and will enter the Site at designated locations;
- The PE/QEP is responsible to ensure that every truck load of imported material is inspected for evidence of contamination; and
- Fill material will be free of solid waste including pavement materials, debris, stumps, roots, and other organic matter, as well as ashes, oil, perishables or foreign matter.

Composite samples of imported material will be taken at a minimum frequency of one sample for every 500 cubic yards of material. Once it is determined that the fill material meets imported backfill or cover soil chemical requirements and is non-hazardous, and lacks petroleum contamination, the material will be loaded onto trucks for delivery to the Site.

Recycled concrete aggregate (RCA) will be imported from facilities permitted or registered by NYSDEC. Facilities will be identified in the RAR. A PE/QEP is responsible to ensure that the facility is compliant with 6NYCRR Part 360 registration and permitting requirements for the period of acquisition of RCA. RCA imported from compliant facilities will not require additional testing, unless required by NYSDEC under its terms for operation of the facility. RCA imported to the Site must be derived from recognizable and uncontaminated concrete. RCA material is not acceptable for, and will not be used as cover material.

1.10 FLUIDS MANAGEMENT

All liquids to be removed from the Site, including dewatering fluids, will be handled, transported and disposed in accordance with applicable laws and regulations. Liquids discharged into the New York City sewer system will receive prior approval by New York City Department

of Environmental Protection (NYC DEP). The NYC DEP regulates discharges to the New York City sewers under Title 15, Rules of the City of New York Chapter 19. Discharge to the New York City sewer system will require an authorization and sampling data demonstrating that the groundwater meets the City's discharge criteria. The dewatering fluid will be pretreated as necessary to meet the NYC DEP discharge criteria. If discharge to the City sewer system is not appropriate, the dewatering fluids will be managed by transportation and disposal at an off-Site treatment facility.

Discharge of water generated during remedial construction to surface waters (i.e. a stream or river) is prohibited without a SPDES permit issued by New York State Department of Environmental Conservation.

1.11 STORM-WATER POLLUTION PREVENTION

Applicable laws and regulations pertaining to storm-water pollution prevention will be addressed during the remedial program. Erosion and sediment control measures identified in this RAWP (silt fences and barriers, and hay bale checks) will be installed around the entire perimeter of the remedial construction area and inspected once a week and after every storm event to ensure that they are operating appropriately. Discharge locations will be inspected to determine whether erosion control measures are effective in preventing significant impacts to receptors. Results of inspections will be recorded in a logbook and maintained at the Site and available for inspection by OER. All necessary repairs shall be made immediately. Accumulated sediments will be removed as required to keep the barrier and hay bale check functional. Undercutting or erosion of the silt fence toe anchor will be repaired immediately with appropriate backfill materials. Manufacturer's recommendations will be followed for replacing silt fencing damaged due to weathering.

1.12 CONTINGENCY PLAN

This contingency plan is developed for the remedial construction to address the discovery of unknown structures or contaminated media during excavation. Identification of unknown contamination source areas during invasive Site work will be promptly communicated to OER's Project Manager. Petroleum spills will be reported to the NYS DEC Spill Hotline. These findings

will be included in the daily report. If previously unidentified contaminant sources are found during on-Site remedial excavation or development-related excavation, sampling will be performed on contaminated source material and surrounding soils and reported to OER. Chemical analytical testing will be performed for TAL metals, TCL volatiles and semi-volatiles, TCL pesticides and PCBs, as appropriate.

1.13 ODOR, DUST AND NUISANCE CONTROL

Odor Control

All necessary means will be employed to prevent on- and off-Site odor nuisances. At a minimum, procedures will include: (a) limiting the area of open excavations; (b) shrouding open excavations with tarps and other covers; and (c) use of foams to cover exposed odorous soils. If odors develop and cannot otherwise be controlled, additional means to eliminate odor nuisances will include: (d) direct load-out of soils to trucks for off-Site disposal; and (e) use of chemical odorants in spray or misting systems.

This odor control plan is capable of controlling emissions of nuisance odors. If nuisance odors are identified, work will be halted and the source of odors will be identified and corrected. Work will not resume until all nuisance odors have been abated. OER will be notified of all odor complaint events. Implementation of all odor controls, including halt of work, will be the responsibility of the PE/QEP's certifying the Remedial Action Report.

Dust Control

Dust management during invasive on-Site work will include, at a minimum:

- Use of a dedicated water spray methodology for roads, excavation areas and stockpiles.
- Use of properly anchored tarps to cover stockpiles.
- Exercise extra care during dry and high-wind periods.
- Use of gravel or recycled concrete aggregate on egress and other roadways to provide a clean and dust-free road surface.

This dust control plan is capable of controlling emissions of dust. If nuisance dust emissions are identified, work will be halted and the source of dusts will be identified and corrected. Work will not resume until all nuisance dust emissions have been abated. OER will be notified of all dust complaint events. Implementation of all dust controls, including halt of work, will be the responsibility of the PE/QEP's responsible for certifying the Remedial Action Report.

Other Nuisances

Noise control will be exercised during the remedial program. All remedial work will conform, at a minimum, to NYC noise control standards.

Rodent control will be provided, during Site clearing and grubbing, and during the remedial program, as necessary, to prevent nuisances.

APPENDIX 4

HEALTH AND SAFETY PLAN



**CONSTRUCTION
HEALTH AND SAFETY PLAN**

**573 4th Avenue
Brooklyn, New York 11215
Block 1052, Lot 6
OER Project Number 13EH-N282K**

ACT File #: 7115-BKNY

September 16, 2013

Prepared for:

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1.0 INTRODUCTION

The construction of a 9-story mixed-use commercial and residential building is being proposed at the property located at 573 4th Avenue, Brooklyn, New York (“the Site”). This Construction Health and Safety Plan (CHASP) has been prepared to identify site-specific health and safety procedures to be followed by on-site contractors during remedial activities at the site. All activities performed under this CHASP are targeted to comply with Occupational Safety and Health Administration (OSHA) Regulations 29 CFR Part 1910, *et seq.*

1.1 Purpose

The purpose of this CHASP is to provide the contractors’ field personnel, and other visitors with an understanding of the potential chemical and physical hazards that exist or may arise while portions of this project are being performed. The primary objective is to ensure the well being of all field personnel and the community surrounding this site. A copy of this CHASP will be available to anyone that requests it. Visiting personnel (e.g. government officials, administrators, bank inspectors, assessors, etc.) that will have limited exposure to the site native soil/fill material during construction activities will be instructed on how to reduce the probability of exposure to site contaminants, but will not be required read the CHASP.

All on-site personnel shall familiarize themselves with the contents of this CHASP and the remedial activities planned for the site. Personnel choosing not to comply with this CHASP will be removed from the worksite.

1.2 Site Description

A diagram of the vicinity of the Site is provided as Figure 1 of the accompanying Work Plan. The site consists of a 2-story commercial and residential building. The building is currently vacant but the most recent use of the building was an auto repair shop on the first floor and apartments on the second floor. The Site is located in a commercial and residential area in the Gowanus section of Brooklyn in New York City. The Site is bounded by a 2-story residential building to the north, a 2-story commercial building to the south and light commercial buildings to the east and west.



1.3 Environmental Concerns

A *Phase I investigation* was conducted by Grant Engineering and completed in March 2012. The results of a review of fire insurance maps show the existing two-story building on the site was constructed in 1906 and was initially utilized as a blacksmith. The site is located in a commercial district and designated as C2-4/R8A. While the building is currently unoccupied the most recent use of the building was an auto repair shop on the first floor and residential living space on the second.

A Remedial Investigation Report was prepared by Advanced Cleanup Technologies and was dated August 2013. During the investigation, soil samples collected showed that no VOC's or SVOC's detected above regulatory standards in any of the samples. All of the samples contained trace levels of metals below standards. SB-2 (0-2') contained lead above CSCOs. SB- 3 (0-2') contained lead above UUSCOs but below RRSCO. Samples SB-1 (0-2'), SB-2 (10-12') and SB-3 (0-2') contained mercury above UUSCOs but below RRSCOs. SB-2 (0-2') contained mercury above RRSCOs but below CSCOs. The only sample to contain PCB's or Pesticides above method detection limits was SB-4 (3-5') with trace amounts of Aroclor 1260, below its UUSCO. Three soil vapor samples were collected during the RIR. One soil vapor sample, SV-1, contained Tetrachloroethene (PCE) was detected at a concentration of 1,830 ug/m³. Soil vapor samples collected during the RI showed that there were no compounds detected above standards in samples SV-3 and SV-4.

2.0 SITE PERSONNEL

All on-site personnel shall have training in accordance with the regulations codified at 29 CFR 1910.20. Proof that the qualifications of the on-site personnel comply with these regulations will be maintained by the Site Supervisor prior to their being allowed to be included in the on-Site workforce.

All on-site personnel shall familiarize themselves with the contents of the CHASP, the scope of the Remedial Action Work Plan (RAWP) for the Site and attend a daily site specific health and safety briefing prior to the commencement of work activities. Personnel choosing not to comply with this CHASP will be removed from the worksite.



ACT's Site Supervisor will have oversight responsibility over the project to ensure that this CHASP is properly implemented and that ACT and its subcontractors adhere to all OSHA regulations and other established industry health and safety practices.

Each contractor will designate an on-site individual responsible for health and safety issues relating to excavation and construction activities. Each contractor will communicate to the Site Supervisor the name of this individual and what specific actions are to be taken by each contractor during that work day that will be required to comply with the CHASP.

The Site Supervisor will coordinate the activities of all other contractors on-site so as not to jeopardize the health and safety of any personnel on-site. In addition, the Site Supervisor will continually monitor and inspect personnel and equipment for compliance with established safe work practices.

A list of the pertinent personnel authorized to supervise site health and safety operations is presented below:

Title	Name	Telephone Number
Site Supervisor ACT	Jeff Diamond	516-933-0655, Ext. 15 516-521-5627 (Mobile)
Project Manager ACT	Theresa Burkard	516-933-0655, Ext. 17 516-417-7660 (Mobile)
Health and Safety Officer ACT	Yisong Yang	516-933-0655, Ext. 15 718-508-2970 (Mobile)

3.0 PROTECTIVE EQUIPMENT

Personal Protective Equipment (PPE) is divided into the following four categories based on the degree of protection afforded:

Level A: This PPE level will be selected when the greatest level of skin, respiratory, and

eye protection is required. It includes positive pressure, full face-piece self-contained breathing apparatus (SCBA), or NIOSH-approved positive pressure supplied air respirator with escape SCBA and a totally-encapsulating chemical-protective suit.

Level B: This PPE level will be selected when the highest level of respiratory protection is necessary but a lesser level of skin protection is needed. It includes positive pressure, full face-piece SCBA, or NIOSH-approved positive pressure supplied air respirator with escape SCBA and hooded chemical-resistant clothing such as overalls and long-sleeved jacket, coveralls, one or two-piece chemical-splash suit or disposable chemical-resistant overalls.

Level C: This PPE level will be selected when the concentration(s) and type(s) of airborne substance(s) present in the work area is known and the criteria for using air purifying respirators are met. It includes full-face or half-mask, NIOSH-approved air purifying respirators and hooded chemical-resistant clothing such as overalls and long-sleeved jacket, coveralls, one or two-piece chemical-splash suit or disposable chemical-resistant overalls.

Level D: This PPE level will be selected for nuisance contamination only. It includes coveralls, gloves, chemical-resistant steel toe and shank boots, safety glasses or chemical splash goggles, hard hat, escape mask and face shield.

PPE shall be selected in accordance with the site air monitoring program (Section 5.3), OSHA 29 CFR 1910.120(c), (g), and 1910.132. Protective equipment shall be NIOSH-approved and respiratory protection shall conform to OSHA 29 CFR Part 1910.133 and 1910.134 specifications; head protection shall conform to 1910.135; eye and face protection shall conform to 1910.133; and foot protection shall conform to 1910.136. The only true difference among the levels of protection from D thru B is the addition of the type of respiratory protection.

Before site personnel are required to use any respirator with a negative or positive pressure tight-fitting face-piece, the personnel will be fit tested with the same make, model, style, and size of respirator that will be used. The fit test shall be administered using only an OSHA-accepted fit test



protocol. The OSHA-accepted fit test protocols and procedures provided for in 29 CFR 1910.120 are contained in Appendix B of this CHASP.

All Site workers will be required to participate in a comprehensive PPE program. The PPE program will consist of daily “Tailgate” Health and Safety meetings, proper inspection, donning, use, maintenance, storage and decontamination of protective clothing and equipment, use of protective equipment in temperature extremes and monitoring of co-workers and the work environment.

The Site Supervisor will determine the level of protection required for all field activities and whether the level of protection should be upgraded. It is anticipated that all on-site activities will be conducted in Level D PPE, unless otherwise upgraded by the Site Supervisor. Changes in the level of protection will be recorded in the dedicated site logbook along with the rationale for the changes.

4.0 HAZARD EVALUATION

4.1 Chemical Exposure

A list of chemicals including VOCs, SVOCs, metals, pesticides and PCBs that are present in subsurface soil at the Site is provided in Table 1. These types of contaminants at the detected concentrations represent a low to moderate potential for exposure. The standards listed in the table represent Immediate Danger to Life and Health (IDLH), Time-Weighted Average (TWA) and Short-Term Exposure Limit (STEL).

The primary routes of exposure for these chemicals are inhalation, ingestion and absorption through the skin and mucous membranes. The health risks associated with the exposure to these substances during construction activities will be minimized through a combination of education, personal protection equipment (PPE) and dust control measures.

4.2 Temperature Hazards

4.2.1 Heat Exposure Hazards

Heat stress may occur even in moderate temperature areas and may present any or all of the following:

Heat Rash

Heat rash results from continuous exposure to heat, humid air, and chafing clothes. Heat rash is uncomfortable and decreases the ability to tolerate heat.

Heat Cramps

Cramps result from the inadequate replacement of body electrolytes lost through perspiration. Signs include severe spasms and pain in the extremities and abdomen.

Heat Exhaustion

Exhaustion results from increased stress on the vital organs of the body in the effort to meet the body's cooling demands. Signs include shallow breathing; pale, cool, moist skin; profuse sweating; and dizziness.

Heat Stroke

Heat stroke results from an overworked cooling system. Heat stroke is the most serious form of heat stress. Body surfaces must be cooled and medical help must be obtained immediately to prevent severe injury and/or death. Signs include red, hot, dry skin, absence of perspiration, nausea, dizziness and confusion, strong, rapid pulse, coma, and death.

The following procedures should be followed to prevent or control heat stroke:

- A. Replace body fluids (water and electrolytes) lost through perspiration. Solutions may include a 0.1% salt and water solution or commercial mixes such as "Gatorade". Employees must be encouraged to drink more than the amount required in order to satisfy thirst.
- B. Use cooling devices to aid the natural body ventilation. Cooling occurs through evaporation of perspiration and limited body contact with heat-absorbing protective clothing. Utilize fans and air conditioners to assist in evaporation. Long, cotton underwear is suggested to absorb perspiration and limit any contact with heat-absorbing protective clothing (i.e., coated Tyvek suits).
- C. Provide shelter against heat and direct sunlight to protect personnel. Take breaks in

shaded areas.

- D. Rotate workers utilizing protective clothing during hot weather.
- E. Establish a work regime that will provide adequate rest periods, with personnel working in shifts.

4.2.2 Cold Exposure Hazards

Work schedules will be adjusted to provide sufficient rest periods in a heated area for warming up during operations conducted in cold weather. Also, thermal protective clothing such as wind and/or moisture resistant outerwear is recommended to be worn.

If work is performed continuously in the cold at or below -7°C (20°F), including wind chill factor, heated warming shelters (company vehicles, rest rooms, etc.) shall be made available nearby and the worker should be encouraged to use these shelters at regular intervals, the frequency depending on the severity of the environmental exposure. The onset of heavy shivering, frostnip, the feeling of excessive fatigue, drowsiness, irritability, or euphoria, are indications for immediate return to the shelter. When entering the heated shelter, the outer layer of clothing shall be removed and the remainder of the clothing loosened to permit sweat evaporation.

A change of dry work clothing shall be provided as necessary to prevent workers from returning to their work with wet clothing. Dehydration, or the loss of body fluids, occurs in the cold environment and may increase the susceptibility of the worker to cold injury due to a significant change in blood flow to the extremities. Warm sweet drinks and soups should be provided at the work site to provide caloric intake and fluid volume. The intake of coffee should be limited because of a diuretic and circulatory effect (adapted from TLV's and Biological Exposure Indices 1988-1989, ACGIH).

4.3 Fire Prevention

One portable fire extinguisher with a rating (ratio) of 20 pound A/B/C will be conspicuously and centrally located at the site. Portable extinguishers will be properly tagged with inspection dates and maintained in accordance with standard maintenance procedures for portable fire extinguishers. The following fire prevention guidelines are to be followed:

- Only approved safety cans will be used to transport and store flammable liquids.
- All gasoline and diesel-driven engines requiring refueling must be shut down and allowed to cool prior to filling.
- Smoking is not allowed during any operations within the work area in which petroleum products or solvents in free-floating, dissolved, or vapor forms, or other flammable liquids may be present.
- No open flame or spark is allowed in any area containing petroleum products or other flammable liquids.

4.4 Operation of Heavy Equipment

When operating or working around heavy equipment, the Site Supervisor will ensure that site personnel conform to this CHASP to include the wearing of proper clothing such as hard hats and safety glasses. Any specific health and safety issues relating to the equipment to be used on-site that work day will be covered in the daily health and safety briefing.

5.0 MANAGEMENT AND PLANNING

5.1 General Site Control

The Site Supervisor will establish a command post within the Site. A perimeter site fence, as required by the New York City Department of Buildings, will be erected to define the limits of the Site. All work must be performed within the site fence. Flagmen and traffic control will be provided as required at all times.

The Site will be left hazard-free at the end of each work day. In addition, all fence gates will be operable and locked in a closed position, all site fencing will be properly standing or braced and site lighting will be operational. The property owner will provide site security during off-work hours.

During site excavation, worker exposure to potential hazardous substances will be minimized through Health and Safety Communication (Section 5.2), Decontamination Procedures (Section 5.3)



and Dust Control Methods (Section 5.3).

5.2 Health and Safety Communication

The relatively small size of the work area makes normal verbal communication the primary mode of communication for the project. In the event that verbal communication is impossible the following hand signals will be used.

Gripping a partners wrist = “Leave area immediately”

Hands on top of head = “ I need assistance”

Thumbs up = “OK; I’m alright; I understand”

Thumbs down = “No; Negative”

Daily Health and Safety Meetings will address a list of tasks to be performed that day, the equipment and machinery involved, and any hazards identified with this type of activity. Workers will be given the opportunity to list out additional perceived hazards, and discuss safe work practices while in these operations. The daily safety meeting will also be an opportunity to review the work performed the previous day, any hazards encountered, mitigating actions taken, and suggestions for future improvement.

5.3 Air Monitoring

This section of the CHASP discusses air monitoring that will be performed to address community and site personnel concerns of possible exposures due to airborne migration of suspected contaminants that may be encountered during on-site field activities.

Periodic air monitoring will be performed for VOCs at the perimeter of the work area once every two hours during field activities. Continuous air monitoring will be performed for VOCs during all ground intrusive activities such as soil excavation, loading and offsite transport. All ambient air readings will be recorded and provided as an appendix in the P.E.-certified Remedial Closure Report.

5.3.1 Community Air Monitoring



Periodic air monitoring for VOCs at the perimeter of the work area will be accomplished as follows:

- VOCs will be monitored at the upwind perimeter of the work area at the start of each work day and periodically thereafter to establish background conditions. The monitoring will be performed utilizing a Photovac 2020 portable Photoionization Detector (PID) equipped with a 10.6 eV lamp capable of detecting the types of contaminants known or suspected to be present.
- VOCs will be monitored at the downwind perimeter of the work area daily at 2 hour intervals. If ambient air concentrations of total organic vapors at the downwind perimeter of the work area exceeds 5 parts per million (ppm) above background, work activities will be halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities will resume with continued monitoring.
- If total organic vapor levels at the downwind perimeter of the work area persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities will be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities will resume provided that the total organic vapor level 200 feet downwind of the work area or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less - but in no case less than 20 feet, is below 5 ppm over background for the 15 minute average.
- If the organic vapor level is above 25 ppm at the perimeter of the work area, activities will be shutdown.

5.3.2 Activity-Specific Air Monitoring

Continuous air monitoring will be conducted inside the work area for VOC levels during all ground-intrusive activities, such as soil excavation, loading and offsite transport in accordance with 29 CFR 1910.120(h). Continuous air monitoring will also be performed utilizing a Photovac 2020 PID. Continuous air monitoring will be performed in the following manner:

- Volatile organic compounds will be monitored inside the work area of construction and health and safety personnel on a continuous basis. The PID will be programmed to calculate 15-minute running average concentrations. If ambient air concentrations of total organic vapors inside the work area exceed 5 ppm above background, work activities will be halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities will resume with continued monitoring.
- If total organic vapor levels inside the work area persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities will be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities will resume provided that the total organic vapor level inside the work area or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less - but in no case less than 20 feet, is below 5 ppm over background for the 15 minute average.

5.4 Dust Control

Each contractor shall control any dust generated on-site that may be produced during work activities. Dust control measures will be employed to ensure that there is no off-site migration of dust into the community by use of a stream of water applied through a fine spray nozzle. The NYC hydrant used for a water source will be fitted with a RPZ control device to prevent inadvertent contamination of the public water supply. In addition, a solid barrier fence will be installed around the perimeter of the property to control any fugitive migration of dust.

5.5 Spill Control and Prevention

Spills associated with site activities may be attributed to project specific heavy equipment and include gasoline, diesel and hydraulic oil. In the event of a leak or a release, site personnel will inform their supervisor immediately, locate the source of spillage and stop the flow if it can be done safely. A spill containment kit including absorbent pads, booms and/or granulated speedy dry absorbent material will be available to site personnel to facilitate the immediate recovery of the spilled material.



Daily inspections of site equipment components including hydraulic lines, fuel tanks, etc. will be performed by their respective operators as a preventative measure for equipment leaks and to ensure equipment soundness. In the event of a spill, site personnel will immediately notify the NYSDEC (1-800-457-7362), and a spill number will be generated.

5.6 Decontamination Procedures

Contaminants will be removed from personnel and equipment through a decontamination regiment. Workers will be required to remove any contaminated PPE before leaving the Site. Work boots, safety glasses, hard hats and work gloves will be washed in a two percent Alconox Solution, followed by three consecutive clean water rinses. All wash and rinse water will be containerized into a DOT drum. Gross contaminants will be brushed from worker's clothing before leaving the Site. A station for hand washing will also be set up.

Decontamination of heavy equipment will also be required before leaving the Site. Excavator buckets and vehicle wheels or tracks will be brushed clean with a broom, before being moved off-site. Reusable hand tools will be washed in a two percent Alconox solution, followed by a series of clean water rinses. All wash and rinse water will be containerized in appropriate steel drums for proper disposal.

