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**New York City Department of Environmental Protection**

# Corrective Measures Work Plan for Perimeter Fencing, Landfill Cover System, and Seawall Restoration

## Pelham Bay Landfill, Bronx, NY

**Contract 1246-PM**

May~~February~~ 2013

ARCADIS

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**Corrective Measures Work Plan for Perimeter Fencing, Landfill Cover System, and Seawall Restoration**

Pelham Bay Landfill, Bronx, NY
Contract 1246-PM

Prepared for:
New York City Department of Environmental Protection

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## 1. Introduction

ARCADIS of New York, Inc. (ARCADIS), at the request of the New York City Department of Environmental Protection (DEP), has prepared this Corrective Measures Work Plan for Perimeter Fencing, Landfill Cover System, and Seawall Restoration (CMWP or Work Plan) to address damaged portions of the perimeter fence, landfill cover system, and seawall at the Pelham Bay Landfill (PBL or Site), located in Bronx, New York. As used herein, the term "restoration" means restore to original condition and/or upgrade with infrastructure to better protect against future storm-related damage. On November 29, 2012, prompted by observations of damage to portions of the PBL engineering controls (i.e., perimeter fencing and landfill cover system) and non-engineering control infrastructure (i.e., the surrounding seawall) following Hurricane Sandy (October 29, 2012), personnel from the New York State Department of Environmental Conservation (DEC) and DEP performed an inspection of the PBL. During the inspection, damage to the perimeter fence, landfill cover system, and the seawall was confirmed and the DEC requested the preparation and submission of a CMWP to address all damage to the engineering controls at the Site. This CMWP complies with the requirements of the PBL Site Management Plan (SMP) and DEC Technical Guidance for Site Investigation and Remediation (DER-10).

### 1.1 Description of Damage and Repairs Needed

Immediately following Hurricane Sandy, ARCADIS conducted an evaluation of conditions and damage to the engineering controls and seawall. The post Hurricane Sandy site evaluation relied on input provided by the PBL Operation Maintenance and Monitoring (OMM) contractor, Stratis Contracting Corp. (Stratis), and consisted of visual observations, site photographs (dated November 11, 2012) and follow up discussions. Pursuant to site observations they made, Stratis personnel indicated that damage to the PBL following Hurricane Sandy was limited to portions of the seawall, the perimeter fencing, and the landfill cover system. A brief summary of the post Hurricane Sandy observed storm-related damage and repairs needed is provided below. However, New York City (NYC) is considering upgrading its infrastructure (including the seawall at PBL) to protect against future anticipated storm-related damage and to incorporate NYC Department of Parks and Recreation (DPR) redevelopment plans.

Post-Hurricane Sandy Observed Damage at the Pelham Bay Landfill

The information provided by Stratis indicates that approximately 1,700 linear feet of seawall has been impacted. Damage includes the loss of rip rap and erosion of the landfill cover (soil) behind the seawall. In addition, erosion in many areas along the seawall has exposed the chain link fence post foundations and portions of the landfill's liner system. Storm-related impacts were observed along the PBL eastern and southern boundaries that border Eastchester Bay (Figure 1).

In the eastern portion of the Site, approximately 600 linear feet of seawall, fencing and landfill cover system has been impacted. Repairs needed for the eastern portion include replacement of seawall riprap, removal and replacement of chain link fencing, and placement of fill/topsoil (landfill cover material) in eroded areas behind the seawall.

In the southern portion of the Site, it appears that the majority of the seawall, fencing and landfill cover system has been impacted and is in need of repair. The estimated length of damage is approximately 1,100 feet. Again, repairs would include replacement of seawall riprap, removal and replacement of chain link fencing, and placement of fill/topsoil in eroded areas behind the seawall.

Of particular importance for PBL is that erosive storm surge forces appear to have exposed the landfill's liner system. As observed in the field, the black HDPE geomembrane is visible along with the overlying gray-colored geocomposite and underlying geotextile. It is estimated that approximately 800 feet of landfill liner is exposed behind the south seawall. The liner is also visible in a several locations along the eastern wall; the total footage however is not known at this time.

## 2. Proposed Scope of Work and Methodology

The scope of work proposed herein includes conduct of a site inspection, topographic and bathymetric surveys, permitting, and restoration of the perimeter fence, landfill cover system, and seawall. Figure 1 shows the locations where restoration work is required. The various tasks associated with this work are described in Subsections 2.1 through 2.9 below. ARCADIS will provide full-time oversight of the work proposed in this CMWP.

### 2.1 Site Inspection, Topographic Survey, Bathymetric Survey, and Limited, Initial Cover System Restoration

ARCADIS will conduct a visual site inspection to verify initial observations (by Stratis) of the storm-related damage. Topographic and bathymetric surveys will then be performed to collect quantitative data to evaluate the severity of erosion and seawall damage. Following the collection of these data, an Interim Report will be prepared to summarize the findings. Additionally, NYC is considering "upgrading" the seawall to provide additional protection against future storm events. Conceptual designs for these "upgrades" are currently being developed. Refinement and selection of the final seawall upgrade design will be conducted concurrent with the site inspection and survey activities described above. Any recommendations for additional data collection activities (e.g., geotechnical borings to assess stability of the seawall), plans for seawall upgrades, and schedule modifications will be included in the Interim Report, as necessary. Accordingly, the Interim Report will serve as an addendum to this CMWP. Detailed information about these activities is described below.

#### 2.1.1 Site Inspection

The initial field activities will include the conduct of an on-site, visual inspection of the seawall, landfill cover system, and fence damage. ARCADIS will perform this inspection to verify the observations made by Stratis and to obtain more detailed information for the restoration efforts. In addition, the inspection will include a determination of whether the exposed geocomposite liner has been damaged.

#### 2.1.2 Topographic Surveys

DEP will retain the services of a licensed surveyor to collect topographical data along the seawall for developing appropriate seawall and landfill cover system restoration measures. Two topographical surveys of the seawall will be conducted.

An initial topographical survey, will be completed along the full length of the seawall (details provided below) prior to conduct of Site restoration activities. As discussed below, this survey will provide information that will be used to develop the specific requirements for seawall, fencing, and landfill cover system repairs. Data (topographic contours) generated from the initial survey will be compared to the existing cover system as-built details to determine the extent of storm-related damages (erosion) that were incurred, to verify the quantities of repair materials needed, and to assess slope

stability issues within the surveyed area. Data from the initial survey will be summarized in the Interim Report.

The second post-restoration topographic survey will be performed after repairs to the seawall and landfill cover system have been completed. This second survey will serve as an "as-built" for documenting the final grades and elevations of the repaired landfill cover system and seawall. It will also be used as a baseline for future surveys and/or evaluations, if needed, of the seawall and landfill.

The topographic survey limits will extend 50 feet land side of the seawall and to the water level on the bay side of the wall. The surveys will focus on seawall and site features such as top of riprap, grade changes, edge of road, and edge of water. An existing conditions plan will be developed showing one foot topographic contours within the limits of the survey. The final as-built plan will also show one foot topographic contours.

#### 2.1.3 Limited, Initial Cover System Restoration

As described in Subsection 2.5, restoration of the landfill cover system cannot be completed until the seawall restoration is completed. However, in areas where the geocomposite liner is exposed, a limited, initial restoration will be performed. Since the geocomposite liner system is subject to ultraviolet (UV) degradation, following the initial topographic survey, the geocomposite liner, where exposed, will be covered with a six inch layer of loamy soil to minimize exposure to UV light. The remaining landfill cover system restoration activities will then be conducted upon completion of the seawall restoration.

#### 2.1.4 Bathymetric Survey

A bathymetric survey will be completed along the seawall to evaluate the condition of the seawall below the water level. This survey could reveal wall issues not apparent by visual inspection alone and will aid ARCADIS in its developing the appropriate seawall restoration activities. The bathymetric survey will supplement the visual inspection conducted by ARCADIS, and provide an additional, more in depth method of evaluating the toe stability of the seawall.

DEP will retain the services of a qualified company experienced in conducting hydrographic surveys. This swath multibeam bathymetric survey will be conducted in accordance with the U.S. Army Corps of Engineers Hydrographic Survey manual (EM

1110-2-1003). An American Congress of Surveying and Mapping (ACSM) Certified Hydrographer will perform all field data acquisition activities and process all bathymetric survey data. A seawall profile and contour plan will be developed from the bathymetric survey data. These data will be summarized in the Interim Report.

#### 2.1.5 Interim Report

Following completion of the site inspection and the topographic and bathymetric surveys, an Interim Report will be prepared. The Interim Report will include:

- Data generated from the initial topographic survey and the bathymetric survey,
- an evaluation of these data,
- recommendations, as necessary, for any additional data collection activities,
- plans for upgrading the seawall to protect against future anticipated storm-related damage (incorporating DPR redevelopment plans, as appropriate), and
- a revised schedule for implementing the proposed recommendations.

### 2.2 Agency Coordination and Permitting

All work conducted under this CMWP will be coordinated with DEP, DEC, DPR, and, as described below, the US Army Corps of Engineers - New York District (USACE). Any changes to the restoration efforts described herein that are required due to site conditions encountered in the field will be communicated to DEP, DEC, DPR, and USACE for approval, immediately upon identification of the need for a change.

Restoration of the seawall requires prior authorization from the US Army Corps of Engineers - New York District, under Regional General Permit NYDGP-15 for Remedial Activities undertaken in response to Major Storms. NYDGP-15 includes authorization for any repair, rehabilitation or reconstruction of bulkheads or retaining walls waterward, but within 18 inches of the existing wall. However, because PBL is located within the Long Island Sound Regional Coastal Management Program, prior notification and written authorization from the USACE New York District would be required for work to proceed under NYDGP-15.

Additionally, in response to the damages from Hurricane Sandy, the DEC has issued a General Permit for work in New York City, designated GP-2-12-002. GP-2-12-002 includes authorization for reconstruction of bulkheads and shoreline erosion structures that were functional before Hurricane Sandy. Prior to implementation of repair measures to the PBL seawall, a Notice of Intent (NOI) for GP-2-12-002 will be prepared and submitted to DEC. The NOI for GP-2-12-002 will be included in the permit application to the New York City Department of Buildings.

Seawall repair work will begin upon submission of the NOI and receipt of written authorization from the USACE. ARCADIS will continue to evaluate the permit requirements as the repair measures for the seawall are developed.

### 2.3 Site Preparation

Prior to initiation of any intrusive field activities, all subsurface utilities will be cleared, as necessary. In addition, the New York City One Call Center will be notified prior to commencement of any such activities.

The restoration activities will require the removal of the existing perimeter fence. The chain link fence and posts in areas to be restored will be removed and disposed of off-site in accordance with the requirements in Section 2.3.2.5 (Materials Disposal Off-Site) of the SMP. Temporary safety fencing shall be installed around the work area(s) to limit access. The temporary safety fence will remain in place until the materials for the perimeter fence restoration activities, as discussed in Section 2.7 below, are delivered to the Site and the restoration work is to begin.

### 2.4 Equipment Mobilization

The selected subcontractor(s) will mobilize all equipment, materials and personnel (to the Site) necessary to complete the restoration activities. The OMM contractor will designate an area on-site for staging of equipment and materials. Only clean equipment and materials will be mobilized to the Site.

### 2.5 Seawall Restoration

In accordance with the initial assessment and current understanding of seawall damage, the seawall restoration activities described in this CMWP include replacement in-kind. Results from the topographic and bathymetric surveys could reveal additional seawall damage that is not currently known and require modifications to the proposed

restoration activities. In addition, as discussed elsewhere in this CMWP, NYC is considering upgrading the seawall to protect against future anticipated storm-related damage and to incorporate NYC Parks' redevelopment plans for the site. Any design changes/upgrades determined to be necessary pursuant to the initial topographic survey and the bathymetric survey will be presented in the Interim Report.

The seawall along the perimeter of the Site is not a PBL Record of Decision (ROD) required engineering control. The seawall was constructed in the 1960s as part of the development of the PBL. However, restoration of the seawall is required prior to restoration of the landfill cover system and perimeter fence, which are ROD-required engineering controls, because the seawall serves as a retaining wall along the water's edge, keeping the cover system in place and minimizing exposure to the tidal forces and storm surges in the Eastchester Bay.

Utilizing the findings of its visual inspection, the initial topographic survey and the bathymetric survey of the seawall, ARCADIS will determine the necessary repair measures, specifications, and quantities to address the damaged portions of the wall. We anticipate using virgin material from a permitted mine or quarry, consistent with DER-10, for the imported materials used to repair the seawall. At a minimum, repairs to the seawall will include replacement of riprap above the water level to the original seawall elevations shown on as-built details of the landfill cover system and fencing. ARCADIS will evaluate the findings of the bathymetric survey to determine whether repair measures are required below the water level; if such measures are required, the proposed work scope will be described in a Supplemental CMWP.

The recommended seawall repairs generally consist of re-establishing the seawall width and height through the placement of riprap. Along with this effort, the landfill cover system will be restored through placement of fill behind the seawall followed by placement of topsoil and seed (as discussed in Subsection 2.6). Additional aspects of the seawall restoration work will include:

- Removal of loose stones or other materials to provide a firm base for riprap placement.

- Riprap will be a mixture of irregular-shaped stone, with the maximum size stone similar to those currently present. Large stones will be well-distributed and the entire mass of stones in their final positions roughly-graded to conform to the gradation specified. The stone selected for the riprap will be dense and well cemented.

- Finished riprap will be free from pockets of small stones and clusters of larger stones.

- The stone used for rip rap restoration will be free of joints, fractures, bedding planes (if sedimentary rock), or other features that could accelerate weathering.

- Placement of riprap will be performed from the land side of the seawall using a hydraulic excavator capable of reaching/extending to the water surface on the bay side of the wall. The hydraulic excavator will be equipped with an appropriate-sized bucket for lifting, placing and positioning the riprap along the seawall.

- When appropriate, re-use of existing riprap that has dislodged from the seawall, will be allowed when it is within reach of the hydraulic excavator, and is above the water surface. Inspection of riprap intended for re-use will be conducted to confirm its quality. Care will be taken in retrieving the riprap so as to not cause further damage to the seawall.

Geotextile fabric will be placed in the anchor trench behind the repaired wall sections to provide a separation between fill materials placed as part of the landfill cover system and the riprap. The geotextile will extend from the geocomposite liner at the bottom of the anchor trench to the top of the cover soils. During the seawall restoration work, the landfill cover system will be protected from additional damage that could potentially be caused by equipment being used. Plywood (or other materials) will be laid down in areas where equipment will be working and along the access routes from the roadway to the seawall.

### 2.6 Landfill Cover System Restoration

The approximate locations of the soil cover erosion and areas where the geocomposite liner is exposed are shown on Figure 1. As shown on Figure 1, soil has been eroded along the entire southern side of the landfill and in limited areas along the eastern side. The geocomposite liner has been exposed in the majority of the areas where soil has been eroded. The precise volume of soil that has been eroded and the precise areas where the geocomposite is exposed is not known at this time; however, these volumes and areas will be determined as part of the site inspection and initial topographic survey discussed in Subsection 2.1 of this CMWP.

If the topographic survey results reveal the presence of depressed or sloughed areas (away from the landfill perimeter), this could be indicative of ~~show that there are~~ more

widespread potential slope stability issues. If depressed or sloughed areas are identified during the topographic survey, these areas will be evaluated to determine the cause. If it is determined that these features are related to stability issues, a stability analysis will be conducted and recommendations for ~~(away from the landfill perimeter),~~ additional cover system restoration will be prepared~~activities, beyond the scope of work proposed in this CMWP, may be necessary~~. If necessary, these additional restoration activities will be addressed under a supplement to this CMWP. Current information and initial assessments indicate that the geocomposite liner has not been damaged in areas where it is exposed. However, if further inspection reveals that the geocomposite liner has been damaged, the geocomposite liner system will be repaired in the same manner described in the DEC-approved Corrective Measures Work Plan for Landfill Gas System Maintenance (March 2011), and the specific areas, methodology and materials to be used will be described in a supplement to this CMWP.

Restoration of the landfill cover system will include replacement of the vegetated soil cover above the geocomposite liner. Directly behind (the landfill side) the seawall, the landfill cover system consists of a three (3)-foot wide anchor trench which is constructed of a four (4)-foot layer of loamy soil directly above the geocomposite liner followed by a six (6)-inch layer of topsoil. A typical detail of the anchor trench construction is shown on Figure 2. The anchor trench will be restored as shown in the detail. To minimize the potential of compromising the geocomposite liner during the fence installation, discussed in greater detail below (Subsection 2.7), at locations where fence posts are to be installed, 16-inch diameter, four-foot long, round concrete forms (Sonotube ®) will be installed during placement of the loamy soil. An initial six-inch layer of loamy soil will be placed in the anchor trench. The four-foot long concrete forms will be placed on top of the initial six-inch layer and then the remaining loamy soil and top soil will be placed around the forms, leaving an open hole for fence post and footing placement.

If erosion has occurred beyond the anchor trench, the soils will be placed as a two (2)-foot layer of loamy soil directly above the geocomposite liner followed by a six (6)-inch topsoil layer. All restored areas will be re-seeded, as necessary, in accordance with the requirements presented in Section 4.2.1.4 (Landfill Cover System Operation: Routine Inspection and Maintenance) of the Site Management Plan (SMP). A typical cover soil section is shown in Figure 2. To prevent erosion and loss of topsoil and seed, erosion control mats will be placed in the restored areas until the vegetative cover has been established.

All backfill materials (loamy soil and top soil) to be imported from off-site sources to be used for the cover system restoration will meet the requirements of Section 2.3.2.9 Backfill from Off-Site Sources of the SMP. All material proposed for import onto the Site must be approved by DEP/ARCADIS and be in compliance with the provisions in the SMP prior to receipt at the site. Material from industrial sites, spill sites, or other environmental remediation sites or potentially contaminated sites will not be imported to the Site. All imported soils will meet the Unrestricted Use Soil Cleanup Objectives as presented in 6 NYCRR Part 375-6.8(a). Non-compliant soils will not be imported onto the Site without prior approval by DEC. Nothing in the approved Soil Management Plan (SoMP) or its approval by DEC should be construed as an approval for this purpose.

Soils that meet 'exempt' fill requirements under 6 NYCRR Part 360, but do not meet backfill or cover soil objectives for this Site, will not be imported onto the Site without prior approval by DEC. Nothing in the SoMP should be construed as an approval for this purpose.

The subcontractor will provide DEP/ARCADIS with the source of the backfill material, analytical results and sieve analyses for review and acceptance prior to importing any backfill material.

Upon completion of the landfill cover system restoration and prior to fence installation, the post-restoration topographic survey, discussed in Subsection 2.1.2, will be conducted.

### 2.7 Perimeter Fence Restoration

Upon completion of the seawall and cover system restorations, and final topographic survey, the perimeter fence restoration will begin.

The materials to be used for perimeter fence restoration are conceptual in nature at this time. Perimeter fence restoration will involve replacement of the damaged sections of existing fencing with new "searail" fencing. The conceptual design of the searail includes two-inch diameter steel posts, five-feet on center connected by five ¼-inch diameter steel cables spaced six inches apart, and a five-inch by three-inch oval metal handrail approximately 40 inches high. The purpose of the searail fence is to facilitate the redevelopment of the PBL as a park (i.e., passive recreational use, consistent with the ROD for the Site), by DPR. The searail fence is part of the NYCDPR re-design plans for the Site. When DPR finalizes the design and specifications of the searail fence, an addendum to this CMWP, will be submitted to DEC for review and approval.

Along the seawall, the fence posts and concrete footings will be buried within the anchor trench. As discussed above in Section 2.6, 16-inch diameter, four-foot long round concrete forms will be installed during the cover system restoration. The fence posts will be placed into the forms and the forms filled with concrete. The concrete forms will be removed as the concrete is being poured. Typical fence post details are provided on Figure 2.

### 2.8 Air Monitoring

Air monitoring will be conducted for the protection of the community and site workers during any soil activities. Dust readings will be taken at upwind locations at the start of excavation activities or anytime there is a significant change in wind direction. Downwind locations will be monitored on a continuous basis. If downwind dust particulate levels are greater than 100 µg/$m^3$, appropriate dust control measures will be undertaken. A photo ionization detector (PID) and a Landfill Gas Meter will be used to screen the work area for Volatile Organic Compounds (VOCs), Lower Explosive Limit (LEL), oxygen, carbon monoxide and Hydrogen Sulfide consistent with the site-specific Health and Safety Plan (HASP).

All readings will be recorded and if requested, made available for review by DEC or New York State Department of Health (NYSDOH) personnel.

#### 2.8.1 Community Air Monitoring Plan (CAMP)

Real-time air monitoring will be conducted at the PBL during the restoration activities to ensure that the downwind community is appropriately protected from potential airborne contaminants related to remedial work activities. Since all of the proposed work is above the landfill liner it is anticipated that the CAMP will be prepared to address monitoring for particulates (dust) only. Continuous monitoring will be conducted during all project activities. All monitoring readings will be recorded and will be available for DEC and NYSDOH personnel to review.

Particulate concentrations will be monitored continuously at the upwind and downwind perimeters of the exclusion zone at temporary particulate monitoring stations. Real-time air monitoring for particulates will be conducted using 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. In addition, fugitive dust migration will be visually assessed during all work activities.

If the downwind PM-10 particulate level is 100 micrograms per cubic meter (µg/$m^3$) 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. If downwind PM-10 particulate levels do not exceed 150 µg/$m^3$ above the upwind level and provided that no visible dust is migrating from the work area, then work activities will continue while dust suppression techniques are implemented.

If downwind PM-10 particulate levels are greater than 150 µg/$m^3$ above the upwind level after implementation of dust suppression techniques, work will be stopped and the activities re-evaluated. When dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 µg/$m^3$ of the upwind level and in preventing visible dust migration, then work activities will resume.

### 2.9 Stormwater Pollution Prevention Plan (SWPPP)

In general, stormwater at the Site~~site~~ is controlled by the Stormwater Management System. The Stormwater Management System was designed to remove stormwater runoff from the landfill surface during storm events to prevent ponding of water on the landfill, provide sediment control prior to discharge to Eastchester Bay, control the effects of erosion on the landfill cap, and collect precipitation infiltrating through the barrier soil to the drainage system above the geo-membrane liner.

To minimize erosion of soils and impacts to adjacent waterways (Eastchester Bay) due to stormwater runoff during the planned seawall and cover system restoration activities, the following temporary erosion and sediment controls will be implemented:

- To minimize erosion of the vegetative cover, vehicular traffic associated with restoration activities will be limited to the site roadways, to the extent practicable. When heavy equipment and/or vehicles are required within the work area for restoration activities, plywood (or other means) will be laid down in areas that equipment will be working at and along the access routes from the roadway to the seawall. The access route to the work area(s) shall be the shortest distance from the roadway to the work area(s).

- To minimize runoff to Eastchester Bay, silt fence, straw bales, or other equivalent means will be installed on downstream portions of the work areas prior to the commencement of any restoration activities. To minimize interference with the restoration activities, these controls may be temporarily removed in sections where

restoration activities are actively being conducted. Once the restoration activities are completed in any given sections, the silt fence and/or straw bales will be replaced. If silt fence is to be used, care will be taken as to not breach the geocomposite liner.

- As an additional means to minimize soil erosion and impacts to adjacent Eastchester Bay, soil and heavy machinery movement will be suspended during any rain event.

- Upon completion of the initial cover system restoration (to protect the exposed geocomposite liner), erosion control mats will be placed in the restored areas to minimize erosion of the newly placed soil. Upon completion of all planned restoration activities, erosion control mats will be place in the restored areas until the vegetative cover has been re-established.

To minimize potential impacts to Eastchester Bay due to spills the following spill prevention practices will be employed for the duration of the restoration activities:

- Material with potential for spillage will be stored in a neat, orderly manner in the staging area designated by the OMM contractor. Products will be kept in their original containers with the original manufacturer's label.

- Material will be brought on-site in the minimum quantities required to limit on-site storage.

- On-site vehicles will be monitored for leaks and receive regular preventative maintenance to reduce the chance of leakage of petroleum products. If a leak is identified, the vehicle will be removed from the work area until the leak has been fixed or a replacement vehicle provided.

- Refueling of vehicles and equipment shall only occur in the staging area designated by the OMM contractor. No refueling will occur within the work areas.

### 3. Health and Safety Plan (HASP)

This project is being performed at a New York State Superfund Site, currently identified by the DEC as a Class 4 Inactive Hazardous Waste Disposal Site. However, as described below, the potential for hazardous conditions exists at the Site. This project is being performed over and adjacent to a closed landfill containing buried wastes and

refuse beneath a landfill liner/cover system. As these buried materials decompose, they may generate landfill gas, which normally consists of methane, carbon dioxide, and occasionally hydrogen sulfide and other gases, depending on the composition of the buried materials. Although all work is proposed to be conducted above the landfill liner, should the liner be breached, exposure to landfill gases and refuse could occur. Additionally, this construction work is being performed in the winter along the elevated waterfront of the property. These working environments can pose significant hazards, including general construction hazards (heavy equipment), fall hazards, exposure to water and cold-related hazards (hypothermia from immersion in water).

A site-specific HASP has been previously prepared and updated by ARCADIS for this work, and is included in Appendix A. Additionally, each subcontractor working on this project will be required to prepare a Contractor's HASP (CHASP) that is at least as stringent as the HASP prepared by ARCADIS and submit it for review by ARCADIS, DEP, and DEC prior to the initiation of its field activities. The CHASPs will be submitted under separate cover as addenda to this CMWP upon selection of the contractors. The CHASPs will address all the potential hazards associated with the site, the construction activities, water/waterfront work, seawall restoration, and the liner repair activities. The CHASPs will also include a section describing the air monitoring to be conducted in each work area, including air monitoring for methane, carbon dioxide, hydrogen sulfide, VOCs, and dust.

## 4. Schedule

Upon DEC's approval of this CMWP, activities including permit application, the site inspection; and identification, selection, and procurement of the survey contractors will begin. Upon procurement of the survey contractors, the initial topographic survey and the bathymetric survey will be completed. Upon completion of the initial topographic survey, the limited, initial cover system restoration will be conducted to protect the exposed geocomposite liner. Upon completion of the site inspection, the surveys, and the delivery of the survey reports, the Interim Report, including any proposed upgrades to the seawall will be prepared. Upon DEC's approval of the Interim Report, construction documents will be finalized and contractors mobilized to the site to begin restoration activities. The first phase of restoration will include restoration of the seawall followed by restoration of the landfill cover system. The final restoration activities will include the conduct of the post-restoration topographical survey and perimeter fence replacement. An estimated project schedule is included as Figure 3.

## 5. Reporting

**Daily progress reports** will be submitted to the DEC and NYSDOH project managers beginning on the date of mobilization for the site survey. Daily progress reports will include: a summary of the work performed and/or completed, a discussion of the work activities planned for the next work day, impacts to the construction schedule, and a summary of changes to the proposed corrective measures (if any). Daily progress reports will be submitted via email to the DEC and NYSDOH project mangers the following day (Monday progress report to be submitted on Tuesday).

An **Interim Report,** as discussed in previous sections of this CMWP, will be prepared following the initial site inspection, initial topographic survey and the bathymetric survey. The Interim Report will summarize the findings of the inspection and surveys, recommendations for additional data collection activities, plans for seawall upgrades, and schedule modifications, as necessary. The Interim Report will serve as an addendum to this CMWP.

A **Corrective Measures Report** will be prepared by ARCADIS upon completion of the restoration work described herein to summarize the restoration activities. In addition, this Report will include all field logs generated, analytical results and bill of lading for any fill material imported onto or from the Site, and updated as-built drawings of the fencing, landfill cover and seawall. Upon DEC's approval of the Corrective Measures Report, the SMP will be modified, as appropriate, to include updated as-built drawings that show the modifications made to engineering controls.

Following DEC's approval of the Corrective Measures Report, DEP will submit a **Periodic Review Report** and the necessary Institutional Control/Engineering Control certifications in accordance with DER-10 Section 6.3.

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# Figures


NYCDEP
PELHAM BAY LANDFILL
BRONX, NEW YORK

**Damage from Hurrican Sandy**

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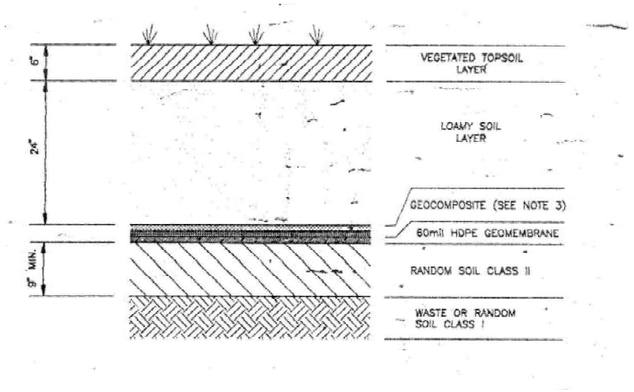
**Figure 1**
**LOCATIONS OF PERIMETER FENCING AND LANDFILL COVER SYSTEM DAMAGE**

**New York City Department of Environmental Protection**

**Corrective Measure Work Plan for Perimeter Fence, Landfill Cover System, and Seawall Restoration Pelham Bay Landfill, Bronx, NY**

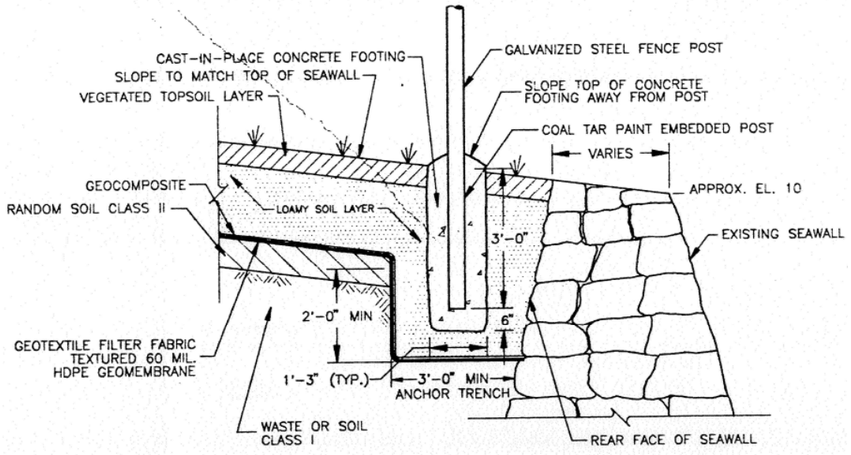
Source: Stratis Contracting Corp.

Project Number



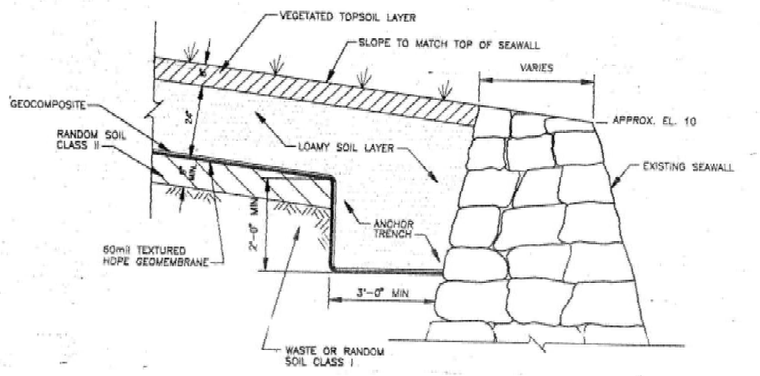

**TYPICAL COVER SECTION**

**N.T.S**




**TYPICAL POST FOOTING ALONG SEAWALL**

**N.T.S**




**TYPICAL ANCHOR TRENCH DETAIL**

**N.T.S**

ARCADIS

**Figure 2**
**TYPICAL DETAILS**

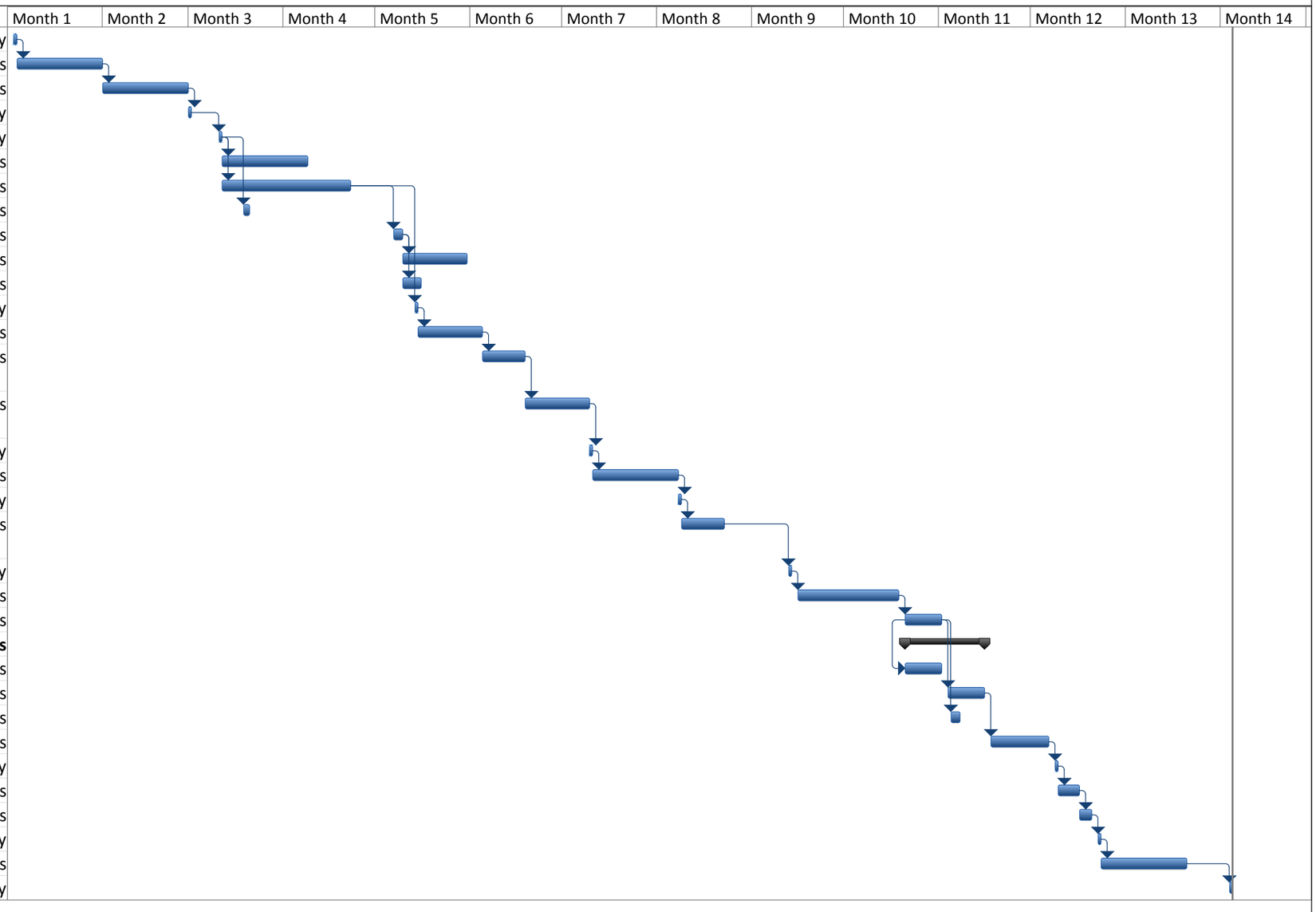
**New York City Department of Environmental Protection**

**Corrective Measure Work Plan for Perimeter Fence, Landfill Cover System, and Seawall Restoration Pelham Bay Landfill, Bronx, NY**

Source: NYCDEP Pelham Bay Landfill Geomembrane Capping and Gas Collection System
Contract No. 876-HP As-Built Drawings
Prepared by Breco Environmental Contractors, Inc.