5.7 Soil Disposal

Any contaminated soil (organic or inorganic constituents) encountered during the remedial activities will be segregated, stockpiled on-site onto polyethylene sheeting, and covered with polyethylene sheeting to prevent exposure to workers and the community until proper transportation and disposal in accordance with all NYSDEC Regulations is arranged.

6.0 EMERGENCY MEDICAL CARE AND PROCEDURES

If a personnel accident occurs on-site requiring emergency care, immediate care will be administered appropriate to the injury in accordance with established Red Cross procedures and practices. In the event of serious injury to on-site personnel, the Emergency Medical Service of the



City of New York (EMS) will be summoned to remove the injured individual to the nearest medical facility for treatment as follows.

Ambulance:	911
Emergency Medical:	911
Fire Department:	911
Brooklyn Hospital Center:	(718) 250-8000
Police Department:	911
Poison Control Center:	(516) 542-2323

The nearest emergency medical facility is the Brooklyn Hospital Center, 121 Dekalb Avenue, Brooklyn, New York, which is located 2.2 miles from the site. A map of the route to this hospital is attached. The directions to this medical facility from the Site are as follows:

- **Go northeast on 4th Avenue towards 16th Street;**
- **Turn right on Pacific Street;**
- **Sharp left onto Flatbush Avenue;**
- **Turn right onto Lafayette Avenue;**
- **Sharp left onto Fulton Street;**
- **Take the 1st right onto Fort Greene Place;**
- **Turn left onto Dekalb Avenue;**
- **The Brooklyn Hospital Center is on the right;**

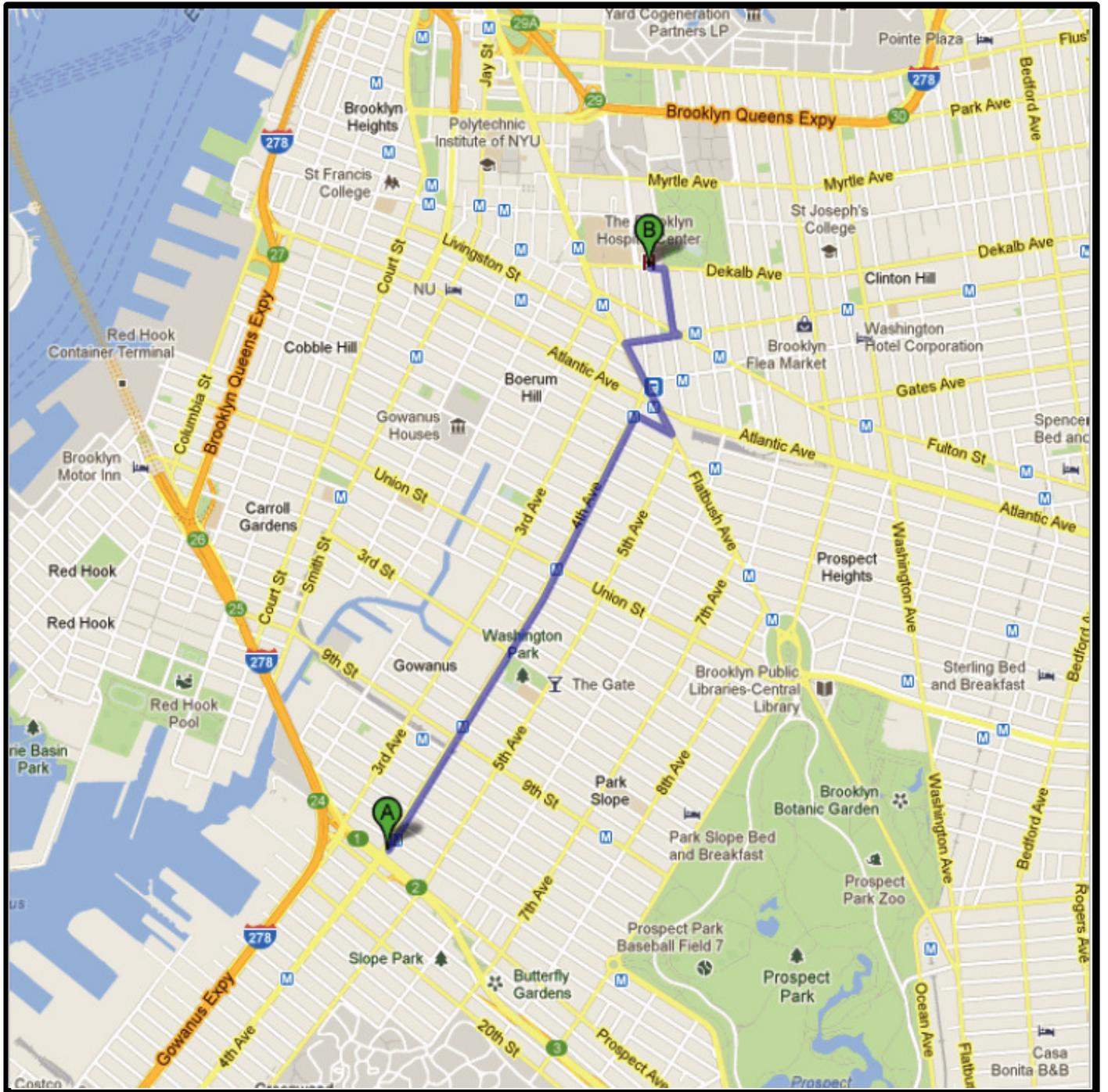
OSHA approved First Aid Kits will be maintained on-Site along with a First Aid blanket for treating shock, and will be readily accessible to all workers if an emergency occurs. The emergency signal for evacuation of personnel from the Site will be three (3) long blasts of a vehicle horn with the off-site rallying point designated as the corner of 35th Street and 8th Avenue. If in the event of a fire, explosion or other life-threatening incident on-site, the emergency signal above will be sounded and all personnel will evacuate the Site. The appropriate New York City emergency personnel (fire, police, etc.) will be immediately notified.



All injuries, no matter how slight, will be reported to the site safety supervisor immediately. The Site Supervisor will complete an accident report for all incidents. Some injuries, such as severe lacerations or burns, may require immediate treatment. Unless required due to immediate danger, seriously injured persons should not be moved without direction from attending medical personnel. The Site Supervisor will record occupational injuries and illnesses within 48 hours of occurrence, as required by statute.

Figure 1

Hospital Route



Hospital Route

Advanced Cleanup Technologies, Inc.
ENVIRONMENTAL CONSULTANTS

960 S. Broadway, Suite 100, Hicksville, New York 11801
 Tel: 516-933-0655 Fax: 516-933-0659

Project No.: 7115-BKNY	Figure No.: 1
Date: 5/31/13	Scale: 1 inch = 2000 feet

Appendix A
Chemical Safety Cards

International Chemical Safety Cards

BENZENE

ICSC: 0015



Cyclohexatriene
Benzol
C₆H₆
Molecular mass: 78.1

ICSC # 0015
CAS # 71-43-2
RTECS # CY1400000
UN # 1114
EC # 601-020-00-8
June 05, 2003 Validated



TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Highly flammable.	NO open flames, NO sparks, and NO smoking.	Powder, AFFF, foam, carbon dioxide.
EXPLOSION	Vapour/air mixtures are explosive. Risk of fire and explosion: see Chemical Dangers.	Closed system, ventilation, explosion-proof electrical equipment and lighting. Do NOT use compressed air for filling, discharging, or handling. Use non-sparking handtools. Prevent build-up of electrostatic charges (e.g., by grounding).	In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE		AVOID ALL CONTACT!	
•INHALATION	Dizziness. Drowsiness. Headache. Nausea. Shortness of breath. Convulsions. Unconsciousness.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Refer for medical attention.
•SKIN	MAY BE ABSORBED! Dry skin. Redness. Pain. (Further see Inhalation).	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse skin with plenty of water or shower. Refer for medical attention.
•EYES	Redness. Pain.	Face shield, or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
•INGESTION	Abdominal pain. Sore throat. Vomiting. (Further see Inhalation).	Do not eat, drink, or smoke during work.	Rinse mouth. Do NOT induce vomiting. Refer for medical attention.
SPILLAGE DISPOSAL		STORAGE	PACKAGING & LABELLING

Remove all ignition sources. Collect leaking and spilled liquid in sealable containers as far as possible. Absorb remaining liquid in sand or inert absorbent and remove to safe place. Do NOT wash away into sewer. Do NOT let this chemical enter the environment. Personal protection: complete protective clothing including self-contained breathing apparatus.	Fireproof. Separated from food and feedstuffs oxidants halogens	Do not transport with food and feedstuffs. Note: E F symbol T symbol R: 45-46-11-36/38-48/23/24/25-65 S: 53-45 UN Hazard Class: 3 UN Packing Group: II
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SEE IMPORTANT INFORMATION ON BACK

ICSC: 0015

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994. No modifications to the International version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

International Chemical Safety Cards

BENZENE

ICSC: 0015

I M P O R T A N T D A T A	<p>PHYSICAL STATE; APPEARANCE: COLOURLESS LIQUID, WITH CHARACTERISTIC ODOUR.</p>	<p>ROUTES OF EXPOSURE: The substance can be absorbed into the body by inhalation through the skin and by ingestion</p>
	<p>PHYSICAL DANGERS: The vapour is heavier than air and may travel along the ground; distant ignition possible. As a result of flow, agitation, etc., electrostatic charges can be generated.</p> <p>CHEMICAL DANGERS: Reacts violently with oxidants, nitric acid, sulfuric acid and halogens causing fire and explosion hazard. Attacks plastic and rubber.</p> <p>OCCUPATIONAL EXPOSURE LIMITS: TLV: 0.5 ppm as TWA 2.5 ppm as STEL (skin) A1 BEI (ACGIH 2004). MAK: H Carcinogen category: 1 Germ cell mutagen group: 3A (DFG 2004). OSHA PEL: 1910.1028 TWA 1 ppm ST 5 ppm See Appendix F NIOSH REL: Ca TWA 0.1 ppm ST 1 ppm See Appendix A NIOSH IDLH: Ca 500 ppm See: <u>71432</u></p>	<p>INHALATION RISK: A harmful contamination of the air can be reached very quickly on evaporation of this substance at 20°C.</p> <p>EFFECTS OF SHORT-TERM EXPOSURE: The substance is irritating to the eyes the skin and the respiratory tract Swallowing the liquid may cause aspirati on into the lungs with the risk of chemical pneumonitis. The substance may cause effects on the central nervous system, resulting in lowering of consciousness Exposure far above the occupational exposure limit value may result in unconsciousness death</p> <p>EFFECTS OF LONG-TERM OR REPEATED EXPOSURE: The liquid defats the skin. The substance may have effects on the bone marrow immune system, resulting in a decrease of blood cells. This substance is carcinogenic to humans.</p>
PHYSICAL PROPERTIES	<p>Boiling point: 80°C Melting point: 6°C Relative density (water = 1): 0.88 Solubility in water, g/100 ml at 25°C: 0.18 Vapour pressure, kPa at 20°C: 10 Relative vapour density (air = 1): 2.7</p>	<p>Relative density of the vapour/air-mixture at 20°C (air = 1): 1.2 Flash point: -11°C c.c. Auto-ignition temperature: 498°C Explosive limits, vol% in air: 1.2-8.0 Octanol/water partition coefficient as log Pow:</p>

	2.13
ENVIRONMENTAL DATA	The substance is very toxic to aquatic organisms. 
NOTES	
Use of alcoholic beverages enhances the harmful effect. Depending on the degree of exposure, periodic medical examination is indicated. The odour warning when the exposure limit value is exceeded is insufficient.	
Transport Emergency Card: TEC (R)-30S1114 / 30GF1-II NFPA Code: H2; F3; R0	
ADDITIONAL INFORMATION	
ICSC: 0015	BENZENE
(C) IPCS, CEC, 1994	
IMPORTANT LEGAL NOTICE:	Neither NIOSH, the CEC or the IPCS nor any person acting on behalf of NIOSH, the CEC or the IPCS is responsible for the use which might be made of this information. This card contains the collective views of the IPCS Peer Review Committee and may not reflect in all cases all the detailed requirements included in national legislation on the subject. The user should verify compliance of the cards with the relevant legislation in the country of use. The only modifications made to produce the U.S. version is inclusion of the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

International Chemical Safety Cards

TOLUENE

ICSC: 0078



Methylbenzene
Toluol
Phenylmethane
C₆H₅CH₃ / C₇H₈
Molecular mass: 92.1

ICSC # 0078
CAS # 108-88-3
RTECS # XS5250000
UN # 1294
EC # 601-021-00-3
October 10, 2002 Validated



TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Highly flammable.	NO open flames, NO sparks, and NO smoking.	Powder, AFFF, foam, carbon dioxide.
EXPLOSION	Vapour/air mixtures are explosive.	Closed system, ventilation, explosion-proof electrical equipment and lighting. Prevent build-up of electrostatic charges (e.g., by grounding). Do NOT use compressed air for filling, discharging, or handling. Use non-sparking handtools.	In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE		STRICT HYGIENE! AVOID EXPOSURE OF (PREGNANT) WOMEN!	
•INHALATION	Cough. Sore throat. Dizziness. Drowsiness. Headache. Nausea. Unconsciousness.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Refer for medical attention.
•SKIN	Dry skin. Redness.	Protective gloves.	Remove contaminated clothes. Rinse and then wash skin with water and soap. Refer for medical attention.
•EYES	Redness. Pain.	Safety goggles.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
•INGESTION	Burning sensation. Abdominal pain. (Further see Inhalation).	Do not eat, drink, or smoke during work.	Rinse mouth. Do NOT induce vomiting. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Evacuate danger area in large spill! Consult an expert in large spill! Remove all ignition sources. Ventilation. Collect leaking liquid in sealable containers. Absorb remaining liquid in sand or inert absorbent and remove to safe place. Do NOT wash away into sewer. Do NOT let this chemical enter the environment. Personal protection: self-contained breathing apparatus	Fireproof. Separated from strong oxidants.	F symbol Xn symbol R: 11-38-48/20-63-65-67 S: 2-36/37-46-62 UN Hazard Class: 3 UN Packing Group: II
SEE IMPORTANT INFORMATION ON BACK		
<p>ICSC: 0078</p> <p style="text-align: center;">Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994 No modifications to the International version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values</p>		

International Chemical Safety Cards

TOLUENE

ICSC: 0078

<p>I M P O R T A N T I N F O R M A T I O N</p>	<p>PHYSICAL STATE; APPEARANCE: COLOURLESS LIQUID, WITH CHARACTERISTIC ODOUR.</p> <p>PHYSICAL DANGERS: The vapour mixes well with air, explosive mixtures are formed easily. As a result of flow, agitation, etc., electrostatic charges can be generated.</p> <p>CHEMICAL DANGERS: Reacts violently with strong oxidants causing fire and explosion hazard.</p> <p>OCCUPATIONAL EXPOSURE LIMITS: TLV: 50 ppm as TWA (skin) A4 BEI issued (ACGIH 2004). MAK: Pregnancy risk group: C (DFG 2004). EU OEL: 192 mg/m³ 50 ppm as TWA 384 mg/m³ 100 ppm as STEL (skin) (EU 2006). OSHA PEL†: TWA 200 ppm C 300 ppm 500 ppm (10-minute maximum peak) NIOSH REL: TWA 100 ppm (375 mg/m³) ST 150 ppm (560 mg/m³) NIOSH IDLH: 500 ppm See: 108883</p>	<p>ROUTES OF EXPOSURE: The substance can be absorbed into the body by inhalation, through the skin and by ingestion.</p> <p>INHALATION RISK: A harmful contamination of the air can be reached rather quickly on evaporation of this substance at 20°C.</p> <p>EFFECTS OF SHORT-TERM EXPOSURE: The substance is irritating to the eyes and the respiratory tract The substance may cause effects on the central nervous system If this liquid is swallowed, aspiration into the lungs may result in chemical pneumonitis. Exposure at high levels may result in cardiac dysrhythmia and unconsciousness.</p> <p>EFFECTS OF LONG-TERM OR REPEATED EXPOSURE: The liquid defats the skin. The substance may have effects on the central nervous system Exposure to the substance may enhance hearing damage caused by exposure to noise. Animal tests show that this substance possibly causes toxicity to human reproduction or development.</p>
<p>PHYSICAL PROPERTIES</p>	<p>Boiling point: 111°C Melting point: -95°C Relative density (water = 1): 0.87 Solubility in water: none</p>	<p>Relative density of the vapour/air-mixture at 20°C (air = 1): 1.01 Flash point: 4°C c.c. Auto-ignition temperature: 480°C</p>

	Vapour pressure, kPa at 25°C: 3.8 Relative vapour density (air = 1): 3.1	Explosive limits, vol% in air: 1.1-7.1 Octanol/water partition coefficient as log Pow: 2.69
ENVIRONMENTAL DATA	The substance is toxic to aquatic organisms.	



NOTES

Depending on the degree of exposure, periodic medical examination is suggested. Use of alcoholic beverages enhances the harmful effect. Card has been partly updated in October 2004: see sections Occupational Exposure Limits, EU classification, Emergency Response. Card has been partly updated in October 2006: see section Occupational Exposure Limits.

Transport Emergency Card: TEC (R)-30S1294
 NFPA Code: H 2; F 3; R 0;

ADDITIONAL INFORMATION

ICSC: 0078	TOLUENE
(C) IPCS, CEC, 1994	

IMPORTANT LEGAL NOTICE:	Neither NIOSH, the CEC or the IPCS nor any person acting on behalf of NIOSH, the CEC or the IPCS is responsible for the use which might be made of this information. This card contains the collective views of the IPCS Peer Review Committee and may not reflect in all cases all the detailed requirements included in national legislation on the subject. The user should verify compliance of the cards with the relevant legislation in the country of use. The only modifications made to produce the U.S. version is inclusion of the OSHA PELs, NIOSH RELs and NIOSH IDLH values.
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International Chemical Safety Cards

ETHYLBENZENE

ICSC: 0268



Ethylbenzol
Phenylethane
EB
C₈H₁₀/C₆H₅C₂H₅
Molecular mass: 106.2

ICSC # 0268
CAS # 100-41-4
RTECS # DA0700000
UN # 1175
EC # 601-023-00-4
November 23, 2007 Validated



TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Highly flammable.	NO open flames, NO sparks, and NO smoking.	Dry powder. Foam. Carbon dioxide.
EXPLOSION	Vapour/air mixtures are explosive.	Closed system, ventilation, explosion-proof electrical equipment and lighting. Do NOT use compressed air for filling, discharging or handling.	In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE		PREVENT GENERATION OF MISTS!	
•INHALATION	Cough. Sore throat. Dizziness. Drowsiness. Headache.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Refer for medical attention.
•SKIN	Redness.	Protective gloves.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
•EYES	Redness. Pain. crimation; deleted at update Nov 07 - only at very high levels.	Safety goggles	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
•INGESTION	Burning sensation in the throat and chest. (Further see Inhalation).	Do not eat, drink, or smoke during work.	Rinse mouth. Do NOT induce vomiting. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Personal protection: filter respirator for organic gases and vapours adapted to the airborne concentration of the substance. Ventilation. Collect leaking	Fireproof. Separated from strong oxidants. Provision to contain effluent from fire extinguishing. Store in an area without drain or sewer access.	F symbol Xn symbol R: 11-20

liquid in covered containers. Absorb remaining liquid in sand or inert absorbent and remove to safe place. Do NOT wash away into sewer Do NOT let this chemical enter the environment.

S: 2-16-24/25-29
 UN Hazard Class: 3
 UN Packing Group: II
 Signal: Danger
 Flame-Excl mark-Health haz
 Highly flammable liquid and vapour
 May be harmful if swallowed
 Harmful if inhaled vapour
 Causes mild skin irritation
 Causes eye irritation
 Suspected of causing cancer
 May cause respiratory irritation
 May cause drowsiness or dizziness
 May be harmful if swallowed and enters airways
 Toxic to aquatic life

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0268

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994. No modifications to the international version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

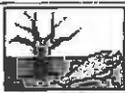
International Chemical Safety Cards

ICSC: 0268

ETHYLBENZENE

<p>I M P O R T A N T A</p>	<p>PHYSICAL STATE; APPEARANCE: COLOURLESS LIQUID , WITH AROMATIC ODOUR.</p> <p>PHYSICAL DANGERS: The vapour mixes well with air, explosive mixtures are easily formed.</p> <p>CHEMICAL DANGERS: Reacts with strong oxidants. Attacks plastic and rubber.</p> <p>OCCUPATIONAL EXPOSURE LIMITS: TLV: 100 ppm as TWA 125 ppm as STEL A3 (confirmed animal carcinogen with unknown relevance to humans); BEI issued (ACGIH 2007). EU OEL: 442 mg/m³ 100 ppm as TWA 884 mg/m³ 200 ppm as STEL (skin) (EU 2006). OSHA PEL: TWA 100 ppm (435 mg/m³) NIOSH REL: TWA 100 ppm (435 mg/m³) ST 125 ppm (545 mg/m³) NIOSH IDLH: 800 ppm 10%LEL See: <u>100414</u></p>	<p>ROUTES OF EXPOSURE: The substance can be absorbed into the body by inhalation of its vapour, and by ingestion.</p> <p>INHALATION RISK: A harmful contamination of the air will be reached rather slowly on evaporation of this substance at 20°C.</p> <p>EFFECTS OF SHORT-TERM EXPOSURE: The substance is irritating to the eyes the skin and the respiratory tract Swallowing the liquid may cause aspiration into the lungs with the risk of chemical pneumonitis. The substance may cause effects on the central nervous system. Exposure above the OEL could cause lowering of consciousness.</p> <p>EFFECTS OF LONG-TERM OR REPEATED EXPOSURE: This substance is possibly carcinogenic to humans. The substance may have effects on the kidneys and liver , resulting in impaired functions Repeated contact with skin may cause dryness and cracking.</p>
<p>PHYSICAL PROPERTIES</p>	<p>Boiling point: 136°C Melting point: -95°C Relative density (water = 1): 0.9</p>	<p>Relative density of the vapour/air-mixture at 20°C (air = 1): 1.02 Flash point: 18°C e.e.</p>

	Solubility in water, g/100 ml at 20°C: 0.015 Vapour pressure, kPa at 20°C: 0.9 Relative vapour density (air = 1): 3.7	Auto-ignition temperature: 432°C Explosive limits, vol% in air: 1.0-6.7 Octanol/water partition coefficient as log Pow: 3.1 Viscosity, mm ² /s at 25 °C: 0.6
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ENVIRONMENTAL DATA	The substance is toxic to aquatic organisms. It is strongly advised that this substance does not enter the environment.	
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NOTES

The odour warning when the exposure limit value is exceeded is insufficient.
 Transport Emergency Card: TEC (R)-305 1135 or 30GF1- I+II
 NFPA Code: H2; F3; R0

ADDITIONAL INFORMATION

ICSC: 0268	(C) IPCS, CEC, 1994	ETHYLBENZENE
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International Chemical Safety Cards

ICSC: 0086

p-XYLENE



para-Xylene
 1,4-Dimethylbenzene
 p-Xylol
 $C_6H_4(CH_3)_2 / C_8H_{10}$
 Molecular mass: 106.2

ICSC # 0086
 CAS # 106-42-3
 RTECS # ZE2625000
 UN # 1307
 EC # 601-022-00-9
 August 03, 2002 Validated



TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Flammable.	NO open flames, NO sparks, and NO smoking.	Powder, water spray, foam, carbon dioxide.
EXPLOSION	Above 27°C explosive vapour/air mixtures may be formed.	Above 27°C use a closed system, ventilation, and explosion-proof electrical equipment. Prevent build-up of electrostatic charges (e.g., by grounding).	In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE		STRICT HYGIENE! AVOID EXPOSURE OF (PREGNANT) WOMEN!	
•INHALATION	Dizziness. Drowsiness. Headache. Nausea.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Refer for medical attention.
•SKIN	Dry skin. Redness.	Protective gloves.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
•EYES	Redness. Pain.	Safety spectacles.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
•INGESTION	Burning sensation. Abdominal pain. (Further see Inhalation).	Do not eat, drink, or smoke during work.	Rinse mouth. Do NOT induce vomiting. Refer for medical attention.
SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING	
Ventilation. Remove all ignition sources. Collect leaking and spilled liquid in sealable containers as far as	Fireproof. Separated from strong oxidants and strong acids	Note: Xn symbol	

possible. Absorb remaining liquid in sand or inert absorbent and remove to safe place. Do NOT let this chemical enter the environment. (Extra personal protection: filter respirator for organic gases and vapours.)