**Figure 3**
**Estimated Project Schedule**

| ID | Task Name | Duration |
|---|---|---|
| 1 | **Submit Draft Corrective Measure Work Plan To NYSDEC** | 1 day |
| 2 | **NYSDEC Review of Work Plan** | 20 days |
| 3 | **Revise Work Plan** | 20 days |
| 4 | **Submit Final Work Plan** | 1 day |
| 5 | **NYSDEC Approval of Corrective Measures Work Plan** | 1 day |
| 6 | **Permitting** | 20 days |
| 7 | **Survey Subcontractor Identification, and Procurement** | 30 days |
| 8 | **Site Inspection** | 2 days |
| 9 | **Initial Topographic Survey** | 3 days |
| 10 | **Prepare Topographic Survey Report (by subcontractor)** | 15 days |
| 11 | **Initial, Limited Cover System Restoration** | 4 days |
| 12 | **Bathymetric Survey** | 1 day |
| 13 | **Prepare Bathymetric Survey Reports (by subcontractor)** | 15 days |
| 14 | **Survey Data Analysis and Evaluation. Coordination with NYCDEP Regarding Results and Recommendations** | 10 days |
| 15 | **Prepare Interim Report Summarizing Survey Results and Recommendations (Including NYCDEP Reviews and Revisions)** | 15 days |
| 16 | **Submit Interim Report to NYSDEC** | 1 day |
| 17 | **NYSDEC Review of Interim Report** | 20 days |
| 18 | **NYSDEC Approval of Interim Report** | 1 day |
| 19 | **Finalize Construction Documents and Volume Estimates for Restoration work** | 10 days |
| 20 | **Restoration Contractor Mobilization** | 1 day |
| 21 | **Seawall Restoration** | 25 days |
| 22 | **Landfill Cover System Restoration** | 10 days |
| 23 | **Perimeter Fence Restoration** | **20 days** |
| 24 | Install Concrete Forms | 10 days |
| 25 | Install Fence Posts, Concrete Footings and Fence | 10 days |
| 26 | **Post-Restoration Topographic Survey** | 3 days |
| 27 | **Prepare Draft Corrective Measure Report** | 15 days |
| 28 | Submit Draft Report to NYCDEP | 1 day |
| 29 | NYCDEP Draft Report Review | 5 days |
| 30 | Revise Corrective Measure Report | 4 days |
| 31 | Submit Final Corrective Measure Report to NYSDEC | 1 day |
| 32 | NYSDEC Review & Approval of Corrective Measures Report | 20 days |
| 33 | **Submit Periodic Review Report and EC/IC Certification** | 1 day |




Project: Schedule-rev2-28-2013.m
Date: Wed 5/29/13

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

**Figure 3**
**Estimated Project Schedule**

**23 Perimeter Fence Restoration**
Temporary safety fencing will remain in place until permanent fencing is installed.
A second mobilization for fence restoration may be required.

# Appendix A

Health and Safety Plan (HASP)

ARCADIS
Infrastructure · Water · Environment · Buildings

# Site Specific Health and Safety Plan

Project Name: 1246- PM Pelham Bay Landfill
Post Closure

Project Number: NY0014430006
Client Name: NYC DEP, NY
Date: 30-Mar-11
Revision: #1: 12/18/2012

Approvals:

HASP Developer: Krista Mastrocola, David Caballero, Arnas Nemickas

HASP Reviewer: Carlo San Giovanni, Charles Webster

Program Manager: Douglas Greeley

# Emergency Information

**Site Address:** Pelham Bay Landfill
300 Shore Road
Bronx, New York

**Emergency Phone Numbers:**

| | | |
|---|---|---|
| Emergency (fire, police, ambulance) | | 911 |
| Emergency (facility specific, if applicable) | | |
| Guard Trailer | | 1-718-597-1150 |
| Emergency Other (specify) | | NA |
| National Response Center (reportable quantities) | | 1-800-424-8802 |
| U.S. Coast Guard (spills to water) | | 1-804-441-3516 |
| WorkCare | | 1-800-455-6155 |
| Project H&S (specify) | Charles Webster | 1-315-671-9297 |
| Corporate Health and Safety | | 1-720-344-3500 |
| ARCADIS Near Loss Reporting Hotline | | 1-866-242-4304 |

**Hospital Name and Address:** Jacobi Medical Center
1400 Pelham Parkway South No. 803
Bronx, NY 10461

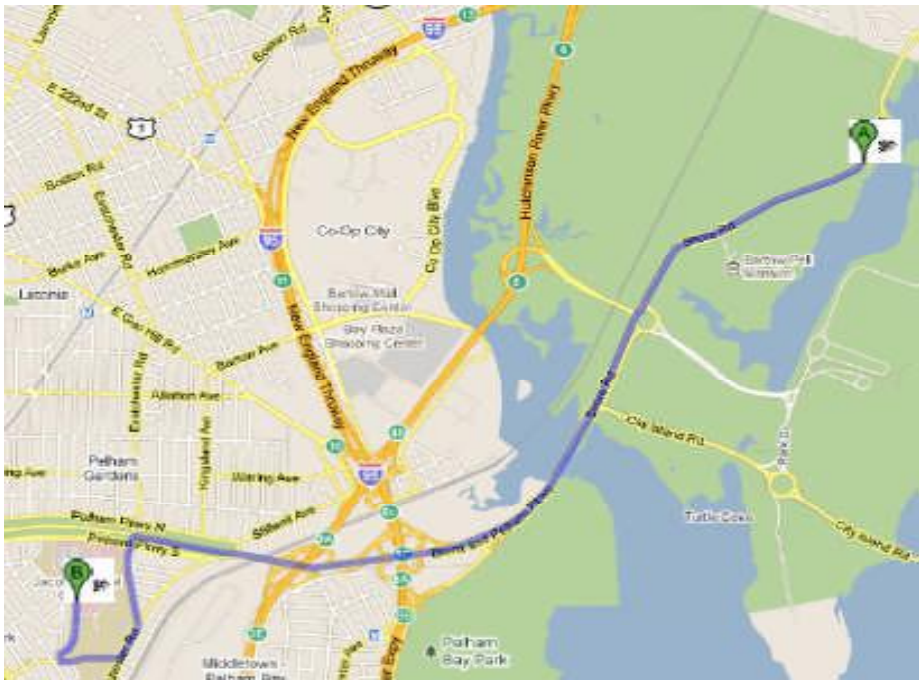
Hospital Phone Number: 1-718-918-5000

Other Important Numbers:

| | |
|---|---|
| Project Manager- Carlo San Giovanni | 1-631-391-5259 |
| Client Contact- Rupak Raha | 1-718-595-6210 |

**Route to the Hospital**

**Directions to Jacobi Medical Center**
1400 Pelham Pkwy S, Bronx, New York 10461 - (
718) 918-5000
**4.1 mi – about 10 mins**




300 Shore Rd, Bronx, NY 10464

| | | |
|---|---|---|
| 1. | Head **southwest** on **Shore Rd**<br>About 2 mins | go 1.0 mi<br>total 1.0 mi |
| 2. | At the traffic circle, continue straight onto **Pelham Bridge Rd/Shore Rd**<br>Continue to follow Shore Rd<br>About 2 mins | go 0.7 mi<br>total 1.7 mi |
| 3. | Continue onto **Bronx and Pelham Pkwy**<br>About 3 mins | go 1.5 mi<br>total 3.2 mi |
| 4. | Turn left at **Eastchester Rd**<br>About 2 mins | go 0.5 mi<br>total 3.6 mi |
| 5. | Turn right at **Morris Park Ave** | go 0.2 mi<br>total 3.8 mi |
| 6. | Take the 1st right onto **Seminole Ave** | go 157 ft<br>total 3.9 mi |
| 7. | Turn right<br>Destination will be on the right | go 0.2 mi<br>total 4.1 mi |

**Jacobi Medical Center**
1400 Pelham Pkwy S, Bronx, New York 10461 - (718) 918-5000

**General Information**

***Site Type (select all applicable):***

| | | | |
|---|---|---|---|
| ☐ | Active | ☐ | Utility |
| ☑ | Inactive | ☑ | Landfill (closed) |
| ☑ | Secure | ☐ | Roadway |
| ☐ | Unsecured | ☐ | Railroad |
| ☐ | Residential | ☐ | Marine |
| ☐ | Retail | ☐ | Remote Area |
| ☐ | Commercial | ☐ | Unknown |
| ☐ | Industrial | ☐ | Other (specify): _____ |
| ☑ | Government | | |

***Surrounding Area and Topography (select one):***

☑ Surrounding area and topography are described in the PBL Site Management Plan
☐ Surrounding area and topography (*briefly describe*):

***Site Background (select one):***

☑ Site background is presented in the PBL Site Management Plan
☐ Site background (*briefly describe)*:

**Project Tasks**

The following tasks are identified for this project:

| | *Examples: "Drilling/soil sampling", "Surveying", "Inspections"* | Supporting Document(s) | | | |
|---|---|---|---|---|---|
| | | JLA (Atch. 5) | Field H&S Handbook | STAR Plan or TCP | Other (specify below) |
| 1 | Oversight of Well Drilling/Installation | ☑ | ☐ | ☐ | ☐ |
| 2 | Oversight of Geosynthetic Liner Repair and site restoration | ☑ | ☐ | ☐ | ☐ |
| 3 | Driving to/from Site | ☑ | ☐ | ☐ | ☐ |
| 4 | Seawall, Cover System and Fence Restoration Oversight | ☑ | ☐ | ☐ | ☐ |
| 5 | | ☐ | ☐ | ☐ | ☐ |
| 6 | | ☐ | ☐ | ☐ | ☐ |

☑ Subcontractor supplied HASP and CAMP (Attachment 9) ARCADIS Standards

Print any relevant JLAs for this scope of work and attach.

FHSHB and/or applicable STAR Plan/TCP are required to be on site even if not referenced above.

Other (state document required to be on site):

☑ Utility clearance required? Utility Clearance Checklist ARCHSF019 (Attachment 8)

**Roles and Responsibilities**

| | *Name* | *Role* | *Additional Responsibilities (Describe)* |
|---|---|---|---|
| 1 | Doug Owen | PIC | |
| 2 | Carlo San Giovanni | PM | |
| 3 | Douglas Greeley | | Project Engineer; Program Manager |
| 4 | Dave Caballero | | Landfill Specialist |
| 5 | Arnas Nemickas | TM | |
| 6 | Mandy Giampaolo | | Project Environmental Engineer |
| 7 | Sunny Xu or other TBD | | ARCADIS SSO;Field Geologist |
| 7 | | SSO | |

**Training**

| *All ARCADIS employees are required to have the following training:* | *Selected ARCADIS employees are required to have the following additional training:* | Names or Numbers from above |
|---|---|---|
| ☑ 40 hr HAZWOPER w current refresh. | ☐ Not applicable | |
| ☐ 24 hr HAZWOPER | ☐ First aid/CPR/BBP | |
| ☐ 10 hr Construction | ☐ 30 hr Construction | |
| ☐ HazMat #1 (Ground/Air/MOT) | ☐ 10 hr Construction | |
| ☐ HazMat #4 (MOT) | ☐ HazMat #1 (Gr./Air/MOT) | |
| ☐ HazCom/Emergency Action Plan | ☐ HazMat #4 (MOT) | |
| ☑ LPS (classroom); or | ☐ Confined space entrant | |
| ☑ LPS (on-line) | ☐ Confined space rescue | |
| ☐ PPE | ☐ Excavation CP | |
| ☐ Respiratory protection | ☐ Electrical (NFPA 70E) | |
| ☑ Smith System (hands on) | ☐ Lockout/Tagout | |
| ☐ Smith System (on-line) | ☐ LPS (classroom) | |
| ☐ OTS/eRailsafe | ☐ OTS/eRailsafe | |
| ☐ Client specific: | ☐ Smith Sys. (hands on) | |
| | ☐ Boating safety | |
| ☐ Other: | ☐ Other: | |

☑ ARCADIS subcontractors are also required to have the above training applicable to all employees, or equivalent

**Hazard Analysis**

*Rank the hazards using HIGH (H), MEDIUM (M) or LOW (L) based on current site knowledge. For hazards that are not applicable, leave blank. Use results of this analysis to verify controls in the JLA, FHSHB or other supporting document are adequate to mitigate task hazards. When in the field, use the Tailgate Safety Meeting Form for task specific evaluation of task hazards.*

Task Specific Hazard Analysis Required? Tailgate Safety Meeting Form

Rank the hazards using the chart below:

| Severity | Consequence | | Probability | | | | |
|---|---|---|---|---|---|---|---|
| | Property Damage | Injury | Frequent | Likely | Occasional | Seldom | Unlikely |
| | > $100,000 | Fatality | H | H | H | H | M |
| | > $10,000 | Injury Requiring Hospitalization | H | H | H | M | L |
| | > $1000 | Injury Requiring Medical Treatment Beyond First Aid | H | M | M | L | L |
| | < $1000 | Injury Requiring First Aid | M | L | L | L | L |

*Use TRACK and identify rank relevant hazards expected to be encountered on this project:*

***Biological***

| | |
|---|---|
| H | Biting/stinging insects |
| L | Biting animals |
| M | Poisonous plants |
| M | Phys. damaging plants |
| | |

***Driving***

| | |
|---|---|
| M | Night driving |
| M | Off-road driving |
| | Urban driving |
| | All terrain vehicle |
| | Boat |
| | |

***Electrical***

| | |
|---|---|
| | Wet environments |
| | Electrical panels |
| | Electric utilities |
| L | Electric power tools |
| | |

***Environment***

| | |
|---|---|
| L | Heat |
| L | Cold |
| M | Lightning |
| M | Inclement weather |
| M | High wind |
| | |
| | |

***Gravity***

| | |
|---|---|
| M | Slip, trip, fall |
| | Fall from height |
| | Ladders or scaffolds |
| M | Struck by falling object |
| M | Potential for subsidence |
| | / voids |

***Mechanical***

| | |
|---|---|
| L | Cuts on equipment/tools |
| M | Pinch points on equipment |
| L | Burns from equipment |
| M | Struck by equipment |
| | |

***Motion***

| | |
|---|---|
| L | Lifting/awkward body positions |
| L | Struck by vehicle/traffic |
| | |

***Personal Safety***

| | |
|---|---|
| L | Working late/night |
| | Working alone |
| | High crime area |
| L | Tresspassers |

***Pressure***

| | |
|---|---|
| M | Utilities (gas, water, etc) |
| L | Compressed gas cylinders |
| | Compressed air/aerosols |
| L | Hydraulic systems |
| | |

***Sound***

| | |
|---|---|
| M | Equipment noise |
| | Tool noise |
| | Traffic noise (vehicle/train/etc) |
| | |

***Chemical/Radiation***

| | |
|---|---|
| | Not applicable |
| | General |
| | Dusts, toxic |
| L | Dusts, nuisance |
| | Chemicals, ARCADIS use |
| | Chemicals, corrosive |
| M | Chemicals, explosive |
| M | Chemicals, flammable |
| | Chemicals, oxidizing |
| | Chemicals, toxic |
| | Chemicals, reactive |
| | Radiation, ionizing |
| | Radiation, non-ionizing |

Other:

| | |
|---|---|
| L | VOCs in groundwater/leachate |
| | |
| | |

*Compound Specific:*

| | |
|---|---|
| H | Methane |
| L | Benzene |
| H | Carbon Monoxide |
| H | Hydrogen sulfide |
| L | Chlorobenzene |
| L | Arsenic |

Comments:

Ticks are the main biological hazard, wear proper PPE and perform frequent "tick checks". The main chemicla hazards are the various landfill gases. Implement air monitoring particularly in low lying areas and before start-up of any equipment. Follow driller HASP for landfill gas displacement and use of low/no sparking tools.

**Monitoring**

☑ Chemical air monitoring will not be conducted by ARCADIS, as the well driller is required by the project specifications to implement comparable borehole air monitoirng program.

*For projects requiring air monitoring, list the relevant constituents representing a hazard to site workers.*

| Need help? | Task Specific Required? | | | | NIOSH Pocket Guide | | | | OSHA Chemical Database | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Constituent | Max. Conc. | Units | TWA | Units | STEL | Units | IDLH | Units | LEL/UEL (%) | VD Air=1 | VP (mm Hg) | IP (eV) |
| Arsenic | 0.057 | ppm | 0.01 | m | NA | - | NA | - | NA/NA | NA | NA | NA |
| Benzene | 0.006 | ppm | 0.5 | p | 2.5 | p | 500 | p,N | 1.2/7.8 | 2.8 | 75 | 9.24 |
| Carbon Monoxide | 10 | ppm | 25 | p | 200 | p,c,N | 1200 | p,N | 12.5/74 | 0.97 | 2600 | 14.01 |
| Chlorobenzene | 0.025 | ppm | 1000 | p | NA | - | 1000 | p,N | 1.3/9.6 | NA | 9 | 9.07 |
| Hydrogen Sulfide | 10 | ppm | 1 | p | 5 | p | 100 | p,N | 4.0/44.0 | 1.19 | 13376 | 10.46 |
| Methane | 600000 | ppm | 1000 | p | NA | - | NA | - | NA | 0.6 | NA | 12.51 |

Notes: TWAs are ACGIH 8 hr-TLVs unless noted.
p-ppm m-mg/m3 c2- ceiling (2 hr) se-sensitizer "#N/A" -Constituent is not in database, manually enter information
s- skin c-ceiling "9999" - NA O-OSHA PEL
r- resipirable i-inhalable N-NIOSH 10 hr REL

Monitoring Equipment and General Protocols — Air Monitoring Documentation Form

*Air monitoring is required for any task or activity where employees have potential exposure to vapors or particulates above the TWA. Action levels below are appropriate for most situations. Contact the project H&S contact for all stop work situations. Check instruments to be used.*

*Monitoring Frequency:* Continuous

| | Instrument | Action Levels | Actions |
|---|---|---|---|
| ☑ | Photoionization Detector | < 0.500 | Continue work |
| | | ≥ 0.500 | Draw Colorimetric Indicator Tube for Benzene |
| | | < 3.000 | Continue work |
| | Calibration Log | 3.000 - 5.000 | Sustained >5 min. continuous monitor, review eng. controls and PPE, proceed with caution |
| | Lamp (eV): 10.6 <= SI | > 5.000 | Sustained >5 min. stop work, contact SSO |
| ☐ | Flame Ionization Detector (FID) | < 0.0 | Continue work |
| | | 0.0 - 0.0 | Sustained >5 min. continuous monitor, review eng. controls and PPE, use caution |
| | | > 0.0 | Sustained >5 min. stop work, contact SSO |
| ☐ | LEL/O2 Meter | 0-10% LEL | Continue work |
| | | >10-25% LEL | Continuous monitor, review eng. controls, proceed with caution |
| | Calibration Log | >25% LEL | Stop work, evacuate, contact SSO |
| | | 19.5%-23.5% O2 | Normal, continue work |
| | | <19.5% O2 | O2 deficient, stop work, evacuate, cont. SSO |
| | | >23.5% O2 | O2 enriched, stop work, evacuate, contact SSO |
| ☑ | Colorimetric Indicator Tube (CIT) When PID | < 0.5 ppm | Continue work and monitor with PID |
| | | >0.5 ppm | Stop work, review eng. controls and PPE, contact SSO |
| | Compound(s):Benzene | | |
| ☐ | Sound Level Meter or Dosimeter | >80 dBA, sustained | Monitor continuously, continue work |
| | Need help? | >85 dBA, sustained | Review controls, use hearing protection |
| | | Result dBA-(NRR-7dBA)>90dBA | Stop work, contact SSO |
| ☑ | Particulate Monitor (mists, aerosols, dusts in $mg/m^3$) | < 2.5 | Continue work |
| | | 2.5 - 5.00 | Use engineering controls, monitor continuously |
| | | > 5.00 | Stop work, review controls, contact SSO |
| ☐ | Radiation Survey Meter | Specify: | Specify: |
| ☑ | Other: Landfill Gas Meter (LEL, oxygen, carbon monoxide, and H2S) | 0-10% LEL | Continue work |
| | | >10-25% LEL | Continuous monitor, review eng. controls, proceed with caution |
| | | >25% LEL | Stop work, evacuate, contact SSO |
| | | 19.5%-23.5% O2 | Normal, continue work |
| | | <19.5% O2 | O2 deficient, stop work, evacuate, cont. SSO |
| | | >23.5% O2 | O2 enriched, stop work, evacuate, contact SSO |
| | | >5 ppm H2S | Stop work, evacuate, contact SSO |

**Personal Protective Equipment (PPE)** PPE assistance: ARC HSGE015

***See JLA for the task being performed for PPE requirements***. *If the work is not conducted under a JLA, refer to the governing document for PPE requirements. At a minimum, the following checked PPE is required for all tasks during field work not covered by a JLA on this project:*

Level D or Level D Modified:

| | | | | | | | Specify Type: |
|---|---|---|---|---|---|---|---|
| ☑ | Hard hat | ☐ | Snake chaps/guards | ☑ | Coveralls: | | |
| ☑ | Safety glasses | ☐ | Briar chaps | ☐ | Apron: | | |
| ☐ | Safety goggles | ☐ | Chainsaw chaps | ☐ | Chem. resistant gloves: | | |
| ☐ | Face shield | ☐ | Sturdy boot | ☐ | Gloves other: | | |
| ☑ | Hearing protection | ☑ | Steel toe boot | ☐ | Chemical boot: | | |
| ☐ | Rain suit | ☐ | Metatarsal boot | ☐ | Boot other: | | |
| ☐ | Other: | | | ☑ | Traffic vest: | | Not for traffic, for visibility |
| | | | | ☐ | Life vest: | | in tall grass |

Task specific PPE:

Level C - complete, print and attach the Level C Supplement for specific requirements and attach.
Level C Supplement
Level B and A - contact the project H&S contact for assistance.

**Medical Surveillance (*check all that apply*)** Med. Surv. assistance: ARC HSGE010

- ☐ Medical Surveillance is not required for this project.
- ☑ HAZWOPER medical surveillance applies to all ARCADIS site workers on the project.
- ☑ HAZWOPER medical surveillance applies to all subcontractors on the project.
- ☐ HAZWOPER medical surveillance applies to all site workers on the project except:

- ☐ Other medical surveillance required (describe type and who is required to participate):

- ☐ Client drug and/or alcohol testing required.

**Hazardous Materials Shipping and Transportation (*check all that apply*)**

- ☑ Not applicable, no HazMat will be transported or shipped — Shipping Determination Form
- ☐ A Shipping Determination has been reviewed and provided to field staff
- ☐ A Shipping Determination is attached — Need help?
- ☐ All HazMat will be transported under Materials of Trade by ARCADIS — DOT Facts-101b
- ☐ Other (specify):

**Roadway Work Zone Safety (*check all that apply*)**

- ☑ Not applicable for this project.
- ☐ All or portions of the work conducted under a TCP — TCP Templates
- ☐ All or portions of the work conducted under a STAR Plan — STAR Templates
- ☐ TCP or STAR Plan provided to field staff
- ☐ TCP or STAR Plan attached
- ☐ Other (specify):

**ARCADIS Commercial Motor Vehicles (CMVs)**

This section is applicable to ARCADIS operated vehicles only

- ☑ This project will **not** utilize CMV drivers — CMV identification help: DOT Facts-001a
- ☐ This project will utilize CMV drivers

**Site Control (*check all that apply*)**

- ☐ Not applicable for this project.
- ☐ Site control protocols are addressed in JLA or other supporting document (attach)
- ☑ Maintain an exclusion zone of 65 ft. around the active work area
- ☐ Site control is integrated into the STAR Plan or TCP for the project
- ☐ Level C site control - refer to Level C Supplement attached
- ☐ Other (specify):

**Decontamination (*check all that apply*)**

- ☐ Not applicable for this project.
- ☐ Decontamination protocols are addressed in JLA or other governing document (attach)
- ☑ Level D work- wash hands and face prior to consuming food, drink or tobacco.
- ☐ Level D Modified work- remove coveralls and contain, wash hands and face prior to consuming food, drink or tobacco. Ensure footwear is clean of site contaminants
- ☐ Level C work - refer to the Level C supplement attached.
- ☐ Other (specify):

**Sanitation *(check all that apply)***

- ☐ Mobile operation with access to off-site restrooms and potable water
- ☑ Restroom facilities on site provided by client or other contractor
- ☐ Project to provide portable toilets (1 per 20 workers)
- ☑ Potable water available on site
- ☐ Project to provide potable water (assume 1 gal./person/day)
- ☐ Project requires running water (hot and cold, or tepid) with soap and paper towels

**Safety Briefings (*check all that apply*)**

- ☑ Safety briefing required daily — Tailgate Safety Meeting Form
- ☐ Safety briefing required twice a day
- ☐ Safety briefings required at the following frequency: _____
- ☑ Subcontractors to participate in ARCADIS safety briefings
- ☑ ARCADIS to participate in client/contractor safety briefings
- ☑ Other (specify): Be familiar with NYCDEP HS Policy and Procedures (Attachment 3)

**Safety Equipment and Supplies**

***Safety equipment/supply requirements are addressed in the JLA for the task being performed***. *If work is not performed under a JLA, the following safety equipment is required to be present on site in good condition (Check all that apply):*

- ☑ First aid kit
- ☐ Bloodborne pathogens kit
- ☑ Fire extinguisher
- ☑ Eyewash (ANSI compliant)
- ☐ Eyewash (bottle)
- ☐ Drinking water
- ☑ Other: Cell phone
- ☑ Insect repellent
- ☑ Sunscreen
- ☐ Air horn
- ☐ Traffic cones
- ☐ 2-way radios
- ☐ Heat stress monitor

**LPS Program (*check all that apply*)** Print a blank LPO form now: 4-Sight LPO

☐ LPS metrics are provided on the account level, refer to account guidance
☑ LPO required at the following frequency on this project:
*Select One:* _____ mhrs 4 time(s) _____ Define: _____
☐ LPS Field Assessment required at the following frequency on this project:
*Select One:* _____ mhrs _____ time(s) _____ Define: _____
☐ Other (specify):

List tasks anticipated for LPO activity:

| |
|---|
| After site set-up completed (prior to start of drilling) |
| Drilling 2nd well |
| Start of 4th well |
| One driving LPO |
| Start of Sewall Restoration |
| Start of Cover System Restoration |
| Start of Fence Restoration |

***For successful LPOs, schedule feedback sessions with supervisor in advance!***

**Signatures**

I have read, understand and agree to abide by the requirements presented in this health and safety plan. I understand that I have the absolute right to stop work if I recognize an unsafe condition affecting my work until corrected.

| Printed Name | Signature | Date |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

Add additional sheets if necessary

☑ Subcontractor Acknowledgement Form attached

**You have an absolute right to STOP WORK if unsafe conditions exist!**

**Attachment 1**
Tailgate Safety Meeting Form

ARCADIS

Control Number:TGM - _____

TGM + *project number plus date as follows: xxxxxxxx.xxxx.xxxxx - dd/mm/year*

# TAILGATE HEALTH & SAFETY MEETING FORM

| **Project Name:** | | | **Project Location:** |
|---|---|---|---|
| **Date:** | **Time:** | **Conducted by:** | **Signature/Title:** |

**Issues or concerns from previous day's activities:**

**Task anticipated to be performed today:**

☐ Additonal permits or checklists attached

**USE TRACK! Evaluate the hazards (h) for the tasks being performed today and rank as Low (L), Medium (M) or High (H). Use relevant JLAs, FHSHB, permit or other work standard to communicate controls (c) to be used to eliminate or mitigate identified hazards.**

| | | |
|---|---|---|
| ☐ Gravity (i.e., ladder, scaffold, trips) (L M H)<br>h: _____<br>c: _____ | ☐ Motion (i.e., traffic, moving water) (L M H)<br>h: _____<br>c: _____ | ☐ Mechanical (i.e., augers, motors) (L M H)<br>h: _____<br>c: _____ |
| ☐ Electrical (i.e., utilities, lightning) (L M H)<br>h: _____<br>c: _____ | ☐ Pressure (i.e., gas cyl., wells) (L M H)<br>h: _____<br>c: _____ | ☐ Environment (i.e., heat, cold, ice) (L M H)<br>h: _____<br>c: _____ |
| ☐ Chemical (i.e., fuel, acid, paint) (L M H)<br>h: _____<br>c: _____ | ☐ Biological (i.e., ticks, poison ivy) (L M H)<br>h: _____<br>c: _____ | ☐ Radiation (i.e., alpha, sun, laser) (L M H)<br>h: _____<br>c: _____ |
| ☐ Sound (i.e., machinery, generators) (L M H)<br>h: _____<br>c: _____ | ☐ Personal (i.e. alone, night, not fit) (L M H)<br>h: _____<br>c: _____ | ☐ Driving (i.e. car, ATV, boat, dozer) (L M H)<br>h: _____<br>c: _____ |

**Comments:**

**Signature and Certification: I have read and understand the project specific HASP for this project.**

| Printed Name/Signature/Company | Sign In Time | Sign Out Time |
|---|---|---|
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**Place any additional signatures on the back of this form.**

**I will STOP** the job any time anyone is concerned or uncertain about health & safety or if anyone identifies a hazard or additional mitigation not recorded in the site, project, job or task hazard assessment.

**I will be** alert to any changes in personnel, conditions at the work site or hazards not covered by the original hazard assessments.

If it is necessary to **STOP THE JOB,** I will perform **TRACK**; and then amend the hazard assessments or the HASP as needed.

**I will not assist** a subcontractor or other party with their work unless it is absolutely necessary and then only after I have done TRACK and I have thoroughly controlled the hazard.

All site staff should arrive fit for work. If not, they should report to the supervisor any restrictions or concerns.

In the event of an injury, employees will call **WorkCare at 1.800.455.6155** and then notify the field supervisor.

Utility strike, motor vehicle accident or 3rd party protperty damage - field supervisor will immediately notify the Project or Task Manager

**Attachment 2**
Air Monitoring Documentation Form

ARCADIS

# Air Monitoring Documentation Form

PID Model: _____ Monitor Frequency: _____

LEL/$O_2$ Model: _____

CIT Model: _____

Dust Mon. Model: _____

Air Monitoring Results

| Date | Time | PID (units) | $O_2$ (%) | LEL (% LEL) | CIT (ppm) | Dusts ($mg/m^3$) | Location |
|---|---|---|---|---|---|---|---|
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|---|---|---|---|
| PID | Photoionization Detector | ppm | Part per million |
| LEL | Lower Explosive Limit | % | Percent |
| O2 | Oxygen | mg/m3 | Miligram per cubic meter |
| CIT | Colorimetric Indicator Tube | | |

**Attachment 3**

NYCDEP Environmental Health and Safety Policy & Procedures, Vol. II, Soil Prevention, Environmental Release, Reporting and Investigation

THE CITY OF NEW YORK
DEPARTMENT OF ENVIRONMENTAL PROTECTION

# ENVIRONMENTAL, HEALTH & SAFETY POLICIES AND PROCEDURES

## Vol. 2

## Spill Prevention, Environmental Release Reporting & Investigation

## Environmental Coordination Committee Approval

The New York City Department of Environmental Protection's Environmental Coordination Committee has reviewed this document and by signing below agree that it adequately defines the program necessary t address regulatory requirements for their Bureau operations and commit to the policies and/or procedures contained within (or substantially equivalent procedures, if Bureau specific amendment is required).

| Revision / Action | Signature(s) of Committee Chair | |
|---|---|---|
| Revision 0, Authorization | | Date: 08/22/02 |
| Revision 1, Authorization | Ann Marie Bynes | Date: 10/29/04 |
| Revision 2, Authorization | Christine Tamicia | Date: 03/31/06 |
| | | Date: |
| | | Date: |
| | | Date: |
| | | Date: |

## Agency Compliance Office Certification

I, a duly authorized representative of the DEP Agency Compliance Office, have reviewed this document, have found it to be acceptable and authorize its use for all DEP operations.

| Revision / Action | Signature(s) | |
|---|---|---|
| Revision 0, Authorization | | Date: 8/22/02 |
| Revision 1, Authorization | | Date: 10/29/04 |
| Revision 2, Authorization | | Date: 3/31/06 |
| | | Date: |
| | | Date: |
| | | Date: |
| | | Date: |

# Table of Contents

## 1 Purpose

The purpose of this procedure is to prevent releases when possible and to ensure that all incidents that result in spills of petroleum, hazardous substances, wastewater/sewage or other pollutants are properly reported, both within DEP and to appropriate regulatory agencies. In an emergency, facility Emergency Action/Response Plans or Contingency Plans are the primary reference for immediate action. Actions necessary to protect life and health are the first priority in any emergency.

## 2 Scope

This procedure applies to all releases of petroleum, hazardous substances, wastewater/sewage or other pollutants on DEP property or at field work locations, whether or not caused by DEP activities or those of its contractors. This procedure does not apply to transportation accidents or other releases caused by third parties unrelated to DEP water or wastewater operations in New York City or its watersheds, although DEP may respond to these incidents as part of its water supply protection and City Hazmat technical support roles. This procedure also does not apply to routine self-reporting required under established permits.

## 3 Responsibilities

The following responsibilities generally apply throughout DEP, although Bureaus and individual facilities may develop more detailed Manuals and Emergency Plans that can deviate from these responsibilities. This is acceptable as long as responsibilities are clearly assigned:

***Employee:*** It is the responsibility of all employees to prevent releases when possible and to immediately report any release of petroleum, a hazardous substance, wastewater/sewage or other pollutant, as described in the procedure below.

***Responsible Manager***: The highest ranking manager or supervisor within each DEP Bureau at each facility (or whose employees perform field operations outside of fixed facilities) is the "***Responsible Manager***" for that Bureau/Office's operation. The ***Responsible Manager*** must make the necessary calls to Division/Bureau management and Division/Bureau EH&S staff for assistance and must cooperate in reporting and investigation.

***Contract Supervisor:*** The senior staff person overseeing a remediation project will be referred to as the "***Contract Supervisor.***" ***Contract Supervisor*** has many definitions, depending on the Contract and/or managing Bureau:

- For contracts managed by BEDC Design, the ***Contract Supervisor*** is the Lead Project Engineer;
- For contracts managed by BEDC Construction, the ***Contract Supervisor*** is the DEP Resident Engineer, or the DEP employee directly responsible for overseeing the consultant Resident Engineer when a Construction Manager (CM) is responsible for resident engineering;
- For contracts managed by various BWS divisions, the ***Contract Supervisor*** is the Director of the Division who hired the Contractor or his/her designee (e.g., Project Manager); and
- For contracts managed by BWSO, the ***Contract Supervisor*** is the BWSO Manager (Director, Chief, Deputy Chief, etc.) responsible for managing and overseeing the contract or his/her designee (e.g., Project Manager).

***National Response Center:*** The National Response Center (NRC) maintains a 24 hour per day, 7 day a week, 365 day a year Operations Call Center where all information is received via a toll-free number, entered directly into an on-line data base system, and electronically disseminated as part of the National Response System.

NRC is the single contact point for reporting all pollution incidents. It acts as a national 911 service for environmental incidents. Calling the toll-free number fulfills nearly all federal requirements for reporting oil and chemical spills, spills of nuclear material, chemical and biological warfare agents, train derailments, and pipeline spills.

The following are examples of incidents that warrant a call to the NRC:

Oil Spills: The responsible party shall notify the NRC as soon as he becomes aware of an oil spill from a vessel or facility operating *in or along U.S. navigable waters***.**

Chemical Spills: The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requires that all spills of hazardous substances (including radionuclides) exceeding reportable quantities, be reported by the responsible party to the NRC.

Transportation Accidents: Transportation accidents involving hazardous materials, including radioactive substances, must be reported to the NRC immediately by the carrier when, as a direct result of the materials: a person is killed; a person receives injuries requiring hospitalization; property damage exceeds $50,000; or fire, breakage, or spillage of an etiologic agent occurs.

## 4 Spill Prevention

A large portion of DEP spills are a result of improperly maintained or damaged equipment. Equipment includes, but is not limited to, vehicles, construction equipment, pumps, meters, storage tanks, etc. ***Responsible Managers*** must prevent spills within their respective facility/work group by employing the following measures, where/when applicable:

- Utilizing checklists to conduct pre-use inspections of equipment;
- Emphasizing proper materials handling and container storage inspection practices;
- Using manufacturer recommended Maintenance Procedures (MPs) to develop in-house MPs for certain types of equipment or activities where there is no adequate preventive maintenance (PM) schedule in place. If neither exists, the facility shall develop equipment-specific MPs;
- Using breakaway or quick disconnect hoses and/or absorbent drip pads during product or fuel transfer and dispensing activities;
- Ensuring the proper labeling of valves and ports transferring or receiving chemical or petroleum products;
- Installing secondary containment devices (e.g., drip pans) on equipment;
- Scheduling replacement of damaged or old equipment; and
- Utilizing any other appropriate spill prevention measures.

The following sections describe the specific procedures to be followed for handling spills that occur within the Bureau of Water Supply (BWS), Bureau of Water & Sewer Operations (BWSO), Bureau of Wastewater Treatment (BWT), and Bureau of Engineering Design & Construction (BEDC).