R: 10-20/21-38
S: 2-25
UN Hazard Class: 3
UN Packing Group: III

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0086

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994. No modifications to the International version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values

International Chemical Safety Cards

p-XYLENE

ICSC: 0086

<p>I M P O R T A N T A T A</p>	<p>PHYSICAL STATE; APPEARANCE: COLOURLESS LIQUID , WITH CHARACTERISTIC ODOUR.</p> <p>PHYSICAL DANGERS: As a result of flow, agitation, etc., electrostatic charges can be generated.</p> <p>CHEMICAL DANGERS: Reacts with strong acids strong oxidants</p> <p>OCCUPATIONAL EXPOSURE LIMITS: TLV: 100 ppm as TWA 150 ppm as STEL A4 (ACGIH 2001). BEI (ACGIH 2001). EU OEL: 50 ppm as TWA 100 ppm as STEL (skin) (EU 2000). OSHA PEL†: TWA 100 ppm (435 mg/m³) NIOSH REL: TWA 100 ppm (435 mg/m³) ST 150 ppm (655 mg/m³) NIOSH IDLH: 900 ppm See: 95476</p>	<p>ROUTES OF EXPOSURE: The substance can be absorbed into the body by inhalation, through the skin and by ingestion.</p> <p>INHALATION RISK: A harmful contamination of the air will be reached rather slowly on evaporation of this substance at 20°C.</p> <p>EFFECTS OF SHORT-TERM EXPOSURE: The substance is irritating to the eyes and the skin. The substance may cause effects on the central nervous system. If this liquid is swallowed, aspiration into the lungs may result in chemical pneumonitis.</p> <p>EFFECTS OF LONG-TERM OR REPEATED EXPOSURE: The liquid defats the skin. The substance may have effects on the central nervous system. Animal tests show that this substance possibly causes toxicity to human reproduction or development.</p>
<p>PHYSICAL PROPERTIES</p>	<p>Boiling point: 138°C Melting point: 13°C Relative density (water = 1): 0.86 Solubility in water: none Vapour pressure, kPa at 20°C: 0.9</p>	<p>Relative vapour density (air = 1): 3.7 Relative density of the vapour/air-mixture at 20°C (air = 1): 1.02 Flash point: 27°C c.c. Auto-ignition temperature: 528°C Explosive limits, vol% in air: 1.1-7.0 Octanol/water partition coefficient as log Pow: 3.15</p>
<p>ENVIRONMENTAL DATA</p>	<p>The substance is toxic to aquatic organisms.</p> 	
<p>NOTES</p>		

Depending on the degree of exposure, periodic medical examination is indicated. The recommendations on this Card also apply to technical xylene. See ICSC 0084 o-Xylene and 0085 m-Xylene.

Transport Emergency Card: TEC (R)-30S1307-III
 NFPA Code: H 2; F 3; R 0;

Card has been partially updated in January 2008: see Occupational Exposure Limits.

ADDITIONAL INFORMATION

ICSC: 0086

p-XYLENE

(C) IPCS, CEC, 1994

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International Chemical Safety Cards

NAPHTHALENE

ICSC: 0667



Naphthene
 $C_{10}H_8$
 Molecular mass: 128.18

ICSC # 0667
 CAS # 91-20-3
 RTECS # QJ0525000
 UN # 1334 (solid); 2304 (molten)
 EC # 601-052-00-2
 April 21, 2005 Validated



TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Combustible.	NO open flames.	Powder, water spray, foam, carbon dioxide.
EXPLOSION	Above 80°C explosive vapour/air mixtures may be formed. Finely dispersed particles form explosive mixtures in air.	Prevent deposition of dust; closed system, dust explosion-proof electrical equipment and lighting.	
EXPOSURE		PREVENT DISPERSION OF DUST!	
•INHALATION	Headache. Weakness. Nausea. Vomiting. Sweating. Confusion. Jaundice. Dark urine.	Ventilation (not if powder), local exhaust, or breathing protection.	Fresh air, rest. Refer for medical attention.
•SKIN	MAY BE ABSORBED! (Further see Inhalation).	Protective gloves.	Rinse skin with plenty of water or shower.
•EYES		Safety spectacles.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
•INGESTION	Abdominal pain. Diarrhoea. Convulsions. Unconsciousness. (Further see Inhalation).	Do not eat, drink, or smoke during work. Wash hands before eating.	Rest. Refer for medical attention.
SPILLAGE DISPOSAL		STORAGE	PACKAGING & LABELLING
Personal protection: filter respirator for organic gases and vapours. Do NOT let this chemical enter the environment. Sweep spilled substance into covered containers; if appropriate, moisten first to prevent dusting. Carefully collect remainder, then remove to safe place.		Separated from strong oxidants, food and feedstuffs. Store in an area without drain or sewer access.	Do not transport with food and feedstuffs. Marine pollutant. Xn symbol N symbol R: 22-40-50/53 S: 2-36/37-46-60-61

UN Hazard Class: 4.1
UN Packing Group: III

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0667

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994. No modifications to the International version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values

International Chemical Safety Cards

ICSC: 0667

NAPHTHALENE

<p>I M P O R T A N T D A T A</p>	<p>PHYSICAL STATE; APPEARANCE: WHITE SOLID IN VARIOUS FORMS , WITH CHARACTERISTIC ODOUR.</p> <p>PHYSICAL DANGERS: Dust explosion possible if in powder or granular form, mixed with air.</p> <p>CHEMICAL DANGERS: On combustion, forms irritating and toxic gases. Reacts with strong oxidants</p> <p>OCCUPATIONAL EXPOSURE LIMITS: TLV: 10 ppm as TWA 15 ppm as STEL (skin) A4 (not classifiable as a human carcinogen); (ACGIH 2005). MAK: skin absorption (H); Carcinogen category: 2; Germ cell mutagen group: 3B; (DFG 2004). OSHA PEL†: TWA 10 ppm (50 mg/m³) NIOSH REL: TWA 10 ppm (50 mg/m³) ST 15 ppm (75 mg/m³) NIOSH IDLH: 250 ppm See: <u>91203</u></p>	<p>ROUTES OF EXPOSURE: The substance can be absorbed into the body by inhalation, through the skin and by ingestion.</p> <p>INHALATION RISK: A harmful contamination of the air will be reached rather slowly on evaporation of this substance at 20°C. See Notes.</p> <p>EFFECTS OF SHORT-TERM EXPOSURE: The substance may cause effects on the blood, resulting in lesions of blood cells (haemolysis) See Notes. The effects may be delayed. Exposure by ingestion may result in death. Medical observation is indicated.</p> <p>EFFECTS OF LONG-TERM OR REPEATED EXPOSURE: The substance may have effects on the blood , resulting in chronic haemolytic anaemia. The substance may have effects on the eyes , resulting in the development of cataract. This substance is possibly carcinogenic to humans.</p>
<p>PHYSICAL PROPERTIES</p>	<p>Boiling point: 218°C Sublimation slowly at room temperature Melting point: 80°C Density: 1.16 g/cm³ Solubility in water, g/100 ml at 25°C: none</p>	<p>Vapour pressure, Pa at 25°C: 11 Relative vapour density (air = 1): 4.42 Flash point: 80°C c.c. Auto-ignition temperature: 540°C Explosive limits, vol% in air: 0.9-5.9 Octanol/water partition coefficient as log Pow: 3.3</p>
<p>ENVIRONMENTAL DATA</p>	<p>The substance is very toxic to aquatic organisms. The substance may cause long-term effects in the aquatic environment.</p> 	
<p>NOTES</p>		
<p>Some individuals may be more sensitive to the effect of naphthalene on blood cells. Transport Emergency Card: TEC (R)-41S1334 (solid); 41GF 1 -II+III (solid); 4 I S2304 (molten) NFPA Code: H2; F2; R0;</p>		

ADDITIONAL INFORMATION**ICSC: 0667****NAPHTHALENE**

(C) IPCS, CEC, 1994

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International Chemical Safety Cards

ACENAPHTHENE

ICSC: 1674



1,2-Dihydroacenaphthylene
 1,8-Ethylenenaphthalene
 $C_{12}H_{10}$
 Molecular mass: 154.2

ICSC # 1674
 CAS # 83-32-9
 RTECS # AB1000000
 UN # 3077

October 12, 2006 Validated



TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Combustible.	NO open flames.	Water spray. Dry powder. Foam. Carbon dioxide.
EXPLOSION	Finely dispersed particles form explosive mixtures in air.	Prevent deposition of dust; closed system, dust explosion-proof electrical equipment and lighting.	
EXPOSURE	See NOTES.	PREVENT DISPERSION OF DUST!	
• INHALATION		Local exhaust or breathing protection.	Fresh air, rest.
• SKIN		Protective gloves.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
• EYES		Safety goggles	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• INGESTION		Do not eat, drink, or smoke during work.	Rinse mouth.
SPILLAGE DISPOSAL		STORAGE	PACKAGING & LABELLING
Personal protection: P2 filter respirator for harmful particles. Do NOT let this chemical enter the environment. Sweep spilled substance into covered containers: if appropriate, moisten first to prevent dusting. Carefully collect remainder, then remove to safe place.		Separated from strong oxidants Provision to contain effluent from fire extinguishing. Store in an area without drain or sewer access.	UN Hazard Class: 9 UN Packing Group: III Signal: Warning Enviro Very toxic to aquatic life with long lasting effects

SEE IMPORTANT INFORMATION ON BACK

ICSC: 1674

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994. No modifications to the International version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

International Chemical Safety Cards

ACENAPHTHENE

ICSC: 1674

<p>I M P O R T A N T D A T A</p>	<p>PHYSICAL STATE; APPEARANCE: WHITE TO BEIGE CRYSTALS</p> <p>PHYSICAL DANGERS: Dust explosion possible if in powder or granular form, mixed with air.</p> <p>CHEMICAL DANGERS: On combustion, forms toxic gases including carbon monoxide. Reacts with strong oxidants</p> <p>OCCUPATIONAL EXPOSURE LIMITS: TLV not established. MAK not established.</p>	<p>ROUTES OF EXPOSURE: The substance can be absorbed into the body by inhalation of its aerosol, through the skin and by ingestion.</p> <p>INHALATION RISK: A harmful concentration of airborne particles can be reached quickly when dispersed</p> <p>EFFECTS OF SHORT-TERM EXPOSURE:</p> <p>EFFECTS OF LONG-TERM OR REPEATED EXPOSURE: See Notes.</p>
PHYSICAL PROPERTIES	<p>Boiling point: 279°C Melting point: 95°C Density: 1.2 g/cm³ Solubility in water, g/100 ml at 25°C: 0.0004</p>	<p>Vapour pressure, Pa at 25°C: 0.3 Relative vapour density (air = 1): 5.3 Flash point: 135°C o.c. Auto-ignition temperature: >450 °C Octanol/water partition coefficient as log Pow: 3.9 - 4.5</p>
ENVIRONMENTAL DATA	<p>The substance is very toxic to aquatic organisms. The substance may cause long-term effects in the aquatic environment. It is strongly advised that this substance does not enter the environment.</p>	
NOTES		
<p>Acenaphthene occurs as a pure substance and also as a component of polyaromatic hydrocarbon (PAH) mixtures. Human population studies have associated PAH's exposure with cancer and cardiovascular diseases. Insufficient data are available on the effect of this substance on human health, therefore utmost care must be taken.</p> <p style="text-align: right;">Transport Emergency Card: TEC (R)-90GM7-III</p>		
ADDITIONAL INFORMATION		



ICSC: 1674**ACENAPHTHENE**

(C) IPCS, CEC, 1994

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International Chemical Safety Cards

ANTHRACENE

ICSC: 0825



Anthracin
 Paranaphthalene
 $C_{14}H_{10} / (C_6H_4CH)_2$
 Molecular mass: 178.2

ICSC # 0825
 CAS # 120-12-7
 RTECS # CA9350000
 March 24, 1999 Validated

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Combustible.	NO open flames.	Powder, water spray, foam, carbon dioxide.
EXPLOSION	Finely dispersed particles form explosive mixtures in air.	Prevent deposition of dust; closed system, dust explosion-proof electrical equipment and lighting.	In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE		PREVENT DISPERSION OF DUST!	
•INHALATION	Cough. Sore throat.	Ventilation (not if powder), local exhaust, or breathing protection.	Fresh air, rest. Refer for medical attention.
•SKIN	Redness.	Protective gloves.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
•EYES	Redness. Pain.	Safety spectacles, face shield, or eye protection in combination with breathing protection if powder.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
•INGESTION	Abdominal pain.	Do not eat, drink, or smoke during work.	Rinse mouth. Rest. Refer for medical attention.
SPILLAGE DISPOSAL		STORAGE	PACKAGING & LABELLING
Sweep spilled substance into containers. Carefully collect remainder, then remove to safe place Do NOT let this chemical enter the environment. (Extra personal protection: P2 filter respirator for harmful particles).		Separated from strong oxidants. Well closed.	
SEE IMPORTANT INFORMATION ON BACK			
ICSC: 0825		Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994. No modifications to the International version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values.	

International Chemical Safety Cards

ANTHRACENE

ICSC: 0825

I M P O R T A N T D A T A	PHYSICAL STATE; APPEARANCE: WHITE CRYSTALS OR FLAKES.	ROUTES OF EXPOSURE: The substance can be absorbed into the body by inhalation.
	PHYSICAL DANGERS: Dust explosion possible if in powder or granular form, mixed with air.	INHALATION RISK: Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly.
	CHEMICAL DANGERS: The substance decomposes on heating, under influence of strong oxidants producing acrid, toxic fume, causing fire and explosion hazard.	EFFECTS OF SHORT-TERM EXPOSURE: The substance slightly irritates the skin and the respiratory tract.
	OCCUPATIONAL EXPOSURE LIMITS: TLV not established.	EFFECTS OF LONG-TERM OR REPEATED EXPOSURE: Repeated or prolonged contact with skin may cause dermatitis under the influence of UV light.

PHYSICAL PROPERTIES	Boiling point: 342°C Melting point: 218°C Density: 1.25-1.28 g/cm ³ Solubility in water, g/100 ml at 20 °C: 0.00013 Vapour pressure, Pa at 25°C: 0.08	Relative vapour density (air = 1): 6.15 Flash point: 121°C Auto-ignition temperature: 538°C Explosive limits, vol% in air: 0.6-? Octanol/water partition coefficient as log Pow: 4.5 (calculated)
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ENVIRONMENTAL DATA	The substance is very toxic to aquatic organisms. The substance may cause long-term effects in the aquatic environment.	
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NOTES

Green oil, Tetra-olive N2G are trade names.

NFPA Code: H0; F1; R;

ADDITIONAL INFORMATION

ICSC: 0825

ANTHRACENE

(C) IPCS, CEC, 1994

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relevant legislation in the country of use. The only modifications made to produce the U.S. version is inclusion of the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

International Chemical Safety Cards

PYRENE

ICSC: 1474



Benzo (d,e,f) phenanthrene
 beta-Pyrene
 $C_{16}H_{10}$
 Molecular mass: 202.26

ICSC # 1474

CAS # 129-00-0

RTECS # UR2450000

November 27, 2003 Validated

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Gives off irritating or toxic fumes (or gases) in a fire.	NO open flames, NO sparks, and NO smoking.	Water spray, carbon dioxide, dry powder, alcohol-resistant foam, foam.
EXPLOSION			
EXPOSURE			
• INHALATION		Avoid inhalation of dust	Fresh air, rest.
• SKIN	Redness.	Protective gloves.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
• EYES	Redness.	Safety spectacles.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• INGESTION		Do not eat, drink, or smoke during work.	Do NOT induce vomiting. Give plenty of water to drink. Refer for medical attention.
SPILLAGE DISPOSAL		STORAGE	PACKAGING & LABELLING
Sweep spilled substance into containers; if appropriate, moisten first to prevent dusting. Carefully collect remainder Do NOT let this chemical enter the environment. (Extra personal protection: P2 filter respirator for harmful particles.)		Separated from strong oxidants. Keep in a well-ventilated room.	Do not transport with food and feedstuffs.
SEE IMPORTANT INFORMATION ON BACK			
ICSC: 1474		Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994. No modifications to the International version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values.	

International Chemical Safety Cards

PYRENE

ICSC: 1474

<p>I M P O R T A N T D A T A</p>	<p>PHYSICAL STATE; APPEARANCE: YELLOW COLOURLESS SOLID IN VARIOUS FORMS</p> <p>PHYSICAL DANGERS:</p> <p>CHEMICAL DANGERS: The substance decomposes on heating producing irritating fumes</p> <p>OCCUPATIONAL EXPOSURE LIMITS: TLV not established. MAK not established.</p>	<p>ROUTES OF EXPOSURE: The substance can be absorbed into the body by inhalation through the skin and by ingestion</p> <p>INHALATION RISK: Evaporation at 20°C is negligible: a harmful concentration of airborne particles can, however, be reached quickly when dispersed.</p> <p>EFFECTS OF SHORT-TERM EXPOSURE: Exposure to sun may provoke an irritating effect of pyrene on skin and lead to chronic skin discoloration.</p> <p>EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:</p>
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PHYSICAL PROPERTIES	<p>Boiling point: 404°C Melting point: 151°C Density: 1.27 g/cm³</p>	<p>Solubility in water: 0.135 mg/l at 25°C Vapour pressure, Pa at °C: 0.08 Octanol/water partition coefficient as log Pow: 4.88</p>
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ENVIRONMENTAL DATA	<p>Bioaccumulation of this chemical may occur in crustacea, in fish, in milk, in algae and in molluscs. It is strongly advised that this substance does not enter the environment.</p>	
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NOTES

Pyrene is one of many polycyclic aromatic hydrocarbons - standards are usually established for them as mixtures, e.g., coal tar pitch volatiles. However, pyrene may be encountered as a laboratory chemical in its pure form. Health effects of exposure to the substance have not been investigated adequately. See ICSC 1415 Coal-tar pitch.

ADDITIONAL INFORMATION

ICSC: 1474	(C) IPCS, CEC, 1994	PYRENE
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relevant legislation in the country of use. The only modifications made to produce the U.S. version is inclusion of the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

International Chemical Safety Cards

CHRYSENE

ICSC: 1672



Benzoaphenanthrene
 1,2-Benzophenanthrene
 1,2,5,6-Dibenzonaphthalene
 $C_{18}H_{12}$
 Molecular mass: 228.3

ICSC # 1672
 CAS # 218-01-9
 RTECS # GC0700000
 UN # 3077
 EC # 601-048-00-0
 October 12, 2006 Validated



TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Combustible.	NO open flames.	Water spray. Dry powder. Foam. Carbon dioxide.
EXPLOSION	Finely dispersed particles form explosive mixtures in air.	Prevent deposition of dust; closed system, dust explosion-proof electrical equipment and lighting.	
EXPOSURE	See EFFECTS OF LONG-TERM OR REPEATED EXPOSURE.	AVOID ALL CONTACT!	
•INHALATION		Local exhaust or breathing protection.	Fresh air, rest.
•SKIN		Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
•EYES		Safety goggles	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
•INGESTION		Do not eat, drink, or smoke during work.	Rinse mouth.
SPILLAGE DISPOSAL		STORAGE	PACKAGING & LABELLING
Personal protection: P3 filter respirator for toxic particles. Do NOT let this chemical enter the environment. Sweep spilled substance into sealable containers; if appropriate, moisten first to prevent dusting. Carefully collect remainder, then remove to safe place.		Separated from strong oxidants, Provision to contain effluent from fire extinguishing. Store in an area without drain or sewer access.	T symbol N symbol R: 45-68-50/53 S: 53-45-60-61 UN Hazard Class: 9 UN Packing Group: III

Signal: Warning
 Health haz-Enviro
 Suspected of causing cancer
 Very toxic to aquatic life
 Toxic to aquatic life with long lasting effects

SEE IMPORTANT INFORMATION ON BACK

ICSC: 1672

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994. No modifications to the International version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values

International Chemical Safety Cards

ICSC: 1672

CHRYSENE

I M P O R T A N T I N F O R M A T I O N	<p>PHYSICAL STATE; APPEARANCE: COLOURLESS TO BEIGE CRYSTALS OR POWDER</p> <p>PHYSICAL DANGERS: Dust explosion possible if in powder or granular form, mixed with air.</p> <p>CHEMICAL DANGERS: The substance decomposes on burning producing toxic fumes. Reacts violently with strong oxidants.</p> <p>OCCUPATIONAL EXPOSURE LIMITS: TLV: A3 (confirmed animal carcinogen with unknown relevance to humans); (ACGIH 2006). MAK: skin absorption (H); Carcinogen category: 2 (DFG 2007).</p>	<p>ROUTES OF EXPOSURE: The substance can be absorbed into the body by inhalation of its aerosol, through the skin and by ingestion.</p> <p>INHALATION RISK: A harmful concentration of airborne particles can be reached quickly when dispersed</p> <p>EFFECTS OF SHORT-TERM EXPOSURE:</p> <p>EFFECTS OF LONG-TERM OR REPEATED EXPOSURE: This substance is possibly carcinogenic to humans.</p>
	<p>PHYSICAL PROPERTIES</p> <p>Boiling point: 448°C Melting point: 254 - 256°C Density: 1.3 g/cm³</p> <p>Solubility in water: very poor Octanol/water partition coefficient as log Pow: 5.9</p>	
<p>ENVIRONMENTAL DATA</p> <p>The substance is very toxic to aquatic organisms. Bioaccumulation of this chemical may occur in seafood. It is strongly advised that this substance does not enter the environment.</p>		

NOTES

Depending on the degree of exposure, periodic medical examination is suggested. Do NOT take working clothes home. This substance does not usually occur as a pure substance but as a component of polyaromatic hydrocarbon (PAH) mixtures. Human population studies have associated PAH's exposure with cancer and cardiovascular diseases.