# 5 Bureau of Water Supply (BWS) - Protocol for Reporting Spills/Releases

## 5.1 Initial Notification

Upon discovery of a spill/release, any DEP Employee or DEP Contractor (the "Discoverer") who becomes aware of any spill/release of a petroleum product, sewage and/or wastewater, hazardous substance, or other pollutant that occurs on DEP property or may potentially impact the DEP watershed/water supply shall:

- Immediately notify Supervisors/Co-workers, if they are or may be in IMMEDIATE DANGER;
- If medical attention is required, contact Emergency 911;
- **Immediately contact their respective Supervisor and *EH&S staff member*** on duty to determine if the spill is at or above the NYSDEC *reportable quantity*; AND
- **Immediately call the BWS DEP Police Croton Command Center** (CCC) at 888-426-7433* and provide as much of the information below as possible:
  - Location of incident;
  - Time of incident;
  - Material released;
  - Status of staff (injuries, if any);
  - Name, position, and contact information of "discoverer";
  - Duration and estimated quantity of material released; and
  - Estimated impact to the environment and site weather conditions; AND
  - Whether or not the spill is at or above the NYSDEC *reportable quantity* and requires that DEP Police call NYSDEC for a Spill Number – **There is a 2-hour time limit to make this determination and contact NYSDEC.**
- **Except for:**

  ***Incidental releases of hazardous substances or petroleum*.** These are releases of small quantities, such as a few ounces, that result from equipment maintenance, repair or leakage, which have impacted only an impervious surface. Only releases which are contained and collected before reaching the environment (land or waters of the State of New York) would fall under this definition.

***BWS personnel working IN CITY**: BWS personnel working IN CITY (i.e., DWQC personnel based in Queens, New York) are directed to **call the BWSO EHS On-Call phone number (646-879-3315) instead of the Croton Command Center** as indicated above.

**BWS Wastewater Treatment Plant Operators:** In addition to the aforementioned notification requirements, ALL BWS Wastewater Treatment Plant (WWTP) Operators must report all wastewater/sewage releases as directed by the facility's respective State Pollutant Discharge Elimination Systems (SPDES) permit(s) to NYSDEC directly as mandated by ***6 NYCRR Subpart 750-2.7 Incident Reporting***. These reporting requirements may include, but not be limited to, Anticipated Non-Compliance, 2-Hour Oral reporting of By-pass, Upset or Other Incident, 24-Hour Oral reporting of Bypass, Upset or Other Incident, 5 Day Written Incident Report and any additional reporting as required under the facility-specific issued SPDES Permit.

## 5.2 Role of BWS DEP Police Croton Command Center (CCC)

Upon notification of a spill/release by the Discoverer or participating Division ***EH&S staff member***, **AND NO LATER THAN 2-HOURS FROM INITIAL DISCOVERY**, the CCC is responsible for:

- Contacting NYSDEC, if the spill is at or above the NYSDEC *reportable quantity*, to relay spill/release information provided by the Discoverer or participating ***EH&S staff member*** and obtaining a Spill Number (IF issued by NYSDEC);
- If needed, dispatching BWS HazMat, Engineering (for spills of sewage and/or wastewater), BWS DEP Police, and/or any additional local authorities for emergency response; and
- If required, contacting the National Response Center (NRC) at (800) 424-8802.

## 5.3 Environmental Release Investigation – PART 1 of the ERR

For all spills/releases (except "incidental" releases), and after contacting the CCC [or the BWSO EHS On-Call phone number (646-879-3315) if working IN CITY], the Discoverer and/or participating Division ***EH&S staff member*** must:

- Complete PART 1 of the Environmental Release Report (ERR – Attachment A) **no later than 48 hours from initial discovery**, and fax to Bureau EH&S at (914) 773-4530; the CCC [or the 24-hour DEP On-Call phone number if working IN CITY] shall provide the assigned Spill Number (IF provided by NYSDEC), to be included in PART 1 of the ERR.

## 5.4 Environmental Release Investigation

After the initial notifications and any necessary emergency response efforts are completed, the participating Division ***EH&S staff member*** (with assistance from the Discoverer, if necessary) shall conduct the necessary investigation to properly complete applicable sections of PARTs 2 and 3 of the ERR. PARTs 2 and 3 of the ERR shall be completed no later than six (6) days after discovery of the spill/release, unless outstanding circumstances warrant additional time for investigation (i.e., sampling/remediation event). These Sections also applies to spills or releases of wastewater and/or sewage at BWS WWTPs.

## 5.5 Communicating Corrective Actions

When the investigation is complete, the participating Division ***EH&S staff member*** shall inform his/her respective ***Division Director*** of any spill prevention recommendations that require follow-up. It is the responsibility of the affected ***Division Director*** (or designee) to ensure that all recommendations are properly resolved and documented in the ERR. Whenever a recommendation is not or cannot be implemented, a written explanation shall be documented in PART 3 of the ERR (or attached to ERR). The ERR will not be "closed" until all recommendations are resolved and documented.

## 5.6 ERR Closure

The affected ***Division Director*** (or designee) and the Bureau E, H & S Director (or designee) shall periodically check the status of completion of all spill prevention recommendations until they are properly resolved and documented in the ERR, within six (6) days of initial spill/release discovery, unless outstanding circumstances warrant additional time for investigation (i.e., sampling/remediation event). Final and/or Closed ERRs shall then be transmitted to ***Bureau EH&S (fax to 914-773-4530)*** for tracking purposes.

## 5.7 Recordkeeping

Copies of all closed ERRs shall be maintained by ***Division EH&S*** and ***Bureau EH&S*** for a minimum of five (5) years. Records of any training provided to fulfill any recommendations shall also be maintained by ***Division EH&S*** for a minimum of five (5) years.

# 6 Bureau of Water and Sewer Operations (BWSO) - Protocol for Reporting Spills/Releases

## 6.1 Initial Notification – Part 1 of the ERR

Any ***Employee*** or contractor who becomes aware of a release of petroleum, hazardous substance or other pollutant shall immediately notify:

- Supervisors/Co-workers, if they are or may be in IMMEDIATE DANGER.
- **Emergency (911)** IF the incident CLEARLY REQUIRES EMERGENCY RESPONDERS (because it presents obvious danger to employees or the public); If employee doesn't have access to a phone, notify a facility Supervisor.
- The ***Responsible Manager*** or highest ranking Supervisor on duty, REGARDLESS OF THE SIZE OF THE RELEASE or whether it is inside a containment area.

Upon being notified of a release, the facility Responsible Manager or highest ranking Supervisor on duty for the operation must immediately notify BWSO Bureau EHS staff verbally either during regular business hours (9:00 am to 5:00 pm Monday through Friday) or the on-call Bureau EHS representative (via the 24-hour On-Call phone number 1-646-879-3248) and the Emergency Communications Center (212-689-1620) after business hours for all spills, **except**:

> ***Incidental releases of hazardous substances or petroleum*.** These are releases of small quantities, such as a few ounces, that result from equipment maintenance, repair or leakage, which have impacted only an impervious surface. As addressed in BWSO spill training, only releases which are contained and collected before reaching the environment would fall under this definition. This exception (incidental releases of hazardous substances and petroleum) only applies to immediate notification of BWSO Bureau EHS. The spill is still logged and tracked by the facility for report to Bureau EHS in a facility monthly incidental spill log. If there is any uncertainty about a spill falling into this category, then Bureau EHS must be contacted immediately.

For all other spill incidents, the initial notification **MUST BE MADE VERBALLY TO AN EHS STAFF MEMBER** in order to guarantee that there will be a timely response to the spill. A voice mail, e-mail or fax is **NOT** acceptable as an initial notification. Notification can be

made to any BWSO EHS staff member, an Environmental or Health and Safety representative or the 24 hour On-Call representative. BWSO Bureau EHS maintains and distributes to its facilities an "EHS Contact List," which provides a list of all EHS employees and their contact numbers, for 24/7 support for releases or other emergencies.

Within **24 HOURS** of initial spill notification to Bureau EHS, the facility ***Responsible Manager*** must also provide Bureau EHS with Part 1 of the DEP Environmental Release Report (ERR - **Attachment A**) with as much of the information as is available, especially material released, quantity, and where the material was released.

## 6.2 Bureau EHS Assistance

The BWSO Bureau EHS staff is responsible for providing technical support to the facility to assess the release and, in most incidents, for notifying the appropriate regulatory agency, when required; for preparing and submitting written reports to NYSDEC (1-800-457-7362) and for leading incident investigations, should they be required.

Bureau EHS Staff will:

- Assess the release and assist the facility in release reporting (e.g., estimating the quantity of release) and cleanup.
- **DETERMINE IF REPORTABLE** (to outside agencies).
- If the release is reportable, **REPORT THE RELEASE** as soon as possible [within 2 hours] to the New York State Department of Environmental Conservation (NYSDEC) and, if situation warrants, "immediately" to the National Response Center (NRC). Be sure to get the NYSDEC and NRC spill numbers.
- If warranted, **ACTIVATE** emergency clean-up contractor's response teams to assist in the response and spill clean-up. BWSO Bureau EHS representatives will be on-site to supervise and direct the contractor's remediation efforts.

## 6.3 Environmental Release Investigation – Part 2 of the EER

After the initial notifications and any necessary emergency response are completed, Part 2 of the DEP ERR will be completed. As with Part 1, Part 2 can be completed by the ***Responsible Manager*** with as much information as available and must be submitted to Bureau EHS within 24 hours. The Bureau EHS Group and Facility EHS Liaison will assist in determining any contributing causes and potential corrective actions to prevent recurrence. This investigation

by EHS should be initiated as soon as possible and no later than 48 hours after the discovery of the spill. The Deputy Commissioner, Director, and Bureau EHS Director shall be informed of all recommendations arising from the investigation. All recommendations will then be assigned by the ***Director*** to the appropriate staff (e.g., operations, maintenance, engineering, or contract personnel) for prompt follow-up.

## 6.4 Closeout of Spill Cases – PART 3 of the ERR

The Bureau EHS staff will periodically check the status of all open spill cases and implementation of any spill prevention recommendations until they are all properly resolved. When all actions regarding a spill have been completed, Part 3 of the ERR will be completed, with a copy of the report stored in Bureau EHS files and the affected facility files.

## 6.5 Communicating Results

All Contractor Representative(s) and DEP employees will be advised of any actions or new operating instructions resulting from the spill incident that may affect them as soon as they are to be implemented. The immediate Supervisor will review the incident investigation results and recommendations with all affected personnel during the next scheduled Safety Meeting. In addition, incident investigation findings will be communicated to all contract employees if relevant to their job tasks. All facility and contract personnel informed of investigation results must sign and date an attendance sheet.

## 6.6 Recordkeeping

Copies of all ERRs shall be maintained by Bureau EHS for a minimum of 5 years. Records (i.e., sign-in sheets and attached summaries) of any training program provided to fulfill spill prevention recommendations shall also be maintained by EHS for a minimum of 5 years.

# 7 Bureau of Wastewater Treatment (BWT) - Protocol for Reporting Spills/Releases

## 7.1 Initial Notification

Any ***Employee*** who becomes aware of a release of petroleum, hazardous substance or other pollutants at a BWT facility shall immediately notify:

- Supervisors/Co-workers IF they may be or are in IMMEDIATE DANGER.
- **911** IF the incident CLEARLY REQUIRES EMERGENCY RESPONDERS (because it presents obvious danger to employees or the public).
- The ***Responsible Manager*** or highest ranking Supervisor on duty, REGARDLESS OF THE SIZE OF THE RELEASE or whether it is inside a containment area.

Upon being notified of a release, the facility ***Responsible Manager*** or highest ranking Supervisor on duty for the operation will immediately refer to the BWT Emergency Procedures Manual for guidance AND notify Bureau EHS staff during regular business hours (6:30 am to 4:00 pm Monday through Friday) or, when after business hours, the on-call Bureau EHS representative directly, for all releases. Bureau EHS will review the incident with the ***Responsible Manager*** and notify NYSDEC.

Additionally, Bureau EHS will notify the DEP 24 Hour Call Center (212-689-1520) for all releases, **except**:

***Incidental releases of hazardous substances***. Releases of small quantities that result from equipment maintenance, repair or leakage, or occur when disconnecting lines after deliveries. [Note: All such releases must be contained and collected before reaching the environment].

***Minor releases of petroleum***. Releases that are less than five gallons AND contained on a non-permeable surface AND are cleaned up within 2 hours.

Make sure to provide Bureau EHS and DEP 24 Hour Call Center with as much of the information on Part 1 of the DEP Environmental Release Report (ERR - **Attachment A**) as is already available, especially material released, quantity, and where the material was released.

Wastewater/sewage releases at BWT Facilities are to be reported as required in the BWT Emergency Procedures Manual, as indicated by the facility's State Pollutant Discharge

Elimination System (SPDES) permit(s), as mandated by ***6 NYCRR Subpart 750-2.7 Incident Reporting***. These reporting requirements may include, but are not limited to, Anticipated Non-Compliance, 2-Hour Oral Reporting of By-pass, Upset or Other Incident, 24-Hour Oral Reporting of Bypass, Upset or Other Incident, 5-Day Written Incident Report and any/all Additional Reporting as required by the facility-specific SPDES Permit.

***Supervisors*** may be required to follow additional, internal DEP notification protocols and are directed to refer to their Emergency Procedures Manual.

## 7.2 Bureau EHS Assistance/Reporting

The Bureau EHS staff is responsible for providing technical support to the facility to assess the releases, for notifying the appropriate regulatory agencies when required (NYSDEC (1-800-457-7362) and NRC (800-424-8802)), and for participating in incident investigations, if necessary. Bureau EHS will maintain an "EHS On-call List" that provides a list of employees with contact numbers for 24/7 support for releases or other emergencies.

Bureau EHS Staff will:

- Assess the release and assist the facility in release reporting (e.g., estimating the quantity of release) and clean-up.
- Determine if DEP 24 Hour Call Center has been notified. If it is determined that the DEP 24 Hour Call Center should be notified and the facility has not yet done so, the Bureau EHS Staff will notify them.
- If the Bureau HazMat and/or emergency clean-up contractors have not already been mobilized, determine if they should be mobilized to assist in the response and **ACTIVATE RESPONSE TEAMS** if necessary.
- **DETERMINE IF REPORTABLE** (to outside agencies).
- If the release is reportable, **REPORT THE RELEASE** within 2 hours to NYSDEC and "immediately" to the NRC. Be sure to get the NYSDEC and NRC spill numbers.

## 7.3 Environmental Release Investigation – Part 2 of the ERR

When called for, or at the direction of the Bureau's EHS Representative, an incident investigation team will be established to investigate the incident. After the initial notifications and any necessary emergency response are completed, the incident will be investigated and Part 2 of the DEP ERR will be completed. The Bureau EHS Group and Facility EHS Liaison

will assist in determining any contributing causes and potential corrective actions to prevent recurrence.

The investigation should be initiated as soon as possible and no later than 48 hours after the incident. Part 2 of the ERR should be completed as soon as possible, and no later than 6 days after the release so that it can be used by Bureau EHS Group for written spill reporting.

## 7.4 Closeout of Spill Cases – PART 3 of the ERR

The Bureau EHS staff will periodically check the status of all open spill cases and implementation of any spill prevention recommendations until they are all properly resolved. When all actions regarding a spill have been completed, Part 3 of the ERR will be completed, with a copy of the report stored in Bureau EHS files and the affected facility's files.

## 7.5 Communicating Results

All Contractor Representative(s) and DEP employees will be advised of any actions or new operating instructions that may affect them as soon as they are to be implemented. The immediate Supervisor will review the incident investigation results and recommendations with all affected personnel during the next scheduled Safety Meeting. In addition, incident investigation findings will be communicated to all contract employees if relevant to their job tasks. All facility and contract personnel informed of investigation results must sign and date an attendance sheet.

## 7.6 Recordkeeping

Copies of all ERR forms shall be maintained by Bureau EHS for a minimum of 5 years. Records (i.e., sign-in sheets and attached summaries) of any training program provided to fulfill spill prevention recommendations shall also be maintained by EHS for a minimum of 5 years.

# 8 Bureau of Engineering, Design and Construction (BEDC) - Protocol for Reporting Spills/Releases

## 8.1 At Bureau of Water Supply (BWS) Sites

Upon discovery of a spill/release, **AND NO LATER THAN 2 HOURS FROM INITIAL DISCOVERY**, any DEP Employee or DEP Contractor (the "Discoverer") who becomes aware of **any** spill/release of a petroleum product, sewage and/or wastewater, hazardous substance, or other pollutant that occurs on DEP property or may potentially impact the DEP watershed/water supply shall:

- Immediately notify Supervisors/Co-workers, if they are or may be in IMMEDIATE DANGER;
- **If medical attention is required, contact Emergency 911;**
- Contact the ***Contract Supervisor*** or Designee (e.g., Resident Engineer) and provide as much of the information below as possible:
  - Location of incident;
  - Time of incident;
  - Material released;
  - Status of staff (injuries, if any);
  - Name, position, and contact information of "discoverer";
  - Duration and estimated quantity of material released; and
  - Estimated impact to the environment and site weather conditions.

The **Contract Supervisor** shall continue as follows:

- Call **the BWS DEP Police Croton Command Center (CCC) at 888-426-7433**; inform the CCC that the appropriate notifications (including the call to NYSDEC) are being handled by BEDC personnel;
- Call the Safety Consultant's 24 hour hotline;
- Call the Facility Responsible Manager and BWS Bureau EHS (914-773-4418);
- In coordination with the Safety Consultant's on-call representative and Bureau EHS (BEDC), determine if the Spill/Release is reportable to NYSDEC and NRC (if applicable);
- Call NYSDEC spill hotline at 800-457-7362 (and NRC, if applicable) and obtain spill number(s); if reportable, NYSDEC must be notified **NO LATER THAN 2 HOURS FROM THE INITIAL DISCOVERY**;

- In coordination with the "Discoverer" and BWS Bureau EHS, **complete PART 1 of the Environmental Release Report (ERR – Attachment A) as soon as possible** and fax to BWS ***Bureau EHS*** at (914) 773-4530;
- E-mail PART 1 of the ERR to the contact list below:

  To: Deputy Commissioner of BEDC

  Cc: Commissioner; First Deputy Commissioner; Chief of Staff; General Counsel; Press Office; Office of EHS Compliance; Human Resources; DEP Police; BEDC Directors; Appropriate BEDC Division Chiefs; Bureau EHS Representative; Safety Consultant;
- Fax PART 1 of the ERR to the *DEP Division of Emergency Response and Technical Assessment* at 718-595-4690 if hazardous materials are involved.

**Notes**:

- Refer to BEDC's latest *Spill/Release Notification Protocol* for names and contact information.
- The ***Contract Supervisor*** may delegate the above tasks to the consultant Resident Engineer if she/he is not present on the job site.
- All spills/releases must be reported at facilities with BEDC-managed contracts, regardless of reportable quantities.

## 8.2 All other Sites (Non-BWS Sites)

Upon discovery of a spill/release, **AND NO LATER THAN 2 HOURS FROM INITIAL DISCOVERY**, any DEP Employee or DEP Contractor (the "Discoverer") who becomes aware of any spill/release of a petroleum product, sewage and/or wastewater, hazardous substance, or other pollutant that occurs on DEP property or may potentially impact the DEP water supply shall:

- Immediately notify Supervisors/Co-workers, if they are or may be in IMMEDIATE DANGER;
- **If medical attention is required, contact Emergency 911;**
- Contact the **Contract Supervisor or Designee (e.g., Resident Engineer)** and provide as much of the information below as possible:
  - Location of incident;
  - Time of incident;
  - Material released;

- Status of staff (injuries, if any);
- Name, position, and contact information of "discoverer";
- Duration and estimated quantity of material released; and
- Estimated impact to the environment and site weather conditions.

The **Contract Supervisor** will continue as follows:

- Call the Safety Consultant's 24 hour hotline;
- Call the Facility Responsible Manager;
- In coordination with the Safety Consultant's on-call representative and Bureau EHS (BEDC), determine if the Spill/Release is reportable to NYSDEC and NRC;
- If reportable, call NYSDEC spill hotline at 800-457-7362 and NRC and obtain spill number(s). NYSDEC must be notified **NO LATER THAN 2 HOURS FROM the INITIAL DISCOVERY**;
- If hazardous materials are involved and spill incident warrants it, call DEP Division of Emergency Response and Technical Assessment at 718-595-4646;
- In coordination with the "Discoverer" and facility Responsible Manager, **complete PART 1 of the ERR as soon as possible**;
- E-mail PART 1 of the ERR to the contact list below:

  To: Deputy Commissioner of BEDC

  Cc: Commissioner; First Deputy Commissioner; Chief of Staff; General Counsel; Press Office; Office of EHS Compliance; Human Resources; DEP Police; BEDC Directors; Appropriate BEDC Division Chiefs; Bureau EHS Representative; Safety Consultant;

- Fax PART 1 of the ERR to the *DEP Division of Emergency Response and Technical Assessment* at 718-595-4690 if hazardous materials are involved.

**Notes**:

- Refer to BEDC's latest *Spill/Release Notification Protocol* for names and contact information.
- The ***Contract Supervisor*** may delegate the above tasks to the consultant Resident Engineer if she/he is not present on the job site.
- All spills/releases must be reported at facilities with BEDC-managed contracts, regardless of reportable quantities.

## 8.3 Environmental Release Investigation – PART 2 of the ERR

If required, form an investigation team in accordance with the Spill Prevention and Spill Reporting Policy. The ***Contract Supervisor***, Host Bureau, Bureau EHS and/or their representatives and the contractor responsible for the Spill/Release shall be included as part of the investigation

When the clean-up operation is completed, complete the remainder of the ERR. Make sure that all members of the investigation team agree and sign the ERR.

## 8.4 Closeout of Spill Cases – PART 3 of the ERR

If applicable, in coordination with Bureau EHS, contact NYSDEC and request the closure of the spill number. Indicate spill number closure date on page 3 of the ERR.

Submit the completed form to Bureau EHS for review and Close-Out. Bureau EHS will provide a copy of the closed-out report to the ***Contract Supervisor*** (e.g., Resident Engineer), the Host Bureau's Responsible Manager and EHS group, Office of Environmental Health and Safety Compliance (OEHSC) and Division of Emergency Response and Technical Assessment.

## 8.5 Communicating Corrective Actions

Once the investigation is complete, the ***Contract Supervisor*** shall inform their respective Division Director and Division EHS personnel of all spill prevention recommendations, if any, that require follow-up. It is the responsibility of the Division Director (or designee) to ensure that all recommendations are properly resolved and documented in the ERR. Whenever a recommendation is not or cannot be implemented, a written explanation shall be documented in PART 3 of the ERR (or attached to ERR). The ERR will not be "closed" until all recommendations are resolved and documented.

## 8.6 Recordkeeping

Copies of all closed ERR forms shall be maintained by Division EHS for a minimum of 5 years. Records of any training provided to fulfill any spill prevention recommendations in PART 2 of the ERR shall also be maintained by Division EH&S for a minimum of 5 years.

# 9 FLEET Maintenance Personnel (Bureau of Human Resources and Administration; HRA) - Protocol for Reporting Spills/Releases

## 9.1 FLEET Maintenance Personnel working Upstate (within BWS Boundaries)

FLEET Maintenance personnel working within the boundaries of the Bureau of Water Supply are directed to report spills/release as directed by Sections 5.1 and 5.3. The ***FLEET Maintenance Supervisor*** is responsible for conducting the necessary investigation required to complete PART 2 of the Environmental Release Report (ERR – Attachment A), communicating corrective actions with ***BWS Bureau EH&S***, and providing copies of the closed ERR (ERR PARTs 1 through 3) to ***BWS Bureau EH&S*** (fax to: 914-773-4530). ERRs are to be closed no later than six (6) days after discovery of the spill/release, unless outstanding circumstances warrant additional time for investigation (i.e., sampling/remediation event). Copies of all closed ERR forms shall be maintained by ***FLEET Maintenance EH&S*** and ***BWS Bureau EH&S*** for a minimum of five (5) years.

## 9.2 FLEET Maintenance Personnel working In-City

FLEET Maintenance personnel working In-City (within the boundaries of the five NYC boroughs) are directed to report all spills/release as directed by Section 6.1, except *minor releases of petroleum. Minor releases of petroleum* are defined as releases/spills that are: (1) less than five gallons; (2) contained on a non-permeable surface; and (3) are cleaned up within two hours.

The ***FLEET Maintenance Supervisor*** is responsible for conducting the necessary investigation required to complete PART 2 of the ERR, and implementing corrective actions for proper ERR closure (PART 3 of the ERR). ERRs are to be closed no later than six (6) days after discovery of the spill/release, unless outstanding circumstances warrant additional time for investigation (i.e., sampling/remediation event). Copies of all closed ERR forms (ERR PARTs 1 though 3) shall be maintained by ***FLEET Maintenance EH&S*** for a minimum of five (5) years.

# 10 Attachments

## 10.1 Attachment A – Environmental Release Report (ERR)

**NEW YORK CITY DEPARTMENT OF ENVIRONMENTAL PROTECTION**
Spill Prevention, Environmental Release Reporting & Investigation

| Volume 2 | **Environmental Release Report (ERR)**<br>**Attachment A** | Revision: 2<br>Effective Date: 3/31/06 |
|---|---|---|

## PART 1 - INITIAL NOTIFICATION (To Be Completed By The Facility Supervisor On-Duty)

**FACILITY/CONTACT INFORMATION:**

Reporting Supervisor: _____ Facility Phone: _____

DEP Bureau/Office: _____

Spill Location (facility/building): _____

Address: _____

Bureau/Office EHS Rep. Contacted: _____ Phone: _____

**VENDOR/CONTRACTOR INVOLVEMENT:** ☐ Yes ☐ No

Vendor/Contractor Responsible (if any): _____ Contract # _____

Company Contact: _____ Phone: _____

**SPILL INFORMATION:**

Start Date, Time of Event ___/___/___ AM / PM End Date, Time of Event ___/___/___ AM / PM

Chemical Name: _____ CAS No: _____

Trade Name: _____ Concentration (if applicable) _____

Source: ☐ Tank ☐ Tank Truck ☐ Drums ☐ Pipe ☐ Other: _____

PBS # Tank # Tank Size Leak Rate Vehicle # _____

Amount Spilled: _____ ☐ gal ☐ lbs. Amount Recovered: _____ ☐ gal ☐ lbs.

How Calculated: ☐ Daily Inventory Record ☐ Meter ☐ Scale ☐ Estimate (how): _____

Weather: _____ Temp.: _____ Wind Direction/Speed: _____

Spilled to: ☐ Secondary Containment ☐ Sewer ☐ Storm Drain ☐ Catch Basin ☐ Air
☐ Surface Water * ☐ Soil ☐ Groundwater ☐ Other (list): _____

* Water Body: _____

Spill Impact: ☐ Fire ☐ Injury *** ☐ Fatality *** ☐ Evacuation
☐ Road Closed ☐ Track Closed ☐ Waterway Closed ☐ SPDES Violation
☐ Damages (describe): _____

***No./Type of Injuries/Fatalities: _____

**NOTIFICATION INFORMATION:**

DEP 24 Hour/DEP Police Rep. Contacted: _____ Date Reported: Time AM / PM

DEP HAZMAT Rep. Contacted (date and time): _____ NYC RQ: _____ lb/gal Ref. No.: _____

NYS DEC Rep. Contacted (date and time): _____ NYS RQ: _____ lb/gal Spill No: _____

NRC Rep. Contacted (date and time): _____ Federal RQ: _____ lb/gal Spill No: _____

Signature _____ Date _____

| Release Report Information | Attach a list of all DEP employees providing information used to complete Part I. Where feasible, such personnel should be shown the completed Part I to verify its accuracy prior to its being signed by the Reporting Supervisor. |
|---|---|

| Volume 2 | **Environmental Release Report (ERR)**<br>**Attachment A** | Revision: 2<br>Effective Date: 3/31/06 |
|---|---|---|

## PART 2 - INVESTIGATION/REPORT (To Be Completed By The Investigator or Team)

**Date Investigation Started:** **Time Started:** AM / PM

**DESCRIPTION OF INCIDENT**

*Provide a summary of the incident, material Spilled, contaminate found, personnel involved (name/title), etc. What, when, where, who, how, and why. Describe operations being conducted.* ***Fact ONLY****. Avoid speculation.*

☐ Continued - see attached

**CONTRIBUTING FACTORS**

*List and explain all factors potentially contributing to the incident. Consider procedures, training, equipment, communications, human factors, environment or any other factors that contributed to the occurrence or severity.*

☐ Continued - see attached

### Root Cause & Contributing Factors:

☐ Procedures ☐ Training ☐ Process Design and Controls ☐ Inspection and Prevent Maint
☐ Equipment, Materials or Changes ☐ Human Action ☐ External
☐ Other: Explanation

**CLEANUP**

*Describe who cleaned up, when, how, and any verification/testing.*

☐ Continued - see attached

**CORRECTIVE ACTIONS**

*List each recommendation to prevent reoccurrence. Complete first 3 columns for Investigation and the last 2 columns after implementation (all recommendations must be resolved to close out the case).*

| Description of Corrective Action and Intent | Assigned to | Target Date | Date Resolved | Resolution/ Comments |
|---|---|---|---|---|
| | | | | |

| | | | | |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CONCLUSIONS** *Summarize investigation conclusions below.*

**INVESTIGATION TEAM** *The incident investigation team members who sign below have reviewed and agree with the conclusions of this Spill investigation report.*

| Name | Signature | Title/Affiliation | Date |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

**REPORTS SUBMITTED:** *Written reports must be sent to DEP Hazmat <u>within 7 days</u>, DEC <u>within 14 days</u> and NRC <u>as soon as possible</u> for Spills above their respective RQs.*

Sent by EHS Rep.: _____ Dates: ☐ DEP ☐ DEC ☐ NRC

**PART 3 - CLOSEOUT** (To Be Completed By The Investigation Team)

**CLOSEOUT** *I {Division Director/_____} have determined that all of the Corrective Actions listed above have been completed or otherwise addressed as indicated above. {transmit final closeout copy to Bureau/Office EHS}*

Name: _____ Signature: _____ Date: _____

## DEFINITIONS USED FOR ROOT CAUSE AND CONTRIBUTING FACTORS

1. Procedures may include, but are not limited to, Policies, procedures, work instructions and plans. Types of procedures may include Environmental, Health & Safety, Administrative, Operating or Maintenance. A Procedural Root Cause or Contributing Factor can be attributed to an incident if:

   - procedures that could have prevented the incident from occurring have not been written.
   - procedures are in place, however, they did not consider the situation in which the incident occurred or contained errors
   - procedures were drafted, but not approved.
   - Procedures exist, but are not typically followed or enforced

   A Procedural Root Cause or Contributing Factor does not include conditions in which training was not performed or was inadequate.

2. A Training Root Cause or Contributing Factor can be attributed to an incident if:

   - training that could have reasonably prevented the incident was not provided.
   - training was significantly late
   - training did not address the tasks assigned to the position.
   - training was performed, but not checked to ensure the person understood (e.g. passing a test or observed for proficiency)

3. A Process Design and Controls Root Cause or Contributing Factor can be attributed to an incident if:

   - The process was not designed to address normal operating conditions
   - Insufficient safeguards were in place ( this does not include if safeguards were by-passed)
   - The process does not have controls to manage design parameters, such as level or pressure

4. An Inspection and Preventive Maintenance Root Cause or Contributing Factor can be attributed to an incident if inspection and preventive maintenance were not in accordance with applicable procedures, manufacturer's recommendations, government standards and industry standards and are adequate for the service conditions. If Preventive Maintenance procedures do not exist, it is considered a Procedural Root Cause.

5. An Equipment, Materials or Change Root Cause or Contributing Factor can be attributed to an incident if:

   - the equipment, parts, and materials procured were not as initially specified,
   - the equipment, parts and materials were defective
   - the equipment, parts and materials did not meet or exceeded the applicable specifications.
   - the process has been changed from its design (excluding changes approved by Engineering).

6. A Human Action Root Cause or Contributing Factor can be attributed to an incident if personnel actions, activities and decisions were in accordance with procedures, training and expected workplace standards. This includes both errors and willfully not following standards.

7. An External Root Cause or Contributing Factor can be attributed to an incident if external items, such as weather or third parties (excluding contractors) did not cause or contribute to the incident.

8. An Other Root Cause or Contributing Factor can be attributed to an incident if the incident has not been satisfactorily classified in one or more of the above categories. The Other cause must be identified.

**Attachment 4**
Subcontractor Acknowledgment Form

**Memorandum of Acknowledgement**

**To:** ARCADIS

**From "Subcontractor":** *{Insert Subcontractor's Name}*

**Date:** *{Insert Date}*

**Re:** Subcontractor Health and Safety Plan

Pursuant to its obligations under the referenced Site and Project, Subcontractor submits the following **as the** Subcontractor's Health and Safety Plan ("HASP") for the following project and client:

| | |
|---|---|
| Client: | Site Name: |
| Project Name: | ARCADIS Project Number: |
| Start Date: | End Date: |

Subcontractor acknowledges that it is responsible for the health and safety of its workers and others relating to the Subcontractor's Work and Site. The Subcontractor is required to submit its Health and Safety Plan for its Work. To comply with its requirements, the Subcontractor represents that its Health and Safety Plan for its Work shall include the Subcontractor's compliance (including compliance by Subcontractor's employees, officers, agents, representatives, invitees, and sub-subcontractors) with the ARCADIS Health and Safety Plan, together with any further amendments to such plan particular to the Subcontractor's Work and Site deemed necessary and appropriate by the Subcontractor.

Subcontractor agrees and understands that ARCADIS claims no responsibility for the use of the HASP and ARCADIS does not represent that the HASP is sufficient to address the Work or Site conditions of the Subcontractor. Subcontractor shall not hold ARCADIS responsible for any claims arising from the Subcontractor's use of the HASP and agrees to indemnify, defend and hold harmless ARCADIS from any claims for personal injury or property damages arising from or related to the compliance with, utilization or application, or any alleged deficiencies of the HASP. Nothing herein, including the use by Subcontractor of the HASP or acknowledgment of the Subcontractor's HASP shall create any duty, obligation, liability, or responsibility of ARCADIS for any act or failure to act in respect to any safety provision of the HASP and the Subcontractor shall remain solely responsible for the health and safety of Subcontractor, its employees or any person entering the Subcontractor's Work Site.