Transport Emergency Card: TEC (R)-90GM7-III
Card has been partially updated in January 2008: see Occupational Exposure Limits.

ADDITIONAL INFORMATION**ICSC: 1672****CHRYSENE**

(C) IPCS, CEC, 1994

**IMPORTANT
LEGAL
NOTICE:**

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International Chemical Safety Cards

ICSC: 0720

BENZO(b)FLUORANTHENE



Benz(e)acephenanthrylene
 2,3-Benzofluoranthene
 Benzo(e)fluoranthene
 3,4-Benzofluoranthene
 $C_{20}H_{12}$
 Molecular mass: 252.3

ICSC # 0720
 CAS # 205-99-2
 RTECS # CU1400000
 EC # 601-034-00-4
 March 25, 1999 Validated

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE			In case of fire in the surroundings: use appropriate extinguishing media.
EXPLOSION			
EXPOSURE		AVOID ALL CONTACT!	
•INHALATION		Local exhaust or breathing protection.	Fresh air, rest.
•SKIN		Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
•EYES		Safety spectacles or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
•INGESTION		Do not eat, drink, or smoke during work.	Rinse mouth. Refer for medical attention.
SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING	
Sweep spilled substance into covered containers: if appropriate, moisten first to prevent dusting. Carefully collect remainder, then remove to safe place. Do NOT let this chemical enter the environment.	Provision to contain effluent from fire extinguishing. Well closed.	T symbol N symbol R: 45-50/53 S: 53-45-60-61	

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0720

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994. No modifications to the International version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

International Chemical Safety Cards

BENZO(b)FLUORANTHENE

ICSC: 0720

I M P O R T A N T D A T A	PHYSICAL STATE; APPEARANCE: COLOURLESS CRYSTALS	ROUTES OF EXPOSURE: The substance can be absorbed into the body by inhalation of its aerosol and through the skin.
	PHYSICAL DANGERS:	INHALATION RISK: Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly.
	CHEMICAL DANGERS: Upon heating, toxic fumes are formed.	EFFECTS OF SHORT-TERM EXPOSURE:
	OCCUPATIONAL EXPOSURE LIMITS: TLV: A2 (suspected human carcinogen); (ACGIH 2004). MAK: Carcinogen category: 2; (DFG 2004).	EFFECTS OF LONG-TERM OR REPEATED EXPOSURE: This substance is possibly carcinogenic to humans. May cause genetic damage in humans.
PHYSICAL PROPERTIES	Boiling point: 481°C Melting point: 168°C Solubility in water: none	Octanol/water partition coefficient as log Pow: 6.12
ENVIRONMENTAL DATA	This substance may be hazardous to the environment; special attention should be given to air quality and water quality.	
NOTES		
Benzo(b)fluoranthene is present as a component of polycyclic aromatic hydrocarbons (PAH) content in the environment usually resulting from the incomplete combustion or pyrolysis of organic matters, especially fossil fuels and tobacco. ACGIH recommends environment containing benzo(b)fluoranthene should be evaluated in terms of the TLV-TWA for coal tar pitch volatile, as benzene soluble 0.2 mg/m ³ . Insufficient data are available on the effect of this substance on human health, therefore utmost care must be taken.		
ADDITIONAL INFORMATION		
ICSC: 0720	BENZO(b)FLUORANTHENE	
(C) IPCS, CEC, 1994		



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International Chemical Safety Cards

BENZO(a)PYRENE

ICSC: 0104



Benz(a)pyrene
 3,4-Benzopyrene
 Benzo(d,e,f)chrysene
 $C_{20}H_{12}$
 Molecular mass: 252.3

ICSC # 0104
 CAS # 50-32-8
 RTECS # DJ3675000
 EC # 601-032-00-3
 October 17, 2005 Validated

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Combustible.	NO open flames.	Water spray, foam, powder, carbon dioxide.
EXPLOSION			
EXPOSURE	See EFFECTS OF LONG-TERM OR REPEATED EXPOSURE.	AVOID ALL CONTACT! AVOID EXPOSURE OF (PREGNANT) WOMEN!	
•INHALATION		Local exhaust or breathing protection.	Fresh air, rest.
•SKIN	MAY BE ABSORBED!	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
•EYES		Safety goggles or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
•INGESTION		Do not eat, drink, or smoke during work.	Induce vomiting (ONLY IN CONSCIOUS PERSONS!). Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Evacuate danger area! Personal protection: complete protective clothing including self-contained breathing apparatus. Do NOT let this chemical enter the environment. Sweep spilled substance into sealable containers; if appropriate, moisten first to prevent dusting. Carefully collect remainder,	Separated from strong oxidants.	T symbol N symbol R: 45-46-60-61-43-50/53 S: 53-45-60-61

then remove to safe place.

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0104

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994. No modifications to the International version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values

International Chemical Safety Cards

BENZO(a)PYRENE

ICSC: 0104

<p>I M P O R T A N T D A T A</p>	<p>PHYSICAL STATE; APPEARANCE: PALE-YELLOW CRYSTALS</p> <p>PHYSICAL DANGERS:</p> <p>CHEMICAL DANGERS: Reacts with strong oxidants causing fire and explosion hazard.</p> <p>OCCUPATIONAL EXPOSURE LIMITS: TLV: Exposure by all routes should be carefully controlled to levels as low as possible A2 (suspected human carcinogen); (ACGIH 2005). MAK: Carcinogen category: 2; Germ cell mutagen group: 2; (DFG 2005).</p>	<p>ROUTES OF EXPOSURE: The substance can be absorbed into the body by inhalation of its aerosol, through the skin and by ingestion.</p> <p>INHALATION RISK: Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly when dispersed.</p> <p>EFFECTS OF SHORT-TERM EXPOSURE:</p> <p>EFFECTS OF LONG-TERM OR REPEATED EXPOSURE: This substance is carcinogenic to humans. May cause heritable genetic damage to human germ cells. Animal tests show that this substance possibly causes toxicity to human reproduction or development.</p>
<p>PHYSICAL PROPERTIES</p>	<p>Boiling point: 496°C Melting point: 178.1°C Density: 1.4 g/cm³</p>	<p>Solubility in water: none (<0.1 g/100 ml) Vapour pressure: negligible Octanol/water partition coefficient as log Pow: 6.04</p>
<p>ENVIRONMENTAL DATA</p>	<p>The substance is very toxic to aquatic organisms. Bioaccumulation of this chemical may occur in fish, in plants and in molluscs. The substance may cause long-term effects in the aquatic environment.</p> 	
<p>NOTES</p>		
<p>Do NOT take working clothes home. Benzo(a)pyrene is present as a component of polycyclic aromatic hydrocarbons (PAHs) in the environment, usually resulting from the incomplete combustion or pyrolysis of organic matters, especially fossil fuels and tobacco.</p>		
<p>ADDITIONAL INFORMATION</p>		

ICSC: 0104**BENZO(a)PYRENE**

(C) IPCS, CEC, 1994

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International Chemical Safety Cards

BENZO(ghi)PERYLENE

ICSC: 0739



1,12-Benzoperylene
 1,12-Benzperylene
 $C_{22}H_{12}$
 Molecular mass: 276.3

ICSC # 0739
 CAS # 191-24-2
 RTECS # DI6200500
 October 18, 1999 Validated

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Combustible under specific conditions.	NO open flames.	In case of fire in the surroundings: all extinguishing agents allowed.
EXPLOSION			
EXPOSURE		PREVENT DISPERSION OF DUST!	
•INHALATION		Local exhaust or breathing protection.	Fresh air, rest.
•SKIN		Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
•EYES		Safety spectacles, or eye protection in combination with breathing protection if powder.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
•INGESTION		Do not eat, drink, or smoke during work.	Rinse mouth. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Sweep spilled substance into covered containers. Carefully collect remainder, then remove to safe place. Do NOT let this chemical enter the environment.	Well closed.	

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0739

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994. No modifications to the international version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

International Chemical Safety Cards

BENZO(ghi)PERYLENE

ICSC: 0739

<p>I M P O R T A N T D A T A</p>	<p>PHYSICAL STATE; APPEARANCE: PALE YELLOW-GREEN CRYSTALS.</p> <p>PHYSICAL DANGERS:</p> <p>CHEMICAL DANGERS: Upon heating, toxic fumes are formed.</p> <p>OCCUPATIONAL EXPOSURE LIMITS: TLV not established.</p>	<p>ROUTES OF EXPOSURE: The substance can be absorbed into the body by inhalation of its aerosol and through the skin.</p> <p>INHALATION RISK: Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly.</p> <p>EFFECTS OF SHORT-TERM EXPOSURE:</p> <p>EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:</p>
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PHYSICAL PROPERTIES	<p>Boiling point: 550°C Melting point: 278°C Density: 1.3 g/cm³</p>	<p>Solubility in water: none Octanol/water partition coefficient as log Pow: 6.58</p>
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ENVIRONMENTAL DATA	<p>This substance may be hazardous to the environment; special attention should be given to air and water.</p>	
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NOTES

Benzo(ghi)perylene is present as a component of polycyclic aromatic hydrocarbons (PAH) content in the environment usually resulting from the incomplete combustion or pyrolysis of organic matters, especially fossil fuels and tobacco. Data are insufficiently available on the effect of this substance on human health, therefore utmost care must be taken.

ADDITIONAL INFORMATION

ICSC: 0739	(C) IPCS, CEC, 1994	BENZO(ghi)PERYLENE
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IMPORTANT LEGAL NOTICE:	<p>Neither NIOSH, the CEC or the IPCS nor any person acting on behalf of NIOSH, the CEC or the IPCS is responsible for the use which might be made of this information. This card contains the collective views of the IPCS Peer Review Committee and may not reflect in all cases all the detailed requirements included in national legislation on the subject. The user should verify compliance of the cards with the relevant legislation in the country of use. The only modifications made to produce the U.S. version is inclusion of the OSHA PELs, NIOSH RELs and NIOSH IDLH values.</p>
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International Chemical Safety Cards

POLYCHLORINATED BIPHENYL (AROCLOR 1254)

ICSC: 0939



Chlorobiphenyl (54% chlorine)
 Chlorodiphenyl (54% chlorine)
 PCB
 Molecular mass: 327 (average)

ICSC # 0939
 CAS # 11097-69-1
 RTECS # TQ1360000
 UN # 2315
 EC # 602-039-00-4
 October 20, 1999 Validated



TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Not combustible. Gives off irritating or toxic fumes (or gases) in a fire.		In case of fire in the surroundings: powder, carbon dioxide.
EXPLOSION			
EXPOSURE		PREVENT GENERATION OF MISTS! STRICT HYGIENE!	
•INHALATION		Ventilation.	Fresh air, rest. Refer for medical attention.
•SKIN	MAY BE ABSORBED! Dry skin. Redness.	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap. Refer for medical attention.
•EYES		Safety goggles, face shield.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
•INGESTION	Headache, Numbness.	Do not eat, drink, or smoke during work.	Rest. Refer for medical attention.
SPILLAGE DISPOSAL		STORAGE	PACKAGING & LABELLING
Consult an expert! Collect leaking liquid in sealable containers. Absorb remaining liquid in sand or inert absorbent and remove to safe place. Do NOT let this chemical enter the environment. Personal protection: complete protective clothing including self-contained breathing apparatus.		Separated from food and feedstuffs. Cool. Dry. Keep in a well-ventilated room.	Unbreakable packaging; put breakable packaging into closed unbreakable container. Do not transport with food and feedstuffs. Severe marine pollutant. Note: C Xn symbol N symbol R: 33-50/53 S: 2-35-60-61 UN Hazard Class: 9 UN Packing Group: II
SEE IMPORTANT INFORMATION ON BACK			
ICSC: 0939		Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994. No modifications to the International version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values.	

International Chemical Safety Cards

POLYCHLORINATED BIPHENYL (AROCLOR 1254)

ICSC: 0939

I M	PHYSICAL STATE; APPEARANCE: LIGHT YELLOW VISCOUS LIQUID.	ROUTES OF EXPOSURE: The substance can be absorbed into the body by inhalation of its aerosol, through the skin and by ingestion.
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P O R T A N T D A T A	PHYSICAL DANGERS:	INHALATION RISK: A harmful contamination of the air will be reached rather slowly on evaporation of this substance at 20°C.
	CHEMICAL DANGERS: The substance decomposes in a fire producing irritating and toxic gases	EFFECTS OF SHORT-TERM EXPOSURE:
	OCCUPATIONAL EXPOSURE LIMITS: TLV: 0.5 mg/m ³ as TWA (skin) A3 (ACGIH 2004). MAK: 0.05 ppm 0.70 mg/m ³ H Peak Irritation category: II(8) Carcinogen category: 3B Pregnancy risk group: B (DFG 2004).	EFFECTS OF LONG-TERM OR REPEATED EXPOSURE: Repeated or prolonged contact with skin may cause dermatitis. The substance may have effects on the liver. Animal tests show that this substance possibly causes toxic effects upon human reproduction.
	OSHA PEL: TWA 0.5 mg/m ³ skin	
	NIOSH REL*: Ca TWA 0.001 mg/m ³ See Appendix A *Note: The REL also applies to other PCBs.	
	NIOSH IDLH: Ca 5 mg/m ³ See: IDLH INDEX	
PHYSICAL PROPERTIES	Relative density (water = 1): 1.5 Solubility in water: none	Vapour pressure, Pa at 25°C: 0.01 Octanol/water partition coefficient as log Pow: 6.30 (estimated)
ENVIRONMENTAL DATA	In the food chain important to humans, bioaccumulation takes place, specifically in aquatic organisms. It is strongly advised not to let the chemical enter into the environment.	
NOTES		
Changes into a resinous state (pour point) at 10°C. Distillation range: 365°-390°C.		
Transport Emergency Card: TEC (R)-90GM2-II-L		
ADDITIONAL INFORMATION		
ICSC: 0939	POLYCHLORINATED BIPHENYL (AROCOR 1254) (C) IPCS, CEC, 1994	
IMPORTANT LEGAL NOTICE:	Neither NIOSH, the CEC or the IPCS nor any person acting on behalf of NIOSH, the CEC or the IPCS is responsible for the use which might be made of this information. This card contains the collective views of the IPCS Peer Review Committee and may not reflect in all cases all the detailed requirements included in national legislation on the subject. The user should verify compliance of the cards with the relevant legislation in the country of use. The only modifications made to produce the U.S. version is inclusion of the OSHA PELs, NIOSH RELs and NIOSH IDLH values	

International Chemical Safety Cards

ALDRIN

ICSC: 0774



1,2,3,4,10,10-Hexachloro-1,4,4a,5,8,8a-hexahydro-exo-1,4-endo-5,8-dimethanonaphthalene
 1,4,5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-,
 (1alpha,4alpha,4aβ,5alpha,8alpha,8aβ)
 HHDN
 $C_{12}H_8Cl_6$
 Molecular mass: 364.9

ICSC # 0774
 CAS # 309-00-2
 RTECS # IO2100000
 UN # 2761
 EC # 602-048-00-3
 March 26, 1998 Validated



TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Not combustible. Liquid formulations containing organic solvents may be flammable. Gives off irritating or toxic fumes (or gases) in a fire.		In case of fire in the surroundings: all extinguishing agents allowed.
EXPLOSION			
EXPOSURE		PREVENT DISPERSION OF DUST! STRICT HYGIENE! AVOID EXPOSURE OF ADOLESCENTS AND CHILDREN!	
•INHALATION	(See Ingestion).	Ventilation (not if powder).	Fresh air, rest. Refer for medical attention.
•SKIN	MAY BE ABSORBED! See Ingestion.	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap. Refer for medical attention.
•EYES		Safety goggles, or face shield.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
•INGESTION	Convulsions. Dizziness. Headache. Nausea. Vomiting. Muscle twitching.	Do not eat, drink, or smoke during work. Wash hands before eating.	Give a slurry of activated charcoal in water to drink. Do NOT induce vomiting. Rest. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Do NOT wash away into sewer. Sweep spilled substance into sealable containers; if appropriate, moisten first to prevent dusting. Carefully collect remainder, then remove to safe place. (Extra personal protection: chemical protection suit including self-contained breathing apparatus).	Provision to contain effluent from fire extinguishing. Separated from food and feedstuffs and incompatible materials: See Chemical Dangers. Well closed. Keep in a well-ventilated room. Store in an area without drain or sewer access.	Do not transport with food and feedstuffs. Severe marine pollutant. T symbol N symbol R: 24/25-40-48/24/25-50/53 S: 1/2-22-36/37-45-60-61 UN Hazard Class: 6.1 UN Packing Group: II
SEE IMPORTANT INFORMATION ON BACK		
ICSC: 0774	Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994. No modifications to the International version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values.	

International Chemical Safety Cards

ALDRIN

ICSC: 0774

<p>I M P O R T A N T D A T A</p>	<p>PHYSICAL STATE; APPEARANCE: COLOURLESS CRYSTALS</p> <p>PHYSICAL DANGERS:</p> <p>CHEMICAL DANGERS: The substance decomposes on heating producing toxic and corrosive fumes including hydrogen chloride. Reacts with acids and oxidants. Attacks many metals in presence of water.</p> <p>OCCUPATIONAL EXPOSURE LIMITS: TLV: 0.25 mg/m³ (as TWA), A3 (skin) (ACGIH 1997). MAK: (Inhalable fraction) 0.25 mg/m³ skin absorption (H); Peak limitation category: II(8) (DFG 2006). OSHA PEL: TWA 0.25 mg/m³ skin NIOSH REL: Ca TWA 0.25 mg/m³ skin <u>See Appendix A</u> NIOSH IDLH: Ca 25 mg/m³ <u>See: 309002</u></p>	<p>ROUTES OF EXPOSURE: The substance can be absorbed into the body through the skin and by ingestion.</p> <p>INHALATION RISK: Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly on spraying.</p> <p>EFFECTS OF SHORT-TERM EXPOSURE: The substance may cause effects on the central nervous system, resulting in convulsions. The effects may be delayed. Medical observation is indicated.</p> <p>EFFECTS OF LONG-TERM OR REPEATED EXPOSURE: The substance accumulates in the human body. Cumulative effects are possible: see Acute Hazards/Symptoms.</p>
<p>PHYSICAL PROPERTIES</p>	<p>Boiling point at 0.27kPa: 145°C Melting point: 104-105°C Density: 1.6 g/cm³</p> <p>Solubility in water: none Vapour pressure, Pa at 20°C: 0.009 Octanol/water partition coefficient as log Pow: 7.4</p>	
<p>ENVIRONMENTAL DATA</p>	<p>The substance is very toxic to aquatic organisms. This substance may be hazardous to the environment; special attention should be given to birds, honey bees. In the food chain important to humans, bioaccumulation takes place, specifically in aquatic organisms. It is strongly advised not to let the chemical enter into the environment because it persists</p> 	

in the environment. The substance may cause long-term effects in the aquatic environment. Avoid release to the environment in circumstances different to normal use.

NOTES

Other melting points: 49-60°C (technical grade). Depending on the degree of exposure, periodic medical examination is indicated. If the substance is formulated with solvent(s) also consult the card(s) (ICSC) of the solvent(s). Carrier solvents used in commercial formulations may change physical and toxicological properties. Do NOT take working clothes home. The recommendations on this Card also apply to ICSC 0787 (dieldrin). Aldrec, Aldrex, Aldrite, Aldron, Aldrosol, Algran, Alttox, Drinox, Octalene, Seedrin, and Toxadrin are trade names.

Transport Emergency Card: TEC (R)-61G41b.
 NFPA Code: H2; F0; R0;

Card has been partially updated in August 2007: see Storage, Occupational Exposure Limits.

ADDITIONAL INFORMATION

ICSC: 0774

ALDRIN

(C) IPCS, CEC, 1994

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International Chemical Safety Cards

ENDRIN

ICSC: 1023



C12H8Cl6O
Molecular mass: 380.9

ICSC # 1023
CAS # 72-20-8
RTECS # IO1575000
UN # 2761
EC # 602-051-00-X
March 10, 2000 Validated



TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Not combustible. Liquid formulations containing organic solvents may be flammable. Gives off irritating or toxic fumes (or gases) in a fire.		In case of fire in the surroundings: all extinguishing agents allowed.
EXPLOSION			
EXPOSURE		PREVENT DISPERSION OF DUST! STRICT HYGIENE!	IN ALL CASES CONSULT A DOCTOR!
•INHALATION	(See Ingestion).	Local exhaust or breathing protection.	Fresh air, rest. Refer for medical attention.
•SKIN	MAY BE ABSORBED!	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap. Refer for medical attention.
•EYES		Face shield or eye protection in combination with breathing protection if powder.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
•INGESTION	Dizziness. Weakness. Headache. Nausea. Vomiting. Convulsions.	Do not eat, drink, or smoke during work. Wash hands before eating.	Give a slurry of activated charcoal in water to drink. Rest. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Do NOT wash away into sewer. Sweep spilled substance into sealable containers; if appropriate, moisten first to prevent dusting. Carefully collect remainder, then remove to safe place. Do NOT let this chemical enter the environment. (Extra personal protection:	Provision to contain effluent from fire extinguishing. Separated from food and feedstuffs Well closed. Keep in a well-ventilated room.	Do not transport with food and feedstuffs. Severe marine pollutant. T+ symbol N symbol R: 24-28-50/53

chemical protection suit including self-contained breathing apparatus).

S: 1/2-22-36/37-45-60-61
UN Hazard Class: 6.1
UN Packing Group: I

SEE IMPORTANT INFORMATION ON BACK

ICSC: 1023

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994. No modifications to the International version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values

International Chemical Safety Cards

ENDRIN

ICSC: 1023

<p>I M P O R T A N T A</p>	<p>PHYSICAL STATE; APPEARANCE: WHITE CRYSTALS</p> <p>PHYSICAL DANGERS:</p> <p>CHEMICAL DANGERS: The substance decomposes on heating above 245°C, producing hydrogen chloride phosgene</p> <p>OCCUPATIONAL EXPOSURE LIMITS: TLV: 0.1 mg/m³ (skin) (ACGIH 2000). OSHA PEL: TWA 0.1 mg/m³ skin NIOSH REL: TWA 0.1 mg/m³ skin NIOSH IDLH: 2 mg/m³ See: <u>72208</u></p>	<p>ROUTES OF EXPOSURE: The substance can be absorbed into the body by inhalation, through the skin and by ingestion.</p> <p>INHALATION RISK: Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly on spraying or when dispersed, especially if powdered.</p> <p>EFFECTS OF SHORT-TERM EXPOSURE: The substance may cause effects on the central nervous system, resulting in convulsions and death. The effects may be delayed. Medical observation is indicated.</p> <p>EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:</p>
<p>PHYSICAL PROPERTIES</p>	<p>Decomposes below boiling point at 245°C Melting point: 200°C Density: 1.7 g/cm³</p>	<p>Solubility in water, g/100 ml at 25°C: none Vapour pressure, Pa at 25°C: negligible Octanol/water partition coefficient as log Pow: 5.34</p>
<p>ENVIRONMENTAL DATA</p>	<p>The substance is very toxic to aquatic organisms. This substance may be hazardous to the environment; special attention should be given to honey bees birds mammals It is strongly advised not to let the chemical enter into the environment because it persists in the environment. In the food chain important to humans, bioaccumulation takes place, specifically in fish seafood Avoid release to the environment in circumstances different to normal use.</p> 	
<p align="center">NOTES</p>		
<p>If the substance is formulated with solvent(s) also consult the card(s) (ICSC) of the solvent(s). Carrier solvents used in commercial formulations may change physical and toxicological properties. Do NOT take working clothes home. Transport Emergency Card: TEC (R)-61G41a</p>		

NFPA Code: H3; F0; R; 0

ADDITIONAL INFORMATION

ICSC: 1023

ENDRIN

(C) IPCS, CEC, 1994

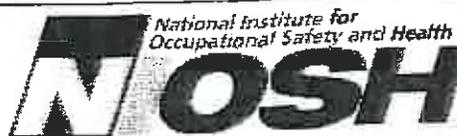
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International Chemical Safety Cards

CHLORDANE (TECHNICAL PRODUCT)

ICSC: 0740



1,2,4,5,6,7,8,8-Octachloro-2,3,3a,4,7,7a-hexahydro-4,7-methanoindene
 1,2,4,5,6,7,8,8-Octachloro-2,3,3a,4,7,7a-hexahydro-4,7-methano-1H-indene
 $C_{10}H_6Cl_8$
 Molecular mass: 409.8

ICSC # 0740
 CAS # 57-74-9
 UN # 2996
 EC # 602-047-00-8
 March 26, 1998 Validated



TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Liquid formulations containing organic solvents may be flammable. Gives off irritating or toxic fumes (or gases) in a fire.	NO open flames.	Alcohol-resistant foam, powder, carbon dioxide.
EXPLOSION			
EXPOSURE		PREVENT GENERATION OF MISTS! STRICT HYGIENE! AVOID EXPOSURE OF ADOLESCENTS AND CHILDREN!	IN ALL CASES CONSULT A DOCTOR!
•INHALATION	(See Ingestion).	Breathing protection.	Fresh air, rest. Refer for medical attention.
•SKIN	MAY BE ABSORBED!	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
•EYES	Redness. Pain.	Safety goggles face shield or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
•INGESTION	Confusion. Convulsions. Nausea. Vomiting.	Do not eat, drink, or smoke during work. Wash hands before eating.	Rest. Refer for medical attention.
SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING	
Collect leaking and spilled liquid in sealable containers as far as possible. Absorb remaining liquid in sand or inert absorbent and remove to safe place. Do NOT wash away into sewer. Personal protection: chemical protection suit	Provision to contain effluent from fire extinguishing. Separated from food and feedstuffs bases and incompatible materials See Chemical Dangers. Well closed. Keep in a well-ventilated room.	Do not transport with food and feeds stuffs. Severe marine pollutant. Xn symbol N symbol	

including self-contained breathing apparatus.

R: 21/22-40-50/53
 S: 2-36/37-60-61
 UN Hazard Class: 6.1
 UN Packing Group: III

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0740

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994. No modifications to the International version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

International Chemical Safety Cards

CHLORDANE (TECHNICAL PRODUCT)

ICSC: 0740

<p>I M P O R T A N T D A T A</p>	<p>PHYSICAL STATE; APPEARANCE: TECHNICAL; LIGHT YELLOW TO AMBER VISCOUS LIQUID</p> <p>PHYSICAL DANGERS:</p> <p>CHEMICAL DANGERS: The substance decomposes on burning, on contact with bases producing toxic fumes including phosgene hydrogen chloride Attacks iron, zinc, plastic, rubber and coatings.</p> <p>OCCUPATIONAL EXPOSURE LIMITS: TLV: 0.5 mg/m³ as TWA (skin) A3 (confirmed animal carcinogen with unknown relevance to humans); (ACGIH 2004). MAK: (Inhalable fraction) 0.5 mg/m³ Peak limitation category: II(8); skin absorption (H); Carcinogen category: 3B; (DFG 2004). OSHA PEL: TWA 0.5 mg/m³ skin NIOSH REL: Ca TWA 0.5 mg/m³ skin <u>See Appendix A</u> NIOSH IDLH: Ca 100 mg/m³ <u>See: 57749</u></p>	<p>ROUTES OF EXPOSURE: The substance can be absorbed into the body by inhalation, through the skin and by ingestion.</p> <p>INHALATION RISK: Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly on spraying.</p> <p>EFFECTS OF SHORT-TERM EXPOSURE: Exposure at high levels may result in disorientation, tremors, convulsions, respiratory failure and death. Medical observation is indicated.</p> <p>EFFECTS OF LONG-TERM OR REPEATED EXPOSURE: The substance may have effects on the liver immune system, resulting in tissue lesions and liver impairment. This substance is possibly carcinogenic to humans.</p>
PHYSICAL PROPERTIES	<p>Boiling point at 0.27kPa: 175°C Relative density (water = 1): 1.59-1.63 Solubility in water: none</p>	<p>Vapour pressure, Pa at 25°C: 0.0013 Octanol/water partition coefficient as log Pow: 2.78</p>
ENVIRONMENTAL DATA	<p>The substance is very toxic to aquatic organisms. This substance may be hazardous to the environment; special attention should be given to soil organisms, honey bees. It is strongly advised that this substance does not enter the environment. The substance may cause long-term effects in the aquatic environment.</p>	
NOTES		
<p>If the substance is formulated with solvents also consult the ICSCs of these materials. Carrier solvents used in commercial formulations may change physical and toxicological properties. Belt, Chlor Kil, Chlortox, Corodan, Gold Crest, Intox,</p>		



Kypchlor, Niran, Octachlor, Sydane, Synklor, Termi-Ded, Topiclor, and Toxichlor are trade names. Also consult ICSC 0743 Heptachlor.

Transport Emergency Card: TEC (R)-61GT6-III

ADDITIONAL INFORMATION

ICSC: 0740

CHLORDANE (TECHNICAL PRODUCT)

(C) IPCS, CEC, 1994

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September 2005

NIOSH Pocket Guide to Chemical Hazards

[NPG Home](#) | [Introduction](#) | [Synonyms & Trade Names](#) | [Chemical Names](#) | [CAS Numbers](#) | [RTECS Numbers](#) | [Appendices](#) | [Search](#)

Chlorinated camphene

CAS 8001-35-2

C₁₀H₁₀Cl₈RTECS [XW5250000](#)

Synonyms & Trade Names

Chlorocamphene, Octachlorocamphene, Polychlorocamphene, Toxaphene

DOT ID & Guide

2761 [151](#)

Exposure

NIOSH REL: Ca [skin] [See Appendix A](#)

Limits

OSHA PEL†: TWA 0.5 mg/m³ [skin]IDLH Ca [200 mg/m³] See:
[8001352](#)[Conversion](#)

Physical Description

Amber, waxy solid with a mild, piney, chloro- and camphor-like odor. [insecticide]

MW: 413.8

BP: Decomposes

MLT: 149-194°F

Sol: 0.0003%

VP(77°F): 0.4 mmHg

IP: ?

Sp.Gr. 1.65

F.P.: NA

UEL: NA

LEL: NA

Noncombustible Solid, but may be dissolved in flammable liquids.

Incompatibilities & Reactivities

Strong oxidizers [Note: Slightly corrosive to metals under moist conditions.]

Measurement Methods

NIOSH [5039](#)See: [NMAM](#) or [OSHA Methods](#)

Personal Protection & Sanitation (See [protection codes](#))

Skin: Prevent skin contact

Eyes: Prevent eye contact

Wash skin: When contaminated/Daily

Remove: When wet or contaminated

Change: Daily

Provide: Eyewash, Quick drench

First Aid (See [procedures](#))

Eye: Irrigate immediately

Skin: Soap wash promptly

Breathing: Respiratory support

Swallow: Medical attention immediately

Respirator Recommendations NIOSH

At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:

(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode

(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:

(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter. [Click here](#) for information on selection of N, R, or P filters./Any appropriate escape-type, self-contained breathing apparatus[Important additional information about respirator selection](#)

Exposure Routes inhalation, skin absorption, ingestion, skin and/or eye contact

Symptoms Nausea, confusion, agitation, tremor, convulsions, unconsciousness; dry, red skin; [potential occupational carcinogen]

Target Organs central nervous system, skin

Cancer Site [in animals: liver cancer]

See also: [INTRODUCTION](#) See [ICSC CARD: 0843](#)

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International Chemical Safety Cards

DDT

ICSC: 0034



Dichlorodiphenyltrichloroethane
 1,1,1-Trichloro-2,2-bis(p-chlorophenyl)ethane
 2,2-bis(p-Chlorophenyl)-1,1,1-trichloroethane
 1,1'-(2,2,2-Trichloroethylidene)bis(4-chlorobenzene)
 p,p'-DDT
C14H9Cl5
 Molecular mass: 354.5

ICSC # 0034
 CAS # 50-29-3
 RTECS # KJ3325000
 UN # 2761
 EC # 602-045-00-7
 April 20, 2004 Validated



TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Combustible. Liquid formulations containing organic solvents may be flammable. Gives off irritating or toxic fumes (or gases) in a fire.	NO open flames.	Powder, water spray, foam, carbon dioxide.
EXPLOSION			
EXPOSURE		PREVENT DISPERSION OF DUST! STRICT HYGIENE! AVOID EXPOSURE OF (PREGNANT) WOMEN!	
•INHALATION	Cough.	Local exhaust or breathing protection.	Fresh air, rest.
•SKIN		Protective gloves.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
•EYES	Redness.	Safety goggles, or eye protection in combination with breathing protection if powder.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
•INGESTION	Tremors. Diarrhoea. Dizziness. Headache. Vomiting. Numbness. Paresthesias. Hyperexcitability. Convulsions.	Do not eat, drink, or smoke during work. Wash hands before eating.	Rinse mouth. Give a slurry of activated charcoal in water to drink. Rest. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Do NOT let this chemical enter the environment. Sweep spilled substance into sealable non-metallic containers; if appropriate, moisten first to prevent dusting. Carefully collect remainder, then remove to safe place. Personal protection: P3 filter respirator for toxic particles.	Provision to contain effluent from fire extinguishing. Separated from iron, aluminum and its salts, food and feedstuffs See Chemical Dangers.	Do not transport with food and feedstuffs. Severe marine pollutant T symbol N symbol R: 25-40-48/25-50/53 S: 1/2-22-36/37-45-60-61 UN Hazard Class: 6.1 UN Packing Group: III

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0034

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International Chemical Safety Cards

DDT

ICSC: 0034

<p>I M P O R T A N T A D D A</p>	<p>PHYSICAL STATE; APPEARANCE: COLOURLESS CRYSTALS WHITE POWDER. TECHNICAL PRODUCT IS WAXY SOLID.</p> <p>PHYSICAL DANGERS:</p> <p>CHEMICAL DANGERS: On combustion, forms toxic and corrosive fumes including hydrogen chloride. Reacts with aluminium and iron.</p> <p>OCCUPATIONAL EXPOSURE LIMITS: TLV: 1 mg/m³ as TWA A3 (ACGIH 2004). MAK: 1 mg/m³ H Peak limitation category: II(8) (DFG 2003). OSHA PEL: TWA 1 mg/m³ skin NIOSH REL: Ca TWA 0.5 mg/m³ <u>See Appendix A</u> NIOSH IDLH: Ca 500 mg/m³ <u>See: 50293</u></p>	<p>ROUTES OF EXPOSURE: The substance can be absorbed into the body by ingestion.</p> <p>INHALATION RISK: Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly especially if powdered.</p> <p>EFFECTS OF SHORT-TERM EXPOSURE: May cause mechanical irritation. The substance may cause effects on the central nervous system, resulting in convulsions and respiratory depression. Exposure at high levels may result in death. Medical observation is indicated.</p> <p>EFFECTS OF LONG-TERM OR REPEATED EXPOSURE: The substance may have effects on the central nervous system and liver. This substance is possibly carcinogenic to humans. Animal tests show that this substance possibly causes toxicity to human reproduction or development.</p>
<p>PHYSICAL PROPERTIES</p>	<p>Boiling point: 260°C Melting point: 109°C Density: 1.6 g/cm³</p>	<p>Solubility in water: poor Octanol/water partition coefficient as log Pow: 6.36</p>
<p>ENVIRONMENTAL DATA</p>	<p>The substance is very toxic to aquatic organisms. This substance may be hazardous to the environment; special attention should be given to birds. Bioaccumulation of this chemical may occur along the food chain, for example in milk and aquatic organisms. This substance does enter the environment under normal use. Great care, however, should be given to avoid any additional release, e.g. through inappropriate disposal.</p>	
<p>NOTES</p>		
<p>Depending on the degree of exposure, periodic medical examination is indicated. Carrier solvents used in commercial formulations may change physical and toxicological properties. Do NOT take working clothes home. Consult national legislation. Agritan, Azotox, Anofex, Ixodex, Gesapon, Gesarex, Gesarol, Guesapon, Clofenotane, Zeidane, Dicophane, Neocid are trade names.</p> <p style="text-align: right;">Transport Emergency Card: TEC (R)-61GT7-III</p>		
<p>ADDITIONAL INFORMATION</p>		
<p>ICSC: 0034</p>	<p>DDT</p>	
<p>(C) IPCS, CEC, 1994</p>		
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International Chemical Safety Cards

SILVER

ICSC: 0810



Argentum
C.I. 77820
Ag

ICSC # 0810
CAS # 7440-22-4
IRTECS # VW3500000
September 10, 1997 Validated

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Not combustible, except as powder.		
EXPLOSION			
EXPOSURE		PREVENT DISPERSION OF DUST!	
• INHALATION		Local exhaust or breathing protection.	Fresh air, rest.
• SKIN		Protective gloves.	Rinse skin with plenty of water or shower.
• EYES		Safety spectacles, or eye protection in combination with breathing protection if powder.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• INGESTION		Do not eat, drink, or smoke during work.	
SPILLAGE DISPOSAL		STORAGE	PACKAGING & LABELLING
Sweep spilled substance into containers: if appropriate, moisten first to prevent dusting. Carefully collect remainder, then remove to safe place. Do NOT let this chemical enter the environment.		Separated from ammonia, strong hydrogen peroxide solutions, strong acids.	
SEE IMPORTANT INFORMATION ON BACK			
ICSC: 0810		Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994. No modifications to the International version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values	

International Chemical Safety Cards

SILVER

ICSC: 0810

I M P O R T A N T A D V I S I T A T I O N A L I N D E X	PHYSICAL STATE; APPEARANCE: WHITE METAL, TURNS DARK ON EXPOSURE TO OZONE, HYDROGEN SULFIDE OR SULFUR.	ROUTES OF EXPOSURE: The substance can be absorbed into the body by inhalation and by ingestion.	
	PHYSICAL DANGERS:	INHALATION RISK: Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly when dispersed.	
	CHEMICAL DANGERS: Shock-sensitive compounds are formed with acetylene. Reacts with acids causing fire hazard. Contact with strong hydrogen peroxide solution will cause violent decomposition to oxygen gas. Contact with ammonia may cause formation of compounds that are explosive when dry.	EFFECTS OF SHORT-TERM EXPOSURE: Inhalation of high amounts of metallic silver vapours may cause lung damage with pulmonary oedema.	
	OCCUPATIONAL EXPOSURE LIMITS: TLV (metal): 0.1 mg/m ³ (ACGIH 1997). EU OEL: 0.1 mg/m ³ as TWA (EU 2000). OSHA PEL: TWA 0.01 mg/m ³ NIOSH REL: TWA 0.01 mg/m ³ NIOSH IDLH: 10 mg/m ³ (as Ag) See: <u>IDLH INDEX</u>	EFFECTS OF LONG-TERM OR REPEATED EXPOSURE: The substance may cause a grey-blue discoloration of the eyes, nose, throat and skin (argyria/argyrosis).	
	PHYSICAL PROPERTIES	Boiling point: 2212°C Melting point: 962°C	Relative density (water = 1): 10.5 Solubility in water: none
	ENVIRONMENTAL DATA	This substance may be hazardous to the environment; special attention should be given to aquatic organisms.	
	NOTES		
	Card has been partially updated in March 2008: see Occupational Exposure Limits.		
	ADDITIONAL INFORMATION		
	ICSC: 0810	SILVER	



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International Chemical Safety Cards

BARIUM

ICSC: 1052



Ba
Atomic mass: 137.3

ICSC # 1052
CAS # 7440-39-3
RTECS # CQ8370000
UN # 1400
October 20, 1999 Validated



TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Flammable. Many reactions may cause fire or explosion.	NO open flames, NO sparks, and NO smoking. NO contact with water.	Special powder, dry sand, NO hydrous agents, NO water.
EXPLOSION	Finely dispersed particles form explosive mixtures in air.	Prevent deposition of dust; closed system, dust explosion-proof electrical equipment and lighting.	
EXPOSURE		PREVENT DISPERSION OF DUST! STRICT HYGIENE!	
•INHALATION	Cough. Sore throat.	Local exhaust or breathing protection.	Fresh air, rest. Refer for medical attention.
•SKIN	Redness.	Protective gloves.	Remove contaminated clothes. Rinse skin with plenty of water or shower. Refer for medical attention.
•EYES	Redness. Pain.	Safety goggles.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
•INGESTION		Do not eat, drink, or smoke during work.	Rinse mouth. Refer for medical attention.
SPILLAGE DISPOSAL		STORAGE	PACKAGING & LABELLING
Sweep spilled substance into sealable containers. Carefully collect remainder, then remove to safe place. Chemical protection suit including self-contained breathing apparatus. Do NOT wash away into sewer.		Separated from halogenated solvents, strong oxidants, acids. Dry. Keep under inert gas, oil or oxygen-free liquid.	UN Hazard Class: 4.3 UN Packing Group: II

SEE IMPORTANT INFORMATION ON BACK

ICSC: 1052

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994. No modifications to the International version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

International Chemical Safety Cards

BARIUM

ICSC: 1052

<p>I M P O R T A N T A I N S</p>	<p>PHYSICAL STATE; APPEARANCE: YELLOWISH TO WHITE LUSTROUS SOLID IN VARIOUS FORMS.</p>	<p>ROUTES OF EXPOSURE: The substance can be absorbed into the body by ingestion.</p>	
	<p>PHYSICAL DANGERS: Dust explosion possible if in powder or granular form, mixed with air.</p>	<p>INHALATION RISK:</p>	
	<p>CHEMICAL DANGERS: The substance may spontaneously ignite on contact with air (if in powder form). The substance is a strong reducing agent and reacts violently with oxidants and acids. Reacts violently with halogenated solvents. Reacts with water, forming flammable/explosive gas (hydrogen - see ICSC0001), causing fire and explosion hazard.</p>	<p>EFFECTS OF SHORT-TERM EXPOSURE: The substance irritates the eyes, the skin and the respiratory tract.</p>	
	<p>OCCUPATIONAL EXPOSURE LIMITS: TLV: 0.5 mg/m³ (as TWA) (ACGIH 1999).</p>	<p>EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:</p>	
	<p>PHYSICAL PROPERTIES</p>	<p>Boiling point: 1640°C Melting point: 725°C Density: 3.6 g/cm³</p>	<p>Solubility in water: reaction</p>
	<p>ENVIRONMENTAL DATA</p>		
	<p>NOTES</p>		
	<p>Reacts violently with fire extinguishing agents such as water, bicarbonate, powder, foam, and carbon dioxide. Rinse contaminated clothes (fire hazard) with plenty of water.</p>		
	<p>Transport Emergency Card: TEC (R)-43G12</p>		
	<p>ADDITIONAL INFORMATION</p>		
<p>ICSC: 1052</p>	<p>BARIUM</p>		
<p>(C) IPCS, CEC, 1994</p>			

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NOTICE:

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International Chemical Safety Cards

ICSC: 0020

CADMIUM



Cd
Atomic mass: 112.4

ICSC # 0020
CAS # 7440-43-9
RTECS # EU9800000
UN # 2570
EC # 048-002-00-0
April 22, 2005 Validated



TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Flammable in powder form and spontaneously combustible in pyrophoric form. Gives off irritating or toxic fumes (or gases) in a fire.	NO open flames, NO sparks, and NO smoking. NO contact with heat or acid(s).	Dry sand. Special powder. NO other agents.
EXPLOSION	Finely dispersed particles form explosive mixtures in air.	Prevent deposition of dust; closed system. dust explosion-proof electrical equipment and lighting.	
EXPOSURE		PREVENT DISPERSION OF DUST! AVOID ALL CONTACT!	IN ALL CASES CONSULT A DOCTOR!
•INHALATION	Cough. Sore throat.	Local exhaust or breathing protection.	Fresh air, rest. Refer for medical attention.
•SKIN		Protective gloves.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
•EYES	Redness. Pain.	Safety goggles or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
•INGESTION	Abdominal pain. Diarrhoea. Headache. Nausea. Vomiting.	Do not eat, drink, or smoke during work.	Rest. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Evacuate danger area! Personal protection: chemical protection suit including self-contained breathing apparatus. Remove all ignition sources. Sweep spilled substance into containers. Carefully collect remainder, then remove to safe place.	Fireproof. Dry. Keep under inert gas. Separated from ignition sources, oxidants acids, food and feedstuffs	Airtight. Unbreakable packaging; put breakable packaging into closed unbreakable container. Do not transport with food and feedstuffs. Note: E T- symbol N symbol

R: 45-26-48/23/25-62-63-68-50/53
 S: 53-45-60-61
 UN Hazard Class: 6.1

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0020

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994. No modifications to the International version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

International Chemical Safety Cards

CADMIUM

ICSC: 0020

<p>I M P O R T A N T D A T A</p>	<p>PHYSICAL STATE; APPEARANCE: SOFT BLUE-WHITE METAL LUMPS OR GREY POWDER. MALLEABLE. TURNS BRITTLE ON EXPOSURE TO 80°C AND TARNISHES ON EXPOSURE TO MOIST AIR.</p>	<p>ROUTES OF EXPOSURE: The substance can be absorbed into the body by inhalation of its aerosol and by ingestion.</p>
	<p>PHYSICAL DANGERS: Dust explosion possible if in powder or granular form, mixed with air.</p>	<p>INHALATION RISK: A harmful concentration of airborne particles can be reached quickly when dispersed, especially if powdered.</p>
	<p>CHEMICAL DANGERS: Reacts with acids forming flammable/explosive gas (hydrogen - see ICSC0001). Dust reacts with oxidants, hydrogen azide, zinc, selenium or tellurium, causing fire and explosion hazard.</p>	<p>EFFECTS OF SHORT-TERM EXPOSURE: The fume is irritating to the respiratory tract. Inhalation of fume may cause lung oedema (see Notes). Inhalation of fumes may cause metal fume fever. The effects may be delayed. Medical observation is indicated.</p>
	<p>OCCUPATIONAL EXPOSURE LIMITS: TLV: (Total dust) 0.01 mg/m³ (Respirable fraction) 0.002 mg/m³ as TWA A2 (suspected human carcinogen); BEI issued (ACGIH 2005). MAK: skin absorption (H); Carcinogen category: 1; Germ cell mutagen group: 3A; (DFG 2004). OSHA PEL*: 1910.1027 TWA 0.005 mg/m³ *Note: The PEL applies to all Cadmium compounds (as Cd). NIOSH REL*: Ca See Appendix A *Note: The REL applies to all Cadmium compounds (as Cd). NIOSH IDLH: Ca 9 mg/m³ (as Cd) See: <u>IDLH INDEX</u></p>	<p>EFFECTS OF LONG-TERM OR REPEATED EXPOSURE: Lungs may be affected by repeated or prolonged exposure to dust particles. The substance may have effects on the kidneys, resulting in kidney impairment. This substance is carcinogenic to humans.</p>
PHYSICAL PROPERTIES	<p>Boiling point: 765°C Melting point: 321°C Density: 8.6 g/cm³</p>	<p>Solubility in water: none Auto-ignition temperature: (cadmium metal dust) 250°C</p>
ENVIRONMENTAL DATA		
NOTES		

Reacts violently with fire extinguishing agents such as water, foam, carbon dioxide and halons. Depending on the degree of exposure, periodic medical examination is indicated. The symptoms of lung oedema often do not become manifest until a few hours have passed and they are aggravated by physical effort. Rest and medical observation are therefore essential. Do NOT take working clothes home. Cadmium also exists in a pyrophoric form (EC No. 048-011-00-X), which bears the additional EU labelling symbol F, R phrase 17, and S phrases 7/8 and 43. UN numbers and packing group will vary according to the physical form of the substance.