**Signed:** *{Insert Subcontractor Name}*

**By:** _____
**Name:** _____
**Title:** _____
**Date:** _____

**Attachment 5**

JLAs

# Job Loss Analysis

**General**

| | |
|---|---|
| **Client Name** | NYC DEP, NY |
| **JSA ID** | 4757 |
| **Job Name** | Environmental-Drilling, soil sampling, well installation |
| **Task Description** | Drilling on a landfill |
| **Project Number** | NY0014430006 |
| **Project Name** | 1246-PM PBL - POST CLOSURE MGMT SERVICES |
| **PIC Name** | STANKUNAS, JOHN J. |
| **Project Manager** | SANGIOVANNI, CARLO |
| **Status** | (3) Completed |
| **Creation Date** | 3/23/2011 11:58:50 AM |
| **Auto Closed** | False |

**User Roles**

| Role | Employee | Due Date | Completed | Approve | Supervisor | Active Employee |
|---|---|---|---|---|---|---|
| Created By | Nemickas, Arnas | 4/12/2011 | 3/29/2011 | | Zahradnik, Arthur | True |
| Developer (Primary Contact) | Nemickas, Arnas | 4/12/2011 | 3/29/2011 | | Zahradnik, Arthur | True |
| HASP Reviewer | Sangiovanni, Carlo | 4/12/2011 | 3/30/2011 | True | Smolensky, Douglas | True |

**Reviewer Comments**

| Role | Employee | Approval Status | Completed Date | Comments |
|---|---|---|---|---|
| HASP Reviewer | Sangiovanni, Carlo | Revise | 03/28/2011 | See comments on hardcopy version left on your desk. We need to get this revised ASAP so HASP can go out on Tues. 3/29. |
| HASP Reviewer | Sangiovanni, Carlo | Revise | 03/29/2011 | as discussed |
| HASP Reviewer | Sangiovanni, Carlo | Approve | 03/30/2011 | |

**Job Steps**

| Job Step | Job Step Description | | Potential Hazard | Critical Action | HSP Reference |
|---|---|---|---|---|---|
| 1 | Driving to/from site | 1 | Injury or vehicle damage from improper motor vehicle operation | Use Smith System Driving techniques and driving JLA | Driving JLA |
| 2 | Set up necessary public access controls | 1 | Unauthorized entry to site | Use a buddy system for placing site control cones and/or signage. Wear Class II traffic vest. | ARCADIS HASP |
| 3 | Stop Work Authority | 1 | Coordinate with the Site Safety Officer (Stratis) on any unsafe condition observed at the site. | Consider use of "Stop Work Authority" as needed. | |
| 4 | Utility Clearance | 1 | Potential to encounter underground or aboveground utilities while drilling | Complete utility clearance in accordance with the ARCADIS H&S procedure | ARCADIS H&S Procedure ARCHSFS019 |
| | | 2 | Potential to encounter "non-typical" (electric, telephone, cable, natral gas) subsurface utilites. The site has a landfill gas collection system (and other engineering controls) that include underground piping throughout the landfill. | Review as-built drawings to familiarize yourself witht he locations of various pipes and remedial compponents at the site. Consider hand digging to top of landfill liner. | ARCADIS H&S Procedure ARCHSFS019 |

| | | | | | |
|---|---|---|---|---|---|
| 5 | Drill rig mobililzation and set-up at landfill | 1 | Crushing landfill gas collection system piping. | Review as-built drawing to familiarize yourself with the location of the site piping and other remdial components, and plan access route to avoid crossing undergroudn pipes. Where no alternate route is possible and crossing over underground utilities are necessary, use blocking, timbers, plywood to distribute drill rig weight as not to crush pipes. | Driller HASP |
| | | 2 | Rolling drill rig driving up steep slopes. | Do not drive drill rig across slope. Minimize any off-raod driving to the extent practical. | Driller HASP |
| | | 3 | Drill rig driving off-road. | When necessary to drive off-road to gain access to drill site, use plywood sheeting under the drill rig to minimize potential for sinking and eliminate ruts that can lead to erosion. | Driller HASP |
| | | 4 | Landfill surface could be soft and contain subsurface voids. There is the potential for the drill rig to sink or becoming off-balanced and rolling over when setting-up. | Use larger than typical timbers/blocks under the drill rig jacks when setting up to distribute the weigh over a larger area. | Driller HASP |
| | | 5 | Unstable drill rig set-up. | Excavate well access pit, per drill spec/contract. Stockpile material used and stage for re-use during backfilling operations. Use licensed vendor to cut through landfill liner. | Driller HASP |
| 6 | General drill rig operation | 1 | Excessive noise is generated by rig operation. | When the engine is used at high RPMs or soil samples are being collected, use hearing protection. | Driller HASP |
| | | 2 | During drill rig operation, surfaces will become hot and cause burns if touched, and COCs in the soils/soil vapor more readily vaporize/generate airborne contaminates. | Due to friction and lack of a drilling fluid, heat will be produced during this method. Mainly auger drilling. When soils and parts become heated, the COC could volatilize. Borehole drilling could allow landfill gases to escape. Air monitoring should always be performed in accordance with the HASP. Consider "Stop Work Authority" to allow borehole to vent and/or use of inert gas (N2) to suppress landfill gases in borehole | Driller HASP |
| | | 3 | Moving parts of the drilling rig can pull you in causing injury. Pinch points on the rig and auger connections can cause pinching or crushing of body parts. | Stay at least 5 feet away from moving parts of the drill rig. Know where the kill switch is, and have the drillers test it to verify that it is working. Do not wear loose clothing, and tie long hair back. Avoid wearing jewelry while drilling. Cone off the work area to keep general public away from the drilling rig | Driller HASP |
| | | 4 | Dust and debris can cause eye injury and soil cuttings and/or water could contain COCs. | Wear safety glasses and stay as far away from drilling operation as practicable. Wear appropriate gloves to protect from COCs. | Driller HASP |
| | | 5 | Drilling equipment laying on the ground (i.e. augers, split spoons, decon equipment, coolers, etc), create a tripping hazard. Water from drill cuttings can cause a slipping hazard. | Keep equipment and trash picked up, and store away from the primary work area. | Driller HASP |
| | | 6 | The raised derrick can strike overhead utilities, tree limbs or other elevated items | Never move the rig with the derrick up. Ensure there is proper clearance to raise the derrick, and that you are far enough away from overhead power lines. See the Utility Location H&S policy and procedure for guidance. | Driller HASP |

| | | | | | |
|---|---|---|---|---|---|
| 7 | Bucket auger drilling | 1 | All hazards in step 3 apply. Additionally,see Driller HASP. | See Driller HASP | Driller HASP |
| 8 | Well installation | 1 | Same hazards as in Step 3 with general drill rig operation | See step 3 | |
| | | 2 | Well construction materials can clutter the work area causing tripping hazards. | Well construction materials should be picked up during the well installation process. | |
| | | 3 | Heavy lifting can cause muscle strains, and cutting open bags can cause lacerations. | Well construction materials are usually 50 lbs or greater. Team lift or use drill rig to hoist bags. Always use work gloves while cutting open bags. | |
| | | 4 | Burns from welding lengths of well casing/screen together. | Avoid hot surfaces of heating/welding equipment. Do not touch welded pipe until it has cooled. Use work gloves to avoid skin coming into contact with hot surface. refer to drill specs and Driller HASP. | |
| | | 5 | Well pack material (i.e. sand, grout, bentonite) can become airborne and get in your eyes. | Wear safety glasses for protection from airborne sand and dust. | |
| | | 6 | Cutting the top of the well to size can cause jagged/sharp edges on the top of the well casing. | Wear gloves when working with the top of the well casing, and file any sharp jagged edges that resulted from cutting to size. | |
| 9 | Soil cutting and purge water management | 1 | Moving full drums can cause back injury, or pinching/crushing injury. | Preferably have the drilling contractor move full drums with their equipment. Use lift assist devices such as drum dollys, lift gates, etc. Employ proper lifting techniques, and perfrom TRACK to identify pinch/crush points. Wear leather work gloves, and clear all walking and work areas of debris prior to moving a drum. | Drum handling JLA |
| 10 | Site restoration and demobilization | 1 | Sealing liner can cause burns if someone comes into contact with heated surfaces. Lanfill gases can accumulate in excavated area where liner is to be sealed. | Monitor workspace for landfill gases and low O2. Use "Stop Work Authority" if unsafe conditions are present and vent work area. Avoid coming into contact with heating equipment and wear gloves. Follow drill specs and Driller HASP. | Driller HASP |
| | | 2 | Flying debris, or being struck by equipment during backfilllling operations. | Keep a safe disatnce from excavated area and heavy equipment. Wear saftey glasses and hard hat in work area. | Driller HASP |
| | | 3 | Stockpiled fencing material can cause slips, trips and fall hazards. Potential for being struck by fence material or machinery during fenc installation. | Keep materials neatly stockpiled away from immediate work area. Consider use of flagging around stockpiled material to identify location. Keep a asafe distance from any equipment being used fopr fence installation. | Driller HASP |
| | | 4 | Spreading/tracking contaminated debris off-site. | Decon drill rig and all all equipmetns prior to demobilizing from site. | Driller HASP |

**Personal Protective Equipment**

| Type | Personal Protective Equipment | Description | Required |
|---|---|---|---|
| Eye Protection | safety glasses | Safety glasses with side shields or saftey goggle | Required |
| Foot Protection | steel-toe boots | | Required |
| Hand Protection | work gloves (specify type) | leather | Required |
| Head Protection | hard hat | | Required |
| Hearing Protection | ear plugs | ore ear muffs | Required |
| Miscellaneous PPE | traffic vest--Class II or III | | Required |
| Respiratory Protection | dust mask | If necessary | Recommended |

**Supplies**

| Type | Supply | Description | Required |
|---|---|---|---|
| Communication Devices | mobile phone | | Required |
| Decontamination | Decon supplies (specify type) | DI water | Required |
| Miscellaneous | fire extinguisher | | Required |
| Miscellaneous | first aid kit | | Required |
| Personal | eye wash (specify type) | bottle | Required |
| Traffic Control | traffic cones | | Required |

# Job Loss Analysis

**General**

| | |
|---|---|
| **Client Name** | NYC DEP, NY |
| **JSA ID** | 4756 |
| **Job Name** | General Industry-Driving - passenger vehicles |
| **Task Description** | Driving to, from and on-site |
| **Project Number** | NY0014430006 |
| **Project Name** | 1246-PM PBL - POST CLOSURE MGMT SERVICES |
| **PIC Name** | STANKUNAS, JOHN J. |
| **Project Manager** | SANGIOVANNI, CARLO |
| **Status** | (3) Completed |
| **Creation Date** | 3/23/2011 11:44:32 AM |
| **Auto Closed** | False |

**User Roles**

| Role | Employee | Due Date | Completed | Approve | Supervisor | Active Employee |
|---|---|---|---|---|---|---|
| Created By | Nemickas, Arnas | 4/12/2011 | 3/29/2011 | | Zahradnik, Arthur | True |
| Developer (Primary Contact) | Nemickas, Arnas | 4/12/2011 | 3/29/2011 | | Zahradnik, Arthur | True |
| HASP Reviewer | Sangiovanni, Carlo | 4/12/2011 | 3/30/2011 | True | Smolensky, Douglas | True |

**Reviewer Comments**

| Role | Employee | Approval Status | Completed Date | Comments |
|---|---|---|---|---|
| HASP Reviewer | Sangiovanni, Carlo | Revise | 03/25/2011 | Don't we have a driving and cell phone policy/H&S standard that we can reference in this JLA? or at least the field handbook? |
| HASP Reviewer | Sangiovanni, Carlo | Revise | 03/29/2011 | as discussed |
| HASP Reviewer | Sangiovanni, Carlo | Approve | 03/30/2011 | |

**Job Steps**

| Job Step | Job Step Description | | Potential Hazard | Critical Action | HSP Reference |
|---|---|---|---|---|---|
| 1 | Preforming Pre-trip inspections | 1 | Cuts scrapes to hands and fingers checking engine fluids | Use TRACK to plan inspection activity in the engine compartment. Wear protective gloves if reaching in poorly illuminated areas of the engine. | ARCADIS Field H&S Handbook (Driving) and ARCADIS Vehicle Use Policy |
| | | 2 | Pinch crush hazards to hands and fingers checking engine fluids or closing doors. | Identify and keep hands fingers away from pinch hazards from doors and vehicle hood or tailgate (if present). | ARCADIS Field H&S Handbook (Driving) and ARCADIS Vehicle Use Policy |
| | | 3 | Awkward body positions checking tires, spare tire, undercarriage, or engine compartment. | Maintain neutral body positions and avoid awkward reaches under the vehicle or in engine compartment. | ARCADIS Field H&S Handbook (Driving) and ARCADIS Vehicle Use Policy |
| | | 4 | Failure to inspect vehicle emergency equipment may result in extensive vehicle damage or delay treatment in the event of injury | Conduct equipment inspections by visibly inspecting fire extinguisher and first aid kit for cleanliness, in date items/tags, readiness for use. | ARCADIS Field H&S Handbook (Driving) and ARCADIS Vehicle Use Policy |

| | | | | | |
|---|---|---|---|---|---|
| 2 | Vehicle loading and unloading | 1 | Object placement obstructing rear, side or blindspot view | Avoid placing objects in a manner that obstructs your view, brake equipment down to a smaller more manageable size to keep low profile in vehicle. If hanging clothes in vehicle, place in manner that does not obstruct blind spots. | ARCADIS Field H&S Handbook (Driving) and ARCADIS Vehicle Use Policy |
| | | 2 | Unsecure objects causing pedal, steering or gear shift obstruction or injury during vehicle operation. | Secure all loads in vehicle (both in the bed of trucks and in passenger cabin) to prevent unanticipated movement or shifting that could injure driver, passenger, or affect safe operation of vehicle. | ARCADIS Field H&S Handbook (Driving) and ARCADIS Vehicle Use Policy |
| | | 3 | Obstuction of vehicle safety equipment caused by object placment in vehicle. | Keep emergency equipment clear and unobstructed to ensure ready availablity. | ARCADIS Field H&S Handbook (Driving) and ARCADIS Vehicle Use Policy |
| 3 | Vehicle operation | 1 | Failure to use Smith System "5-Keys" increases risk of accident and injruy. | Use Smith System "5-Keys", maintain space cushion around vehicle, maintain 4 second rule and add (second for each addtional hazard (wet roads, snow, etc). Brake gradual, keep eyes moving, check mirrors every 6-8 seconds, use turn signals, focus on relavent objects, use early lane positioning when approaching turns. | ARCADIS Field H&S Handbook (Driving) and ARCADIS Vehicle Use Policy |
| | | 2 | Injury or death from failure to wear seatbelt | Always wear seatbelts even if driving short distances off of a public roadway. | ARCADIS Field H&S Handbook (Driving) and ARCADIS Vehicle Use Policy |
| | | 3 | Cell phone use increases risk of accidnt and injury | Avoid using cell phones in any capacity when operating a vehicle, check client for cell use on project sites and follow requirements. Follow all local laws. | ARCADIS Field H&S Handbook (Driving) and ARCADIS Vehicle Use Policy |
| | | 4 | Use of radar detectors encourages speeding resulting in increased risk for accident or injury | Use of radar detectors and similar devices is prohibited. | ARCADIS Field H&S Handbook (Driving) and ARCADIS Vehicle Use Policy |
| | | 5 | Intruders attempting to enter vehicle while stopped at intersections and/or while it is vacant. Doors opening during an accident. | Lock doors before driving vehicle and always after leaving vehcile when it is stopped unless client requires vehicles to remain unlocked while onsite. | ARCADIS Field H&S Handbook (Driving) and ARCADIS Vehicle Use Policy |
| 4 | Driving on-site | 1 | Vehicle damage or injury from flying gravel | Roadways on-site are gravel. Maintain slow speeds while driving on-site to minimize potential for loose gravel to be thrown by vehicle tires. Do not walk behind moving vehicles. Keep a safe distance when following other vehicles. | ARCADIS Field H&S Handbook (Driving) and ARCADIS Vehicle Use Policy |
| | | 2 | Although the roadways themselves are flat, the slopes just off the roadway are steep causing the potential to roll a vehicle causing vehle damage or injury/death. | Never drive a vehicle off the designated gravel roadways. | ARCADIS Field H&S Handbook (Driving) and ARCADIS Vehicle Use Policy |
| 5 | Routine maintenance | 1 | Pinch crush hazards to hands and fingers replacing engine fluids or closing doors/hood. | Inspect and indetify pinch and crush hazards and keep hands/fingers clear when closing hood, tailgates, or doors. | ARCADIS Field H&S Handbook (Driving) and ARCADIS Vehicle Use Policy |
| | | 2 | Burn hazards to hand form checking/replacing fluids in engine compartment | When practical allow engine to cool prior to servicing or adding fluids. Use protective gloves. | ARCADIS Field H&S Handbook (Driving) and ARCADIS Vehicle Use Policy |
| | | 3 | Vehicle damage from improper fuse replacement | Never replace a fuse with a higher amperage than the one being replaced. Only replace fuses of type being replaced. | ARCADIS Field H&S Handbook (Driving) and ARCADIS Vehicle Use Policy |
| | | 4 | Failing to use Wright Express for vehicles equipped with fuel card impairs maintenace tracking that could affect vehicle safety | If vehicle is assigned a Wright Express Card, use the card so accurate maintenance tracking can be performed by LeasePlan. | ARCADIS Field H&S Handbook (Driving) and ARCADIS Vehicle Use Policy |

**Supplies**

| Type | Supply | Description | Required |
|---|---|---|---|
| Communication Devices | mobile phone | | Required |
| Miscellaneous | fire extinguisher | | Required |
| Miscellaneous | first aid kit | | Required |
| Traffic Control | Other | Roadway emergency kit | Required |

# Job Loss Analysis

**General**

| | |
|---|---|
| **Client Name** | NYC DEP, NY |
| **JSA ID** | 2828 |
| **Job Name** | Environmental-Other |
| **Task Description** | Landfill Work |
| **Project Number** | NY0014430005 |
| **Project Name** | 1139-PM PELHAM BAY LANDFILL-POST CLOSURE |
| **PIC Name** | STANKUNAS, JOHN J. |
| **Project Manager** | SANGIOVANNI, CARLO |
| **Status** | (3) Completed |
| **Creation Date** | 6/18/2010 8:21:37 AM |
| **Auto Closed** | False |

**User Roles**

| Role | Employee | Due Date | Completed | Approve | Supervisor | Active Employee |
|---|---|---|---|---|---|---|
| Created By | Nemickas, Arnas | 4/12/2011 | 3/29/2011 | | Zahradnik, Arthur | True |
| Developer (Primary Contact) | Nemickas, Arnas | 4/12/2011 | 3/29/2011 | | Zahradnik, Arthur | True |
| HASP Reviewer | Sangiovanni, Carlo | 4/12/2011 | 3/30/2011 | True | Smolensky, Douglas | True |

**Reviewer Comments**

| Role | Employee | Approval Status | Completed Date | Comments |
|---|---|---|---|---|
| HASP Reviewer | Sangiovanni, Carlo | Revise | 06/25/2010 | Arnie, Before I complet review of this, it needs a major update. First, prepare a separate JLA for each activity drilling and sampling. then start with the standard templates and modify for the PBL hazards. there are many job steps that go into the sampling and drilling tasks, that these JLAs should be expanded to include. |
| HASP Reviewer | Sangiovanni, Carlo | Revise | 03/25/2011 | General: Provide cross reference to the other JLAs, such as the drilling JLA, where appropriate. For Task 1, revise task to say OVERSIGHT of ..., delete reference to well sampling and upgrade to Level C and use of respirators, also fix typo should be inert gas (N2). Delete dust mask and respirator from PPE list. |
| HASP Reviewer | Sangiovanni, Carlo | Revise | 03/29/2011 | as discussed |
| HASP Reviewer | Sangiovanni, Carlo | Approve | 03/30/2011 | |

**Job Steps**

| Job Step | Job Step Description | | Potential Hazard | Critical Action | HSP Reference |
|---|---|---|---|---|---|
| 1 | Oversight of landfill work including drilling and well construction. | 1 | Landfill Gases | During drilling activities continuously monitor for volatile organic vapors, O2, H2S, and methane. Use inert gas (N2) to displce borhole gases if necessary. If action levels are exceeded, stop work and evaluate use of engineering controls such as industrial fans or air handlers to direct vapors away from borehole or wellhead. | Solid Waste Association of North America (SWANA)Safety Guidelines. Drilling and Driving JLAs. |
| | | 2 | Fires and Explosions | Have at least one dry-chemical type fire extinguisher onsite. Use industrial fans to direct vapors away from work area. Consider use of vertical exhaust and/or spark arrestors for combustion engines, such as drill rigs. Field instruments, motors,and controls should be explosion proof. Do not introduce water into the landfill through borehole, as it can cause underground fires. No smoking or welding. | Solid Waste Association of North America (SWANA)Safety Guidelines. Drilling and Driving JLAs. |
| | | 3 | Voids and Subsidence - Sink holes can develop very quickly and unexpectedly at a landfill. Large voids can be created due to weight/noise/vibration of drill rig. Common especially in older landfills where waste not as well compacted. | Keep away from rigs except as necessary. Pay attention to area around you for subsidence, cracks, voids - don't focus solely on the rig or drilling. | Solid Waste Association of North America (SWANA)Safety Guidelines. Drilling and Driving JLAs. |
| | | 4 | Personal Safety and Hygiene | Do not smoke, eat or drink at the landfill due to presence of bacteria. If you get an open wound, even a scratch, make sure it is cleaned right away, because bacterial populations are very high and danger of infection is heightened. Use hand sanitizer often. Hearing protection is important around drill rigs. | Solid Waste Association of North America (SWANA)Safety Guidelines. Drilling and Driving JLAs. |

**Personal Protective Equipment**

| Type | Personal Protective Equipment | Description | Required |
|---|---|---|---|
| Eye Protection | safety glasses | | Required |
| Foot Protection | boots | | Required |
| Hand Protection | chemical resistant gloves (specify type) | Nitrile | Required |
| Head Protection | hard hat | | Required |
| Hearing Protection | ear muffs | During Drilling | Recommended |
| Hearing Protection | ear plugs | During Drilling | Required |
| Miscellaneous PPE | traffic vest--Class II or III | | Required |
| Respiratory Protection | dust mask | As needed for air rotary drilling | Recommended |
| Respiratory Protection | full face respirator | For upgrade to Level C | Required |

**Supplies**

| Type | Supply | Description | Required |
|---|---|---|---|
| Communication Devices | mobile phone | | Required |
| Decontamination | Decon supplies (specify type) | For level D and C | Required |
| Miscellaneous | fire extinguisher | | Required |
| Miscellaneous | first aid kit | | Required |
| Personal | eye wash (specify type) | | Required |

# Job Safety Analysis

## General

| | | | |
|---|---|---|---|
| **JSA ID** | 8619 | **Status** | (3) Completed |
| **Job Name** | Environmental-Other | **Created Date** | 12/18/2012 |
| **Task Description** | Seawall, Cover system and Fence Restoration Oversight | **Completed Date** | 12/19/2012 |
| **Template** | False | **Auto Closed** | False |

## Client / Project

| | |
|---|---|
| **Client** | NYC DEP, NY |
| **Project Number** | NY001443007B |
| **Project Name** | Pellham Bay Landfill-Hurricane Sandy |
| **PIC** | OWEN, DOUGLAS M. |
| **Project Manager** | SANGIOVANNI, CARLO |

## User Roles

| Role | Employee | Due Date | Completed Date | Supervisor | Active |
|---|---|---|---|---|---|
| Developer | Nemickas, Arnie | 1/1/2013 | 12/19/2012 | Smolensky, Douglas | ☑ |
| HASP Reviewer | San Giovanni, Carlo | 1/2/2013 | 12/19/2012 | Smolensky, Douglas | ☑ |
| Quality Reviewer | Adams, Richard | 12/19/2012 | 12/19/2012 | Valkenburg, Nicholas | ☑ |

## Job Steps

| Job Step No. | Job Step Description | | Potential Hazard | Critical Action | H&S Reference |
|---|---|---|---|---|---|
| 1 | Oversight of landfill work including restoration of seawall, landfill cover system and perimeter fence | 1 | Landfill Gases | During restoration activities, continuosly monitor for volatile organic vapors, O2, H2S, and methane. If action levels are exceeded, stop work and evaluate engineering controls to minimize/eliminate hazard. | Solid Waste Association of North America (SWANA) Safety Guidelines |
| | | 2 | Fires and Explosions | Have at leat one dry-chemical type fire extinguisher onsite. Consider using spark arrestors for combustion engines. Field instruments, motors, and controls should be explosion proof. No smoking or welding. | |
| | | 3 | Unstable ground - Sink holes can develop very quickly at a landfill. large voids can be cretad due to weight/noise/vibration of heavy equipment. Soil erosion along landfill perimeter (along waters edge) can potentially cause additional instability issues. | Keep away from equipment except as necesary. Pay attention to the area around you for subsidence, cracks, voids. stay away from edge of landfill (in areas of soil erosion) | |
| | | 4 | Personal Safety and Hygiene (Including Biohazards associated with waste [if uncovered]) | Do not smoke, eat or drink at the landfill due to presence of bacteria. If you get an open wound, even a scratch, make sure it is cleaned right away, because bacterial populations are very high and danger if infection is heightened. Use hand sanitizer often, Hearing protection is important around heavy equipment. | |
| 2 | Oversight of landfill work including restoration of sewall, landfill cover system and perimeter fence. | 1 | Heavy Equipment | Stay away from all heavy equipment, If you need to approach the equipment, make sure the operator sees you and acknowledges your presence prior to approaching. | ARCADIS Heavy and Mechanized Equipment HS Standard ARC HSCS006 |
| 3 | Oversight of landfill work including restoration of sewall, landfill cover system and perimeter fence. | 1 | Elevated Surfaces | Some work will be conducted along the top of the existing seawall. Keep a safe distance away from the edge of the seawall. Use appropriate fall protection as needed. | ARCADIS Elevated Work and Fall Protection HS Standard ARC HSFS007 |

## PPE — Personal Protective Equipment

| Type | Personal Protective Equipment | Description | Required |
|---|---|---|---|
| **Eye Protection** | safety glasses | | Required |
| **Foot Protection** | steel-toe boots | | Required |
| **Hand Protection** | chemical resistant gloves (specify type) | | Recommended |
| | insulated gloves | | Recommended |
| **Head Protection** | hard hat | | Required |
| **Hearing Protection** | ear muffs | when near operating heavy equipment | Recommended |
| | ear plugs | when near operating heavy equipment | Required |
| **Miscellaneous PPE** | traffic vest--Class II or III | | Required |

## Supplies

| Type | Supply | Description | Required |
|---|---|---|---|
| **Communication Devices** | mobile phone | | Required |
| **Decontamination** | Decon supplies (specify type) | For Level D | Required |
| **Miscellaneous** | fire extinguisher | | Required |
| | first aid kit | | Required |
| **Personal** | eye wash (specify type) | | Required |
| | insect repellant | | Recommended |

## Review Comments

| Reviewer | | Comments |
|---|---|---|
| **Employee:**<br>**Role**<br>**Review Type**<br>**Completed Date** | San Giovanni, Carlo<br>HASP Reviewer<br>Revise<br>12/18/2012 | See my hand written comments on printout . |
| **Employee:**<br>**Role**<br>**Review Type**<br>**Completed Date** | San Giovanni, Carlo<br>HASP Reviewer<br>Approve<br>12/19/2012 | Approved. Nice job on this. |
| **Employee:**<br>**Role**<br>**Review Type**<br>**Completed Date** | Adams, Richard<br>Quality Reviewer<br>NA<br>12/19/2012 | Nice job on this. I have several comments: 1.) does it make sense to consider monitoring LEL levels as well; 2.) Landfill work involves walking up and down steep surfaces- slips trips and falls are a major concern; and 3.) heat and cold stress are also significant safety issues on landfills. |

**Attachment 6**

MSDS

*Material Safety Data Sheet Collection*

Genium group inc.
1171 RiverFront Center Amsterdam, NY 12010
(518) 842-4111

**Arsenic**
**ARS2340**

Issue Date: 2007-08

## Section 1 - Chemical Product and Company Identification 63

**Material Name:** Arsenic
**CAS Number:** 7440-38-2
**Chemical Formula:** As
**Structured Chemical Formula:** $As_4$
**EINECS Number:** 231-148-6
**International Chemical Safety Card (ICSC) Number:** 0013
**ACX Number:** X1002785-7
**Synonyms:** ARSEN; ARSENIA; ARSENIC; ARSENIC-75; ARSENIC BLACK; ARSENICALS; COLLOIDAL ARSENIC; GRAY ARSENIC; GREY ARSENIC; METALLIC ARSENIC
**General Use:** In metallurgy for hardening copper, lead alloys. In the manufacture of certain types of glass.

## Section 2 - Composition / Information on Ingredients

| Name | CAS | % |
|---|---|---|
| Arsenic | | >98 |

**OSHA PEL**
TWA: 0.01 mg/m$^3$.

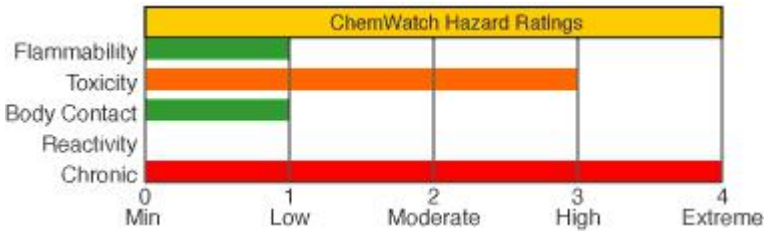
**NIOSH REL**
Ceiling: 0.002 mg/m$^3$ (15-minute).

**ACGIH TLV**
TWA: 0.01 mg/m$^3$.

**IDLH Level**
5 mg/m$^3$ (as As).

## Section 3 - Hazards Identification

Fire Diamond





**ANSI Signal Word**
Warning!


**••••• Emergency Overview •••••**

Brittle, crystalline, silvery-black metal. Irritating to eyes/skin/respiratory tract. Chronic Effects: damage to blood-forming organs, nervous/cardiovascular systems effects. Cancer hazard. Powder is flammable.

### Potential Health Effects

**Target Organs:** liver, kidneys, skin, lungs, lymphatic system
**Primary Entry Routes:** inhalation, ingestion of dust and fumes, skin absorption
**Acute Effects**
**Inhalation:** The dust is toxic and discomforting to the upper respiratory tract and lungs.
Acute inhalation exposure can cause cough, chest pain, shortness of breath, dizziness, headache, pulmonary edema and extreme general weakness.
Prolonged or repeated exposure can cause perforation of the nasal septum.
High exposures can cause poor appetite, nausea, vomiting and muscle cramps. Heart effects with abnormal EKG can also occur with very high exposures.
**Eye:** The dust may produce eye discomfort causing smarting, pain and redness.
**Skin:** The material is moderately discomforting to the skin and may be harmful.
Exposure may result in abnormal redness (caused by capillary congestion), burning, itching, swelling, skin eruptions and dermatitis.
Toxic effects may result from skin absorption.

Repeated skin contact can cause thickened skin and/or patchy areas of darkening and loss of pigment. Some persons develop white lines on the nails.

**Ingestion:** The solid/dust is discomforting to the gastrointestinal tract and is toxic and may be fatal if swallowed.
Symptoms of acute poisoning by ingestion, which develop within 4 hours include epigastric pain, vomiting and watery diarrhea. Blood may appear in vomitus and stools. If amount ingested is sufficiently high, shock may develop, followed by death within 24 hours.
Considered an unlikely route of entry in commercial/industrial environments.

**Carcinogenicity:** NTP - Class 1, Known to be a carcinogen; IARC - Group 1, Carcinogenic to humans; OSHA - Listed as a carcinogen; NIOSH - Listed as carcinogen; ACGIH - Class A1, Confirmed human carcinogen; EPA - Class A, Human carcinogen; MAK - Class A1, Capable of inducing malignant tumors as shown by experience with humans.

**Chronic Effects:**
Symptoms of chronic poisoning by inhalation include weight loss, nausea and diarrhea alternating with constipation, pigmentation and eruption of the skin, loss of hair, peripheral neuritis, blood disorders (anemia), striations on fingernails and toenails.
Long-term exposure can cause an ulcer or hole in the `bone' dividing the inner nose. Hoarseness and sore eyes also occur.
High or repeated exposure can cause nerve damage with `pins and needles', burning, numbness, and later weakness of arms and legs.
Repeated exposure can also damage the liver, causing narrowing of the blood vessels, or interfere with the bone marrow's ability to make red blood cells.
Many cases of skin cancer have been reported among people exposed to arsenic through medical treatment with inorganic trivalent arsenic compounds. In some instances skin cancers have occurred in combination with other cancers, such as liver angiosarcoma, intestinal and urinary bladder carcinomas and meningioma. Epidemiological studies of cancer after medical treatment have shown an excess of skin cancers but no clear association with other cancers has been shown. An association between environmental exposure to arsenic through drinking water and skin cancer has been observed and confirmed. Epidemiological studies in areas where drinking water contained 0.35-1.14 mg/l arsenic elevated risks for cancers of the bladder, kidney, skin, liver, lung and colon in both men and women.
Occupational exposure to inorganic arsenic, especially in mining and copper smelting, has consistently been associated with an increased risk of cancer. An almost tenfold increase in the incidence of lung cancer was found in workers most heavily exposed to arsenic and relatively clear dose-response relationships have been obtained with regard to cumulative exposure. Other smelter worker populations have been shown to have consistent increases in lung cancer incidence, as well as increases of about 20% in the incidence of gastrointestinal cancer and of 30% for renal cancer and hematolymphatic malignancies.

## Section 4 - First Aid Measures


**Inhalation:** Remove to fresh air. Lay patient down. Keep warm and rested.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

**Eye Contact:** Immediately hold the eyes open and wash continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.
Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

**Skin Contact:** Quickly but gently, wipe material off skin with a dry, clean cloth.
Immediately remove all contaminated clothing, including footwear.
Wash affected areas with water (and soap if available) for at least 15 minutes. Transport to hospital or doctor.

**Ingestion:** Contact a Poison Control Center.
If swallowed, and if more than 15 minutes from a hospital, induce vomiting, preferably using Ipecac Syrup APF.
Note: DO NOT INDUCE VOMITING in an unconscious person

***After first aid, get appropriate in-plant, paramedic, or community medical support.***

**Note to Physicians:** For acute or short term repeated exposures to arsenic, soluble compounds:
Treat as per arsenic poisoning.
1. Acute skin lesions such as contact dermatitis usually do not require other treatment than removal from exposure.
2. If more severe symptoms of the respiratory system, the skin or the gastrointestinal tract occur, British Anti-Lewisite (BAL, dimercaprol) may be given. Prompt administration in such cases is vital; to obtain maximum benefit such treatment should be administered within 4 hours of poisoning.
3. In addition, general treatment such as prevention of further absorption from the gastrointestinal tract are mandatory.
4. General supportive therapy such as maintenance of respiration and circulation, maintenance of water and electrolyte balance and control of nervous system effects, as well as elimination of absorbed poison through dialysis and exchange transfusion, may be used if feasible.
5. Dimercaprol is given by deep intramuscular injection as a 5% solution in peanut oil (or a 10% solution with benzyl-benzoate in vegetable oil). It is usually given in a dose of 3 mg/kg, 4-hourly, for the first two days, or twice daily for up to seven days.
6. BAL Therapy is effective for hematological manifestations of chronic arsenic poisoning but not for neurological symptoms. Watch for side effects (e.g. urticaria, burning sensation in the lips, mouth and throat, fever, conjunctivitis etc).
7. Some relief results from administration of diphenhydramine (Benadryl) (1.5 mg/kg intramuscularly or by mouth every 6 hour).

BIOLOGICAL EXPOSURE INDEX - BEI
These represent the determinants observed in specimens collected from a healthy worker exposed at the Exposure Standard (ES or TLV):

| Determinant | Index | Sampling Time | Comments |
|---|---|---|---|
| Inorganic arsenic metabolites in urine | 50 ug/g creatinine | End of workweek | B |

B: Background levels occur in specimens collected from subjects NOT exposed
Consult specific documentation.

## Section 5 - Fire-Fighting Measures

See DOT ERG

Fire Diamond

**Flash Point:** Noncombustible solid
**Extinguishing Media:** Use fire fighting procedures suitable for surrounding area.
**General Fire Hazards/Hazardous Combustion Products:** Solid which exhibits difficult combustion or is difficult to ignite.
Avoid generating dust, particularly clouds of dust in a confined or unventilated space. Dust may form an explosive mixture with air, and any source of ignition, i.e. flame or spark, will cause fire or explosion.
Dry dust can be charged electrostatically by turbulence, pneumatic transport, pouring, in exhaust ducts and during transport. Build-up of electrostatic charge may be prevented by bonding and grounding.
Powder handling equipment such as dust collectors, dryers and mills may require additional protection measures such as explosion venting.
Decomposes on heating and produces toxic fumes of arsenic oxides ($AsO_x$).
**Fire Incompatibility:** Avoid contact with acids, oxidizing agents, halogens.
**Fire-Fighting Instructions:** Contact fire department and tell them location and nature of hazard.
Wear breathing apparatus plus protective gloves for fire only. Prevent, by any means available, spillage from entering drains or waterways.
Use fire fighting procedures suitable for surrounding area.
Do not approach containers suspected to be hot.
Cool fire exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.
Equipment should be thoroughly decontaminated after use.

## Section 6 - Accidental Release Measures

See DOT ERG

**Small Spills:** Clean up all spills immediately. Wear protective clothing, impervious gloves and safety glasses. Increase ventilation.
Use a vacuum or a wet method to reduce dust during clean-up. DO NOT dry sweep.
Place in suitable containers for disposal.
Wash area down with large quantity of water and prevent runoff into drains.
**Large Spills:** POLLUTANT -contain spillage. Clear area of personnel and move upwind.
Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
If contamination of drains or waterways occurs, advise emergency services.
Shut off all possible sources of ignition and increase ventilation.
Stop leak if safe to do so.
Contain spill with sand, earth or vermiculite.
Use dry clean up procedures and avoid generating dust.
Collect recoverable product into labeled containers for recycling. Collect residues and seal in labeled drums for disposal.
Wash area down with large quantity of water and prevent runoff into drains.
**Regulatory Requirements:** Follow applicable OSHA regulations (29 CFR 1910.120).