ADDITIONAL INFORMATION

ICSC: 0020

CADMIUM

(C) IPCS, CEC, 1994

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NOTICE:**

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International Chemical Safety Cards

SELENIUM

ICSC: 0072



Se
(powder)

ICSC # 0072
 CAS # 7782-49-2
 RTECS # VS7700000
 EC # 034-001-00-2
 April 26, 1993 Validated

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Combustible. Gives off irritating or toxic fumes (or gases) in a fire.	NO open flames. NO contact with oxidants.	Powder, AFFF, foam, carbon dioxide. NO water
EXPLOSION	Risk of fire and explosion on contact with oxidants.		
EXPOSURE		PREVENT DISPERSION OF DUST! STRICT HYGIENE!	
•INHALATION	Irritation of nose. Cough. Dizziness. Headache. Laboured breathing. Nausea. Sore throat. Vomiting. Weakness. Symptoms may be delayed (see Notes).	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Refer for medical attention.
•SKIN	Redness. Skin burns. Pain. Discolouration.	Protective gloves. Protective clothing.	Rinse skin with plenty of water or shower. Refer for medical attention. Remove and isolate contaminated clothes.
•EYES	Redness. Pain. Blurred vision.	Safety spectacles or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
•INGESTION	Metallic taste. Diarrhoea. Chills. Fever. (Further see Inhalation).	Do not eat, drink, or smoke during work.	Rinse mouth. Induce vomiting (ONLY IN CONSCIOUS PERSONS!). Refer for medical attention.
SPILLAGE DISPOSAL		STORAGE	PACKAGING & LABELLING
Do NOT wash away into sewer. Sweep spilled substance into containers; if appropriate, moisten first to prevent dusting. Carefully collect remainder, then remove to safe place. Personal protection: P3 filter respirator for toxic particles.		Fireproof. Separated from strong oxidants, strong acids, food and feedstuffs Dry.	Airtight. Do not transport with food and feedstuffs. T symbol R: 23/25-33-53 S: 1/2-20/21-28-45-61

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0072

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994. No modifications to the International version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

International Chemical Safety Cards

SELENIUM

ICSC: 0072

I M P O R T A N T I N F O R M A T I O N	<p>PHYSICAL STATE; APPEARANCE: ODOURLESS SOLID IN VARIOUS FORMS. DARK RED-BROWN TO BLUISH-BLACK AMORPHOUS SOLID OR RED TRANSPARENT CRYSTALS OR METALLIC GREY TO BLACK CRYSTALS.</p> <p>PHYSICAL DANGERS:</p> <p>CHEMICAL DANGERS: Upon heating, toxic fumes are formed. Reacts violently with oxidants strong acids Reacts with water at 50°C forming flammable/explosive gas (hydrogen - see ICSC0001) and selenious acids. Reacts with incandescence on gentle heating with phosphorous and metals such as nickel, zinc, sodium, potassium, platinum.</p> <p>OCCUPATIONAL EXPOSURE LIMITS: TLV: 0.2 mg/m³ as TWA (ACGIH 2004). MAK: (Inhalable fraction) 0.05 mg/m³ Peak limitation category: II(4); Carcinogen category: 3B; Pregnancy risk group: C; (DFG 2004). OSHA PEL*: TWA 0.2 mg/m³ *Note: The PEL also applies to other selenium compounds (as Se) except Selenium hexafluoride. NIOSH REL*: TWA 0.2 mg/m³ *Note: The REL also applies to other selenium compounds (as Se) except Selenium hexafluoride. NIOSH IDLH: 1 mg/m³ (as Se) See: 7782492</p>	<p>ROUTES OF EXPOSURE: The substance can be absorbed into the body by inhalation, through the skin and by ingestion.</p> <p>INHALATION RISK: Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly when dispersed.</p> <p>EFFECTS OF SHORT-TERM EXPOSURE: The substance is irritating to the eyes and the respiratory tract. Inhalation of dust may cause lung oedema (see Notes). Inhalation of fume may cause symptoms of asphyxiation, chills and fever and bronchitis. The effects may be delayed.</p> <p>EFFECTS OF LONG-TERM OR REPEATED EXPOSURE: Repeated or prolonged contact with skin may cause dermatitis. The substance may have effects on the respiratory tract, gastrointestinal tract, and skin, resulting in nausea, vomiting, cough, yellowish skin discoloration, loss of nails, garlic breath and bad teeth.</p>
	<p>PHYSICAL PROPERTIES</p> <p>Boiling point: 685°C Melting point: 170-217°C Relative density (water = 1): 4.8</p> <p>Solubility in water: none Vapour pressure, Pa at 20°C: 0.1</p>	
<p>ENVIRONMENTAL DATA</p>		
<p>NOTES</p> <p>Do NOT take working clothes home.</p>		
<p>ADDITIONAL INFORMATION</p>		

ICSC: 0072

SELENIUM

(C) IPCS, CEC, 1994

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International Chemical Safety Cards

LEAD

ICSC: 0052



Lead metal
Plumbum
Pb
(powder)

ICSC # 0052
CAS # 7439-92-1
RTECS # OF7525000
August 10, 2002 Validated

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Not combustible. Gives off irritating or toxic fumes (or gases) in a fire.		In case of fire in the surroundings: use appropriate extinguishing media.
EXPLOSION	Finely dispersed particles form explosive mixtures in air.	Prevent deposition of dust; closed system, dust explosion-proof electrical equipment and lighting.	
EXPOSURE	See EFFECTS OF LONG-TERM OR REPEATED EXPOSURE.	PREVENT DISPERSION OF DUST! AVOID EXPOSURE OF (PREGNANT) WOMEN!	
• INHALATION		Local exhaust or breathing protection.	Fresh air, rest.
• SKIN		Protective gloves.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
• EYES		Safety spectacles.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• INGESTION	Abdominal pain. Nausea. Vomiting.	Do not eat, drink, or smoke during work. Wash hands before eating.	Rinse mouth. Give plenty of water to drink. Refer for medical attention.
SPILLAGE DISPOSAL		STORAGE	PACKAGING & LABELLING
Sweep spilled substance into containers; if appropriate, moisten first to prevent dusting. Carefully collect remainder, then remove to safe place. Do NOT let this chemical enter the environment. Personal protection: P3 filter respirator for toxic particles.		Separated from food and feedstuffs incompatible materials See Chemical Dangers.	

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0052

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994. No modifications to the International version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values

International Chemical Safety Cards

LEAD

ICSC: 0052

<p>I M P O R T A N T I N F O R M A T I O N</p>	<p>PHYSICAL STATE; APPEARANCE: BLUISH-WHITE OR SILVERY-GREY SOLID IN VARIOUS FORMS. TURNS TARNISHED ON EXPOSURE TO AIR.</p>	<p>ROUTES OF EXPOSURE: The substance can be absorbed into the body by inhalation and by ingestion.</p>
	<p>PHYSICAL DANGERS: Dust explosion possible if in powder or granular form, mixed with air.</p>	<p>INHALATION RISK: A harmful concentration of airborne particles can be reached quickly when dispersed, especially if powdered.</p>
	<p>CHEMICAL DANGERS: On heating, toxic fumes are formed. Reacts with oxidants. Reacts with hot concentrated nitric acid, boiling concentrated hydrochloric acid and sulfuric acid. Attacked by pure water and by weak organic acids in the presence of oxygen.</p>	<p>EFFECTS OF SHORT-TERM EXPOSURE:</p>
	<p>OCCUPATIONAL EXPOSURE LIMITS: TLV: 0.05 mg/m³ as TWA A3 (confirmed animal carcinogen with unknown relevance to humans); BEI issued (ACGIH 2004). MAK: Carcinogen category: 2; Germ cell mutagen group: 3A; (DFG 2006). EU OEL: as TWA 0.15 mg/m³ (EU 2002). OSHA PEL*: 1910.1025 TWA 0.050 mg/m³ See <u>Appendix C</u> *Note: The PEL also applies to other lead compounds (as Pb) -- see <u>Appendix C</u>. NIOSH REL*: TWA 0.050 mg/m³ See <u>Appendix C</u> *Note: The REL also applies to other lead compounds (as Pb) -- see <u>Appendix C</u>. NIOSH IDLH: 100 mg/m³ (as Pb) See: <u>7439921</u></p>	<p>EFFECTS OF LONG-TERM OR REPEATED EXPOSURE: The substance may have effects on the blood bone marrow central nervous system peripheral nervous system kidneys, resulting in anaemia, encephalopathy (e.g., convulsions), peripheral nerve disease, abdominal cramps and kidney impairment. Causes toxicity to human reproduction or development. This substance is probably carcinogenic to humans. fast track change Oct 06 - IARC 2A.</p>
PHYSICAL PROPERTIES	<p>Boiling point: 1740°C Melting point: 327.5°C</p>	<p>Density: 11.34 g/cm³ Solubility in water: none</p>
ENVIRONMENTAL DATA	<p>Bioaccumulation of this chemical may occur in plants and in mammals. It is strongly advised that this substance does not enter the environment.</p>	
NOTES		
<p>Depending on the degree of exposure, periodic medical examination is suggested. Do NOT take working clothes home. Card has been partly updated in April 2005. See section Occupational Exposure Limits. Card has been partly updated in October 2006: see section Occupational Exposure Limits, Effects Long Tem Exposure.</p>		



ADDITIONAL INFORMATION	
ICSC: 0052	LEAD
(C) IPCS, CEC, 1994	
IMPORTANT LEGAL NOTICE:	<p>Neither NIOSH, the CEC or the IPCS nor any person acting on behalf of NIOSH, the CEC or the IPCS is responsible for the use which might be made of this information. This card contains the collective views of the IPCS Peer Review Committee and may not reflect in all cases all the detailed requirements included in national legislation on the subject. The user should verify compliance of the cards with the relevant legislation in the country of use. The only modifications made to produce the U.S. version is inclusion of the OSHA PELs, NIOSH RELs and NIOSH IDLH values.</p>

International Chemical Safety Cards

MERCURY

ICSC: 0056



Quicksilver
Liquid silver
Hg

ICSC # 0056
CAS # 7439-97-6
RTECS # OY4550000
UN # 2809
EC # 080-001-00-0
April 22, 2004 Validated



TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Not combustible. Gives off irritating or toxic fumes (or gases) in a fire.		In case of fire in the surroundings: use appropriate extinguishing media.
EXPLOSION	Risk of fire and explosion.		In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE		STRICT HYGIENE! AVOID EXPOSURE OF (PREGNANT) WOMEN! AVOID EXPOSURE OF ADOLESCENTS AND CHILDREN!	IN ALL CASES CONSULT A DOCTOR!
•INHALATION	Abdominal pain. Cough. Diarrhoea. Shortness of breath. Vomiting. Fever or elevated body temperature.	Local exhaust or breathing protection.	Fresh air, rest. Artificial respiration if indicated. Refer for medical attention.
•SKIN	MAY BE ABSORBED! Redness.	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap. Refer for medical attention.
•EYES		Face shield, or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
•INGESTION		Do not eat, drink, or smoke during work. Wash hands before eating.	Refer for medical attention.
SPILLAGE DISPOSAL		STORAGE	PACKAGING & LABELLING
Evacuate danger area in case of a large spill! Consult an expert! Ventilation. Collect leaking and spilled liquid in		Provision to contain effluent from fire extinguishing. Separated from food and feedstuffs Well closed.	Special material. Do not transport with food and feedstuffs. T symbol

sealable non-metallic containers as far as possible. Do NOT wash away into sewer. Do NOT let this chemical enter the environment. Chemical protection suit including self-contained breathing apparatus.

N symbol
R: 23-33-50/53
S: 1/2-7-45-60-61
UN Hazard Class: 8
UN Packing Group: III

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0056

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994. No modifications to the International version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

International Chemical Safety Cards

ICSC: 0056

MERCURY

<p>I M P O R T A N T D A T A</p>	<p>PHYSICAL STATE; APPEARANCE: ODOURLESS, HEAVY AND MOBILE SILVERY LIQUID METAL.</p> <p>PHYSICAL DANGERS:</p> <p>CHEMICAL DANGERS: Upon heating, toxic fumes are formed. Reacts violently with ammonia and halogens causing fire and explosion hazard. Attacks aluminium and many other metals forming amalgams.</p> <p>OCCUPATIONAL EXPOSURE LIMITS: TLV: 0.025 mg/m³ as TWA (skin) A4 BEI issued (ACGIH 2004). MAK: 0.1 mg/m³ Sh Peak limitation category: II(8) Carcinogen category: 3B (DFG 2003). OSHA PEL†: C 0.1 mg/m³ NIOSH REL: Hg Vapor: TWA 0.05 mg/m³ skin Other: C 0.1 mg/m³ skin NIOSH IDLH: 10 mg/m³ (as Hg) See: <u>7439976</u></p>	<p>ROUTES OF EXPOSURE: The substance can be absorbed into the body by inhalation of its vapour and through the skin, also as a vapour!</p> <p>INHALATION RISK: A harmful contamination of the air can be reached very quickly on evaporation of this substance at 20°C.</p> <p>EFFECTS OF SHORT-TERM EXPOSURE: The substance is irritating to the skin. Inhalation of the vapours may cause pneumonitis. The substance may cause effects on the central nervous system and kidneys. The effects may be delayed. Medical observation is indicated.</p> <p>EFFECTS OF LONG-TERM OR REPEATED EXPOSURE: The substance may have effects on the central nervous system kidneys, resulting in irritability, emotional instability, tremor, mental and memory disturbances, speech disorders. Danger of cumulative effects. Animal tests show that this substance possibly causes toxic effects upon human reproduction.</p>
<p>PHYSICAL PROPERTIES</p>	<p>Boiling point: 357°C Melting point: -39°C Relative density (water = 1): 13.5 Solubility in water: none</p>	<p>Vapour pressure, Pa at 20°C: 0.26 Relative vapour density (air = 1): 6.93 Relative density of the vapour/air-mixture at 20°C (air = 1): 1.009</p>
<p>ENVIRONMENTAL DATA</p>	<p>The substance is very toxic to aquatic organisms. In the food chain important to humans, bioaccumulation takes place, specifically in fish.</p> 	
<p>NOTES</p>		

Depending on the degree of exposure, periodic medical examination is indicated. No odour warning if toxic concentrations are present. Do NOT take working clothes home.

Transport Emergency Card: TEC (R)-80GC9-II+III

ADDITIONAL INFORMATION

ICSC: 0056

MERCURY

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International Chemical Safety Cards

ICSC: 0013

ARSENIC



Grey arsenic
As
Atomic mass: 74.9

ICSC # 0013
CAS # 7440-38-2
RTECS # CG0525000
UN # 1558
EC # 033-001-00-X
October 18, 1999 Validated



TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Combustible. Gives off irritating or toxic fumes (or gases) in a fire.	NO open flames. NO contact with strong oxidizers. NO contact with hot surfaces.	Powder, water spray, foam, carbon dioxide.
EXPLOSION	Risk of fire and explosion is slight when exposed to hot surfaces or flames in the form of fine powder or dust.	Prevent deposition of dust, closed system, dust explosion-proof electrical equipment and lighting.	
EXPOSURE		PREVENT DISPERSION OF DUST! AVOID ALL CONTACT! AVOID EXPOSURE OF (PREGNANT) WOMEN!	IN ALL CASES CONSULT A DOCTOR!
•INHALATION	Cough. Sore throat. Shortness of breath. Weakness. See Ingestion.	Closed system and ventilation.	Fresh air, rest. Artificial respiration may be needed. Refer for medical attention.
•SKIN	Redness.	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse skin with plenty of water or shower.
•EYES	Redness.	Face shield or eye protection in combination with breathing protection if powder.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
•INGESTION	Abdominal pain. Diarrhoea. Nausea. Vomiting. Burning sensation in the throat and chest. Shock or collapse. Unconsciousness.	Do not eat, drink, or smoke during work. Wash hands before eating.	Rinse mouth. Induce vomiting (ONLY IN CONSCIOUS PERSONS!). Refer for medical attention.

SPILLAGE DISPOSAL STORAGE PACKAGING & LABELLING

Evacuate danger area! Sweep spilled substance into sealable containers. Carefully collect remainder, then remove to safe place. Chemical protection suit including self-contained breathing apparatus. Do NOT let this chemical enter the environment.	Separated from strong oxidants, acids, halogens, food and feedstuffs. Well closed.	Do not transport with food and feedstuffs. Marine pollutant. T symbol N symbol R: 23/25-50/53 S: 1/2-20/21-28-45-60-61 UN Hazard Class: 6.1 UN Packing Group: II
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SEE IMPORTANT INFORMATION ON BACK

ICSC: 0013

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International Chemical Safety Cards

ARSENIC

ICSC: 0013

I M P O R T A N T D A T A	<p>PHYSICAL STATE; APPEARANCE: ODOURLESS, BRITTLE, GREY, METALLIC-LOOKING CRYSTALS.</p> <p>PHYSICAL DANGERS:</p> <p>CHEMICAL DANGERS: Upon heating, toxic fumes are formed. Reacts violently with strong oxidants and halogens, causing fire and explosion hazard. Reacts with acids to produce</p> <p>OCCUPATIONAL EXPOSURE LIMITS: OSHA PEL: 1910.1018 TWA 0.010 mg/m³ NIOSH REL: Ca C 0.002 mg/m³ 15-minute <u>See Appendix A</u> NIOSH IDLH: Ca 5 mg/m³ (as As) See: <u>7440382</u> TLV: 0.01 mg/m³ as TWA A1 (confirmed human carcinogen); BEI issued (ACGIH 2004). MAK: Carcinogen category: 1; Germ cell mutagen group: 3A; (DFG 2004).</p>	<p>ROUTES OF EXPOSURE: The substance can be absorbed into the body by inhalation of its aerosol and by ingestion.</p> <p>INHALATION RISK: Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly, when dispersed.</p> <p>EFFECTS OF SHORT-TERM EXPOSURE: The substance is irritating to the eyes the skin and the respiratory tract. The substance may cause effects on the gastrointestinal tract cardiovascular system central nervous system kidneys, resulting in severe gastroenteritis, loss of fluid, and electrolytes, cardiac disorders shock convulsions and kidney impairment Exposure above the OEL may result in death. The effects may be delayed. Medical observation is indicated.</p> <p>EFFECTS OF LONG-TERM OR REPEATED EXPOSURE: Repeated or prolonged contact with skin may cause dermatitis. The substance may have effects on the mucous membranes, skin, peripheral nervous system liver bone marrow, resulting in pigmentation disorders, hyperkeratosis, perforation of nasal septum, neuropathy, liver impairment anaemia This substance is carcinogenic to humans. Animal tests show that this substance possibly causes toxicity to human reproduction or development.</p>
	<p>PHYSICAL PROPERTIES</p> <p>Sublimation point: 613°C Density: 5.7 g/cm³</p>	<p>Solubility in water: none</p>

ENVIRONMENTAL DATA	The substance is toxic to aquatic organisms. It is strongly advised that this substance does not enter the environment.	
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NOTES

The substance is combustible but no flash point is available in literature. Depending on the degree of exposure, periodic medical examination is suggested. Do NOT take working clothes home. Refer also to cards for specific arsenic compounds, e.g., Arsenic pentoxide (ICSC 0377), Arsenic trichloride (ICSC 0221), Arsenic trioxide (ICSC 0378), Arsine (ICSC 0222).
 Transport Emergency Card: TEC (R)-61GT5-II

ADDITIONAL INFORMATION

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ICSC: 0013	(C) IPCS, CEC, 1994	ARSENIC
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International Chemical Safety Cards

CHROMIUM

ICSC: 0029



Chrome
Cr
Atomic mass: 52.0
(powder)

ICSC # 0029
CAS # 7440-47-3
RTECS # GB4200000
October 27, 2004 Validated

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Combustible under specific conditions.	No open flames if in powder form.	In case of fire in the surroundings: use appropriate extinguishing media.
EXPLOSION		Prevent deposition of dust; closed system, dust explosion-proof electrical equipment and lighting.	
EXPOSURE		PREVENT DISPERSION OF DUST!	
• INHALATION	Cough.	Local exhaust or breathing protection.	Fresh air, rest.
• SKIN		Protective gloves.	Remove contaminated clothes. Rinse skin with plenty of water or shower.
• EYES	Redness.	Safety goggles.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• INGESTION		Do not eat, drink, or smoke during work.	Rinse mouth.
SPILLAGE DISPOSAL		STORAGE	PACKAGING & LABELLING
Sweep spilled substance into containers; if appropriate, moisten first to prevent dusting. Personal protection: P2 filter respirator for harmful particles.			

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0029

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994. No modifications to the International version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

International Chemical Safety Cards

ICSC: 0029

CHROMIUM

I M P O R T A N T I N F O R M A T I O N	PHYSICAL STATE; APPEARANCE: GREY POWDER	ROUTES OF EXPOSURE:
	PHYSICAL DANGERS: Dust explosion possible if in powder or granular form, mixed with air.	INHALATION RISK: A harmful concentration of airborne particles can be reached quickly when dispersed.
	CHEMICAL DANGERS: Chromium is a catalytic substance and may cause reaction in contact with many organic and inorganic substances, causing fire and explosion hazard.	EFFECTS OF SHORT-TERM EXPOSURE: May cause mechanical irritation to the eyes and the respiratory tract.
	OCCUPATIONAL EXPOSURE LIMITS: TLV: (as Cr metal, Cr(III) compounds) 0.5 mg/m ³ as TWA A4 (ACGIH 2004). MAK not established.	EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:
	OSHA PEL*: TWA 1 mg/m ³ See Appendix C *Note: The PEL also applies to insoluble chromium salts.	
	NIOSH REL: TWA 0.5 mg/m ³ See Appendix C	
	NIOSH IDLH: 250 mg/m ³ (as Cr) See: 7440473	

PHYSICAL PROPERTIES	Boiling point: 2642°C Melting point: 1900°C Density: 7.15 g/cm ³	Solubility in water: none
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ENVIRONMENTAL DATA	
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NOTES	
The surface of the chromium particles is oxidized to chromium(III)oxide in air. See ICSC 1531 Chromium(III) oxide.	

ADDITIONAL INFORMATION	

ICSC: 0029	(C) IPCS, CEC, 1994	CHROMIUM
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IMPORTANT LEGAL NOTICE:	Neither NIOSH, the CEC or the IPCS nor any person acting on behalf of NIOSH, the CEC or the IPCS is responsible for the use which might be made of this information. This card contains the collective views of the IPCS Peer Review Committee and may not reflect in all cases all the detailed requirements included in national legislation on the subject. The user should verify compliance of the cards with the relevant legislation in the country of use. The only modifications made to produce the U.S. version is inclusion of the OSHA PELs, NIOSH RELs and NIOSH IDLH values.
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Appendix B

Respirator Fit Test Procedures



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- **Part Number:** 1910
- **Part Title:** Occupational Safety and Health Standards
- **Subpart:** I
- **Subpart Title:** Personal Protective Equipment
- **Standard Number:** [1910.134 App A](#)
- **Title:** Fit Testing Procedures (Mandatory).

Appendix A to § 1910.134: Fit Testing Procedures (Mandatory)

Part I. OSHA-Accepted Fit Test Protocols

A. Fit Testing Procedures -- General Requirements

The employer shall conduct fit testing using the following procedures. The requirements in this appendix apply to all OSHA-accepted fit test methods, both QLFT and QNFT.

1. The test subject shall be allowed to pick the most acceptable respirator from a sufficient number of respirator models and sizes so that the respirator is acceptable to, and correctly fits, the user.
2. Prior to the selection process, the test subject shall be shown how to put on a respirator, how it should be positioned on the face, how to set strap tension and how to determine an acceptable fit. A mirror shall be available to assist the subject in evaluating the fit and positioning of the respirator. This instruction may not constitute the subject's formal training on respirator use, because it is only a review.
3. The test subject shall be informed that he/she is being asked to select the respirator that provides the most acceptable fit. Each respirator represents a different size and shape, and if fitted and used properly, will provide adequate protection.
4. The test subject shall be instructed to hold each chosen facepiece up to the face and eliminate those that obviously do not give an acceptable fit.
5. The more acceptable facepieces are noted in case the one selected proves unacceptable; the most comfortable mask is donned and worn at least five minutes to assess comfort. Assistance in assessing comfort can be given by discussing the points in the following item A.6. If the test subject is not familiar with using a particular respirator, the test subject shall be directed to don the mask several times and to adjust the straps each time to become adept at setting proper tension on the straps.
6. Assessment of comfort shall include a review of the following points with the test subject and allowing the test subject adequate time to determine the comfort of the respirator:
 - (a) Position of the mask on the nose
 - (b) Room for eye protection
 - (c) Room to talk
 - (d) Position of mask on face and cheeks
7. The following criteria shall be used to help determine the adequacy of the respirator fit:
 - (a) Chin properly placed;
 - (b) Adequate strap tension, not overly tightened;
 - (c) Fit across nose bridge;
 - (d) Respirator of proper size to span distance from nose to chin;
 - (e) Tendency of respirator to slip;
 - (f) Self-observation in mirror to evaluate fit and respirator position.
8. The test subject shall conduct a user seal check, either the negative and positive pressure seal checks described in Appendix B-1 of this section or those recommended by the respirator manufacturer which provide equivalent protection to the procedures in Appendix B-1. Before conducting the negative and positive pressure checks, the subject shall be told to seat the mask on the face by moving the head from side-to-side and up and down slowly while taking in a few slow deep breaths. Another facepiece shall be selected and retested if the test subject fails the user seal check tests.
9. The test shall not be conducted if there is any hair growth between the skin and the facepiece sealing surface, such as stubble beard growth, beard, mustache or sideburns which cross the respirator sealing surface. Any type of apparel which interferes with a satisfactory fit shall be altered or removed.

10. If a test subject exhibits difficulty in breathing during the tests, she or he shall be referred to a physician or other licensed health care professional, as appropriate, to determine whether the test subject can wear a respirator while performing her or his duties.
11. If the employee finds the fit of the respirator unacceptable, the test subject shall be given the opportunity to select a different respirator and to be retested.
12. Exercise regimen. Prior to the commencement of the fit test, the test subject shall be given a description of the fit test and the test subject's responsibilities during the test procedure. The description of the process shall include a description of the test exercises that the subject will be performing. The respirator to be tested shall be worn for at least 5 minutes before the start of the fit test.
13. The fit test shall be performed while the test subject is wearing any applicable safety equipment that may be worn during actual respirator use which could interfere with respirator fit.
14. Test Exercises.

(a) Employers must perform the following test exercises for all fit testing methods prescribed in this appendix, except for the CNP quantitative fit testing protocol and the CNP REDON quantitative fit testing protocol. For these two protocols, employers must ensure that the test subjects (*i.e.*, employees) perform the exercise procedure specified in Part I.C.4(b) of this appendix for the CNP quantitative fit testing protocol, or the exercise procedure described in Part I.C.5(b) of this appendix for the CNP REDON quantitative fit-testing protocol. For the remaining fit testing methods, employers must ensure that employees perform the test exercises in the appropriate test environment in the following manner:

- (1) Normal breathing. In a normal standing position, without talking, the subject shall breathe normally.
- (2) Deep breathing. In a normal standing position, the subject shall breathe slowly and deeply, taking caution so as not to hyperventilate.
- (3) Turning head side to side. Standing in place, the subject shall slowly turn his/her head from side to side between the extreme positions on each side. The head shall be held at each extreme momentarily so the subject can inhale at each side.
- (4) Moving head up and down. Standing in place, the subject shall slowly move his/her head up and down. The subject shall be instructed to inhale in the up position (*i.e.*, when looking toward the ceiling).
- (5) Talking. The subject shall talk out loud slowly and loud enough so as to be heard clearly by the test conductor. The subject can read from a prepared text such as the Rainbow Passage, count backward from 100, or recite a memorized poem or song.

Rainbow Passage

When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch, with its path high above, and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look, but no one ever finds it. When a man looks for something beyond reach, his friends say he is looking for the pot of gold at the end of the rainbow.

- (6) Grimace. The test subject shall grimace by smiling or frowning. (This applies only to QNFT testing; it is not performed for QLFT)
- (7) Bending over. The test subject shall bend at the waist as if he/she were to touch his/her toes. Jogging in place shall be substituted for this exercise in those test environments such as shroud type QNFT or QLFT units that do not permit bending over at the waist.
- (8) Normal breathing. Same as exercise (1).

(b) Each test exercise shall be performed for one minute except for the grimace exercise which shall be performed for 15 seconds. The test subject shall be questioned by the test conductor regarding the comfort of the respirator upon completion of the protocol. If it has become unacceptable, another model of respirator shall be tried. The respirator shall not be adjusted once the fit test exercises begin. Any adjustment voids the test, and the fit test must be repeated.

B. Qualitative Fit Test (QLFT) Protocols

1. General

- (a) The employer shall ensure that persons administering QLFT are able to prepare test solutions, calibrate equipment and perform tests properly, recognize invalid tests, and ensure that test equipment is in proper working order.
- (b) The employer shall ensure that QLFT equipment is kept clean and well maintained so as to operate within the parameters for which it was designed.

2. Isoamyl Acetate Protocol

Note: This protocol is not appropriate to use for the fit testing of particulate respirators. If used to fit test particulate respirators, the respirator must be equipped with an organic vapor filter.

(a) Odor Threshold Screening

Odor threshold screening, performed without wearing a respirator, is intended to determine if the individual tested can detect the odor of isoamyl acetate at low levels.

- (1) Three 1 liter glass jars with metal lids are required.
- (2) Odor-free water (*e.a.*, distilled or spring water) at approximately 25 deg. C (77 deg. F) shall be used for the

solutions.

(3) The isoamyl acetate (IAA) (also known as isopentyl acetate) stock solution is prepared by adding 1 ml of pure IAA to 800 ml of odor-free water in a 1 liter jar, closing the lid and shaking for 30 seconds. A new solution shall be prepared at least weekly.

(4) The screening test shall be conducted in a room separate from the room used for actual fit testing. The two rooms shall be well-ventilated to prevent the odor of IAA from becoming evident in the general room air where testing takes place.

(5) The odor test solution is prepared in a second jar by placing 0.4 ml of the stock solution into 500 ml of odor-free water using a clean dropper or pipette. The solution shall be shaken for 30 seconds and allowed to stand for two to three minutes so that the IAA concentration above the liquid may reach equilibrium. This solution shall be used for only one day.

(6) A test blank shall be prepared in a third jar by adding 500 cc of odor-free water.

(7) The odor test and test blank jar lids shall be labeled (e.g., 1 and 2) for jar identification. Labels shall be placed on the lids so that they can be peeled off periodically and switched to maintain the integrity of the test.

(8) The following instruction shall be typed on a card and placed on the table in front of the two test jars (i.e., 1 and 2): "The purpose of this test is to determine if you can smell banana oil at a low concentration. The two bottles in front of you contain water. One of these bottles also contains a small amount of banana oil. Be sure the covers are on tight, then shake each bottle for two seconds. Unscrew the lid of each bottle, one at a time, and sniff at the mouth of the bottle. Indicate to the test conductor which bottle contains banana oil."

(9) The mixtures used in the IAA odor detection test shall be prepared in an area separate from where the test is performed, in order to prevent olfactory fatigue in the subject.

(10) If the test subject is unable to correctly identify the jar containing the odor test solution, the IAA qualitative fit test shall not be performed.

(11) If the test subject correctly identifies the jar containing the odor test solution, the test subject may proceed to respirator selection and fit testing.

(b) Isoamyl Acetate Fit Test

(1) The fit test chamber shall be a clear 55-gallon drum liner suspended inverted over a 2-foot diameter frame so that the top of the chamber is about 6 inches above the test subject's head. If no drum liner is available, a similar chamber shall be constructed using plastic sheeting. The inside top center of the chamber shall have a small hook attached.

(2) Each respirator used for the fitting and fit testing shall be equipped with organic vapor cartridges or offer protection against organic vapors.

(3) After selecting, donning, and properly adjusting a respirator, the test subject shall wear it to the fit testing room. This room shall be separate from the room used for odor threshold screening and respirator selection, and shall be well-ventilated, as by an exhaust fan or lab hood, to prevent general room contamination.

(4) A copy of the test exercises and any prepared text from which the subject is to read shall be taped to the inside of the test chamber.

(5) Upon entering the test chamber, the test subject shall be given a 6-inch by 5-inch piece of paper towel, or other porous, absorbent, single-ply material, folded in half and wetted with 0.75 ml of pure IAA. The test subject shall hang the wet towel on the hook at the top of the chamber. An IAA test swab or ampule may be substituted for the IAA wetted paper towel provided it has been demonstrated that the alternative IAA source will generate an IAA test atmosphere with a concentration equivalent to that generated by the paper towel method.

(6) Allow two minutes for the IAA test concentration to stabilize before starting the fit test exercises. This would be an appropriate time to talk with the test subject; to explain the fit test, the importance of his/her cooperation, and the purpose for the test exercises; or to demonstrate some of the exercises.

(7) If at any time during the test, the subject detects the banana-like odor of IAA, the test is failed. The subject shall quickly exit from the test chamber and leave the test area to avoid olfactory fatigue.

(8) If the test is failed, the subject shall return to the selection room and remove the respirator. The test subject shall repeat the odor sensitivity test, select and put on another respirator, return to the test area and again begin the fit test procedure described in (b) (1) through (7) above. The process continues until a respirator that fits well has been found. Should the odor sensitivity test be failed, the subject shall wait at least 5 minutes before retesting. Odor sensitivity will usually have returned by this time.

(9) If the subject passes the test, the efficiency of the test procedure shall be demonstrated by having the subject break the respirator face seal and take a breath before exiting the chamber.

(10) When the test subject leaves the chamber, the subject shall remove the saturated towel and return it to the person conducting the test, so that there is no significant IAA concentration buildup in the chamber during subsequent tests. The used towels shall be kept in a self-sealing plastic bag to keep the test area from being contaminated.

3. Saccharin Solution Aerosol Protocol

The entire screening and testing procedure shall be explained to the test subject prior to the conduct of the screening test.

(a) Taste threshold screening. The saccharin taste threshold screening, performed without wearing a respirator, is intended to determine whether the individual being tested can detect the taste of saccharin.

(1) During threshold screening as well as during fit testing, subjects shall wear an enclosure about the head and shoulders that is approximately 12 inches in diameter by 14 inches tall with at least the front portion clear and that allows free movements of the head when a respirator is worn. An enclosure substantially similar to the 3M hood assembly, parts # FT 14 and # FT 15 combined, is adequate.

(2) The test enclosure shall have a 3/4-inch (1.9 cm) hole in front of the test subject's nose and mouth area to accommodate the nebulizer nozzle.

(3) The test subject shall don the test enclosure. Throughout the threshold screening test, the test subject shall breathe through his/her slightly open mouth with tongue extended. The subject is instructed to report when he/she detects a sweet taste.

(4) Using a DeVilbiss Model 40 Inhalation Medication Nebulizer or equivalent, the test conductor shall spray the threshold check solution into the enclosure. The nozzle is directed away from the nose and mouth of the person. This nebulizer shall be clearly marked to distinguish it from the fit test solution nebulizer.

(5) The threshold check solution is prepared by dissolving 0.83 gram of sodium saccharin USP in 100 ml of warm water. It can be prepared by putting 1 ml of the fit test solution (see (b)(5) below) in 100 ml of distilled water.

(6) To produce the aerosol, the nebulizer bulb is firmly squeezed so that it collapses completely, then released and allowed to fully expand.

(7) Ten squeezes are repeated rapidly and then the test subject is asked whether the saccharin can be tasted. If the test subject reports tasting the sweet taste during the ten squeezes, the screening test is completed. The taste threshold is noted as ten regardless of the number of squeezes actually completed.

(8) If the first response is negative, ten more squeezes are repeated rapidly and the test subject is again asked whether the saccharin is tasted. If the test subject reports tasting the sweet taste during the second ten squeezes, the screening test is completed. The taste threshold is noted as twenty regardless of the number of squeezes actually completed.

(9) If the second response is negative, ten more squeezes are repeated rapidly and the test subject is again asked whether the saccharin is tasted. If the test subject reports tasting the sweet taste during the third set of ten squeezes, the screening test is completed. The taste threshold is noted as thirty regardless of the number of squeezes actually completed.

(10) The test conductor will take note of the number of squeezes required to solicit a taste response.

(11) If the saccharin is not tasted after 30 squeezes (step 10), the test subject is unable to taste saccharin and may not perform the saccharin fit test.

Note to paragraph 3. (a): If the test subject eats or drinks something sweet before the screening test, he/she may be unable to taste the weak saccharin solution.

(12) If a taste response is elicited, the test subject shall be asked to take note of the taste for reference in the fit test.

(13) Correct use of the nebulizer means that approximately 1 ml of liquid is used at a time in the nebulizer body.

(14) The nebulizer shall be thoroughly rinsed in water, shaken dry, and refilled at least each morning and afternoon or at least every four hours.

(b) Saccharin solution aerosol fit test procedure.

(1) The test subject may not eat, drink (except plain water), smoke, or chew gum for 15 minutes before the test.

(2) The fit test uses the same enclosure described in 3. (a) above.

(3) The test subject shall don the enclosure while wearing the respirator selected in section I. A. of this appendix. The respirator shall be properly adjusted and equipped with a particulate filter(s).

(4) A second DeVilbiss Model 40 Inhalation Medication Nebulizer or equivalent is used to spray the fit test solution into the enclosure. This nebulizer shall be clearly marked to distinguish it from the screening test solution nebulizer.

(5) The fit test solution is prepared by adding 83 grams of sodium saccharin to 100 ml of warm water.

(6) As before, the test subject shall breathe through the slightly open mouth with tongue extended, and report if he/she tastes the sweet taste of saccharin.

(7) The nebulizer is inserted into the hole in the front of the enclosure and an initial concentration of saccharin fit test solution is sprayed into the enclosure using the same number of squeezes (either 10, 20 or 30 squeezes) based on the number of squeezes required to elicit a taste response as noted during the screening test. A minimum of 10 squeezes is required.

- (8) After generating the aerosol, the test subject shall be instructed to perform the exercises in section I. A. 14. of this appendix.
- (9) Every 30 seconds the aerosol concentration shall be replenished using one half the original number of squeezes used initially (e.g., 5, 10 or 15).
- (10) The test subject shall indicate to the test conductor if at any time during the fit test the taste of saccharin is detected. If the test subject does not report tasting the saccharin, the test is passed.
- (11) If the taste of saccharin is detected, the fit is deemed unsatisfactory and the test is failed. A different respirator shall be tried and the entire test procedure is repeated (taste threshold screening and fit testing).
- (12) Since the nebulizer has a tendency to clog during use, the test operator must make periodic checks of the nebulizer to ensure that it is not clogged. If clogging is found at the end of the test session, the test is invalid.

4. Bitrex™ (Denatonium Benzoate) Solution Aerosol Qualitative Fit Test Protocol

The Bitrex™ (Denatonium benzoate) solution aerosol QLFT protocol uses the published saccharin test protocol because that protocol is widely accepted. Bitrex is routinely used as a taste aversion agent in household liquids which children should not be drinking and is endorsed by the American Medical Association, the National Safety Council, and the American Association of Poison Control Centers. The entire screening and testing procedure shall be explained to the test subject prior to the conduct of the screening test.

(a) Taste Threshold Screening.

The Bitrex taste threshold screening, performed without wearing a respirator, is intended to determine whether the individual being tested can detect the taste of Bitrex.

- (1) During threshold screening as well as during fit testing, subjects shall wear an enclosure about the head and shoulders that is approximately 12 inches (30.5 cm) in diameter by 14 inches (35.6 cm) tall. The front portion of the enclosure shall be clear from the respirator and allow free movement of the head when a respirator is worn. An enclosure substantially similar to the 3M hood assembly, parts # FT 14 and # FT 15 combined, is adequate.
- (2) The test enclosure shall have a $\frac{3}{4}$ inch (1.9 cm) hole in front of the test subject's nose and mouth area to accommodate the nebulizer nozzle.
- (3) The test subject shall don the test enclosure. Throughout the threshold screening test, the test subject shall breathe through his or her slightly open mouth with tongue extended. The subject is instructed to report when he/she detects a bitter taste
- (4) Using a DeVilbiss Model 40 Inhalation Medication Nebulizer or equivalent, the test conductor shall spray the Threshold Check Solution into the enclosure. This Nebulizer shall be clearly marked to distinguish it from the fit test solution nebulizer.
- (5) The Threshold Check Solution is prepared by adding 13.5 milligrams of Bitrex to 100 ml of 5% salt (NaCl) solution in distilled water.
- (6) To produce the aerosol, the nebulizer bulb is firmly squeezed so that the bulb collapses completely, and is then released and allowed to fully expand.
- (7) An initial ten squeezes are repeated rapidly and then the test subject is asked whether the Bitrex can be tasted. If the test subject reports tasting the bitter taste during the ten squeezes, the screening test is completed. The taste threshold is noted as ten regardless of the number of squeezes actually completed.
- (8) If the first response is negative, ten more squeezes are repeated rapidly and the test subject is again asked whether the Bitrex is tasted. If the test subject reports tasting the bitter taste during the second ten squeezes, the screening test is completed. The taste threshold is noted as twenty regardless of the number of squeezes actually completed.
- (9) If the second response is negative, ten more squeezes are repeated rapidly and the test subject is again asked whether the Bitrex is tasted. If the test subject reports tasting the bitter taste during the third set of ten squeezes, the screening test is completed. The taste threshold is noted as thirty regardless of the number of squeezes actually completed.
- (10) The test conductor will take note of the number of squeezes required to solicit a taste response.
- (11) If the Bitrex is not tasted after 30 squeezes (step 10), the test subject is unable to taste Bitrex and may not perform the Bitrex fit test.
- (12) If a taste response is elicited, the test subject shall be asked to take note of the taste for reference in the fit test.
- (13) Correct use of the nebulizer means that approximately 1 ml of liquid is used at a time in the nebulizer body.
- (14) The nebulizer shall be thoroughly rinsed in water, shaken to dry, and refilled at least each morning and afternoon or at least every four hours.

(b) Bitrex Solution Aerosol Fit Test Procedure.

- (1) The test subject may not eat, drink (except plain water), smoke, or chew gum for 15 minutes before the test.

- (2) The fit test uses the same enclosure as that described in 4. (a) above.
- (3) The test subject shall don the enclosure while wearing the respirator selected according to section I. A. of this appendix. The respirator shall be properly adjusted and equipped with any type particulate filter(s).
- (4) A second DeVilbiss Model 40 Inhalation Medication Nebulizer or equivalent is used to spray the fit test solution into the enclosure. This nebulizer shall be clearly marked to distinguish it from the screening test solution nebulizer.
- (5) The fit test solution is prepared by adding 337.5 mg of Bitrex to 200 ml of a 5% salt (NaCl) solution in warm water.
- (6) As before, the test subject shall breathe through his or her slightly open mouth with tongue extended, and be instructed to report if he/she tastes the bitter taste of Bitrex.
- (7) The nebulizer is inserted into the hole in the front of the enclosure and an initial concentration of the fit test solution is sprayed into the enclosure using the same number of squeezes (either 10, 20 or 30 squeezes) based on the number of squeezes required to elicit a taste response as noted during the screening test.
- (8) After generating the aerosol, the test subject shall be instructed to perform the exercises in section I. A. 14. of this appendix.
- (9) Every 30 seconds the aerosol concentration shall be replenished using one half the number of squeezes used initially (e.g., 5, 10 or 15).
- (10) The test subject shall indicate to the test conductor if at any time during the fit test the taste of Bitrex is detected. If the test subject does not report tasting the Bitrex, the test is passed.
- (11) If the taste of Bitrex is detected, the fit is deemed unsatisfactory and the test is failed. A different respirator shall be tried and the entire test procedure is repeated (taste threshold screening and fit testing).