## Section 7 - Handling and Storage

**Handling Precautions:** Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.
Use good occupational work practice.
Avoid contact with skin and eyes.
Avoid generating and breathing dust.
Use in a well-ventilated area.
Wear protective clothing when risk of exposure occurs.
Avoid sources of heat. Avoid contact with incompatible materials. Avoid physical damage to containers.
Keep containers securely sealed when not in use.
When handling, DO NOT eat, drink or smoke.
Wash hands with soap and water after handling.
Work clothes should be laundered separately: NOT at home.
**Recommended Storage Methods:** Glass container. Plastic drum. Polyethylene or polypropylene container. Steel drum. Metal drum.
Check that containers are clearly labeled.
**Storage Requirements:** Observe manufacturer's storing and handling recommendations.
Store in a cool, dry place. Store in a well-ventilated area. Store away from sources of heat or ignition/bare lights. Avoid storage at temperatures higher than 60 °C. Store away from incompatible materials. Store away from foodstuff containers.
Protect containers against physical damage.
Keep containers securely sealed.
Check regularly for spills and leaks.
**Regulatory Requirements:** Follow applicable OSHA regulations.

## Section 8 - Exposure Controls / Personal Protection

**Engineering Controls:** General exhaust is adequate under normal operating conditions.

Local exhaust ventilation may be required.
Use ventilated helmet or air-line hood to provide clean air at the breathing zone.
If risk of overexposure exists, wear NIOSH approved respirator. Correct fit is essential to obtain adequate protection.

**Personal Protective Clothing/Equipment:**

**Eyes:** Safety glasses. Chemical goggles.
Full face shield.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

**Hands/Feet:** Impervious, gauntlet length gloves; Rubber gloves. Neoprene gloves.
Rubber boots.

**Respiratory Protection:**

Exposure Range >0.01 to 0.1 mg/$m^3$: Air Purifying, Negative Pressure, Half Mask
Exposure Range >0.1 to 1 mg/$m^3$: Air Purifying, Negative Pressure, Full Face
Exposure Range >1 to <5 mg/$m^3$: Supplied Air, Constant Flow/Pressure Demand, Full Face
Exposure Range 5 to unlimited mg/$m^3$: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: magenta (P100)

**Other:** Overalls. PVC apron. PVC protective suit may be required if exposure severe.
Eyewash unit. Ensure there is ready access to a safety shower.
* Preplacement and periodic medical examinations are essential for workers exposed to arsenic. Preplacement physical examinations should give particular attention to allergic and chronic skin lesions, eye disease, psoriasis, chronic eczematous dermatitis, hyperpigmentation of the skin, keratosis and warts, baseline weight, baseline blood and hemoglobin counts, baseline urinary arsenic determinations.
Annual physical examinations should give attention to general health, weight, skin condition, and any evidence of excessive exposure or absorption of arsenic.

## Section 9 - Physical and Chemical Properties

**Appearance/General Info:** Grey, shiny, brittle, metallic-looking rhombohedral crystals. Can be heated to burn in air with a bluish flame, giving off an odor of garlic and dense white fumes of arsenic trioxide. Loses its luster on exposure to air. Converted by nitric acid or hot sulfuric acid into arsenous or arsenic acid.
Brinell hardness: 147
Mohs' scale: 3.5

**Physical State:** Divided solid
**Vapor Pressure (kPa):** Not applicable
**Vapor Density (Air=1):** Not applicable
**Formula Weight:** 74.92
**Specific Gravity ($H_2O$=1, at 4 °C):** 5.73
**Evaporation Rate:** Not applicable
**pH:** Not applicable

**pH (1% Solution):** Not applicable
**Boiling Point:** Sublimes
**Freezing / Melting Point:** 817 °C (1502.6 °F) at 28 atm
**Volatile Component (% Vol):** Not applicable
**Water Solubility:** Insoluble

## Section 10 - Stability and Reactivity

**Stability / Polymerization / Conditions to Avoid:** Contact with acids liberates toxic gases. Presence of heat source and ignition source.
Product is considered stable under normal handling conditions. Hazardous polymerization will not occur.
**Storage Incompatibilities:** Segregate from oxidizing agents, halogens.
Contact with acids produces toxic fumes.

## Section 11 - Toxicological Information

**Toxicity**

Oral (man) $TD_{Lo}$: 7857 mg/kg/55 years
Oral (rat) $LD_{50}$: 763 mg/kg
Tumorigenic - Carcinogenic by RTECS criteria.

**Irritation**

Nil reported

See *RTECS* **CG 0525000** for additional data.

## Section 12 - Ecological Information

**Environmental Fate:** No data found.
**Ecotoxicity:** Food chain concentration potential: Bioaccumulated by fresh water and marine aquatic organisms
**BCF:** bioaccumulated by aquatic organisms
**Biochemical Oxygen Demand (BOD):** none

## Section 13 - Disposal Considerations

**Disposal:**

Follow all federal, state, and local regulations.

## Section 14 - Transport Information

### DOT Hazardous Materials Table Data (49 CFR 172.101):

**Shipping Name and Description:** Arsenic
**ID:** UN1558
**Hazard Class:** 6.1 - Poisonous materials
**Packing Group:** II - Medium Danger
**Symbols:**
**Label Codes:** 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
**Special Provisions:** IB8, IP2, IP4
**Packaging:**
**Exceptions:** None
**Non-bulk:** 212
**Bulk:** 242
**Quantity Limitations:**
**Passenger aircraft/rail:** 25 kg
**Cargo aircraft only:** 100 kg
**Vessel Stowage:**
**Location:** A
**Other:**


## Section 15 - Regulatory Information

**EPA Regulations:**
**RCRA 40 CFR:** Listed
**CERCLA 40 CFR 302.4:** Listed per CWA Section 307(a), per CAA Section 112 1 lb (0.454 kg)
**SARA 40 CFR 372.65:** Listed
**SARA EHS 40 CFR 355:** Not listed
**TSCA:** Listed

## Section 16 - Other Information

**Disclaimer:** Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

*Material Safety Data Sheet Collection*

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1171 RiverFront Center Amsterdam, NY 12010
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**Benzene**
**BEN2200**

Issue Date: 2007-08

## Section 1 - Chemical Product and Company Identification 63

**Material Name:** Benzene
**CAS Number:** 71-43-2
**Chemical Formula:** $C_6H_6$
**Structured Chemical Formula:** $C_6H_6$
**EINECS Number:** 200-753-7
**International Chemical Safety Card (ICSC) Number:** 0015
**ACX Number:** X1001488-9
**Synonyms:** Benzene; BENZENE; (6)ANNULENE; BENZEEN; BENZEN; BENZIN; BENZINE; BENZOL; BENZOL 90; BENZOLE; BENZOLENE; BENZOLO; BICARBURET OF HYDROGEN; CARBON OIL; COAL NAPHTHA; CYCLOHEXATRIENE; EPA PESTICIDE CHEMICAL CODE 008801; FENZEN; MINERAL NAPHTHA; MOTOR BENZOL; NITRATION BENZENE; PHENE; PHENYL HYDRIDE; POLYSTREAM; PYROBENZOL; PYROBENZOLE
**General Use:** Manufacture of chemicals including styrene, dyes, and many other organic chemicals. Has been used in artificial leather, linoleum, oil cloth, airplane dopes, lacquers; as solvent for waxes, resins, oils etc.
May also be a minor component of gasoline, petrol.
Exposure should be minimized by use in closed systems.
Handling procedures and control measures should be evaluated for exposure before commencement of use in plant operations.

## Section 2 - Composition / Information on Ingredients

| Name | CAS | % |
|---|---|---|
| benzene | 71-43-2 | 99.9 |

**OSHA PEL**
TWA: 1 ppm; STEL: 5 ppm.

**NIOSH REL**
TWA: 0.1 ppm; STEL: 1 ppm.

**DFG (Germany) MAK**
Skin.

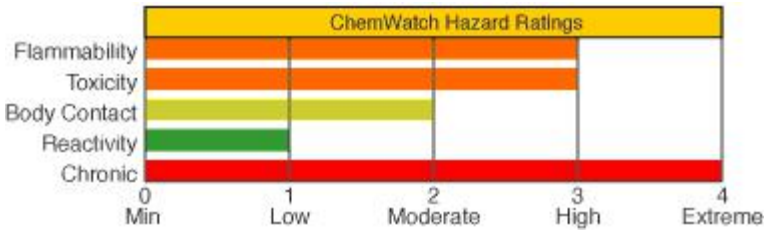
**ACGIH TLV**
TWA: 0.5 ppm; STEL: 2.5 ppm; skin.

**IDLH Level**
500 ppm.

**EU OEL**
TWA: 1 ppm.

## Section 3 - Hazards Identification

Fire Diamond





**ANSI Signal Word**
Danger!


••••• **Emergency Overview** •••••

Colorless liquid; sweet odor. Irritating to eyes/skin/respiratory tract. Toxic. Other Acute Effects: headache, dizziness, drowsiness. Absorbed through skin. Chronic Effects: dermatitis, leukemia, bone marrow damage. Carcinogen. Reproductive effects. Flammable.

### Potential Health Effects

**Target Organs:** blood, central nervous system (CNS), bone marrow, eyes, upper respiratory system, skin
**Primary Entry Routes:** inhalation, skin contact
**Acute Effects**

**Inhalation:** The vapor is discomforting to the upper respiratory tract and lungs and may be harmful if inhaled.
If exposure to highly concentrated solvent atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma and possible death.
Acute effects from inhalation of high concentrations of vapor are pulmonary irritation, including coughing, with nausea; central nervous system depression - characterized by headache and dizziness, increased reaction time, fatigue and loss of coordination.
Inhalation hazard is increased at higher temperatures.
The symptoms of acute exposure to high vapor concentrations include confusion, dizziness, tightening of the leg muscles and pressure over the forehead followed by a period of excitement. If exposure continues the casualty quickly becomes stupefied and lapses into a coma with narcosis.
Effects of inhalation may include nausea, vomiting headache, dizziness, drowsiness, weakness, sometimes preceded by brief periods of exhilaration, or euphoria, irritability, malaise, confusion, ataxia, staggering, weak and rapid pulse, chest pain and tightness with breathlessness, pallor, cyanosis of the lips and fingertips and tinnitus. Severe exposures may produce blurred vision, shallow, rapid breathing, delirium, cardiac arrhythmias, unconsciousness, deep anesthesia, paralysis and coma characterized by motor restlessness, tremors and hyperreflexia (occasionally preceded by convulsions). Polyneuritis and persistent nausea, anorexia, muscular weakness, headache, drowsiness, insomnia and agitation may also occur. Two-three weeks after the exposure, nervous irritability, breathlessness and unsteady gait may still persist; cardiac distress and an unusual dicoloration of the skin may be evident for up to four weeks. Hemotoxicity is not normally a feature of acute exposures although anemia, thrombocytopenia, petechial hemorrhage, and spontaneous internal bleeding have been reported. Fatal exposures may result from asphyxia, central nervous system depression, cardiac and respiratory failure and circulatory collapse; sudden ventricular fibrillation may also be fatal.
Death may be sudden or may be delayed for 24 hours. Central nervous system, respiratory or hemorrhagic complications may occur up to five days after the exposure and may be lethal; pathological findings include respiratory inflammation with edema, and lung hemorrhage, renal congestion, cerebral edema and extensive petechial hemorrhage in the brain, pleurae, pericardium, urinary tract, mucous membrane and skin.
Exposure to toxic levels has also produced chromosome damage.
**Eye:** The liquid is highly discomforting to the eyes, may be harmful following absorption and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/or other transient eye damage/ulceration.
The vapor is moderately discomforting to the eyes.
The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.
**Skin:** The liquid may produce skin discomfort following prolonged contact.
Defatting and/or drying of the skin may lead to dermatitis. Open cuts, abraded or irritated skin should not be exposed to this material.
Toxic effects may result from skin absorption.
The material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis. Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.
**Ingestion:** The liquid is discomforting to the gastrointestinal tract and may be harmful if swallowed.
Ingestion may result in nausea, pain, vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis.
**Carcinogenicity:** NTP - Class 1, Known to be a carcinogen; IARC - Group 1, Carcinogenic to humans; OSHA - Listed as a carcinogen; NIOSH - Listed as carcinogen; ACGIH - Class A2, Suspected human carcinogen; EPA - Class A, Human carcinogen; MAK - Class A1, Capable of inducing malignant tumors as shown by experience with humans.
**Chronic Effects:**
Liquid is an irritant and may cause burning and blistering of skin on prolonged exposure.
Chronic exposure may cause headache, fatigue, loss of appetite and lassitude with incipient blood effects including anemia and blood changes.
Benzene is a myelotoxicant known to suppress bone-marrow cell proliferation and to induce hematologic disorders in humans and animals. Signs of benzene-induced aplastic anemia include suppression off leukocytes (leukopenia), red cells (anemia), platelets (thromocytopenia) or all three cell types (pancytopenia). Classic symptoms include weakness, purpura, and hemorrhage. The most significant toxic effect is insidious and often irreversible injury to the blood forming tissue. Leukemia may develop.

## Section 4 - First Aid Measures


**Inhalation:** Remove to fresh air.
Lay patient down. Keep warm and rested.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.
**Eye Contact:** Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.
Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.
**Skin Contact:** Immediately remove all contaminated clothing, including footwear (after rinsing with water).
Wash affected areas thoroughly with water (and soap if available).
Seek medical attention in event of irritation.
**Ingestion:** Contact a Poison Control Center.
Do NOT induce vomiting. Give a glass of water.
***After first aid, get appropriate in-plant, paramedic, or community medical support.***
**Note to Physicians:** For acute or short-term repeated exposures to petroleum distillates or related hydrocarbons:
1.Primary threat to life from pure petroleum distillate ingestion and/or inhalation is respiratory failure.
2.Patients should be quickly evaluated for signs of respiratory distress (e.g. cyanosis, tachypnea, intercostal retraction, obtundation) and given oxygen. Patients with inadequate tidal volumes or poor arterial blood gases ($pO_2$ <50 mm Hg or $pCO_2$ >50 mm Hg) should be intubated.
3.Arrhythmias complicate some hydrocarbon ingestion and/or inhalation and electrocardiographic evidence of myocardial injury has been

reported; intravenous lines and cardiac monitors should be established in obviously symptomatic patients. The lungs excrete inhaled solvents, so that hyperventilation improves clearance.
4.A chest x-ray should be taken immediately after stabilization of breathing and circulation to document aspiration and detect the presence of pneumothorax.
5.Epinephrine (adrenalin) is not recommended for treatment of bronchospasm because of potential myocardial sensitization to catecholamines.
Inhaled cardioselective bronchodilators (e.g. Alupent, Salbutamol) are the preferred agents, with aminophylline a second choice.
6.Lavage is indicated in patients who require decontamination; ensure use of cuffed endotracheal tube in adult patients.
Consider complete blood count. Evaluate history of exposure.

## Section 5 - Fire-Fighting Measures


Fire Diamond

**Flash Point:** -11 °C Closed Cup
**Autoignition Temperature:** 562 °C
**LEL:** 1.3% v/v
**UEL:** 7.1% v/v
**Extinguishing Media:** Foam, dry chemical powder, BCF (where regulations permit), carbon dioxide.
Water spray or fog - Large fires only.
**General Fire Hazards/Hazardous Combustion Products:** Liquid and vapor are highly flammable.
Severe fire hazard when exposed to heat, flame and/or oxidizers.
Vapor forms an explosive mixture with air.
Severe explosion hazard, in the form of vapor, when exposed to flame or spark. Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion/decomposition with violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO).
**Fire Incompatibility:** Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.
**Fire-Fighting Instructions:** Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
Fight fire from a safe distance, with adequate cover.
If safe, switch off electrical equipment until vapor fire hazard removed.
Use water delivered as a fine spray to control fire and cool adjacent area.
Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.
Equipment should be thoroughly decontaminated after use.

## Section 6 - Accidental Release Measures


**Small Spills:** Remove all ignition sources. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb small quantities with vermiculite or other absorbent material. Wipe up. Collect residues in a flammable waste container.
**Large Spills:** Pollutant - contain spillage. Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so. Water spray or fog may be used to disperse/absorb vapor. Contain spill with sand, earth or vermiculite.
Use only spark-free shovels and explosion proof equipment.
Collect recoverable product into labeled containers for recycling.
Absorb remaining product with sand, earth or vermiculite.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
If contamination of drains or waterways occurs, advise emergency services.
**Regulatory Requirements:** Follow applicable OSHA regulations (29 CFR 1910.120).

## Section 7 - Handling and Storage

**Handling Precautions:** Avoid all personal contact, including inhalation.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
Avoid smoking, bare lights, heat or ignition sources.
When handling, DO NOT eat, drink or smoke.
Vapor may ignite on pumping or pouring due to static electricity.
DO NOT use plastic buckets. Ground and secure metal containers when dispensing or pouring product. Use spark-free tools when

handling.
Avoid contact with incompatible materials.
Keep containers securely sealed. Avoid physical damage to containers.
Always wash hands with soap and water after handling.
Work clothes should be laundered separately.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.
**Recommended Storage Methods:** Metal can; metal drum. Packing as recommended by manufacturer.
Check all containers are clearly labeled and free from leaks.
**Storage Requirements:** Store in original containers in approved flame-proof area.
No smoking, bare lights, heat or ignition sources.
DO NOT store in pits, depressions, basements or areas where vapors may be trapped. Keep containers securely sealed.
Store away from incompatible materials in a cool, dry well ventilated area.
Protect containers against physical damage and check regularly for leaks.
Observe manufacturer's storing and handling recommendations.
**Regulatory Requirements:** Follow applicable OSHA regulations.

## Section 8 - Exposure Controls / Personal Protection

**Engineering Controls:** Use in a well-ventilated area. Local exhaust ventilation usually required.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection. NIOSH-approved self contained breathing apparatus (SCBA) may be required in some situations.
Provide adequate ventilation in warehouse or closed storage area.
**Personal Protective Clothing/Equipment:**
**Eyes:** Chemical goggles. Full face shield.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.
**Hands/Feet:** Nitrile gloves; Neoprene gloves.
Safety footwear.
Do NOT use this product to clean the skin.
**Respiratory Protection:**
Exposure Range >1 to 10 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range >10 to 100 ppm: Air Purifying, Negative Pressure, Full Face
Exposure Range >100 to 1000 ppm: Supplied Air, Constant Flow/Pressure Demand, Full Face
Exposure Range >1000 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black
**Note:** must change cartridge at beginning of each shift
**Other:** Overalls. Eyewash unit. Barrier cream. Skin cleansing cream.

**Glove Selection Index:**

| | |
|---|---|
| PE/EVAL/PE | Best selection |
| PVA | Best selection |
| TEFLON | Best selection |
| VITON | Best selection |
| VITON/NEOPRENE | Best selection |
| NITRILE+PVC | Poor to dangerous choice for other than short-term immersion |
| BUTYL | Poor to dangerous choice for other than short-term immersion |
| NITRILE | Poor to dangerous choice for other than short-term immersion |
| NEOPRENE | Poor to dangerous choice for other than short-term immersion |
| PVC | Poor to dangerous choice for other than short-term immersion |
| NATURAL RUBBER | Poor to dangerous choice for other than short-term immersion |
| BUTYL/NEOPRENE | Poor to dangerous choice for other than short-term immersion |

## Section 9 - Physical and Chemical Properties

**Appearance/General Info:** Clear, highly flammable liquid; floats on water. Characteristic aromatic odor. Highly volatile. Mixes with alcohol, chloroform, ether, carbon disulfide, carbon tetrachloride, glacial acetic acid, acetone and oils.

**Physical State:** Liquid
**Odor Threshold:** 4.68 ppm
**Vapor Pressure (kPa):** 9.95 at 20 °C
**Vapor Density (Air=1):** 2.77
**Formula Weight:** 78.12
**Specific Gravity ($H_2O$=1, at 4 °C):** 0.879 at 20 °C
**Evaporation Rate:** Fast
**pH:** Not applicable
**pH (1% Solution):** Not applicable.
**Boiling Point:** 80.1 °C (176 °F)
**Freezing / Melting Point:** 5.5 °C (41.9 °F)
**Volatile Component (% Vol):** 100
**Water Solubility:** 0.18 g/100 g of water at 25 °C

## Section 10 - Stability and Reactivity

**Stability / Polymerization / Conditions to Avoid:** Product is considered stable. Hazardous polymerization will not occur.
**Storage Incompatibilities:** Avoid reaction with oxidizing agents.

## Section 11 - Toxicological Information

**Toxicity**

Oral (man) $LD_{Lo}$: 50 mg/kg
Oral (rat) $LD_{50}$: 930 mg/kg
Inhalation (rat) $LC_{50}$: 10000 ppm/7h
Inhalation (human) $LC_{Lo}$: 2000 ppm/5m
Inhalation (man) $TC_{Lo}$: 150 ppm/1y - I
Inhalation (human) $TC_{Lo}$: 100 ppm
Reproductive effector in rats

**Irritation**

Skin (rabbit): 20 mg/24 hr - mod
Eye (rabbit): 2 mg/24 hr - SEVERE

See *RTECS* **CY 1400000** for additional data.

## Section 12 - Ecological Information

**Environmental Fate:** If released to soil, it will be subject to rapid volatilization near the surface and that which does not evaporate will be highly to very highly mobile in the soil and may leach to groundwater. It may be subject to biodegradation based on reported biodegradation of 24% and 47% of the initial 20 ppm in a base-rich para-brownish soil in 1 and 10 weeks, respectively. It may be subject to biodegradation in shallow, aerobic groundwaters, but probably not under anaerobic conditions. If released to water, it will be subject to rapid volatilization; the half-life for evaporation in a wind-wave tank with a moderate wind speed of 7.09 m/sec was 5.23 hours; the estimated half-life for volatilization from a model river one meter deep flowing 1 m/sec with a wind velocity of 3 m/sec is estimated to be 2.7 hours at 20 °C. It will not be expected to significantly adsorb to sediment, bioconcentrate in aquatic organisms or hydrolyze. It may be subject to biodegradation based on a reported biodegradation half-life of 16 days in an aerobic river die-away test. In a marine ecosystem biodegradation occurred in 2 days after an acclimation period of 2 days and 2 weeks in the summer and spring, respectively, whereas no degradation occurred in winter. According to one experiment, it has a half-life of 17 days due to photodegradation which could contribute to removal in situations of cold water, poor nutrients, or other conditions less conductive to microbial degradation. If released to the atmosphere, it will exist predominantly in the vapor phase. Gas-phase will not be subject to direct photolysis but it will react with photochemically produced hydroxyl radicals with a half-life of 13.4 days calculated using an experimental rate constant for the reaction. The reaction time in polluted atmospheres which contain nitrogen oxides or sulfur dioxide is accelerated with the half-life being reported as 4-6 hours. Products of photooxidation include phenol, nitrophenols, nitrobenzene, formic acid, and peroxyacetyl nitrate. It is fairly soluble in water and is removed from the atmosphere in rain.

**Ecotoxicity:** $LC_{50}$ Clawed toad (3-4 wk after hatching) 190 mg/l/48 hr /Conditions of bioassay not specified; $LC_{50}$ Morone saxatilis (bass) 5.8 to 10.9 ppm/96 hr /Conditions of bioassay not specified; $LC_{50}$ Poecilia reticulata (guppy) 63 ppm/14 days /Conditions of bioassay not specified; $LC_{50}$ Salmo trutta (brown trout yearlings) 12 mg/l/1 hr (static bioassay); $LD_{50}$ Lepomis macrochirus (bluegill sunfish) 20 mg/l/24 to 48 hr /Conditions of bioassay not specified; $LC_{100}$ Tetrahymena pyriformis (ciliate) 12.8 mmole/l/24 hr /Conditions of bioassay not specified; $LC_{50}$ Cancer magister (crab larvae) stage 1, 108 ppm/96 hr /Conditions of bioassay not specified; $LC_{50}$ Crangon franciscorum (shrimp) 20 ppm/96 hr /Conditions of bioassay not specified

**Henry's Law Constant:** $5.3 \times 10^{-3}$
**BCF:** eels 3.5
**Biochemical Oxygen Demand (BOD):** 1.2 lb/lb, 10 days
**Octanol/Water Partition Coefficient:** log $K_{ow}$ = 2.13
**Soil Sorption Partition Coefficient:** $K_{oc}$ = woodburn silt loam 31 to 143

## Section 13 - Disposal Considerations

**Disposal:**

Consult manufacturer for recycling options and recycle where possible.
Follow applicable federal, state, and local regulations.
Incinerate residue at an approved site.
Recycle containers where possible, or dispose of in an authorized landfill.

## Section 14 - Transport Information

### DOT Hazardous Materials Table Data (49 CFR 172.101):

**Shipping Name and Description:** Benzene
**ID:** UN1114

**Hazard Class:** 3 - Flammable and combustible liquid
**Packing Group:** II - Medium Danger
**Symbols:**
**Label Codes:** 3 - Flammable Liquid
**Special Provisions:** IB2, T4, TP1
**Packaging:**
**Exceptions:** 150
**Non-bulk:** 202
**Bulk:** 242
**Quantity Limitations:**
**Passenger aircraft/rail:** 5 L
**Cargo aircraft only:** 60 L
**Vessel Stowage:**
**Location:** B
**Other:** 40


## Section 15 - Regulatory Information

**EPA Regulations:**
**RCRA 40 CFR:** Listed U019 Toxic Waste, Ignitable Waste
**CERCLA 40 CFR 302.4:** Listed per CWA Section 311(b)(4), per RCRA Section 3001, per CWA Section 307(a), per CAA Section 112 10 lb (4.535 kg)
**SARA 40 CFR 372.65:** Listed
**SARA EHS 40 CFR 355:** Not listed
**TSCA:** Listed

## Section 16 - Other Information

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*Material Safety Data Sheet Collection*

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(518) 842-4111

Issue Date: 2007-08

**Carbon Monoxide**
**CAR5180**

## Section 1 - Chemical Product and Company Identification 63

**Material Name:** Carbon Monoxide
**CAS Number:** 630-08-0
**Chemical Formula:** CO
**Structured Chemical Formula:** CO
**EINECS Number:** 211-128-3
**International Chemical Safety Card (ICSC) Number:** 0023
**ACX Number:** X1002848-9
**Synonyms:** CARBON MONOXIDE; CARBON OXIDE; CARBONE (OXYDE DE); CARBONIC OXIDE; CARBONIO (OSSIDO DI); EXHAUST GAS; FLUE GAS; KOHLENMONOXID; KOHLENOXYD; KOOLMONOXYDE; OXYDE DE CARBONE; WEGLA TLENEK
**General Use:** Used as a reducing agent in metallurgical processes; in organic synthesis; in the manufacture of metal carbonyls.

## Section 2 - Composition / Information on Ingredients

| Name | CAS | % |
|---|---|---|
| carbon monoxide | 630-08-0 | > 99 |

**OSHA PEL**
TWA: 50 ppm; 55 mg/m$^3$.

**NIOSH REL**
TWA: 35 ppm (40 mg/m$^3$); Ceiling: 200 ppm (229 mg/m$^3$).

**DFG (Germany) MAK**
TWA: 30 ppm; PEAK: 30 ppm.

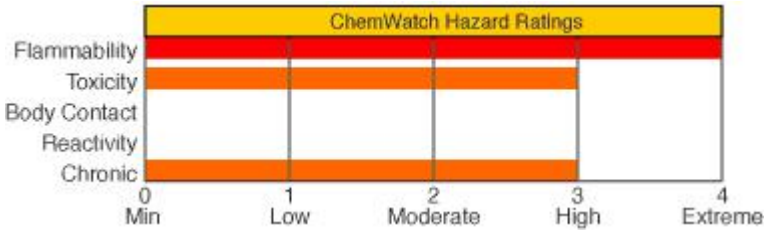
**ACGIH TLV**
TWA: 25 ppm.

**IDLH Level**
1200 ppm.

**EU OEL**
TWA: 23 mg/m$^3$; STEL: 117 mg/m$^3$.

## Section 3 - Hazards Identification

Fire Diamond





**ANSI Signal Word**
Danger!


**••••• Emergency Overview •••••**

Colorless gas; odorless. Poison. Acut Effects: chemical asphyxia, frostbite, headache, mental confusion, vomiting, giddiness, exhaustion, collapse, unconsciousness, coma, convulsions, death, cerebral edema, angina pectoris, myocardial infarction. Flammable.

### Potential Health Effects

**Target Organs:** blood, central nervous system (CNS), cardiovascular system
**Primary Entry Routes:** inhalation
**Acute Effects**
**Inhalation:** Symptoms of poisoning resulting from carbon monoxide exposure include respiratory disorders, diarrhea and shock. Carbon monoxide competes with oxygen for hemoglobin binding sites and has a 240-fold affinity for these sites compared to oxygen. In addition to oxygen deficiency further disability is produced by the formation of carboxymyoglobin in muscles, to produce disturbances in muscle metabolism, particularly that of the heart.
**Eye:** Not applicable.

**Skin:** Not applicable.
**Ingestion:** Not applicable.
**Carcinogenicity:** NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Not listed; MAK - Not listed.
**Chronic Effects:**
Carbon monoxide reduces the oxygen-carrying capacity of the blood.
Effects on the body are considered to be reversible as long as brain cell damage or heart failure has not occurred. Avoid prolonged exposure, even to small concentrations. A well-established and probably causal relationship exists between maternal smoking (resulting in carboxyhemoglobin levels of 2-7% in the fetus) and low birth weight. There also appears to be a dose-related increase in perinatal deaths and a retardation of mental ability in infants born to smoking mothers.

## Section 4 - First Aid Measures


**Inhalation:** Remove to fresh air.
Lay patient down. Keep warm and rested.
If available, administer medical oxygen by trained personnel.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor, without delay.
**Eye Contact:** Not applicable.
**Skin Contact:** Not applicable.
**Ingestion:** Not applicable.
***After first aid, get appropriate in-plant, paramedic, or community medical support.***
**Note to Physicians:** For carbon monoxide intoxications:
1. Administer pure oxygen by the best means possible. An oro-nasal mask is usually best. Artificial respiration is necessary wherever breathing is inadequate. Apneic patients have often been saved by persistent and efficient artificial ventilation. A patent airway must be carefully maintained. Patients with 40% carboxyhemoglobin or more and an uncompensated metabolic acidosis (arterial pH less than 7.4) should be managed aggressively with ventilatory support/ hyperbaric oxygenation.
2. Gastric aspiration and lavage early in the course of therapy may prevent aspiration pneumonitis and reveal the presence of ingested intoxicants.
3. Avoid stimulant drugs including carbon dioxide. Do NOT inject methylene blue.
4. Hypothermia has been employed to reduce patient's oxygen requirement.
5. Consider antibiotics as prophylaxis against pulmonary infection.
6. A whole blood transfusion may be useful if it can be given early in the treatment program.
7. Infuse sodium bicarbonate and balanced electrolyte solutions if blood analyses indicate a significant metabolic acidosis.
8. Ancillary therapy for brain edema may be necessary if hypoxia has been severe.
9. Ensure absolute rest in bed for at least 48 hours; in severe poisonings, 2 to 4 weeks in bed may prevent sequelae.
10.Watch for late neurological, psychiatric and cardiac complications.

## Section 5 - Fire-Fighting Measures


Fire Diamond

**Flash Point:** Flammable gas
**Autoignition Temperature:** 609 °C
**LEL:** 12.5% v/v
**UEL:** 74% v/v
**Extinguishing Media:** Carbon dioxide; dry chemical powder.
**General Fire Hazards/Hazardous Combustion Products:** Flammable gas. May form an explosive mixture with air.
Carbon monoxide burns in air with a violet flame to produce carbon dioxide ($CO_2$).
**Fire Incompatibility:** Avoid contamination/mixing with oxidizing agents as ignition may result.
**Fire-Fighting Instructions:** Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. May be washed to drain with large quantities of water.
Consider evacuation.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.
If safe to do so, stop flow of gas.
Use water delivered as a fine spray to control the fire and cool adjacent area.

## Section 6 - Accidental Release Measures


**Small Spills:** Avoid breathing vapor and any contact with liquid or gas. Protective equipment including respirator should be used. Do NOT enter confined spaces where gas may have accumulated. Shut of all sources of possible ignition and increase ventilation. Clear area of personnel. Stop leak only if safe to so do. Remove leaking cylinders to safe place. Release pressure under safe controlled conditions by opening valve. Keep area clear of personnel until gas has dispersed.
**Large Spills:** Clear area of all unprotected personnel and move upwind.
Contact fire department and advise them of the location and nature of hazard.
May be violently or explosively reactive.
Wear full body clothing with breathing apparatus.
Prevent by any means available, spillage from entering drains and waterways.
Consider evacuation.

Shut off all possible sources of ignition and increase ventilation.
No smoking or bare lights within area.
Use extreme caution to prevent violent reaction.
Stop leak only if safe to so do.
Water spray or fog may be used to disperse vapor.
Do NOT enter confined space where gas may have collected.
Keep area clear until gas has dispersed.
Remove leaking cylinders to a safe place. Fit vent pipes. Release pressure under safe, controlled conditions by opening valve. Burn issuing gas at vent pipes.
**Regulatory Requirements:** Follow applicable OSHA regulations (29 CFR 1910.120).

## Section 7 - Handling and Storage

**Handling Precautions:** Avoid sources of heat.Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area.
Keep containers securely sealed when not in use.
Transport containers on a trolley.
**Recommended Storage Methods:** Check that containers are clearly labeled. Cylinder. Ensure the use of equipment rated for cylinder pressure.
Ensure the use of compatible materials of construction.
Valve protection cap to be in place until cylinder is secured, connected.
Cylinder must be properly secured either in use or in storage.
Cylinder valve must be closed when not in use or when empty.
Segregate full from empty cylinders.
WARNING: Suckback into cylinder may result in rupture.
Use back-flow preventive device in piping.
**Regulatory Requirements:** Follow applicable OSHA regulations.

## Section 8 - Exposure Controls / Personal Protection

**Engineering Controls:** Use in a well-ventilated area.
If risk of overexposure exists, wear air supplied breathing apparatus.
**Personal Protective Clothing/Equipment:**
**Eyes:** Safety glasses with side shields; or as required, chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.
**Hands/Feet:** Wear general protective gloves: i.e. disposable polythene gloves or cotton gloves or light weight rubber gloves, preferably with barrier cream. Wear safety footwear.
**Respiratory Protection:**
Exposure Range >50 to <1200 ppm: Supplied Air, Constant Flow/Pressure Demand, Full Face
Exposure Range 1200 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
**Note:** poor odor threshold
**Other:** Protective overalls, closely fitted at neck and wrist. Eye-wash unit.
IN CONFINED SPACES:
1. Non-sparking protective boots.
2. Static-free clothing.
3. Ensure availability of lifeline.
Staff should be trained in all aspects of rescue work.
Operators should be trained in correct use & maintenance of respirators.

## Section 9 - Physical and Chemical Properties

**Appearance/General Info:** A colorless, odorless, highly toxic and flammable gas with no warning properties of exposure. Generated by all processes involving incomplete combustion of carbon containing materials/fuels. Commercially supplied as a compressed gas. Carbon monoxide is a common cause of fatal poisoning in industry and homes. Nonfatal poisoning may result in permanent nervous system damage.

**Physical State:** Compressed gas
**Vapor Density (Air=1):** 0.97
**Formula Weight:** 28.01
**Specific Gravity ($H_2O$=1, at 4 °C):** 0.00125 at 0 °C
**Evaporation Rate:** Not applicable
**pH:** Not applicable

**Boiling Point:** -191.5 °C (-313 °F)
**Freezing / Melting Point:** -205 °C (-337 °F)
**Volatile Component (% Vol):** 100
**Decomposition Temperature (°C):** 400-700
**Water Solubility:** 2% by weight

## Section 10 - Stability and Reactivity

**Stability / Polymerization / Conditions to Avoid:** Inadequate ventilation. Presence of heat source. Hazardous polymerization will not occur.
**Storage Incompatibilities:** Avoid reaction with oxidizing agents. Avoid fluorine.
If quantity exceeds limits prescribed by appropriate Dangerous Goods Code, restrictions exist on the transport or containerized storage of the material with: Class 1 - Explosives; Class 3 - Flammable liquids (where both flammable liquids and flammable gases are in bulk); Class

4.1 - Flammable solids; Class 4.2 - Spontaneously combustible substances; Class 4.3 - Dangerous when wet substances; Class 5.1 - Oxidizing agents; Class 5.2 - Organic peroxides; Class 7 - Radioactive substances.

## Section 11 - Toxicological Information

**Toxicity**

Inhalation (man) $TC_{Lo}$: 150 ppm/24h
Inhalation (man) $LC_{Lo}$: 4000 ppm/30m
Inhalation (man) $TC_{Lo}$: 650 ppm/45m
Inhalation (rat) $LC_{50}$: 1807 ppm/4H

**Irritation**

Nil reported

See *RTECS* **FG 3500000** for additional data.

## Section 12 - Ecological Information

**Environmental Fate:** No data found.
**Ecotoxicity:** Aquatic toxicity: 1.5 ppm/1-6 hr/minnows and sunfish/killed/fresh water
**BCF:** no food chain concentration potential
**Biochemical Oxygen Demand (BOD):** none

## Section 13 - Disposal Considerations

**Disposal:**

Consult manufacturer for recycling options.
Remove leaking cylinders to a safe place. Fit vent pipes. Release pressure under safe, controlled conditions by opening valve. Burn issuing gas at vent pipes.

## Section 14 - Transport Information

### DOT Hazardous Materials Table Data (49 CFR 172.101):

**Note:** This material has multiple possible HMT entries. Choose the appropriate one based on state and condition of specific material when shipped.

---

**Shipping Name and Description:** Carbon monoxide, compressed
**ID:** UN1016
**Hazard Class:** 2.3 - Poisonous gas
**Packing Group:**
**Symbols:**
**Label Codes:** 2.3 - Poison Gas, 2.1 - Flammable Gas
**Special Provisions:** 4
**Packaging:**
**Exceptions:** None
**Non-bulk:** 302
**Bulk:** 314, 315
**Quantity Limitations:**
**Passenger aircraft/rail:** Forbidden
**Cargo aircraft only:** 25 kg
**Vessel Stowage:**
**Location:** D
**Other:** 40


---

**Shipping Name and Description:** Carbon monoxide, refrigerated liquid *(cryogenic liquid)*
**ID:** NA9202
**Hazard Class:** 2.3 - Poisonous gas
**Packing Group:**
**Symbols:** D - Domestic transportation
**Label Codes:** 2.3 - Poison Gas, 2.1 - Flammable Gas
**Special Provisions:** 4, T75, TP5
**Packaging:**
**Exceptions:** None
**Non-bulk:** 316
**Bulk:** 318
**Quantity Limitations:**
**Passenger aircraft/rail:** Forbidden

**Cargo aircraft only:** Forbidden
**Vessel Stowage:**
**Location:** D
**Other:**

## Section 15 - Regulatory Information

**EPA Regulations:**
**RCRA 40 CFR:** Not listed
**CERCLA 40 CFR 302.4:** Not listed
**SARA 40 CFR 372.65:** Not listed
**SARA EHS 40 CFR 355:** Not listed
**TSCA:** Listed

## Section 16 - Other Information

**Disclaimer:** Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

*Material Safety Data Sheet Collection*

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**Chlorobenzene**
**CHL2800**

Issue Date: 2007-08

## Section 1 - Chemical Product and Company Identification 63

**Material Name:** Chlorobenzene
**CAS Number:** 108-90-7
**Chemical Formula:** $C_6H_5Cl$
**Structured Chemical Formula:** $C_6H_5Cl$
**EINECS Number:** 203-628-5
**International Chemical Safety Card (ICSC) Number:** 0642
**ACX Number:** X1001545-9
**Synonyms:** BENZENE CHLORIDE; BENZENE,CHLORO-; CHLOORBENZEEN; CHLORBENZENE; CHLORBENZOL; CHLOROBENZEN; CHLOROBENZENE; CHLOROBENZENU; CHLOROBENZOL; CLOROBENZENE; CP 27; EPA PESTICIDE CHEMICAL CODE 056504; I P CARRIER T 40; MCB; MONOCHLOORBENZEEN; MONOCHLORBENZENE; MONOCHLORBENZOL; MONOCHLOROBENZENE; MONOCLOROBENZENE; PHENYL CHLORIDE; TETROSIN SP
**General Use:** Used in textile processing as a fiber swelling agent and a dye carrier; as an extractant in the manufacture of diisocyanates, rubber, perfumes and pharmaceuticals; and in the manufacture of phenol, aniline and DDT.
Also a tar and grease remover, a solvent for paints and a heat transfer medium.

## Section 2 - Composition / Information on Ingredients

| Name | CAS | % |
|---|---|---|
| chlorobenzene | 108-90-7 | >95 |

**OSHA PEL**
TWA: 75 ppm; 350 mg/m$^3$.

**NIOSH REL**

**IDLH Level**
1000 ppm.

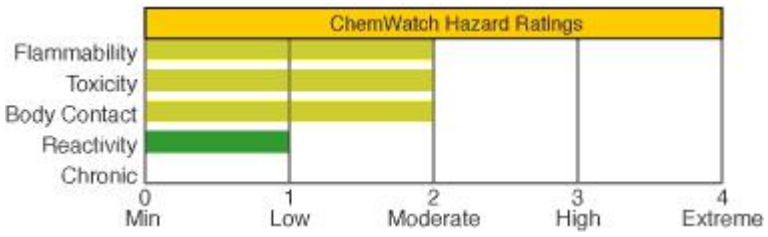
**DFG (Germany) MAK**
TWA: 10 ppm; PEAK: 20 ppm.

**ACGIH TLV**
TWA: 10 ppm.

**EU OEL**
TWA: 23 mg/m$^3$ (5 ppm); STEL: 70 mg/m$^3$ (15 ppm).

## Section 3 - Hazards Identification

Fire Diamond





**ANSI Signal Word**
Warning!


••••• **Emergency Overview** •••••

Colorless, volatile liquid; almond-like odor. Irritating to eyes/skin/respiratory tract. Other Acute Effects: dizziness, drowsiness, cyanosis, spastic contractions of extremities, unconsciousness. Chronic Effects: skin burns; lung/liver/kidney damage. Flammable.

### Potential Health Effects

**Target Organs:** respiratory system, eyes, skin, central nervous system (CNS), liver
**Primary Entry Routes:** inhalation, ingestion, eye contact, skin contact
**Acute Effects**

**Inhalation:** The vapor is discomforting to the upper respiratory tract and may be harmful if inhaled.
Headaches and upper respiratory tract and eye irritation were reported in a worker exposed to the substance contained in a glue preparation.
Inhalation of 200 ppm may produce mucous membrane irritation and coughing whilst higher concentrations produce central nervous system depression with headache, dizziness, drowsiness, somnolence, transient anesthesia, and incoherence, cyanosis from methemoglinemia, spastic contractions of the extremities, rapid respiration, weak and irregular pulse, burgundy-red urine, loss of consciousness, coma and respiratory and circulatory collapse.
Central nervous system (CNS) depression may include nonspecific discomfort, symptoms of giddiness, headache, dizziness, nausea, anesthetic effects, slowed reaction time, slurred speech and may progress to unconsciousness.
Serious poisonings may result in respiratory depression and may be fatal.
The substance and/or its metabolites may bind to hemoglobin inhibiting normal uptake of oxygen. This condition, known as "methemoglobinemia", is a form of oxygen starvation (anoxia). Symptoms include cyanosis (a bluish discoloration to skin and mucous membranes) and breathing difficulties. Symptoms may not be evident until several hours after exposure. At about 15% concentration of blood methemoglobin there is observable cyanosis of the lips, nose and earlobes. Symptoms may be absent although euphoria, flushed face and headache are commonly experienced. At 25-40%, cyanosis is marked but little disability occurs other than that produced on physical exertion. At 40-60%, symptoms include weakness, dizziness, lightheadedness, increasingly severe headache, ataxia, rapid shallow respiration, drowsiness, nausea, vomiting, confusion, lethargy and stupor.
Above 60% symptoms include dyspnea, respiratory depression, tachycardia or bradycardia, and convulsions. Levels exceeding 70% may be fatal.
Narcosis may also result.
Rats exposed for 2 hours at 1200 ppm showed definite narcosis but 220-660 ppm could be tolerated without obvious clinical signs of sedation. Central nervous system depression was seen at 5850 ppm.
**Eye:** The vapor is discomforting to the eyes and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/or other transient eye damage/ulceration.
**Skin:** The liquid may produce skin discomfort following prolonged contact.
Defatting and/or drying of the skin may lead to dermatitis. Toxic effects may result from skin absorption.
Prolonged exposure may cause chemical burns.
**Ingestion:** The liquid is discomforting to the gastrointestinal tract and may be harmful if swallowed in large quantity.
Ingestion may produce nausea, loss of consciousness and possibly coma.
**Carcinogenicity:** NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Class A3, Animal carcinogen; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.
**Chronic Effects:**
Exposure to high levels or prolonged exposure may cause liver damage, chronic respiratory disease and changes to the kidney (urine may be burgundy red).
Workers exposed to chlorobenzene vapors from 1-2 years reported headache, dizziness, somnolence, and dyspeptic disorders. Other symptoms included acroparaesthesia, spastic contractions of the finger muscles, hypesthesia, spastic contractions of the gastocnemius muscle and vasovegetative instability.
Repeated exposure of rats, rabbits and guinea pigs to chlorobenzene at 1000 ppm, 7 hours/day, 5 days/week over 44 days resulted in lung, liver and kidney changes.
Male rats receiving high doses during chronic gavage studies showed an increase in the occurrence of neoplastic nodules of the liver.

## Section 4 - First Aid Measures


**Inhalation:** Remove to fresh air.
Lay patient down. Keep warm and rested.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.
**Eye Contact:** Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.
Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.
**Skin Contact:** Immediately remove all contaminated clothing, including footwear (after rinsing with water).
Wash affected areas thoroughly with water (and soap if available).
Seek medical attention in event of irritation.
In case of burns: Quickly immerse affected area in cold running water for 10 to 15 minutes.
Bandage lightly with a sterile dressing. Treat for shock if required.
Lay patient down. Keep warm and rested. Transport to hospital or doctor.
**Ingestion:** Contact a Poison Control Center. DO NOT induce vomiting. Observe the patient carefully. Never give liquid to a person showing signs of being sleepy or with reduced awareness; i.e. becoming unconscious. Give water (or milk) to rinse out mouth. Then provide liquid slowly and as much as casualty can comfortably drink. Transport to hospital or doctor without delay.
***After first aid, get appropriate in-plant, paramedic, or community medical support.***
**Note to Physicians:** Treat symptomatically.
For ingestion, consider gastric lavage.
Chlorobenzene administered orally is mainly excreted in the urine with 32% appearing in the first 24 hours mostly as metabolites (4-chlorophenylmercaturic acid, chlorophenols, chlorocatechols and mandelic acid) Periodic medical examinations are recommended for occupationally exposed workers. Persons with pre-existing skin disorders or impaired liver, kidney or pulmonary function may be more susceptible to the effects of this substance.

## Section 5 - Fire-Fighting Measures

**Flash Point:** 29.2 °C Closed Cup
**Autoignition Temperature:** 638 °C


**LEL:** 1.8% v/v
**UEL:** 9.6% v/v
**Extinguishing Media:** Foam, dry chemical powder, BCF (where regulations permit), carbon dioxide.
Water spray or fog - Large fires only.
**General Fire Hazards/Hazardous Combustion Products:** Liquid and vapor are flammable.
Moderate fire hazard when exposed to heat or flame.
Vapor forms an explosive mixture with air.
Moderate explosion hazard when exposed to heat or flame.
Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion or decomposition leading to violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO).
Other combustion products include hydrogen chloride and phosgene.
**Fire Incompatibility:** Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.
**Fire-Fighting Instructions:** Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
Cool fire-exposed containers with water spray from a protected location.
Do not approach cylinders suspected to be hot.
If safe to do so, switch off electrical equipment until vapor fire hazard is removed.
Fight fire from a safe distance, with adequate cover.

## Section 6 - Accidental Release Measures


**Small Spills:** Environmental hazard - contain spillage.
Remove all ignition sources. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb small quantities with vermiculite or other absorbent material. Wipe up. Collect residues in a flammable waste container.
Wash spill site with soda solution.
**Large Spills:** Pollutant - Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent by any means available, spillage from entering drains or watercourse.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so.
Water spray or fog may be used to disperse/absorb vapor.
Contain spill with sand, earth or vermiculite.
Use only spark-free shovels and explosion proof equipment.
Collect recoverable product into labeled containers for recycling.
Absorb remaining product with sand, earth or vermiculite.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
If contamination of drains or waterways occurs, advise emergency services.
After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.
**Regulatory Requirements:** Follow applicable OSHA regulations (29 CFR 1910.120).

## Section 7 - Handling and Storage

**Handling Precautions:** Use good occupational work practices.
Avoid breathing vapors and contact with skin and eyes.
Avoid contact with incompatible materials.
Avoid all ignition sources.
Avoid sources of heat.
Avoid physical damage to containers.
Keep containers securely sealed when not in use.
Use in a well-ventilated area.
Ground and secure containers when dispensing or pouring.
Prevent concentration in hollows and sumps. DO NOT enter confined spaces until atmosphere has been checked.
Vapor may travel a considerable distance to source of ignition.
Avoid generation of static electricity.
Always wash hands with soap and water after handling. Work clothes should be laundered separately.
**Recommended Storage Methods:** Check that containers are clearly labeled.
Packaging as recommended by manufacturer.
Glass container.
Plastic containers may only be used if approved for flammable liquids.
Metal drum.
**Regulatory Requirements:** Follow applicable OSHA regulations.

## Section 8 - Exposure Controls / Personal Protection

**Engineering Controls:** General exhaust is adequate under normal operating conditions.
Local exhaust ventilation may be required in specific circumstances.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection.
Provide adequate ventilation in warehouse or closed storage areas.

**Personal Protective Clothing/Equipment:**

**Eyes:** Chemical goggles. Safety glasses.
Full face shield.
DO NOT wear contact lenses.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

**Hands/Feet:** Impervious gloves; Viton gloves.
Neoprene gloves.
Protective footwear.
Safety footwear.

**Respiratory Protection:**

Exposure Range >75 to 750 $mg/m^3$: Air Purifying, Negative Pressure, Half Mask
Exposure Range >750 to <1000 $mg/m^3$: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Exposure Range 1000 to unlimited $mg/m^3$: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black

**Other:** Ensure there is ready access to a safety shower. Eyewash unit.
Impervious apron.
Overalls.
Laboratory coat.
Impervious protective clothing.
If gas concentrations are high, full-face air supplied breathing apparatus.
Barrier cream.
Skin cleansing cream.

**Glove Selection Index:**

| | |
|---|---|
| VITON | Best selection |
| TEFLON | Best selection |
| PVA | Satisfactory; may degrade after 4 hours continuous immersion |
| NITRILE | Poor to dangerous choice for other than short-term immersion |

## Section 9 - Physical and Chemical Properties

**Appearance/General Info:** A clear, colorless, volatile, flammable liquid with a faint, almond- like, aromatic odor. It is a very refractive liquid (1.528); freely miscible with in alcohol, benzene, chloroform and ether. Environmental pollutant.

**Physical State:** Liquid
**Odor Threshold:** 0.98 to 280 $mg/m^3$
**Vapor Pressure (kPa):** 1.2 at 20 °C
**Vapor Density (Air=1):** 3.9
**Formula Weight:** 112.56
**Specific Gravity ($H_2O$=1, at 4 °C):** 1.11
**pH:** Not applicable

**pH (1% Solution):** Not applicable.
**Boiling Point:** 132 °C (270 °F)
**Freezing / Melting Point:** -45.6 °C (-50.08 °F)
**Volatile Component (% Vol):** approx. 100
**Water Solubility:** 0.05% by weight

## Section 10 - Stability and Reactivity

**Stability / Polymerization / Conditions to Avoid:** Hazardous polymerization will not occur. Stable under normal storage conditions.
**Storage Incompatibilities:** Avoid reaction with oxidizing agents.
Avoid dimethyl sulfoxide and silver perchlorate (forms shock-sensitive solvated salts). Also avoid extreme humidity.

## Section 11 - Toxicological Information

**Toxicity**

Oral (rat) $LD_{50}$: >2290 mg/kg
Oral (rat) $LD_{50}$: 1100 mg/kg
Inhalation (rat) $LC_{Lo}$: 9000 ppm
Mammalian somatic cell mutagen

**Irritation**

Nil reported

See *RTECS* **CZ 0175000** for additional data.

## Section 12 - Ecological Information

**Environmental Fate:** Once released it will decrease in concentration due to dilution and photooxidation. Releases into water and onto land will decrease in concentration due to vaporization into the atmosphere and slow biodegradation in the soil or water. It would be expected to percolate into the ground water if soil is sandy and poor in organic matter. Little bioconcentration is expected into fish and food products.
**Ecotoxicity:** $LC_{50}$ Poecilia reticulata (guppy) 19 ppm/14 days /Conditions of bioassay not specified; $LC_{50}$ Pimephales promelas (fathead minnow) 16.9 mg/l/96 hr (confidence limit 13.8 - 20.6 mg/l), flow-through bioassay with measured concentrations, 25.7 °C, dissolved oxygen 6.2 mg/l, hardness 43.8 mg/l calcium carbonate, alkalinity 43.4 mg/l calcium carbonate; $LD_{50}$ Salmo gairdneri (rainbow trout) 1.8 mg/kg/24 hr /Conditions of bioassay not specified
**Henry's Law Constant:** calculated at $3.56 \times 10^{-3}$
**BCF:** fish 1 to 2
**Biochemical Oxygen Demand (BOD):** 0.3 lb/lb, 5 days
**Octanol/Water Partition Coefficient:** log $K_{ow}$ = 2.18 to 2.84

## Section 13 - Disposal Considerations

**Disposal:**
Recycle wherever possible. Consult manufacturer for recycling options.
Follow applicable federal, state, and local regulations.
Bury or incinerate residue at an approved site.
Recycle containers if possible, or dispose of in an authorized landfill.

## Section 14 - Transport Information

### DOT Hazardous Materials Table Data (49 CFR 172.101):

**Shipping Name and Description:** Chlorobenzene
**ID:** UN1134
**Hazard Class:** 3 - Flammable and combustible liquid
**Packing Group:** III - Minor Danger
**Symbols:**
**Label Codes:** 3 - Flammable Liquid
**Special Provisions:** B1, IB3, T2, TP1
**Packaging:**
**Exceptions:** 150
**Non-bulk:** 203
**Bulk:** 242
**Quantity Limitations:**
**Passenger aircraft/rail:** 60 L
**Cargo aircraft only:** 220 L
**Vessel Stowage:**
**Location:** A
**Other:**


## Section 15 - Regulatory Information

**EPA Regulations:**
**RCRA 40 CFR:** Listed U037 Toxic Waste
**CERCLA 40 CFR 302.4:** Listed per CWA Section 311(b)(4), per RCRA Section 3001, per CWA Section 307(a) 100 lb (45.35 kg)
**SARA 40 CFR 372.65:** Listed
**SARA EHS 40 CFR 355:** Not listed
**TSCA:** Listed

## Section 16 - Other Information

**Disclaimer:** Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

*Material Safety Data Sheet Collection*

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(518) 842-4111

**Hydrogen Sulfide**
**HYD2760**

Issue Date: 2007-08

## Section 1 - Chemical Product and Company Identification 63

**Material Name:** Hydrogen Sulfide
**CAS Number:** 7783-06-4
**Chemical Formula:** $H_2S$
**Structured Chemical Formula:** $H_2S$
**EINECS Number:** 231-977-3
**International Chemical Safety Card (ICSC) Number:** 0165
**ACX Number:** X1003092-1
**Synonyms:** ACIDE SULFHYDRIQUE; ACIDE SULPHHYDRIQUE; DIHYDROGEN MONOSULFIDE; DIHYDROGEN SULFIDE; HYDROGEN SULFIDE; HYDROGEN SULFIDE,LIQUEFIED; HYDROGEN SULFURE; HYDROGEN SULFURIC ACID; HYDROGEN SULPHIDE; HYDROGENE SULFURE; HYDROGENE SULPHURE; HYDROSULFURIC ACID; IDROGENO SOLFORATO; SCHWEFELWASSERSTOFF; SEWER GAS; SIARKOWODOR; STINK DAMP; SULFUR HYDRIDE; SULFURETED HYDROGEN; SULFURETTED HYDROGEN; ZWAVELWATERSTOF
**General Use:** Used in the manufacture of inorganic sulfides. In the purification of sulfuric acid and hydrochloric acid; the precipitation of sulfides of metals in metallurgy; a source of hydrogen and sulfide.
Also as an analytical reagent and a disinfectant in agriculture.

## Section 2 - Composition / Information on Ingredients

| Name | CAS | % |
|---|---|---|
| hydrogen sulfide | 7783-06-4 | >98 |

**OSHA PEL**
Ceiling: 20 ppm; 50 ppm, 10-minute maximum peak.

**NIOSH REL**
Ceiling: 10 ppm (15 mg/m$^3$) (10-minute).

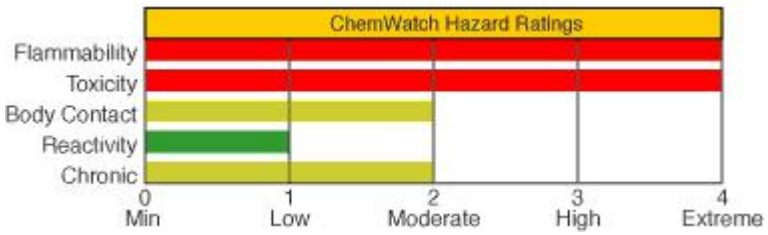
**DFG (Germany) MAK**
TWA: 10 ppm; PEAK: 20 ppm.

**ACGIH TLV**
TWA: 10 ppm; STEL: 15 ppm.

**IDLH Level**
100 ppm.

## Section 3 - Hazards Identification

Fire Diamond





**ANSI Signal Word**
Danger!


••••• **Emergency Overview** •••••

Colorless gas; rotten-egg smell. Irritating to eyes/skin/respiratory tract. Poison. Other Acute Effects: headache, dizziness, nausea, respiratory paralysis, death, cardiac effects. Highly flammable.

### Potential Health Effects

**Target Organs:** eyes, respiratory system, central nervous system (CNS)
**Primary Entry Routes:** inhalation, eye contact, skin contact
**Acute Effects**
**Inhalation:** The gas is highly toxic if exposure is prolonged.
Symptoms of hydrogen sulfide exposure may include profuse salivation, nausea, vomiting, diarrhea, giddiness, headache, vertigo, amnesia, palpitations, arrhythmia, weakness, muscle cramps, confusion, sudden collapse, unconsciousness and death due to respiratory paralysis (above 300 ppm). Although hydrogen sulfide is extremely odorous, the "rotten egg" odor is not a reliable indicator for warning

of exposure since odor fatigue readily occurs. Odor sensation is lost immediately at concentrations exceeding 200 ppm. Case reports suggest that toxic amounts can enter the body through a punctured ear drum, even while wearing some sorts of respiratory protection. Hydrogen sulfide is primarily a respiratory toxin which inhibits the cytochrome-oxidase system and is probably more potent than hydrogen cyanide. The lifetime of hydrogen sulfide in oxygenated blood is short and sulfmethemoglobin is rapidly detoxified by red blood cells and the liver. Most fatalities due to hydrogen sulfide intoxication occur at the scene of exposure and immediate supportive care is imperative. Ensure such contingencies are addressed as part of the site emergency plan and that operators or other employees who may become accidentally exposed, are made aware of the existence of such a plan.

**Eye:** The gas is discomforting to the eyes and may be harmful following absorption.
Eye irritation may produce conjunctivitis, photophobia, pain, and at higher concentrations blurred vision and corneal blistering.

**Skin:** The gas has little effect on the skin.
The liquid is extremely discomforting and may cause severe cold burns.
The liquid is irritating to the skin if allowed to remain in contact for a period, causing redness and may cause frostbite.

**Ingestion:** Overexposure is unlikely in this form.The liquid is extremely discomforting and toxic if swallowed.
Frost bite of the lips and mouth occurs from contact with the liquid.

**Carcinogenicity:** NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Not listed; MAK - Not listed.

**Chronic Effects:**
Chronic low level exposures to hydrogen sulfide may produce headache, fatigue, dizziness, irritability and loss of libido. These symptoms may also result from damage produced by isolated or repeated unmeasured peak high level exposures in healthy persons or those suffering from pre-existing neurological diseases.

## Section 4 - First Aid Measures


**Inhalation:** Remove to fresh air.
Lay patient down. Keep warm and rested.
If available, administer medical oxygen by trained personnel.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor, without delay.

**Eye Contact:** Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.
Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

**Skin Contact:** In case of cold burns (frost-bite): Bathe the affected area immediately in cold water for 10 to 15 minutes, immersing if possible and without rubbing.
Do not apply hot water or radiant heat. Apply a clean, dry dressing.
Transport to hospital or doctor.

**Ingestion:** Highly unlikely route of exposure but frostbite of lips and mouth may occur from contact with liquid. Treat as with skin.

***After first aid, get appropriate in-plant, paramedic, or community medical support.***

**Note to Physicians:** If exposure has been severe and/or symptoms marked, observation in hospital for 48 hours should be considered due to possibility of delayed pulmonary edema.
Hydrogen sulfide is metabolized by oxidation to sulfate, methylation and reaction with metallic ion- or disulfide containing proteins (principally cytochrome c oxidase). This latter reaction is associated with aerobic, cellular respiration and is largely responsible for the toxic effects.
For exposures involving sulfides and hydrogen sulfide (including gastric acid decomposition products of alkaline sulfides).
1. Hydrogen sulfide anion produces its major toxic effect through inhibition of cytochrome oxidases.
2. Symptoms include profuse salivation, nausea, vomiting and diarrhea.
Central nervous effects may include giddiness, headache, vertigo, amnesia, confusion and unconsciousness. Tachypnea, palpitation, tachycardia, arrhythmia, sweating, weakness and muscle cramps may also indicate over-exposures.
Treatment involves:
1. If respirations are depressed, application of artificial respiration, administration of oxygen (continue after spontaneous breathing is established).
2. For severe poisonings administer amyl nitrite and sodium nitrite (as for cyanide poisoning) but omit sodium thiosulfate injection.
3. Atropine sulfate (0.6 mg intramuscularly) may contribute symptomatic relief.
4. Conjunctivitis may be relieved by installation of 1 drop of olive-oil in each eye and sometimes by 3 drops of epinephrine solution (1:1000) at frequent intervals. Occasionally local anesthetics and hot and cold compresses are necessary to control pain.
5. Antibiotics at first hint of pulmonary infection.

## Section 5 - Fire-Fighting Measures


Fire Diamond

**Flash Point:** Flammable gas
**Autoignition Temperature:** 260 °C
**LEL:** 4.3% v/v
**UEL:** 45% v/v
**Extinguishing Media:** Water spray or fog.
Bromochlorodifluoromethane (BCF) (where regulations permit).
Dry chemical powder.
Foam.
Carbon dioxide.

**General Fire Hazards/Hazardous Combustion Products:** Liquid and vapor are highly flammable.
Dangerous hazard when exposed to heat, flame and oxidizers.
Gas may travel a considerable distance to source of ignition.
May form an explosive mixture with air.

Reacts violently with many incompatible materials.
Heating may cause expansion or decomposition leading to violent rupture of containers.
If involved in fire emits toxic fumes of sulfur oxides ($SO_x$).

**Fire Incompatibility:** Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.

**Fire-Fighting Instructions:** Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
If safe to do so, switch off electrical equipment until vapor fire hazard is removed.
If safe to do so, remove containers from path of fire.
Do not approach cylinders suspected to be hot.
If flow of gas cannot be stopped, leave gas to burn.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, stop flow of gas.
Fight fire from a safe distance, with adequate cover.

## Section 6 - Accidental Release Measures


**Small Spills:** Clean up all spills immediately. Clear area of personnel and move upwind.
Avoid breathing vapors and contact with skin and eyes.
If risk of overexposure exists, wear air supplied breathing apparatus.
Shut off all possible sources of ignition and increase ventilation.
Apply leak detection solution to suspected sites in lines and equipment.
Water spray or fog may be used to disperse vapor.

**Large Spills:** Contact fire department and tell them location and nature of hazard.
Clear area of personnel and move upwind.
May be violently or explosively reactive. Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
Shut off all possible sources of ignition and increase ventilation.
Stop leak if safe to do so.
Do not exert excessive pressure on valve; do not attempt to operate damaged valve.
Remove leaking cylinders to a safe place. Fit vent pipes. Release pressure under safe, controlled conditions by opening valve. Burn issuing gas at vent pipes.
Water spray or fog may be used to disperse vapor.
Use extreme caution to avoid a violent reaction.
If contamination of drains or waterways occurs, advise emergency services.
After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.

**Regulatory Requirements:** Follow applicable OSHA regulations (29 CFR 1910.120).

## Section 7 - Handling and Storage

**Handling Precautions:** Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.
Use good occupational work practices.
Avoid breathing vapors and contact with skin and eyes.
Avoid all personal contact.
Avoid smoking, bare lights or ignition sources.
Avoid sources of heat.
Wear protective clothing and gloves when handling containers.
Avoid physical damage to containers.
Handle and open container with care.
Local exhaust ventilation may be required for safe working, i.e. to keep exposures below required standards; otherwise, PPE is required.
Use spark-free tools when handling.
Keep containers securely sealed when not in use.
Gas may travel a considerable distance to source of ignition.
Avoid generation of static electricity.
Always wash hands with soap and water after handling. Work clothes should be laundered separately.

**Recommended Storage Methods:** Packaging as recommended by manufacturer.
Check that containers are clearly labeled.
Cylinder. Ensure the use of equipment rated for cylinder pressure.
Ensure the use of compatible materials of construction.
Valve protection cap to be in place until cylinder is secured, connected.
Cylinder must be properly secured either in use or in storage.
Cylinder valve must be closed when not in use or when empty.
Segregate full from empty cylinders.
WARNING: Suckback into cylinder may result in rupture.
Use back-flow preventive device in piping.

**Regulatory Requirements:** Follow applicable OSHA regulations.

## Section 8 - Exposure Controls / Personal Protection

**Engineering Controls:** Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.
If risk of overexposure exists, wear air supplied breathing apparatus.
Provide adequate ventilation in warehouse or closed storage areas.

**Personal Protective Clothing/Equipment:**

**Eyes:** Close fitting gas tight goggles. Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

**Hands/Feet:** Butyl rubber gloves; Neoprene gloves.
PVC gloves.
Safety footwear.
Rubber boots.
PVC boots.

**Respiratory Protection:**
Exposure Range >20 to <100 ppm: Supplied Air, Constant Flow/Pressure Demand, Half Mask
Exposure Range 100 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
**Note:** poor warning properties

**Other:** Impervious protective clothing. Eyewash unit.
Ensure there is ready access to a safety shower.

## Section 9 - Physical and Chemical Properties

**Appearance/General Info:** Colorless flammable gas with a rotten egg odor at low concentrations but has no odor above 200 ppm due to olfactory fatigue and may give little warning of exposure.
Burns in air with a blue flame. Usually transported as colorless liquid under pressure. Soluble in Carbon disulfide.

**Physical State:** Liquefied gas
**Odor Threshold:** 0.0007 to 0.140 mg/m$^3$
**Vapor Pressure (kPa):** 2026.4
**Vapor Density (Air=1):** 1.2
**Formula Weight:** 34.08
**Specific Gravity ($H_2O$=1, at 4 °C):** 1.54 g/l at 0 °C
**Evaporation Rate:** Fast
**pH:** Not applicable

**pH (1% Solution):** 4.5 (saturated)
**Boiling Point:** -60.33 °C (-77 °F)
**Freezing / Melting Point:** -85.49 °C (-121.882 °F)
**Volatile Component (% Vol):** 100
**Water Solubility:** 1 g dissolves in 242 ml water at 20 °C

## Section 10 - Stability and Reactivity

**Stability / Polymerization / Conditions to Avoid:** Presence of heat source and ignition source.
Stable under normal storage conditions. Hazardous polymerization will not occur.
**Storage Incompatibilities:** Avoid reaction with oxidizing agents. Avoid strong acids, bases.
Avoid reaction with strong nitric acid, organic compounds, alkalis and metal oxides.

## Section 11 - Toxicological Information

**Toxicity**

Inhalation (human) $LD_{Lo}$: 5.7 mg/kg
Inhalation (human) $LC_{Lo}$: 600 ppm/30M
Inhalation (human) $LC_{Lo}$: 800 ppm/5M
Inhalation (rat) $LC_{50}$: 444ppm

**Irritation**

Nil reported

See *RTECS* **MX 1225000** for additional data.

## Section 12 - Ecological Information

**Environmental Fate:** No data found.
**Ecotoxicity:** $TL_m$ Lepomis macrochirus (bluegill sunfish) 35 day old fry 0.0131 mg/l/96 hr at 21-22 °C in a flow through bioassay; $TL_m$ Pimephales promelas (fathead minnow) 0.0071-0.55 mg/l/96 hr at 6-24 °C in a flow through bioassay; $TL_m$ Asellus sp 0.111 mg/l/96 hr /Conditions of bioassay not specified; $LC_{50}$ Fly inhalation 380 mg/cu m/ > 960 min
**Henry's Law Constant:** 5.5 x10$^2$
**BCF:** none

## Section 13 - Disposal Considerations

**Disposal:**
Consult manufacturer for recycling options.
Follow applicable federal, state, and local regulations.

Return empty cylinders to supplier.

## Section 14 - Transport Information

### DOT Hazardous Materials Table Data (49 CFR 172.101):

**Shipping Name and Description:** Hydrogen sulfide
**ID:** UN1053
**Hazard Class:** 2.3 - Poisonous gas
**Packing Group:**
**Symbols:**
**Label Codes:** 2.3 - Poison Gas, 2.1 - Flammable Gas
**Special Provisions:** 2, B9, B14
**Packaging:**
**Exceptions:** None
**Non-bulk:** 304
**Bulk:** 314, 315
**Quantity Limitations:**
**Passenger aircraft/rail:** Forbidden
**Cargo aircraft only:** Forbidden
**Vessel Stowage:**
**Location:** D
**Other:** 40


## Section 15 - Regulatory Information

**EPA Regulations:**
**RCRA 40 CFR:** Listed U135 Toxic Waste
**CERCLA 40 CFR 302.4:** Listed per CWA Section 311(b)(4), per RCRA Section 3001 100 lb (45.35 kg)
**SARA 40 CFR 372.65:** Listed
**SARA EHS 40 CFR 355:** Listed
**RQ:** 100 lb
**TPQ:** 500 lb
**TSCA:** Listed

## Section 16 - Other Information

**Disclaimer:** Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

*Material Safety Data Sheet Collection*

Genium group inc.
1171 RiverFront Center Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2007-08

**Methane**
**MET1340**

## Section 1 - Chemical Product and Company Identification 63

**Material Name:** Methane
**CAS Number:** 74-82-8
**Chemical Formula:** $CH_4$
**Structured Chemical Formula:** $CH_4$
**EINECS Number:** 200-812-7
**International Chemical Safety Card (ICSC) Number:** 0291
**ACX Number:** X1003162-8
**Synonyms:** BIOGAS; FIRE DAMP; MARSH GAS; METHANE; METHANE,COMPRESSED; METHANE,REFRIGERATED LIQUID; METHYL HYDRIDE; R 50; R 50 (REFRIGERANT)
**General Use:** Constituent of illuminating and cooking gas.
Base raw material for many chemicals, in the manufacture of hydrogen, methanol, methyl chloride, methylene chloride, hydrogen cyanide, ammonia, acetylene, formaldehyde, in organic syntheses.
Operators should be trained in procedures for safe use of this material.

## Section 2 - Composition / Information on Ingredients

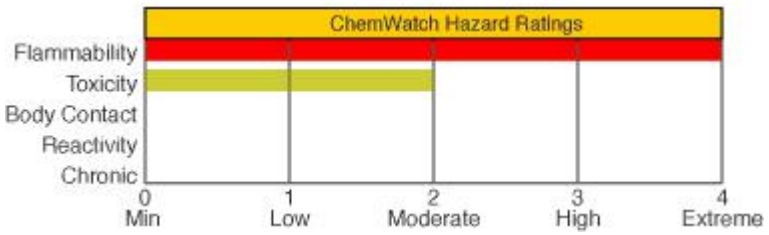
| Name | CAS | % |
|---|---|---|
| methane | 74-82-8 | >98 |

**OSHA PEL** **NIOSH REL**

**ACGIH TLV**

## Section 3 - Hazards Identification

Fire Diamond





**ANSI Signal Word**
**Danger!**


••••• **Emergency Overview** •••••

Colorless gas; odorless. Stored as compressed gas which can cause frostbite. Other Acute Effects: simple asphyxiant. Extremely flammable.