5. Irritant Smoke (Stannic Chloride) Protocol

This qualitative fit test uses a person's response to the irritating chemicals released in the "smoke" produced by a stannic chloride ventilation smoke tube to detect leakage into the respirator.

(a) General Requirements and Precautions

- (1) The respirator to be tested shall be equipped with high efficiency particulate air (HEPA) or P100 series filter(s).
- (2) Only stannic chloride smoke tubes shall be used for this protocol.
- (3) No form of test enclosure or hood for the test subject shall be used.
- (4) The smoke can be irritating to the eyes, lungs, and nasal passages. The test conductor shall take precautions to minimize the test subject's exposure to irritant smoke. Sensitivity varies, and certain individuals may respond to a greater degree to irritant smoke. Care shall be taken when performing the sensitivity screening checks that determine whether the test subject can detect irritant smoke to use only the minimum amount of smoke necessary to elicit a response from the test subject.
- (5) The fit test shall be performed in an area with adequate ventilation to prevent exposure of the person conducting the fit test or the build-up of irritant smoke in the general atmosphere.

(b) Sensitivity Screening Check

The person to be tested must demonstrate his or her ability to detect a weak concentration of the irritant smoke.

- (1) The test operator shall break both ends of a ventilation smoke tube containing stannic chloride, and attach one end of the smoke tube to a low flow air pump set to deliver 200 milliliters per minute, or an aspirator squeeze bulb. The test operator shall cover the other end of the smoke tube with a short piece of tubing to prevent potential injury from the jagged end of the smoke tube.
- (2) The test operator shall advise the test subject that the smoke can be irritating to the eyes, lungs, and nasal passages and instruct the subject to keep his/her eyes closed while the test is performed.
- (3) The test subject shall be allowed to smell a weak concentration of the irritant smoke before the respirator is donned to become familiar with its irritating properties and to determine if he/she can detect the irritating properties of the smoke. The test operator shall carefully direct a small amount of the irritant smoke in the test subject's direction to determine that he/she can detect it.

(c) Irritant Smoke Fit Test Procedure

- (1) The person being fit tested shall don the respirator without assistance, and perform the required user seal check(s).
- (2) The test subject shall be instructed to keep his/her eyes closed.
- (3) The test operator shall direct the stream of irritant smoke from the smoke tube toward the faceseal area of the test subject, using the low flow pump or the squeeze bulb. The test operator shall begin at least 12 inches from the facepiece and move the smoke stream around the whole perimeter of the mask. The operator shall gradually make two more passes around the perimeter of the mask, moving to within six inches of the
respirator

respirator.

- (4) If the person being tested has not had an involuntary response and/or detected the irritant smoke, proceed with the test exercises.
- (5) The exercises identified in section I.A. 14. of this appendix shall be performed by the test subject while the respirator seal is being continually challenged by the smoke, directed around the perimeter of the respirator at a distance of six inches.
- (6) If the person being fit tested reports detecting the irritant smoke at any time, the test is failed. The person being retested must repeat the entire sensitivity check and fit test procedure.
- (7) Each test subject passing the irritant smoke test without evidence of a response (involuntary cough, irritation) shall be given a second sensitivity screening check, with the smoke from the same smoke tube used during the fit test, once the respirator has been removed, to determine whether he/she still reacts to the smoke. Failure to evoke a response shall void the fit test.
- (8) If a response is produced during this second sensitivity check, then the fit test is passed.

C. Quantitative Fit Test (QNFT) Protocols

The following quantitative fit testing procedures have been demonstrated to be acceptable: Quantitative fit testing using a non-hazardous test aerosol (such as corn oil, polyethylene glycol 400 [PEG 400], di-2-ethyl hexyl sebacate [DEHS], or sodium chloride) generated in a test chamber, and employing instrumentation to quantify the fit of the respirator; Quantitative fit testing using ambient aerosol as the test agent and appropriate instrumentation (condensation nuclei counter) to quantify the respirator fit; Quantitative fit testing using controlled negative pressure and appropriate instrumentation to measure the volumetric leak rate of a facepiece to quantify the respirator fit.

1. General

- (a) The employer shall ensure that persons administering QNFT are able to calibrate equipment and perform tests properly, recognize invalid tests, calculate fit factors properly and ensure that test equipment is in proper working order.
- (b) The employer shall ensure that QNFT equipment is kept clean, and is maintained and calibrated according to the manufacturer's instructions so as to operate at the parameters for which it was designed.

2. Generated Aerosol Quantitative Fit Testing Protocol

(a) Apparatus.

- (1) Instrumentation. Aerosol generation, dilution, and measurement systems using particulates (corn oil, polyethylene glycol 400 [PEG 400], di-2-ethyl hexyl sebacate [DEHS] or sodium chloride) as test aerosols shall be used for quantitative fit testing.
- (2) Test chamber. The test chamber shall be large enough to permit all test subjects to perform freely all required exercises without disturbing the test agent concentration or the measurement apparatus. The test chamber shall be equipped and constructed so that the test agent is effectively isolated from the ambient air, yet uniform in concentration throughout the chamber.
- (3) When testing air-purifying respirators, the normal filter or cartridge element shall be replaced with a high efficiency particulate air (HEPA) or P100 series filter supplied by the same manufacturer.
- (4) The sampling instrument shall be selected so that a computer record or strip chart record may be made of the test showing the rise and fall of the test agent concentration with each inspiration and expiration at fit factors of at least 2,000. Integrators or computers that integrate the amount of test agent penetration leakage into the respirator for each exercise may be used provided a record of the readings is made.
- (5) The combination of substitute air-purifying elements, test agent and test agent concentration shall be such that the test subject is not exposed in excess of an established exposure limit for the test agent at any time during the testing process, based upon the length of the exposure and the exposure limit duration.
- (6) The sampling port on the test specimen respirator shall be placed and constructed so that no leakage occurs around the port (e.g., where the respirator is probed), a free air flow is allowed into the sampling line at all times, and there is no interference with the fit or performance of the respirator. The in-mask sampling device (probe) shall be designed and used so that the air sample is drawn from the breathing zone of the test subject, midway between the nose and mouth and with the probe extending into the facepiece cavity at least 1/4 inch.
- (7) The test setup shall permit the person administering the test to observe the test subject inside the chamber during the test.
- (8) The equipment generating the test atmosphere shall maintain the concentration of test agent constant to within a 10 percent variation for the duration of the test.
- (9) The time lag (interval between an event and the recording of the event on the strip chart or computer or integrator) shall be kept to a minimum. There shall be a clear association between the occurrence of an event and its being recorded.
- (10) The sampling line tubing for the test chamber atmosphere and for the respirator sampling port shall be of equal diameter and of the same material. The length of the two lines shall be equal.
- (11) The exhaust flow from the test chamber shall pass through an appropriate filter (i.e., high efficiency particulate filter) before release.

(12) When sodium chloride aerosol is used, the relative humidity inside the test chamber shall not exceed 50

(12) When sodium chloride aerosol is used, the relative humidity inside the test chamber shall not exceed 90 percent.

(13) The limitations of instrument detection shall be taken into account when determining the fit factor.

(14) Test respirators shall be maintained in proper working order and be inspected regularly for deficiencies such as cracks or missing valves and gaskets.

(b) Procedural Requirements.

(1) When performing the initial user seal check using a positive or negative pressure check, the sampling line shall be crimped closed in order to avoid air pressure leakage during either of these pressure checks.

(2) The use of an abbreviated screening QLFT test is optional. Such a test may be utilized in order to quickly identify poor fitting respirators that passed the positive and/or negative pressure test and reduce the amount of QNFT time. The use of the CNC QNFT instrument in the count mode is another optional method to obtain a quick estimate of fit and eliminate poor fitting respirators before going on to perform a full QNFT.

(3) A reasonably stable test agent concentration shall be measured in the test chamber prior to testing. For canopy or shower curtain types of test units, the determination of the test agent's stability may be established after the test subject has entered the test environment.

(4) Immediately after the subject enters the test chamber, the test agent concentration inside the respirator shall be measured to ensure that the peak penetration does not exceed 5 percent for a half mask or 1 percent for a full facepiece respirator.

(5) A stable test agent concentration shall be obtained prior to the actual start of testing.

(6) Respirator restraining straps shall not be over-tightened for testing. The straps shall be adjusted by the wearer without assistance from other persons to give a reasonably comfortable fit typical of normal use. The respirator shall not be adjusted once the fit test exercises begin.

(7) The test shall be terminated whenever any single peak penetration exceeds 5 percent for half masks and 1 percent for full facepiece respirators. The test subject shall be refitted and retested.

(8) Calculation of fit factors.

(i) The fit factor shall be determined for the quantitative fit test by taking the ratio of the average chamber concentration to the concentration measured inside the respirator for each test exercise except the grimace exercise.

(ii) The average test chamber concentration shall be calculated as the arithmetic average of the concentration measured before and after each test (i.e., 7 exercises) or the arithmetic average of the concentration measured before and after each exercise or the true average measured continuously during the respirator sample.

(iii) The concentration of the challenge agent inside the respirator shall be determined by one of the following methods:

(A) Average peak penetration method means the method of determining test agent penetration into the respirator utilizing a strip chart recorder, integrator, or computer. The agent penetration is determined by an average of the peak heights on the graph or by computer integration, for each exercise except the grimace exercise. Integrators or computers that calculate the actual test agent penetration into the respirator for each exercise will also be considered to meet the requirements of the average peak penetration method.

(B) Maximum peak penetration method means the method of determining test agent penetration in the respirator as determined by strip chart recordings of the test. The highest peak penetration for a given exercise is taken to be representative of average penetration into the respirator for that exercise.

(C) Integration by calculation of the area under the individual peak for each exercise except the grimace exercise. This includes computerized integration.

(D) The calculation of the overall fit factor using individual exercise fit factors involves first converting the exercise fit factors to penetration values, determining the average, and then converting that result back to a fit factor. This procedure is described in the following equation:

$$\text{Overall Fit Factor} = \frac{\text{Number of exercises}}{1/ff_1 + 1/ff_2 + 1/ff_3 + 1/ff_4 + 1/ff_5 + 1/ff_6 + 1/ff_7 + 1/ff_8}$$

Where ff_1 , ff_2 , ff_3 , etc. are the fit factors for exercises 1, 2, 3, etc.

(9) The test subject shall not be permitted to wear a half mask or quarter facepiece respirator unless a minimum fit factor of 100 is obtained, or a full facepiece respirator unless a minimum fit factor of 500 is obtained.

(10) Filters used for quantitative fit testing shall be replaced whenever increased breathing resistance is encountered, or when the test agent has altered the integrity of the filter media.

3. Ambient aerosol condensation nuclei counter (CNC) quantitative fit testing protocol.

The ambient aerosol condensation nuclei counter (CNC) quantitative fit testing (Portacount™) protocol quantitatively fit tests respirators with the use of a probe. The probed respirator is only used for quantitative fit tests. A probed respirator has a special sampling device, installed on the respirator, that allows the probe to sample the air from inside the mask. A probed respirator is required for each make, style, model, and size that the employer uses and can be obtained from the respirator manufacturer or distributor. The CNC instrument manufacturer, TSI Inc., also provides probe attachments (TSI sampling adapters) that permit fit testing in an employee's own respirator. A minimum fit factor pass level of at least 100 is necessary for a half-mask respirator and a minimum fit factor pass level of at least 500 is required for a full facepiece negative pressure respirator. The entire screening and testing procedure shall be explained to the test subject prior to the conduct of the screening test.

(a) Portacount Fit Test Requirements.

- (1) Check the respirator to make sure the sampling probe and line are properly attached to the facepiece and that the respirator is fitted with a particulate filter capable of preventing significant penetration by the ambient particles used for the fit test (e.g., NIOSH 42 CFR 84 series 100, series 99, or series 95 particulate filter) per manufacturer's instruction.
- (2) Instruct the person to be tested to don the respirator for five minutes before the fit test starts. This purges the ambient particles trapped inside the respirator and permits the wearer to make certain the respirator is comfortable. This individual shall already have been trained on how to wear the respirator properly.
- (3) Check the following conditions for the adequacy of the respirator fit: Chin properly placed; Adequate strap tension, not overly tightened; Fit across nose bridge; Respirator of proper size to span distance from nose to chin; Tendency of the respirator to slip; Self-observation in a mirror to evaluate fit and respirator position.
- (4) Have the person wearing the respirator do a user seal check. If leakage is detected, determine the cause. If leakage is from a poorly fitting facepiece, try another size of the same model respirator, or another model of respirator.
- (5) Follow the manufacturer's instructions for operating the Portacount and proceed with the test.
- (6) The test subject shall be instructed to perform the exercises in section I. A. 14. of this appendix.
- (7) After the test exercises, the test subject shall be questioned by the test conductor regarding the comfort of the respirator upon completion of the protocol. If it has become unacceptable, another model of respirator shall be tried.

(b) Portacount Test Instrument.

- (1) The Portacount will automatically stop and calculate the overall fit factor for the entire set of exercises. The overall fit factor is what counts. The Pass or Fail message will indicate whether or not the test was successful. If the test was a Pass, the fit test is over.
- (2) Since the pass or fail criterion of the Portacount is user programmable, the test operator shall ensure that the pass or fail criterion meet the requirements for minimum respirator performance in this Appendix.
- (3) A record of the test needs to be kept on file, assuming the fit test was successful. The record must contain the test subject's name; overall fit factor; make, model, style, and size of respirator used; and date tested.

4. Controlled negative pressure (CNP) quantitative fit testing protocol.

The CNP protocol provides an alternative to aerosol fit test methods. The CNP fit test method technology is based on exhausting air from a temporarily sealed respirator facepiece to generate and then maintain a constant negative pressure inside the facepiece. The rate of air exhaust is controlled so that a constant negative pressure is maintained in the respirator during the fit test. The level of pressure is selected to replicate the mean inspiratory pressure that causes leakage into the respirator under normal use conditions. With pressure held constant, air flow out of the respirator is equal to air flow into the respirator. Therefore, measurement of the exhaust stream that is required to hold the pressure in the temporarily sealed respirator constant yields a direct measure of leakage air flow into the respirator. The CNP fit test method measures leak rates through the facepiece as a method for determining the facepiece fit for negative pressure respirators. The CNP instrument manufacturer Occupational Health Dynamics of Birmingham, Alabama also provides attachments (sampling manifolds) that replace the filter cartridges to permit fit testing in an employee's own respirator. To perform the test, the test subject closes his or her mouth and holds his/her breath, after which an air pump removes air from the respirator facepiece at a pre-selected constant pressure. The facepiece fit is expressed as the leak rate through the facepiece, expressed as milliliters per minute. The quality and validity of the CNP fit tests are determined by the degree to which the in-mask pressure tracks the test pressure during the system measurement time of approximately five seconds. Instantaneous feedback in the form of a real-time pressure trace of the in-mask pressure is provided and used to determine test validity and quality. A minimum fit factor pass level of 100 is necessary for a half-mask respirator and a minimum fit factor of at least 500 is required for a full facepiece respirator. The entire screening and testing procedure shall be explained to the test subject prior to the conduct of the screening test.

(a) CNP Fit Test Requirements.

- (1) The instrument shall have a non-adjustable test pressure of 15.0 mm water pressure.
- (2) The CNP system defaults selected for test pressure shall be set at -- 15 mm of water (-0.58 inches of water) and the modeled inspiratory flow rate shall be 53.8 liters per minute for performing fit tests.

(**Note:** CNP systems have built-in capability to conduct fit testing that is specific to unique work rate, mask, and gender situations that might apply in a specific workplace. Use of system default values, which were selected to represent respirator wear with medium cartridge resistance at a low-moderate work rate, will allow inter-test comparison of the respirator fit.)
- (3) The individual who conducts the CNP fit testing shall be thoroughly trained to perform the test.
- (4) The respirator filter or cartridge needs to be replaced with the CNP test manifold. The inhalation valve

downstream from the manifold either needs to be temporarily removed or propped open.

- (5) The employer must train the test subject to hold his or her breath for at least 10 seconds.
- (6) The test subject must don the test respirator without any assistance from the test administrator who is conducting the CNP fit test. The respirator must not be adjusted once the fit-test exercises begin. Any adjustment voids the test, and the test subject must repeat the fit test.
- (7) The QNFT protocol shall be followed according to section I. C. 1. of this appendix with an exception for the CNP test exercises.

(b) CNP Test Exercises.

- (1) Normal breathing. In a normal standing position, without talking, the subject shall breathe normally for 1 minute. After the normal breathing exercise, the subject needs to hold head straight ahead and hold his or her breath for 10 seconds during the test measurement.
- (2) Deep breathing. In a normal standing position, the subject shall breathe slowly and deeply for 1 minute, being careful not to hyperventilate. After the deep breathing exercise, the subject shall hold his or her head straight ahead and hold his or her breath for 10 seconds during test measurement.
- (3) Turning head side to side. Standing in place, the subject shall slowly turn his or her head from side to side between the extreme positions on each side for 1 minute. The head shall be held at each extreme momentarily so the subject can inhale at each side. After the turning head side to side exercise, the subject needs to hold head full left and hold his or her breath for 10 seconds during test measurement. Next, the subject needs to hold head full right and hold his or her breath for 10 seconds during test measurement.
- (4) Moving head up and down. Standing in place, the subject shall slowly move his or her head up and down for 1 minute. The subject shall be instructed to inhale in the up position (i.e., when looking toward the ceiling). After the moving head up and down exercise, the subject shall hold his or her head full up and hold his or her breath for 10 seconds during test measurement. Next, the subject shall hold his or her head full down and hold his or her breath for 10 seconds during test measurement.
- (5) Talking. The subject shall talk out loud slowly and loud enough so as to be heard clearly by the test conductor. The subject can read from a prepared text such as the Rainbow Passage, count backward from 100, or recite a memorized poem or song for 1 minute. After the talking exercise, the subject shall hold his or her head straight ahead and hold his or her breath for 10 seconds during the test measurement.
- (6) Grimace. The test subject shall grimace by smiling or frowning for 15 seconds.
- (7) Bending Over. The test subject shall bend at the waist as if he or she were to touch his or her toes for 1 minute. Jogging in place shall be substituted for this exercise in those test environments such as shroud-type QNFT units that prohibit bending at the waist. After the bending over exercise, the subject shall hold his or her head straight ahead and hold his or her breath for 10 seconds during the test measurement.
- (8) Normal Breathing. The test subject shall remove and re-don the respirator within a one-minute period. Then, in a normal standing position, without talking, the subject shall breathe normally for 1 minute. After the normal breathing exercise, the subject shall hold his or her head straight ahead and hold his or her breath for 10 seconds during the test measurement. After the test exercises, the test subject shall be questioned by the test conductor regarding the comfort of the respirator upon completion of the protocol. If it has become unacceptable, another model of a respirator shall be tried.

(c) CNP Test Instrument.

- (1) The test instrument must have an effective audio-warning device, or a visual-warning device in the form of a screen tracing, that indicates when the test subject fails to hold his or her breath during the test. The test must be terminated and restarted from the beginning when the test subject fails to hold his or her breath during the test. The test subject then may be refitted and retested.
- (2) A record of the test shall be kept on file, assuming the fit test was successful. The record must contain the test subject's name; overall fit factor; make, model, style and size of respirator used; and date tested.

5. Controlled negative pressure (CNP) REDON quantitative fit testing protocol.

- (a) When administering this protocol to test subjects, employers must comply with the requirements specified in paragraphs (a) and (c) of Part I.C.4 of this appendix ("Controlled negative pressure (CNP) quantitative fit testing protocol"), as well as use the test exercises described below in paragraph (b) of this protocol instead of the test exercises specified in paragraph (b) of Part I.C.4 of this appendix.
- (b) Employers must ensure that each test subject being fit tested using this protocol follows the exercise and measurement procedures, including the order of administration, described below in Table A-1 of this appendix.

Table A-1. -- CNP REDON Quantitative Fit Testing Protocol

Exercises ⁽¹⁾	Exercise procedure	Measurement procedure
Facing Forward	Stand and breathe normally, without talking, for 30 seconds.	Face forward, while holding breath for 10 seconds.
Bending Over	Bend at the waist, as if going to touch his or her toes, for 30 seconds.	Face parallel to the floor, while holding breath for 10 seconds
Head Shaking	For about three seconds, shake head back and forth vigorously several times while shouting.	Face forward, while holding breath for 10 seconds.
REDON 1	Remove the respirator mask, loosen all facepiece straps, and then redon the respirator mask.	Face forward, while holding breath for 10 seconds.

REDON 2	Remove the respirator mask, loosen all facepiece straps, and then redon the respirator mask again.	Face forward, while holding breath for 10 seconds.
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¹ Exercises are listed in the order in which they are to be administered.

(c) After completing the test exercises, the test administrator must question each test subject regarding the comfort of the respirator. When a test subject states that the respirator is unacceptable, the employer must ensure that the test administrator repeats the protocol using another respirator model.

(d) Employers must determine the overall fit factor for each test subject by calculating the harmonic mean of the fit testing exercises as follows:

$$\text{Overall Fit Factor} = \frac{N}{\left[\frac{1}{FF_1} + \frac{1}{FF_2} + \dots + \frac{1}{FF_N} \right]}$$

Where:

N = The number of exercises;

FF1 = The fit factor for the first exercise;

FF2 = The fit factor for the second exercise; and

FFN = The fit factor for the nth exercise.

Part II. New Fit Test Protocols

A. Any person may submit to OSHA an application for approval of a new fit test protocol. If the application meets the following criteria, OSHA will initiate a rulemaking proceeding under section 6(b)(7) of the OSH Act to determine whether to list the new protocol as an approved protocol in this Appendix A.

B. The application must include a detailed description of the proposed new fit test protocol. This application must be supported by either:

1. A test report prepared by an independent government research laboratory (e.g., Lawrence Livermore National Laboratory, Los Alamos National Laboratory, the National Institute for Standards and Technology) stating that the laboratory has tested the protocol and had found it to be accurate and reliable; or

2. An article that has been published in a peer-reviewed industrial hygiene journal describing the protocol and explaining how test data support the protocol's accuracy and reliability.

C. If OSHA determines that additional information is required before the Agency commences a rulemaking proceeding under this section, OSHA will so notify the applicant and afford the applicant the opportunity to submit the supplemental information. Initiation of a rulemaking proceeding will be deferred until OSHA has received and evaluated the supplemental information.

[63 FR 20098, April 23, 1998; 69 FR 46993, August 4, 2004]

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