### Potential Health Effects

**Target Organs:** None reported
**Primary Entry Routes:** inhalation
**Acute Effects**
**Inhalation:** The gas acts as a simple asphyxiant by partially displacing, replacing the air required to support human life. Symptoms of asphyxia (suffocation) may include headache, dizziness, shortness of breath, muscular weakness, drowsiness and ringing in the ears. If the asphyxia is allowed to progress, there may be nausea and vomiting, further physical weakness and unconsciousness and, finally, convulsions, coma and death. Significant concentrations of the non-toxic gas reduce the oxygen level in the air. As the amount of oxygen is reduced from 21 to 14 volume %, the pulse rate accelerates and the rate and volume of breathing increase. The ability to maintain attention and think clearly is diminished and muscular coordination is somewhat disturbed. As oxygen decreases from 14-10% judgement becomes faulty; severe injuries may cause no pain. Muscular exertion leads to rapid fatigue. Further reduction to 6% may produce nausea and vomiting and the ability to move may be lost. Permanent brain damage may result even after resuscitation at exposures to this lower oxygen level. Below 6% breathing is in gasps and convulsions may occur. Inhalation of a mixture containing no oxygen may result in

unconsciousness from the first breath and death will follow in a few minutes.
**Eye:** The gas is not harmful to the eyes. Contact with liquid may cause burns.
**Skin:** The gas is non harmful to the skin. Vaporizing liquid causes rapid cooling and contact may cause cold burns, frostbite.
**Ingestion:** Not applicable.
**Carcinogenicity:** NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Not listed; MAK - Not listed.
**Chronic Effects:**
No long term effects.

## Section 4 - First Aid Measures


**Inhalation:** Remove to fresh air.
Lay patient down. Keep warm and rested.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.
**Eye Contact:** Not applicable.
**Skin Contact:** In case of cold burns (frost-bite): Bathe the affected area immediately in cold water for 10 to 15 minutes, immersing if possible and without rubbing.
Do not apply hot water or radiant heat. Apply a clean, dry dressing.
Transport to hospital or doctor.
**Ingestion:** Refer to procedure for inhalation.
***After first aid, get appropriate in-plant, paramedic, or community medical support.***
**Note to Physicians:** Treat symptomatically.

## Section 5 - Fire-Fighting Measures


Fire Diamond

**Flash Point:** -218 °C
**Autoignition Temperature:** 537 °C
**LEL:** 5.0% v/v
**UEL:** 15% v/v
**Extinguishing Media:** Dry chemical powder; BCF (where regulations permit); carbon dioxide.
**General Fire Hazards/Hazardous Combustion Products:** Flammable gas. Severe vapor explosion hazard, when exposed to flame or spark.
Dangerous hazard when exposed to heat or flame.
Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion or decomposition leading to violent rupture of containers.
On combustion, emits toxic fumes of carbon monoxide (CO) and carbon dioxide ($CO_2$).
**Fire Incompatibility:** Explosion hazard may follow contact with incompatible materials.
Reacts violently with oxidizing agents such as chlorine.
Contact with chlorine dioxide causes spontaneous explosion.
Contact with liquid fluorine causes spontaneous explosion, even at very low temperatures (-19 °C).
A mixture of liquid methane and liquid oxygen is an explosive.
**Fire-Fighting Instructions:** Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
Fight fire from a safe distance, with adequate cover.
If safe, switch off electrical equipment until vapor fire hazard removed.
Use water delivered as a fine spray to control fire and cool adjacent area.
Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.
Do not extinguish burning gas. If safe to do so, stop flow of gas.
If flow of gas cannot be stopped, leave gas to burn.

## Section 6 - Accidental Release Measures


**Small Spills:** Avoid breathing vapor and any contact with liquid or gas. Protective equipment including respirator should be used. Do NOT enter confined spaces where gas may have accumulated. Shut of all sources of possible ignition and increase ventilation. Clear area of personnel. Stop leak only if safe to so do. Remove leaking cylinders to safe place. Release pressure under safe controlled conditions by opening valve. Keep area clear of personnel until gas has dispersed.
**Large Spills:** Contact fire department and tell them location and nature of hazard.
Clear area of personnel and move upwind.
Shut off all possible sources of ignition and increase ventilation.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. May be washed to drain with large quantities of water.
Consider evacuation.
Apply leak detection solution to suspected sites in lines and equipment.
Remove leaking cylinders to a safe place. Fit vent pipes. Release pressure under safe, controlled conditions by opening valve. Burn issuing gas at vent pipes.
Do not exert excessive pressure on valve; do not attempt to operate damaged valve.

**Regulatory Requirements:** Follow applicable OSHA regulations (29 CFR 1910.120).

## Section 7 - Handling and Storage

**Handling Precautions:** Used in closed pressurized systems, fitted with safety relief valve.
Vented gas is flammable, denser than air and will spread. Vent path must not contain ignition sources, pilot lights, bare flames.
Atmospheres must be tested and O.K. before work resumes after leakage.
Obtain a work permit before attempting any repairs.
Do not attempt repair work on lines, vessels under pressure.
Handle and open container with care.
Avoid all personal contact, including inhalation.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
Avoid smoking, bare lights, heat or ignition sources.
When handling, DO NOT eat, drink or smoke.
Vapor may ignite on pumping or pouring due to static electricity.
DO NOT use plastic buckets. Ground and secure metal containers when dispensing or pouring product. Use spark-free tools when handling.
Avoid contact with incompatible materials.
Keep containers securely sealed. Avoid physical damage to containers.
Always wash hands with soap and water after handling.
Work clothes should be laundered separately.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.
Avoid generation of static electricity. Ground all lines and equipment.
DO NOT transfer gas from one cylinder to another.
Natural gases contain a contaminant, radon-222, a naturally occurring radioactive gas. During subsequent processing, radon tends to concentrate in liquified petroleum streams and in product streams having similar boiling points. Industry experience indicates that the commercial product may contain small amounts of radon-222 and its radioactive decay products (radon daughters). The actual concentration of radon-222 and radioactive daughters in process equipment (IE lines, filters, pumps and reactor units) may reach significant levels and produce potentially damaging levels of gamma radiation. A potential external radiation hazard exists at or near any pipe, valve or vessel containing a radon enriched stream or containing internal deposits of radioactive material. Field studies, however, have not shown that conditions exist that expose the worker to cumulative exposures in excess of general population limits. Equipment containing gamma-emitting decay products should be presumed to be internally contaminated with alpha- emitting decay products which may be hazardous if inhaled or ingested.
During maintenance operations that require the opening of contaminated process equipment, the flow of gas should be stopped and a four hour delay enforced to allow gamma-radiation to drop to background levels. Protective equipment (including high efficiency particulate respirators (P3) suitable for radionucleotides or supplied air) should be worn by personnel entering a vessel or working on contaminated process equipment to prevent skin contamination or inhalation of any residue containing alpha-radiation.
Airborne contamination may be minimized by handling scale and/or contaminated materials in a wet state.
**Recommended Storage Methods:** Cylinder. Ensure the use of equipment rated for cylinder pressure.
Ensure the use of compatible materials of construction.
Valve protection cap to be in place until cylinder is secured, connected.
Cylinder must be properly secured either in use or in storage.
Cylinder valve must be closed when not in use or when empty.
Segregate full from empty cylinders.
WARNING: Suckback into cylinder may result in rupture.
Use back-flow preventive device in piping.
Check that containers are clearly labeled.
Packaging as recommended by manufacturer.
**Regulatory Requirements:** Follow applicable OSHA regulations.

## Section 8 - Exposure Controls / Personal Protection

**Engineering Controls:** Areas where cylinders are stored require good ventilation and if enclosed need discrete/controlled exhaust ventilation.
Local exhaust ventilation (explosion proof) usually required.
Ventilation should ensure that work place atmospheres do not reach 25% of lower explosive limit.
Respiratory protection in form of air supplied or self contained breathing equipment must be worn if oxygen concentration in the air is suspected to be less than 19%. Cartridge respirators do NOT give protection and may result in rapid suffocation.
**Personal Protective Clothing/Equipment:**
**Eyes:** Safety glasses with side shields; or as required, chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.
**Hands/Feet:** Wear chemical protective gloves, eg. PVC. Wear safety footwear.
**Respiratory Protection:**
Exposure Range unlimited: Self-contained Breathing Apparatus, Pressure Demand, Full Face
**Note:** asphyxiant - no protection needed unless atmosphere is oxygen deficient
**Other:** Protective overalls, closely fitted at neck and wrist. Eye-wash unit.
IN CONFINED SPACES:
1. Non-sparking protective boots.

2. Static-free clothing.
3. Ensure availability of lifeline.
Staff should be trained in all aspects of rescue work.
Operators should be trained in correct use & maintenance of respirators.
Ensure that there is ready access to breathing apparatus.
Ensure ready access to a burns first aid kit.

## Section 9 - Physical and Chemical Properties

**Appearance/General Info:** Colorless, odorless and tasteless gas. Gas has no odor detection level; unless mercaptan odorant is deliberately added. Gas is less dense than air. Burns with a pale, faintly luminous flame. Soluble in alcohol, ether, hydrocarbon and other organic solvents. Packed as a gas under pressure. Sudden release of pressure or leakage may result in generation of a large volume of highly flammable/ explosive gas.
Critical temperature: -82.1 °C. Critical pressure: 4640 kPa.

**Physical State:** Compressed gas
**Odor Threshold:** 200 ppm
**Vapor Pressure (kPa):** Not applicable
**Vapor Density (Air=1):** 0.55
**Formula Weight:** 16.04
**Specific Gravity ($H_2O$=1, at 4 °C):** 0.422 as liquid
**Evaporation Rate:** Not applicable
**pH:** Not applicable

**pH (1% Solution):** Not applicable.
**Boiling Point:** -161.4 °C (-259 °F)
**Freezing / Melting Point:** -182.6 °C (-296.68 °F)
**Volatile Component (% Vol):** 100
**Water Solubility:** 0.6 ml in 1 g ethyl alcohol at 20 °C

## Section 10 - Stability and Reactivity

**Stability / Polymerization / Conditions to Avoid:** Presence of heat source and ignition source. Presence of elevated temperatures.
Product is considered stable under normal handling conditions. Hazardous polymerization will not occur.
**Storage Incompatibilities:** Segregate from oxygen gas and oxidizing agents.

## Section 11 - Toxicological Information

No relevant toxicological data found at time of research.

See *RTECS* **PA 1490000** for additional data.

## Section 12 - Ecological Information

**Environmental Fate:** Photolysis, hydrolysis and bioconcentration are not expected to be important environmental fate processes. A $K_{oc}$ of 753 indicates low mobility with water in soil. However, its high vapor pressure would suggest that the gas may permeate through soil. Biodegradation and adsorption may occur in soil and water; however, volatilization is expected to be a far more important environmental fate process in water. Volatilization half lives from a model river and a model environmental pond have been estimated to be 1.17 and 13.89 hr, respectively. It is expected to exist entirely in the vapor phase in the ambient atmosphere. Reaction with hydroxyl radicals is the major sink (half life of 1,908 days).
**Ecotoxicity:** No data found.
**Henry's Law Constant:** estimated at 6.58 $x10^{-1}$
**BCF:** no food chain concentration potential
**Biochemical Oxygen Demand (BOD):** none
**Octanol/Water Partition Coefficient:** log $K_{ow}$ = 1.09
**Soil Sorption Partition Coefficient:** $K_{oc}$ = estimated at 753

## Section 13 - Disposal Considerations

**Disposal:**
Discharge to burning flare.
Ensure damaged or non-returnable cylinders are gas-free before disposal.
Return empty or damaged cylinders to supplier.

## Section 14 - Transport Information

### DOT Hazardous Materials Table Data (49 CFR 172.101):

**Note:** This material has multiple possible HMT entries. Choose the appropriate one based on state and condition of specific material when shipped.

---

**Shipping Name and Description:** Methane, compressed *or* Natural gas, compressed *(with high methane content)*
**ID:** UN1971
**Hazard Class:** 2.1 - Flammable gas

**Packing Group:**
**Symbols:**
**Label Codes:** 2.1 - Flammable Gas
**Special Provisions:**
**Packaging:**
**Exceptions:** 306
**Non-bulk:** 302
**Bulk:** 302
**Quantity Limitations:**
**Passenger aircraft/rail:** Forbidden
**Cargo aircraft only:** 150 kg
**Vessel Stowage:**
**Location:** E
**Other:** 40


---

**Shipping Name and Description:** Methane, refrigerated liquid *(cryogenic liquid) or* Natural gas, refrigerated liquid *(cryogenic liquid), with high methane content)*
**ID:** UN1972
**Hazard Class:** 2.1 - Flammable gas
**Packing Group:**
**Symbols:**
**Label Codes:** 2.1 - Flammable Gas
**Special Provisions:** T75, TP5
**Packaging:**
**Exceptions:** None
**Non-bulk:** None
**Bulk:** 318
**Quantity Limitations:**
**Passenger aircraft/rail:** Forbidden
**Cargo aircraft only:** Forbidden
**Vessel Stowage:**
**Location:** D
**Other:**


## Section 15 - Regulatory Information

**EPA Regulations:**
**RCRA 40 CFR:** Not listed
**CERCLA 40 CFR 302.4:** Not listed
**SARA 40 CFR 372.65:** Not listed
**SARA EHS 40 CFR 355:** Not listed
**TSCA:** Listed

## Section 16 - Other Information

**Disclaimer:** Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

**Attachment 7**

LPOs

H&S - Field Multi-task (General) Print

**General**

| | |
|---|---|
| **Observed Company** | Arcadis Other Company |
| **Observation Type** | Select Observation Type |
| **LPO Form** | Select LPO Type |
| **Task Observed** | |
| **Observee Name** | |
| **Observer Name** | |
| **Observation Date** | |
| **Observation Due Date** | |
| **Observee Supervisor** | |
| **Project Number** | |
| **Project Name** | |
| **Client Name** | |

**Feedback Session**

| | |
|---|---|
| **Feedback Conducted By** | |
| **Date and Time** | |
| **Positive Comments** | |

**Observations**

| Task | Correct | Questionable | Comments |
|---|---|---|---|
| **H&S - Field Multi-task (General)** | | | |
| **General** | | | |
| PPE worn according to HASP/JLA specifications and inspected before use | | | |
| STOP work authority used where appropriate | | | |
| **Body Use / Positioning** | | | |
| Proper lifting/pushing / pulling techniques used (no awkward positions/posture; no twisting or excessive reaching; no straining; no excessive weight; load under control/stable; etc.) | | | |
| Body parts away from pinch points (clear or | | | |

| | | | |
|---|---|---|---|
| protected from being caught between objects/equipment or from contacting sharp objects/edges, etc.) | ☐ | ☐ | |
| Body parts not in the Line of Fire (protected from being struck by traffic, equipment, falling/flying objects, etc.) | ☐ | ☐ | |
| **Work Procedures/Environment** | | | |
| Correct type and number of barricades/warning devices/cones | ☐ | ☐ | |
| Communication with others when necessary (hand signals, flags, etc.) | ☐ | ☐ | |
| Right tools and equipment selected for the job and inspected before use | ☐ | ☐ | |
| Tools and equipment used properly | ☐ | ☐ | |
| Housekeeping performed (work areas and pathways clear of hazards, uneven surfaces addressed, etc.) | ☐ | ☐ | |
| Slip/trip/fall hazards addressed (path selected and cleared, eyes on path, speed, footing, etc.) | ☐ | ☐ | |
| Proper energy control (electrical systems grounded, lock out / tag out performed, isolated, cords / fixtures in good condition, GFCI inspected and utilized when appropriate and used properly, etc.) | ☐ | ☐ | |
| Protected from overhead/underground utilities (proper clearance, properly marked, spotters as necessary, etc.) | ☐ | ☐ | |
| Safe work on/near water (appropriate flotation device, appropriate boat for body of water and operation of boat, etc.) | ☐ | ☐ | |
| Chemical/Radiation protection (decontamination ones set up properly, air monitoring completed and logged, etc.) | ☐ | ☐ | |
| Fall from elevated height prevention (maintains 3-points of contact, appropriate ladder, mounting/dismounting vehicle/equipment, fall arrest system, etc.) | ☐ | ☐ | |
| Any additional safety issues identified? | ☐ | ☐ | |

**Solutions and Root Cause Analysis**

| Contributing Factors | Root Causes |
|---|---|
| | |
| | |
| | |
| | |

| Explanation of Root Cause(s) Analysis Numbers (RCA No): |
|---|
| 1 Lack of skill or knowledge |
| |

| |
|---|
| 2 In the past, did not follow procedures or acceptable practices and no incident occurred |
| 3 Doing the job according to procedures or acceptable practices takes more time or effort |
| 4 Short-cutting procedures or acceptable practices is positively reinforced or tolerated |
| 5 Lack of or inadequate operational procedures or work standards |
| 6 Inadequate communication of expectations regarding procedures or acceptable practices |
| 7 Inadequate tools or equipment |
| 8 External factors |

| Item No | RCA No | Solution(s): How to Prevent Questionable Behavior From Reocurring | Person Responsible | Due Date | Completed | Verified / Validated |
|---|---|---|---|---|---|---|
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Solution Verification & Validation Comments

Standard Review

| Reviewed By | Position/Title | Date |
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Desktop Quality Review

| Reviewed By | Position/Title | Date |
|---|---|---|
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Filed Verification & Validation

| Reviewed By | Position/Title | Date |
|---|---|---|
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H&S - Drilling-Borings/Well Installation Print

**General**

| | |
|---|---|
| Observed Company | Arcadis Other Company |
| Observation Type | Select Observation Type |
| LPO Form | Select LPO Type |
| Task Observed | |
| Observee Name | |
| Observer Name | |
| Observation Date | |
| Observation Due Date | |
| Observee Supervisor | |
| Project Number | |
| Project Name | |
| Client Name | |

Feedback Session

| | |
|---|---|
| Feedback Conducted By | |
| Date and Time | |
| Positive Comments | |

Observations

| Task | Correct | Questionable | Comments |
|---|---|---|---|
| H&S - Drilling-Borings/Well Installation | | | |
| Equipment Care and Maintenance | | | |
| PPE worn according to HASP/JLA specifications and inspected before use | | | |
| STOP work authority used where appropriate | | | |
| Electrical systems grounded, lock out / tag out performed, cords / fixtures in good | | | |

| | | | |
|---|---|---|---|
| condition | | | |
| Corded portable power tool or other cord connected equipment plugged into a GFCI whip and GFCI whip plugged directly into power source (electrical outlet) | ☐ | ☐ | |
| GFCI whip inspected, tested, and appropriate size for the equipment | ☐ | ☐ | |
| Wheel chocks in place on heavy vehicles and trailers | ☐ | ☐ | |
| Tool selection/use appropriate for job and inspected before | ☐ | ☐ | |
| Air monitoring equipment is on site, calibrated | ☐ | ☐ | |
| Containers with hazardous materials properly labeled; other containers appropriately labeled; compressed gas bottles separated, secured & upright | ☐ | ☐ | |
| Drill rig appropriate for task, inspected prior to use and in good condition | ☐ | ☐ | |
| High energy systems -mud/air/water (hose condition, hose routing, whip checks, and pop offs) inspected and functional | ☐ | ☐ | |
| Hoisting equipment, slings, tag lines and chains inspected prior to use, in good condition and used properly | ☐ | ☐ | |
| Emergency shut-off locations functional | ☐ | ☐ | |
| Work Environment | | | |
| Onsite vehicles and equipment located and marked properly, backed in when possible | ☐ | ☐ | |
| Underground utility, piping locates completed and locations marked, utilities and structures checklist used and minimum of 3 lines of evidence | ☐ | ☐ | |
| Maintains appropriate distance between equipment and power lines/ overhead obstructions | ☐ | ☐ | |
| Exclusion zone set up properly with correct type and number of barricades | ☐ | ☐ | |
| Work areas and pathways designated and clear of trip/slip hazards; uneven surfaces identified/addressed | ☐ | ☐ | |
| Work Procedures (Driller) | | | |
| Proper lifting/pushing/pulling techniques | ☐ | ☐ | |
| 3 points of contact maintained on ladders/steps, no jumping from equipment/platforms | ☐ | ☐ | |
| Pinch points and rotating hazards marked or guarded | ☐ | ☐ | |
| Follows sawcutting and jackhammering procedures and best management practices including mitigation of dust hazards | ☐ | ☐ | |

| | | | |
|---|---|---|---|
| Drill rig blocking stable; drill rig not moved when mast is up; spotters used when rig is moved | ☐ | ☐ | |
| Flying debris hazards addressed | ☐ | ☐ | |
| Proper use of tools to handle soil, water during drilling or hole clearance | ☐ | ☐ | |
| Using correct cutting tools to open liners containing soils | ☐ | ☐ | |
| Good housekeeping maintained | ☐ | ☐ | |
| Surface water/run-off diverted from boring | ☐ | ☐ | |
| Soil/water/waste materials stored properly, labeling complete | ☐ | ☐ | |
| Rig movement completely stopped before approaching with workers clear before beginning rotation/movement; rods, auger, casing moved properly, guided with lines | ☐ | ☐ | |
| Use of proper methods to break rods (no use of cheater bars, etc) | ☐ | ☐ | |
| Tag/sand lines used during hoist operations | ☐ | ☐ | |
| Maintain safe distance from moving equipment at full reach | ☐ | ☐ | |
| Fall protection available and used at heights greater than 6’ | ☐ | ☐ | |
| Open holes protected Proper tools used when installing or opening well lids; well heads closed/locked | ☐ | ☐ | |
| Hands clear of cable when developing new wells | ☐ | ☐ | |
| Personnel deconned per HASP/JLA | ☐ | ☐ | |
| Equipment deconned per HASP/JLA (pressure washer used properly) | ☐ | ☐ | |
| Equipment in passenger compartment/bed of vehicle secured; load distributed evenly | ☐ | ☐ | |
| Any additional safety issues identified? | ☐ | ☐ | |
| Work Procedures (ARCADIS) | | | |
| Observee performing required air monitoring at specified intervals | ☐ | ☐ | |
| Uses proper lifting techniques | ☐ | ☐ | |
| Not using awkward body positions or heavy lifting when logging samples | ☐ | ☐ | |
| Not using hand tools or hands near borehole to obtain cuttings when rig is in operating | ☐ | ☐ | |
| Using correct cutting tools to open liners containing soils | ☐ | ☐ | |
| Maintains communication with driller | ☐ | ☐ | |
| Maintains good housekeeping in work area and in vehicle | ☐ | ☐ | |
| | | | |

| | | | |
|---|---|---|---|
| Maintains safe distance from drill stem when rig is operating | ☐ | ☐ | |
| Establishes work area upwind of drill rig to extent possible | ☐ | ☐ | |
| Has established and maintains any required exclusion zones specified by the HASP or JLA | ☐ | ☐ | |
| Use best practices to perform decontamination of soil sampling equipment (avoids over spraying, contain rinsate, avoids spraying towards body, etc) | ☐ | ☐ | |
| Any additional safety issues identified? | ☐ | ☐ | |

**Solutions and Root Cause Analysis**

| **Contributing Factors** | **Root Causes** |
|---|---|
| | |
| | |
| | |
| | |

| Explanation of Root Cause(s) Analysis Numbers (RCA No): |
|---|
| 1 Lack of skill or knowledge |
| 2 In the past, did not follow procedures or acceptable practices and no incident occurred |
| 3 Doing the job according to procedures or acceptable practices takes more time or effort |
| 4 Short-cutting procedures or acceptable practices is positively reinforced or tolerated |
| 5 Lack of or inadequate operational procedures or work standards |
| 6 Inadequate communication of expectations regarding procedures or acceptable practices |
| 7 Inadequate tools or equipment |
| 8 External factors |

| Item No | RCA No | Solution(s): How to Prevent Questionable Behavior From Reocurring | Person Responsible | Due Date | Completed | Verified / Validated |
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Solution Verification & Validation Comments

Standard Review
Reviewed By Position/Title Date

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Desktop Quality Review

| Reviewed By | Position/Title | Date |
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Filed Verification & Validation

| Reviewed By | Position/Title | Date |
|---|---|---|
| | | |

H&S - Driving - Smith System 5 Keys Print

**General**

| | |
|---|---|
| Observed Company | Arcadis Other Company |
| Observation Type | Select Observation Type |
| LPO Form | Select LPO Type |
| Task Observed | |
| Observee Name | |
| Observer Name | |
| Observation Date | |
| Observation Due Date | |
| Observee Supervisor | |
| Project Number | |
| Project Name | |
| Client Name | |

Feedback Session

| | |
|---|---|
| Feedback Conducted By | |
| Date and Time | |
| Positive Comments | |

Observations

| Task | Correct | Questionable | Comments |
|---|---|---|---|
| H&S - Driving - Smith System 5 Keys | | | |
| General | | | |
| Performed vehicle inspection using vehicle inspection checklist | | | |
| Seat, steering wheel and mirrors properly adjusted | | | |
| Secured loose items | | | |

| | | | |
|---|---|---|---|
| Key 1 - Aim High in Steering | | | |
| Looks 15 seconds ahead | ☐ | ☐ | |
| Anticipates actions of others (evaluates relevant/non-relevant objects) | ☐ | ☐ | |
| Elevates eyes around corners and turns | ☐ | ☐ | |
| Strives to drive in the lane of least resistance | ☐ | ☐ | |
| Key 2 - Get the Big Picture | | | |
| Uses 4 second rule as following distance; adds 1 second for each additional hazard | ☐ | ☐ | |
| Observes traffic ahead, to the side and rear | ☐ | ☐ | |
| Observes pedestrians, bicyclist and animals (evaluates relevant/non-relevant objects) Observing signs and signals | ☐ | ☐ | |
| Adjusts speed for weather and road conditions | ☐ | ☐ | |
| Key 3 - Keep Your Eyes Moving | | | |
| Scans intersections prior to “point of no return” | ☐ | ☐ | |
| Checks mirrors every 6-8 seconds | ☐ | ☐ | |
| Checks mirrors prior to slowing or stopping | ☐ | ☐ | |
| Checks blind spot when changing lanes | ☐ | ☐ | |
| Moves eyes every 2 seconds (avoids blank/fixed stares) | ☐ | ☐ | |
| Key 4 - Leave Yourself An Out | | | |
| Stops 1 car length behind vehicle ahead at intersections and allows vehicle ahead to move before accelerating | ☐ | ☐ | |
| Stops 1 car length behind intersection line | ☐ | ☐ | |
| Uses “space cushions” in traffic | ☐ | ☐ | |
| Brakes early and gradually | ☐ | ☐ | |
| Key 5 - Make Sure They See You | | | |
| Effectively times use of the turn indicator and uses signals appropriately | ☐ | ☐ | |
| Establishes eye contact with other drivers | ☐ | ☐ | |
| Looks at rear-view mirror at initiation of brake pedal | ☐ | ☐ | |
| Uses the horn properly to signal others | ☐ | ☐ | |
| Parking and Backing | | | |
| Maintains proper speed in parking lot | ☐ | ☐ | |
| Selects parking places to pull through without backing | ☐ | ☐ | |
| Backs into parking places when pull through not available | ☐ | ☐ | |
| | | | |

| | | | |
|---|---|---|---|
| Selects parking place away from other vehicles/cart return when safe to do so | ☐ | ☐ | |
| Checks the backing area first | ☐ | ☐ | |
| Backs slowly and carefully | ☐ | ☐ | |
| Looking at all sides when backing | ☐ | ☐ | |
| Backs no further than necessary | ☐ | ☐ | |
| Maintains eye contact with pedestrians and other moving vehicles in parking lot | ☐ | ☐ | |
| Vehicle is legally parked | ☐ | ☐ | |
| Sets parking brake and secures vehicle | ☐ | ☐ | |
| Any additional safety issues identified? | ☐ | ☐ | |

**Solutions and Root Cause Analysis**

| **Contributing Factors** | **Root Causes** |
|---|---|
| | |
| | |
| | |
| | |

| Explanation of Root Cause(s) Analysis Numbers (RCA No): |
|---|
| 1 Lack of skill or knowledge |
| 2 In the past, did not follow procedures or acceptable practices and no incident occurred |
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| 4 Short-cutting procedures or acceptable practices is positively reinforced or tolerated |
| 5 Lack of or inadequate operational procedures or work standards |
| 6 Inadequate communication of expectations regarding procedures or acceptable practices |
| 7 Inadequate tools or equipment |
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| Item No | RCA No | Solution(s): How to Prevent Questionable Behavior From Reocurring | Person Responsible | Due Date | Completed | Verified / Validated |
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Solution Verification & Validation Comments

Standard Review

| Reviewed By | Position/Title | Date |
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Desktop Quality Review

| Reviewed By | Position/Title | Date |
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Filed Verification & Validation

| Reviewed By | Position/Title | Date |
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**Attachment 8**
ARCADIS Health and Safety Standards

**EXECUTIVE SUMMARY**

Damaging an underground or above ground utility can result in serious injury and loss of life, disrupt essential services, and create significant liability to ARCADIS, clients and subcontractors. Therefore, it is ARCADIS' policy that the presence of all existing utilities will be investigated and cleared (to the extent feasible) by locating, marking, and, where appropriate, visually verifying before the start of any field operation. The following requirements are mandatory under this policy:

- A minimum of three (3) reliable lines of evidence are required for an acceptable utility clearance.
- Additional lines of evidence are required if the primary lines of evidence cannot adequately identify subsurface, submarine or above ground utilities with reasonable certainty.
- The lines of evidence used will be reasonable and appropriate for the conditions expected to be encountered and the type of utilities expected to be encountered (e.g., gas line versus an irrigation line).
- Utility clearance information will be documented on the ARCADIS Utility and Structures Checklist or equivalent client provided checklist or permit presenting equivalent information.
- Employees overseeing utility clearance activities will:
    - Be familiar with the contents of this standard;
    - Have one year field experience in the identification of utilities; and
    - Have training and six months experience in the proper operation and results interpretation of any clearance equipment used by ARCADIS employees, including without limitation, magnetometers and ground penetrating radar.
- All utility strikes must be reported to Corporate Health and Safety and Legal within 24 hours using the Utility Line Strike Investigation Form. Do not enter the incident into 4-Sight until approved to do so by Corporate Legal.

Report Utility Incident Now

## 1. POLICY

It is the practice of ARCADIS and its affiliated companies to implement appropriate, reasonable and practical standards within acceptable and customary industry practices to promote the health and safety of its employees, and avoid and mitigate exposure of risk in the performance of their work. In furtherance of this policy, ARCADIS promotes and encourages compliance by all employees with this policy and standards relating to work in the vicinity of subsurface, submarine or aboveground utilities.

## 2. PURPOSE AND SCOPE

### 2.1 Purpose

This standard directs general safety standards and best practices associated with the identification and management of subsurface, submarine and aboveground utilities on project sites.

### 2.2 Scope

This standard assigns responsibilities and expectations for proper utility clearance by both ARCADIS employees and ARCADIS subcontractors at project sites.

## 3. DEFINITIONS

Refer to ARC HSFS-019 Supplement 1 for definitions of terms used in this standard.

## 4. RESPONSIBILITIES

### 4.1 Project Manager Responsibilities

For every project site having the potential to come into contact with utilities, Project Managers must ensure that:

- The requirements of this standard are followed.
- Local regulations governing utility clearance are followed. This includes ensuring local and or state laws defining activities or depth of intrusive work/excavation requiring utility clearance are reviewed as they vary by location.
- Efforts are made to work with the client, project site representatives and subcontractors to identify the nature of any utilities, and to determine what control processes need to be implemented by ARCADIS and the subcontractors to prevent damage to these utilities and to properly manage the effects in the event there is utility damage.
- Utility clearance activities are only delegated to a Task Manager or other individual meeting the requirements of section 4.2 below, as appropriate. However, even if the Project Manager delegates certain responsibilities, the

Project Manager maintains primary responsibility for a complete utility clearance.

### 4.2 Field Personnel Responsibilities

ARCADIS field personnel conducting work on a project site having the potential to come into contact with utilities have the responsibility to:

- Read, understand, and follow this standard and complete the appropriate checklists during the on-site utility locate process.
- Complete a minimum of 1 year of utility clearance related experience before accepting responsibility for any utility clearance tasks.
- Complete training and have 6 months of experience in operating and interpreting the results of remote sensing technologies, including without limitation, magnetometers and ground penetrating radar, before operating such technologies.
- Use their Stop Work Authority to eliminate any reasonable concern if utilities cannot be reasonably located.
- Ensure that ARCADIS subcontractors conduct their own reasonable independent utility clearance efforts as required by ARCADIS' standard subcontract, and are aware of any ARCADIS clearance standards used onsite.
- Be on site during any active intrusive activities involving contractor under contract to ARCADIS.

### 4.3 ARCADIS Subcontractor Responsibilities

According to ARCADIS' standard subcontract, subcontractors have agreed to take responsibility for any damages resulting from a utility impact cause by their work. Therefore, ARCADIS subcontractors are expected to take reasonable time and diligence to conduct their own independent utility clearance using reasonable standards and processes. Subcontractors have the responsibility to stop their work if utility concerns are identified and will report those concerns to the ARCADIS employee overseeing their work activities. ARCADIS staff should reinforce these responsibilities with subcontractors during job safety briefings.

In jurisdictions where the actual contractor performing the intrusive work activity is required to perform utility clearance notifications, the contractor will perform the clearance notification and will provide evidence of the notification to ARCADIS (ticket or ticket number, etc).

## 5. STANDARD

### 5.1 General

Protocols to be followed during utility clearance activities are outlined in:

- Best Practices for Project Managers (or Their Delegates) Concerning Utility Clearance (ARC HSFS-019 Supplement 2).

- Best Practices for Field Personnel Concerning Utility Clearance (ARC HSFS-019 Supplement 3).

### 5.2 Lines of Evidence

A minimum of 3 lines of evidence are required for an appropriate utility clearance as defined in this standard. Generally, the following lines of evidence may be utilized to meet this requirement:

- Contact the State One Call or equivalent service (Nationwide "811" is acceptable) if working within the right-of-way or public areas served by such services. For work on private property or in areas not served by such services, utilize a reputable private utility locating company to locate and mark the utilities. Utilization of a private utility locator is encouraged for all projects with subsurface or submarine utility issues.

- Use detailed scaled site utility plans, preferably in the form of an "as-built" or "record" drawing, to identify and/or confirm utility locations.

- Conduct a detailed visual site inspection to identify and/or confirm utility locations. For underground utilities, conduct an inspection for structures that tend to indicate the presence and general location of such utilities, including, but not limited to manholes, vaults, valve covers, valve markers, telephone pedestals, transform housings, fire hydrants, spigots, sprinkler heads, air relief valves, backflow preventers, meters, downspouts going into the subsurface, power poles with wring going into the subsurface and line markers. Saw cut lines and concrete /asphalt repairs often yield valuable information regarding utility locations. Always discuss the presence of utilities with the site owner, operator or occupant to identify any potential utilities that might not be readily identified by non intrusive clearing methods or may be:

    - At depths > 5 ft below ground surface; or

    - At very shallow depths (< 2ft below ground surface) such as electrical conduits/wiring, irrigation lines, etc.

View the Utilities and Structures Checklist

If one of the above lines of evidence cannot be utilized, or if using the above lines of evidence does not adequately identify utilities with reasonable certainty, one or more additional lines of evidence must be utilized. Commonly used lines of evidence are listed on the Utility and Structures Checklist.

A discussion of use and limitations associated with common utility clearance methods is provided in ARC HSFS-019 Supplement 4.

The lines of evidence will be recorded on the Utility and Structures Checklist or equivalent client provided checklist or permit presenting equivalent information.

### 5.3 Color Codes Used for Utility Markings

The following colors are used for marking utilities. Some government agencies or large industrial facilities may use additional colors not provided below. ARCADIS policy is to assume any paint marking or pin flag color not provided below is a subsurface utility marking until proven otherwise.

| COLOR | Utility Line |
|---|---|
| WHITE | Proposed Excavation |
| PINK | Temporary Survey Markings |
| RED | Electrical Power Lines, Cables, Conduit and Lighting Cables |
| YELLOW | Gas, Oil, Steam, Petroleum or Gaseous Materials |
| ORANGE | Communication, Alarm or Signal Lines, Cables or Conduit |
| BLUE | Potable Water |
| PURPLE | Reclaimed Water, Irrigation and Slurry Lines |
| GREEN | Sewer and Drain Lines |

*APWA and ANSI standard Z-53.1*

### 5.4 Working in Close Vicinity of Subsurface Utilities

No work will be conducted within 30 inches of a subsurface utility marking, or as prescribed by the utility owner, unless the utility is exposed through hand clearing. Make sure to factor the diameter of the utility when determining the 30 inch buffer zone as this may increase the distance from the actual marking (if the markings do not indicate diameter of utility).

Manual clearing methods such as shoveling, using pick axes, digging bars and other hand tools should be used with caution. Excessive down force, prying or use in poor/obstructed visibility conditions is prohibited as these tools can damage utilities.

For borings and excavations, if the utility is known to be at depths where hand clearing is not reasonable or creates additional safety concerns, no work will be performed within 30 inches vertically or horizontally of the utility unless manual clearing is performed under the oversight of an Excavation Competent Person as defined in the ARCADIS Excavation and Trenching H&S standard (ARC HSCS005).

For horizontal borings, to avoid potential of utility strike, damage from vibration, damage by pressure of the advancing boring, do not plan the drill boring location within 30 inches vertically of utilities. This requirement applies even if the operating contractor has technology that places the location to within a few inches. Make sure to factor the diameter of the utility when determining the 30 inch buffer zone.

Additional cautions are required when coring/cutting through or removing concrete or asphalt. Utilities may be encased within these materials or in the gravel sub grade under these materials and may be damaged during the utility clearance process. Always work slowly, methodically and frequently stop work to evaluate conditions during these work activities.

Additional cautions for horizontal borings include gravity utilities such as sewers and storm drains as the depth of these utilities will change (sometimes significantly) as they run across the project site. Always obtain the utility depth at the location where the boring will actually cross the line.

### 5.5 Acceptable Clearance for Working in Vicinity of Overhead Power Lines

No work will be performed by ARCADIS or a subcontractor where any equipment is within the limits specified below, unless the power line has been properly covered or de-energized by the owner or operator of the power line:

| Power Line Voltage Phase to phase (kV) | Minimum Safe Clearance (feet) |
|---|---|
| 50 or below | 10 |
| Above 50 to 200 | 15 |
| Above 200 to 350 | 20 |
| Above 350 to 500 | 25 |
| Above 500 to 750 | 35 |
| Above 750 to 1,000 | 45 |

*ANSI standard B30.5-1994, 5-3.4.5*

### 5.6 Reporting Utility Incidents

ARCADIS field personnel involved with any subsurface, submarine, and above-ground utility strikes should immediately stop work and contact the Project Manager to discuss the incident. The utility strike must be reported to Corporate Health and Safety and Legal Departments within 24 hours. Use the Utility Line Strike Investigation Form as part of the notification process.

Selected utility strike incidents may also utilize a conference call with operations management to review findings and lessons learned. The Divisional Health and Safety Manager will make the determination concerning the need to have the call, and will arrange the call, if deemed necessary.

### 5.7 Relationship of this standard to the Project Specific HASP

With the exception of the Utility and Structures Checklist, this standard, including most supplements, are not designed to be printed off and attached to project HASPs. During project health and safety planning, this standard will be reviewed

and applicable clearance technologies and methods will be documented on the Utility and Structures Checklist.

Additionally, emergency action standards specific to utility strikes should be addressed. ARC HSFS-019 Supplement 5 provides general guidelines for emergency response to utility strikes. Applicable information may be attached to the Utility and Structures Checklist to facilitate communication of response expectations.

### 5.8 Required Contract Terms and Conditions

ARCADIS' standard client and subcontractor contracts contain required terms and conditions defining responsibility for utility clearance and the allocation of risk associated with an impacted utility. These terms and conditions have prescribed language concerning subsurface work that is presented in ARCADIS client contracts and ARCADIS subcontractor contracts. If such provisions cannot be agreed upon, the reasons are documented and other risk-management actions should be identified, such as limits of liability, additional physical investigations, additional lines of evidence or utility location, assignment of risk to subcontractors, etc. In addition, any changes to these terms and conditions require approval by Legal Services.

## 6. TRAINING

Employees responsible for coordinating or conducting utility clearance activities will be familiar with the requirements of this standard.

## 7. REFERENCES

- Utility and Structures Checklist
- Utility Line Strike Investigation Form
- HSFS-019 Supplement 1, Utility Definitions
- HSFS-019 Supplement 2, Best Practices for Project Managers (or Their Delegates) Concerning Utility Clearance
- HSFS-019 Supplement 3, Best Practices for Field Personnel Concerning Utility Clearance
- HSFS-019 Supplement 4, Use and Limitations Associated with Common Utility Clearance Methods
- HSFS-019 Supplement 5, Emergency Action Plan guidelines for Utility Strikes
- ARC HSCS005 Excavation and Trenching
- Required client contract language concerning subsurface work

- Required subcontractor language concerning subsurface work

## 8. RECORDS

### 8.1 Utility Clearance Records

All records (maps, checklists and documentation of communications) used to determine the location of utilities should be retained and kept in the project file.

## 9. APPROVALS AND HISTORY OF CHANGE

Approved By: Tony Tremblay, Environment Division Health and Safety Manager

**History of Change**

| Revision Date | Revision Number | Reason for change |
|---|---|---|
| 13 December 2006 | 01 | Original document |
| 26 March 2007 | 02 | Put in new company format |
| 15 May 2007 | 03 | Added nation-wide 811 number |
| 6 September 2007 | 04 | Changing over to new template format |
| 22 February 2008 | 05 | Changing over to new template format |
| 13 January 2009 | 06 | Define lines of evidence |
| 4 October 2010 | 07 | Reformatting and addition of utility clearance information |
| 13 February 2012 | 08 | Modified link information for utility strike reporting, clarified local/state requirements in section 4.1 and 4.3 |

**Utilities and Structures Checklist**

Project: _____
Project Number: _____
Date: _____
Work locations applicable to this clearance checklist:

**Pre-Field Work**

One Call or "811" notified 48-72 hours in advance of work? ☐ Yes ☐ No
Utility companies notified during the One Call process ☐ See attached ticket

_____ _____ _____ _____
_____ _____ _____ _____
_____ _____ _____ _____

List any other utilities requiring notification: ☐ None

_____ _____ _____ _____

Client provided utility maps or "as built" drawings showing utilities? ☐ Yes ☐ No

**Field Work**

Markings present: ☐ Paint ☐ Pin flags/stakes ☐ Other ☐ None

Subsurface Utility Lines of Evidence Used (3 Minimum):

☐ One Call/"811"
☐ Client Provided Maps/Drawings
☐ Client Clearance
☐ Interviews: Name(s)/Affiliation(s) _____
_____
_____

Did persons interviewed indicate depths of any utilities in the subsurface?
☐ Yes, depths provided:

☐ Did not know or refused to answer

Comments:

☑ Site Inspection
☐ GPR
☐ Air-Knife
☐ Hydro-Knife
☐ Public Records/Maps
☐ Radiofrequency
☐ Metal Detector
☐ Handauger
☐ Potholing
☐ Probing
☐ Private Locator: Name and Company: _____
☐ Marine Locator: Name and Company: _____
☐ Other:

_____
_____

Tips for Successful Utility Location:
1. No excessive turning or downward force of handaugers/shovels, etc.
2. No hammering- no pickaxes-no digging bars-no hurrying or shortcutting
3. Select alternate/backup locations for clearance
4. Utilities may run directly under asphalt/concrete or be > 5 ft depth
5. Be on site when utilizing private utility locators

Site Inspection

During inspections look for the following ("YES" requires follow up investigation):

| | | Utility color codes | | |
|---|---|---|---|---|
| a) | Natural gas line present (evidence of a gas meter)? | Yellow | ☐ Yes | ☐ No |
| b) | Evidence of subsurface electric lines : | Red | | |
| | i) Conduits to ground from electric meter? | | ☐ Yes | ☐ No |
| | ii) Overhead electric lines absent | | ☐ Yes | ☐ No |
| | iii) Light poles, electric devices with no overhead lines? | | ☐ Yes | ☐ No |
| c) | Evidence of water lines: | Blue | | |
| | i) Water meter on site? | | ☐ Yes | ☐ No |
| | ii) Fire hydrants in vicinity of work? | | ☐ Yes | ☐ No |
| | iii) Irrigation systems? | | ☐ Yes | ☐ No |
| d) | Evidence of sewers or storm drains: | Green | | |
| | i) Restrooms or kitchen on site? | | ☐ Yes | ☐ No |
| | ii) Gutter down spouts going into ground | | ☐ Yes | ☐ No |
| | iii) Grates in ground in work area | | ☐ Yes | ☐ No |
| e) | Evidence of telecommunication lines: | Orange | | |
| | i) Fiber optic warning signs in areas? | | ☐ Yes | ☐ No |
| | ii) Lines from cable boxes running into ground? | | ☐ Yes | ☐ No |
| | iii) Conduits from power poles running into ground? | | ☐ Yes | ☐ No |
| | iv) Aboveground boxes or housings in work area? | | ☐ Yes | ☐ No |
| f) | Underground storage tanks: | | | |
| | i) Tank pit present? | | ☐ Yes | ☐ No |
| | ii) Product lines running to dispensers/buildings? | | ☐ Yes | ☐ No |
| | iii) Vent present away from tank pit? | | ☐ Yes | ☐ No |
| g) | Proposed excavation markings in work area? | White | ☐ Yes | ☐ No |
| h) | Other: | | | |
| | i) Evidence of linear asphalt or concrete repair | | ☐ Yes | ☐ No |
| | ii) Evidence of linear ground subsidence or change in vegetation? | | ☐ Yes | ☐ No |
| | iii) Manholes or valve covers in work area? | | ☐ Yes | ☐ No |
| | iv) Warning signs ("Call Before you Dig", etc) on or adjacent to site? | | ☐ Yes | ☐ No |
| | v) Utility color markings not illustrated in this checklist? | | ☐ Yes | ☐ No |
| i) | Aboveground lines in or near the work area: | | | |
| | i) < 50 kV within 10 ft of work area? | | ☐ Yes | ☐ No |
| | ii) >50 - 200 kV within 15 ft of work area? | | ☐ Yes | ☐ No |
| | iii) >200-350 kV within 20 ft of work area? | | ☐ Yes | ☐ No |
| | iv) >350-500 kV within 25 ft of work area? | | ☐ Yes | ☐ No |
| | v) >500-750 kV within 35 ft or work area? | | ☐ Yes | ☐ No |
| | vi) >750-1000 kV within 45 ft of work area? | | ☐ Yes | ☐ No |

Comments:

Do not initiate intrusive work if utilities are suspected to be present in area and are not located, markings are over 14 days old, or if clearance methods provide incomplete or conflicting information. Do not perform intrusive work within 30 inches of a utility marking without hand clearing.

Name and signature of person completing the checklist:

Name: _____

Signature: _____

Date: _____

**EXECUTIVE SUMMARY**


ARCADIS employs a wide range of heavy, mechanized equipment in various operations. Operating heavy equipment requires, at minimum, the policies set forth in this Standard. In addition to federally mandated requirements, each state may enforce more stringent standards related to training, licensure, inspection and documentation.

The requirements set forth in this policy provide direction in heavy equipment operations:

- Only authorized personnel will operate heavy equipment.
- If Operator training is required, it will occur under controlled conditions.
- Specific training for Powered Industrial Trucks (forklifts) will be in compliance with OSHA 29CFR 1910.178. Refer to ARCADIS Forklifts HS Procedure ARC HSSP006 for additional details and requirements.
- All employees involved in Heavy Equipment Operations shall read and understand documented hazard identification and risk assessments conducted using the Hazard Assessment and Risk Control (HARC) Process.
- ARCADIS Utility Location Standard shall be followed prior to beginning work which involves heavy or mechanized equipment. A minimum of 3 lines of evidence is required for subsurface activities.
- Preventative maintenance and pre-operation checks in accordance with the manufacturer's requirements shall be conducted prior to equipment usage.
- Understand and actively use TRACK and Stop Work Authority during heavy equipment operations.
- Supervisors shall verify clients' operating procedures and identify site hazards.
- PICs, PMs and TMs will be responsible for verifying operator training, maintaining equipment and operator documentation, identifying all operations which use heavy equipment in the work plan and researching and adhering to any additional policies required by the state in which the project operates.
- Maintain all current and applicable licensing, permits and project documentation as required by federal and state regulations. Required operation permits and checklists can be found in Exhibit 2.
- Work Practices associated with Heavy Equipment Operations such as PPE usage, illumination, equipment testing, travel path verification and maximum capacity rating adherence shall be strictly followed at all times. A complete list of Work Practices can be found in section 5.2.

## 1. POLICY

It is ARCADIS-US policy to be proactive in the identification, assessment and control of health and safety hazards and associated risks. To those means, it is ARCADIS' policy that our staff will be adequately trained and experienced before operating heavy and mechanized equipment. If it becomes necessary for ARCADIS employees to operate heavy or mechanized equipment, this procedure, at a minimum, will be strictly followed.

## 2. PURPOSE AND SCOPE

### 2.1 Purpose

To effectively mitigate or eliminate the hazards presented by working with or around heavy or mechanized equipment, i.e. back-hoes, track-hoes, bobcats, concrete crushers, etc.

### 2.2 Scope

This procedure Equipment Checklist, Operator Permit and Hazard Review apply to all employees of ARCADIS-US. Only trained and authorized personnel are permitted to operate heavy or mechanized equipment.

## 3. DEFINITIONS

Definitions related to Heavy Equipment Operations can be found in Exhibit 1.

## 4. RESPONSIBILITIES

### 4.1 Corporate H&S with Division and Practice Experts

Review and update, as necessary, this standard and associated attachments.

Audit Business Unit documentation files of authorized equipment operators and Site Project Supervisors.

### 4.2 Principal in Charge (PIC), Project Manager (PM) and Task Manager (TM):

- Verify that all activities that require use of heavy or mechanized equipment are properly identified and addressed within the project work plan, project health & safety plan, and/or other project-related documents.
- Investigate the State and Local licensure and/or certification requirements for mechanized equipment operation and verify ARCADIS operators or subcontractors have required licenses and certifications.
- Verify that their divisional or project team employees have received the proper training and have the required experience and skills to operate heavy or mechanized equipment.

- Verify that copies of the completed Hazard Review and Evaluation for Heavy Equipment Operators form(s) are maintained in the project files and maintained in a central file managed by the Business Unit.

- Verify that copies of the completed Heavy Equipment Inspection Checklists are submitted and retained with the project files.

### 4.3 Health and Safety Plan Writers and Reviewers

Use this procedure as guidance to ensure the appropriate identification, assessment and control of heavy and mechanical equipment operations are covered in the HASP.

Investigate the State and Local licensure and permit requirements for mechanized equipment operation and verify all ARCADIS operators or subcontractors have required licenses and certifications. A summary of state specific requirements is provided as an attachment. However, the latest regulations should be consulted.

### 4.4 Site Project Supervisors

Site Project Supervisors are responsible for evaluating, qualifying, monitoring and coaching/mentoring of Heavy Equipment Operators.

Site/Project Supervisors will have a minimum of 3 years construction management and/or hands-on operating experience and demonstrated proficiency with the skills required for heavy and mechanized equipment. A list of Site/Project Supervisors will be maintained by the Business Unit Management.

Specific job responsibilities include:

- Interface with the client representative to identify hazards associated with the client's project site.

- Review the client's equipment operating procedures and permit requirements, as applicable.

- Review and ensure compliance with the ARCADIS Utility Clearance Standard ARC HSFS019 before any heavy equipment operation.

- Evaluate prospective Authorized Operators using the attached Hazard Review and Evaluation for Heavy Equipment Operators and determine if an adequate level of hands-on skill has been demonstrated to safely operate the equipment.

- Upon completion of the Hazard Review and Evaluation for Heavy Equipment Operators form, complete the Heavy Equipment Operator Permit and retain a copy in the project files and maintain central file within Business Unit to document those employees evaluated and qualified as Heavy Equipment operators. In addition, the Heavy Equipment Operator Permit must be available on the project site for review.

- Verify that copies of the Heavy Equipment Inspection Checklists are being completed and retained with the project files, as specified in Section 8.0 – Records.

- Monitor Authorized Operators and provide coaching and feedback as necessary.

- Revoke operating privileges as necessary, if required skill level is not maintained. Outline a specific Corrective Action Plan and discuss with employee and supervisor. Training Group must be notified and operator "Authorized" status revoked until necessary skill/competency is demonstrated and verified by Site Project Supervisor.

### 4.5 Authorized Operators

Must have adequate training and instruction in their duties and responsibilities regarding equipment operation, as documented in the Hazard Review and Evaluation for Heavy Equipment Operators form.

Responsibilities include:

- Complete required daily preventive maintenance and pre-operation checks in accordance with the manufacturer's requirements and the attached Equipment Inspection Checklist (Equipment/Manufacturer Specific Checklists may be used in lieu of this form where appropriate to cover all required items).

- Conduct TRACK Assessment in order to identify, assess and control the hazards which may be faced during equipment operation as well as the signs and symptoms of exposure to the hazard(s) of the work environment.

- Review and comply with the ARCADIS above grade and subsurface utility clearance standard ARC HSFS019 before any heavy equipment operation.

- Above grade utilities in proximity to a heavy equipment work area must be marked with warning signs, shields or other protective measures, if the minimum required clearance distances cannot be maintained.

- Maintain visual contact and/or verbal communications with the spotters and other personnel in the area at all times.

- Use the PPE, air monitoring and testing equipment as specified in the HASP.

- Maintain an awareness of all barriers, operating limits and other warning devices required to protect from external hazards (e.g., traffic, pedestrians) and the proper use of those barriers.

- Obey "Stop Work" orders given by personnel in the area automatic alarm activation, or when self-perceived.

### 4.6 Affected Employees

- Conduct TRACK Assessment and monitor activities near areas where heavy and mechanized equipment is in operation.

- Maintain visual contact or verbal communication with all Authorized Operators and Designated Signal Person prior to approaching or when within the operating range of the equipment.

- Order evacuation of the area if a hazard develops, either within or outside the operating area.
- Warn unauthorized persons away from the operating area.
- Summon rescue and other emergency services as necessary.
- Minimum Class II High visibility vests shall be worn by Affected Employees.

### 4.7 All ARCADIS Employees

Use the TRACK process described below regularly and frequently. In addition, employees read and understand all documented hazard identification and risk assessments conducted using the HARC process. ARCADIS employees will:

- Participate in entry operations only if trained and authorized to do so.
- Never enter an active work area without first getting acknowledgment and approval of the operator and Designated Signal Person, as applicable.
- Use STOP WORK Authority if unsafe or unexpected conditions arise during operation and immediately notify other personnel in the area.

## 5. PROCEDURE

Heavy and mechanized equipment operation can present a unique set of hazards. Only trained, qualified, authorized employees will be allowed to operate heavy or mechanized equipment in accordance with this standard. Prior to starting work with heavy or mechanized equipment all of the required permits, clearance and required project documentation will be in place. The ARCADIS Utility Location Procedure ARC HSFS 019 will be followed prior to starting work with heavy or mechanized equipment.

For work with Powered Industrial Trucks (Forklifts) refer to ARCADIS Standard ARC HSSP006 for details.

### 5.1 Operator Approval

Prior to operating any heavy or mechanized equipment including but not limited to:

- Track-hoes and Wheel Mounted Excavators
- Back-hoes
- Articulating Trucks
- Street Sweepers
- Compactors
- Tractors

- Water trucks
- Hydro seeding and other truck or vehicle mounted equipment
- Concrete crushers
- Other Heavy Mechanized Equipment

All operators must be evaluated by a Site Project Supervisor and be observed on the specific equipment that will be in use. The Site Project Supervisor will complete the attached Hazard Review and Evaluation for Heavy Equipment Operators form and the Heavy Equipment Operator Permit. Both documents must be maintained in the project files and copies maintained in a central file within Business Unit to document those employees evaluated and qualified as Heavy Equipment operators.

All equipment will be inspected daily prior to use using the attached Equipment Inspection Form or an equivalent inspection form provided by the manufacturer or vendor to address equipment specific items.

**Note:** **Gantry and Bridge Cranes and other equipment that require more formal certification or licensure are not covered by this procedure. Project managers are required to verify that selected contractors have the required training, certification and equipment maintenance programs in place.**

### 5.2 Heavy Equipment Requirements

All vehicles used in construction must have:

- brake lights;
- appropriate lights or reflectors, or barricades equipped with appropriate lights or reflectors, to identify the location of the equipment;
- service, parking and emergency brakes;
- fenders on vehicles with rubber tires made after 1972;
- mud flaps on vehicles with rubber tires made before 1972;
- seats and compliant seat belts for the intended number of passengers;
- an audible warning system;
- an audible reverse alarm if the vehicle travels in reverse with an obstructed view;
- lights, if the vehicle operates in dimness or darkness;
- a defroster, if windshields fog;
- a windshield and wipers on vehicles with cabs; and
- *rollover protective structure* (ROPS)

### 5.3 General Requirements

The following Work Practices must be followed for Heavy and Mechanized Equipment operations:

- Must be equipped with appropriate lights or reflectors.
- Controls must be in a neutral position, with the motors stopped and brakes set, unless work being performed requires otherwise.
- Whenever the equipment is parked, the parking brake shall be set. Equipment parked on inclines shall have the wheels chocked and the parking brake set.
- All cab glass shall be safety glass, or equivalent, that introduces no visible distortion affecting the safe operation of equipment.
- Any overhead wire shall be considered to be an energized line unless and until the person owning such line or the electrical utility authorities indicate that it is not an energized line and it has been visibly grounded.
- For power lines rated 50 kV or below, minimum clearance between the lines and any part of the equipment or load shall be 10 feet.
- In transit with no load and boom lowered, the equipment clearance shall be a minimum of 4 feet for voltages less than 50 kV, and 10 feet for voltages over 50 kV, up to and including 345 kV, and 16 feet for voltages up to and including 750 kV.
- Keep the vehicle on safe roadways and inclines. Do not move or cause to be moved construction equipment or vehicles upon any access roadway or grade unless the access roadway or grade is constructed and maintained to accommodate safely the movement of the equipment and vehicles involved.
- Maintain 3-points of contact with the steps and hand rails while getting on/into the equipment. Do not use the controls or steering wheel as a handhold.
- Operate equipment only in well ventilated areas.
- Select a gear that will prevent excessive speed when going downhill – Do not coast downhill.
- Lower all the hydraulic equipment before shutting down or getting off the machine.
- Adequate illumination in accordance with OSHA standards and work activities must be provided for all work areas. An approved type (explosion-proof as necessary) lighting device must be used.
- Rigging and lifts will only be made when the operator judges it a safe operation.
- Personnel in the vicinity of equipment will wear hard hats, safety-toe shoes, high visibility vests and safety glasses.
- Hoist hooks will have safety latches.

- Equipment will only be used within the maximum rated capacity.
- Personnel will remain at a distance from overhead loads.
- Test directional and speed controls prior to operation.
- Test limit switches (as applicable) and the emergency stop.
- Not engage in practices that will divert attention while operating the equipment.
- Respond to signals only from the person who is directing the lift or appointed signal person.
- Not move a load over people.
- Avoid excessive force pulls.
- Determine the center of gravity and balance of the equipment and the load before moving it.
- Verify the stability of the structure or area that the equipment will be used on. When working on an elevated level a Professional Engineer or qualified building inspector must determine the adequacy of the work surface prior to placing equipment.
- Initially lift the load only a few inches to test the rigging and balance.
- Check the travel path in order to avoid personnel and obstructions.
- Center the sling over the load to keep the cables from slipping, and to prevent the load from swinging when it is lifted.
- Use a tag line when loads require precise control.
- Lift the load only high enough to clear the tallest obstruction in the travel path.
- Start and stop slowly.
- Choose a safe landing.
- Land the load when the move is finished.
- Never leave suspended loads unattended.

5.3.1 Motor Vehicle Specific Requirements

- Must be inspected at the beginning of each shift to ensure that the equipment and safety controls are in safe operating condition.
- Must have a service brake system, an emergency brake system, and a parking brake system.
- When working in areas of low visibility, motor vehicles must be equipped with at least two headlights and two taillights, which are operable.

- If motor vehicle has an obstructed rear view, it must be equipped with reverse signal alarm that must be audible above the surrounding noise level or the vehicle is backed up only when an observer signals that it is safe to do so.
- Dumping, lifting and hauling vehicles must have overhead protection for the operator.
- Operating levers controlling hoisting or dumping devices on haulage bodies must be equipped with a latch or other device which will prevent accidental starting or tripping of the mechanism.
- Trip handles for tailgates of dump trucks shall be so arranged that, in dumping, the operator will be in the clear.
- Never exceed load capacities for the vehicle.
- Use the parking brake when parking and chock the wheels when needed to prevent rolling.
- Secure loose tools in the cab with workers.
- Dumping and lifting mechanisms must be secured when not in use.
- Verify that areas are clear before lifting, loading and unloading.
- All controls shall be in a neutral position, with the motors stopped and brakes set, unless work being performed requires otherwise

5.3.2 Earthmoving Equipment

- Use seat belts and do not carry passengers where not intended on the vehicle. Seat belts need not be provided for equipment which is designed only for standup operation. Seat belts need not be provided for equipment which does not have roll-over protective structure (ROPS) or adequate canopy protection.
- All bidirectional machines, such as rollers, compacters, front-end loaders, bulldozers, and similar equipment, shall be equipped with a horn, distinguishable from the surrounding noise level, which shall be operated as needed when the machine is moving in either direction.
- Use the audible reverse alarm or signals from another worker when driving in reverse with an obstructed view.

5.3.3 Designated Signal Person

The site will use only Designated Signal Person(s) to direct heavy equipment.

Only persons who are competent and qualified by experience and/or training with the operations being directed shall be used as signal persons.

Where manual (hand) signals are used, only one person shall be designated to give signals to the operator. This signal person shall be located to see the load and be clearly visible to the operator at all times.

Manual (hand) signals may be used when the distance between the operator and signal person is not more than 100 ft (30.4 m). Radio, telephone, or a visual and audible electrically operated system shall be used when the distance between operator and signal person is more than 100 ft (30.4 m) or when they cannot see each other.

Standard hand signals shall be posted at the operator's position, signal control points, and other points as necessary to inform those concerned.

Signal persons shall back one vehicle at a time. While under control of a signal person, the heavy equipment driver shall not back or maneuver until directed and the driver shall stop when visual contact with the signal person is lost.

The signal person shall have a warning device of clear range and penetrating sound to warn persons when the load is coming in so they have time to get in the clear.

Minimum Class II High visibility vests shall be worn by flag and signal persons.

5.3.4 Refueling

- If refueling on site, the fueling area must be clearly marked (NO SMOKING), ignition sources eliminated and spill kit available.
- Turn off the engine before refueling.
- If refueling could result in gasoline/diesel coming into contact with hot engine parts, shut off and cool the engine and any electrical equipment before refueling.
- Ensure the fueling area is well ventilated.
- Do not smoke while refueling. Keep open flames and sparks away from area.
- Ground the funnel or fuel nozzle against the filler neck to avoid sparks when refueling.
- Do not use gasoline or diesel fuel for cleaning parts.
- A dry chemical or carbon dioxide fire extinguisher (rated 6:BC or larger) is in a location accessible to the fueling area.

Diesel cold start systems contain ether which is explosive. Keep away from heat, sparks, and open flames. Work in a well-ventilated area.

- If swallowed, breathed or contacted on skin or eyes seek medical attention immediately. Follow recommendations on the Material Safety Data Sheets.
- Point the openings of the valve, tube or atomizer away from yourself and others while testing the diesel cold start system.
- Store replacement ether cylinders in a cool dry place away from direct sunlight. Do not keep them in the operator’s compartment.

## 6. TRAINING

Training, when required, will be provided by a qualified vendor or through supervised operation by a Site Project Supervisor under controlled conditions.

## 7. REFERENCES

ARCADIS Health and Safety Procedure ARC HSFS010 – Health and Safety Planning

ARCADIS Employee Field Health & Safety Handbook

OSHA 29 CFR 1910 Subpart O - Motor Vehicles, Mechanized Equipment and Marine Operations

## 8. RECORDS - DATA RECORDING AND MANAGEMENT

Certification and Training records will be kept by the individual employee with copies of such certificates kept by Corporate Training. Training dates and times will be kept by Corporate Training.

Operator evaluation and certification documentation will be maintained at the project site and retained with the project files. Operator certification will be valid for 1 year after the date of initial issue.

## 9. APPROVALS AND HISTORY OF CHANGE

Approved by: Anthony Tremblay, CSP – Infrastructure Division Director of Health & Safety

**History of Change**

| Revision Date | Revision Number | Reason for change |
|---|---|---|
| 22 November 2011 | 01 | Original document |
| | | |
| | | |

## Exhibit 1 – Definitions

**Affected Employees –** Employees who are trained and authorized to work on projects where heavy or mechanized equipment is in use by either ARCADIS employees or subcontractors.

**Authorized Operator –** A trained, authorized individual with the experience, training, license (as applicable) and demonstrated skills to safely operate heavy or mechanized equipment in accordance with this procedure and applicable regulatory requirements.

**Backhoe-Loader** – As the name implies, it has a loader assembly on the front and a backhoe on the back.

**Bulldozer** – A powerful crawler (caterpillar tracked tractor) equipped with a blade.

**Crane –** A machine for hoisting and moving heavy objects by means of cables attached to a movable boom. Cranes can include the following types: overhead, gantry, locomotive and truck. Requirements for cranes are covered under ARCADIS standard ARCHSCS003. Cranes are not usually operated by ARCADIS employees; the PM is responsible for verifying proper qualifications and licensure for crane operation by subcontractors.

**Earthmoving Equipment** – Scrapers, loaders, crawler or wheel tractors, bulldozers, off-highway trucks, graders, agricultural and industrial tractors, and similar equipment.

**Excavator** – An engineering vehicle consisting of a backhoe and cab mounted on a pivot (turntable is a more apt description) atop an undercarriage with tracks or wheels.

**Heavy Equipment –** includes excavators/track-hoes, back-hoes, bucket loaders, bulldozers, articulating all terrain trucks, graders, agricultural and industrial tractors, sweepers and other powered mechanical equipment.

**Manlifts –** includes boom lifts, scissor lifts and other powered equipment designed to provide an elevated work surface. Manlifts require training by an authorized vendor or provider that includes a hands-on demonstration of competency that meets regulatory requirements and meets fall protection requirements. Refer to the ARCADIS Aerial Lifts Standard ARC HSFS017 for details.

**Motor Vehicles (as referenced in this standard) –** Vehicles that operate within an off-highway jobsite, not open to public traffic. The definition of Motor Vehicles does not include earthmoving equipment.

**Powered Industrial Truck (Forklift)** – includes fork trucks, tractors, platform lift trucks, motorized hand trucks and other specialized industrial trucks powered by electric motors or internal combustion engines. Forklifts require training by an authorized vendor or provider that includes a hands-on demonstration of competency and meets the regulatory requirements. Refer to the ARCADIS Powered Industrial Truck (Forklift) Standard ARC HSSP006 for details.

**Site Project Supervisor –** The employee responsible for reviewing the project scope and determining if an acceptable skill level has been achieved and demonstrated by an employee, prior to being considered an Authorized Operator.

**Skid Loader** – Also called a skid steer, is a compact, low capacity machine used for pushing or lifting material and for digging. It is typically used for earth moving during construction and landscaping in limited spaces but is also used to move loose materials in farming and industry.

**Skidder** – A type of vehicle used in forestry for pulling cut down trees (timber) out of a forest (logging).

**Exhibit 2 – Permits, Operator Evaluation, Inspection Checklists and State Summary**

Equipment Operator Permit

Hazard Review and Evaluation for Heavy Equipment Operators

Heavy Equipment Inspection Checklist

State by State Summary of Equipment Operations Regulations

**EXECUTIVE SUMMARY**


This Health and Safety Standard (HSS) sets forth minimum requirements for ARCADIS personnel to safely conduct work on elevated surfaces in conjunction with the use of fall protection systems. There are various applications and components of fall protection systems that can be effectively used to eliminate or reduce fall hazards. The information contained in this Standard covers these specific requirements.

The designated Competent Person will refer to this Standard and select the fall protection system that offers the best protection for the specific job, in order to appropriately and adequately protect ARCADIS personnel.To identify these hazards and establish appropriate fall protection measures, the following program and associated ARCADIS Elevated Work Permit have been provided.

When an ARCADIS employee has the potential to be exposed to a fall hazard, an Elevated Work Permit must be completed prior to the beginning of a project, task or work action. This permit shall be used to assess the hazards, identify fall protection system/equipment requirements, outline training requirements and identify methods for prompt, safe rescue and removal of a fallen or injured worker.

In General Industry related work, fall protection must be used an provided for each employee who is working at an elevated level in which the potential exists for a free fall of more than 4 feet.

For Construction Industry related work, the fall protection system selected must be used by each employee who is working at an elevated level in which the potential exists for a free fall of more than 6 feet.

The available fall protection measures include:

1. Guardrails
2. Safety Nets
3. Personal Fall Arrest System
4. Positioning Device System
5. Warning Line System
6. Controlled Access Zones
7. Fall Protection System
8. Non-conforming Guardrail
9. Designated Area

## 1. POLICY

It is the policy of ARCADIS to comply with OSHA's Fall Protection Standard **as it relates to the work we do.** In general, we have no control over how our clients select, incorporate, construct and maintain fall protection systems or devices. However, employees, subcontractors and personnel working on a site under ARCADIS control must be aware of and control hazards created during elevated work (working at heights) and what fall protection measures are compatible with the type of work they are doing.

Prior to the start of work where new facilities will be constructed and/or where work will be performed at a client's existing facility, ARCADIS shall make an initial survey of the types of fall hazards that may be encountered and complete the Work at Elevated Heights Permit to identify the kind and number of safeguards that are needed to protect against these fall hazards. The Elevated Work Permit located in Exhibit 2 will be used to assess the hazards, identify fall protection equipment requirements, outline training requirements/documentation, and identify methods for prompt, safe rescue and removal of a fallen or injured worker.

## 2. PURPOSE AND SCOPE

### 2.1 Purpose

This standard sets forth practices and policies to be used by employees and subcontractors of ARCADIS when working from elevated work surfaces. The purpose of this standard is to designate the requirements on fall protection systems, to enable employers, employees and supervisors to recognize the fall hazards and establish the practices that will be followed to prevent falls. In addition, this standard identifies the requirements to perform hazard evaluations ahead of the foreseeable fall hazard occurrence; to provide training to employees on the use, inspection, and limitations of fall protection equipment; and to plan/provide for the swift rescue of fallen workers suspended from their equipment.

### 2.2 Scope

This standard and associated practices apply to those ARCADIS projects in which elevated work hazards exist. As required, fall protection equipment is supplied and/or approved by ARCADIS for use by employees in carrying out their assignments. Employees and subcontractors conducting work from an elevated work surface are required to be protected by approved conventional fall protection methods. (i.e. Guardrails), or use a Personal Fall Arrest System (PFAS), as required by the project Health and Safety Plan (HASP), Job Safety Analysis (JSA), and applicable regulatory standard or client requirements.

**Exemption**: The provisions of this Fall Protection Standard do not apply when employees are making an inspection, investigation, or assessment of workplace conditions prior to the actual start of construction work or after all construction work has been completed. ARCADIS has established this exception because employees engaged in inspecting, investigating and assessing workplace conditions before the actual work begins or after work has been completed are exposed to fall hazards for very short durations, if at all, since they most likely would be able to accomplish their work without going near the danger zone. In addition, the use of a ladder to gain access to a work surface over 6 feet will also be applied under this exemption. However, scenarios that

keep employees within 6 feet of a fall hazard would not fall under this exemption (e.g. an employee collecting a roof flashing sample at the very edge of a flat roof 20 feet above the ground). If inspections are made while construction operations are underway, all employees who are exposed to fall hazards while performing these inspections must be protected as required by this Standard.

*OSHA de minimis* policy for non-conforming guardrails 15 or more feet from the edge under certain circumstances

With regards to General Industry compliance, when inspecting for a maintenance activity (e.g., not construction) such as an employee checking an HVAC unit on a roof, the worker is not covered under the Construction Standard exemption and must be protected by a guardrail or some form of acceptable fall protection system if temporary installation of guardrails atop a client's roof is not feasible. Another option for General Industry compliance with regards to roof access might be use of the proposed "designated area".

## 3. DEFINITIONS

There are a number of definitions associated with this standard and its associated procedures. These definitions are presented in Exhibit 1 of this document.

## 4. RESPONSIBILITIES

### 4.1 Employees

Employees are required to work within approved protection systems or use proper fall protection systems during work activities from elevated work surfaces. In addition, employees are required to have their provided fall protection available where the potential for falls exists and to use as required by HASPs, JSAs, or client requirements.

In addition, potentially affected employees have the responsibility to:

- Be capable of recognizing existing or predictable hazards in surroundings and/or working conditions associated with elevated work activities.
- Take prompt corrective measures to eliminate hazardous conditions associated with elevated work and fall protection activities, including, but not limited to stopping work.
- Understand safety requirements to be utilized to protect themselves and others during elevated work activities
- Attend Elevated Work / Fall Protection training as assigned and provide ARCADIS with training documentation prior to beginning work.
- Inspecting fall protection equipment prior to each use.
- Inspect, Clean, and Maintain their fall protection equipment in accordance with training requirements and manufacturer's specifications.

- Properly use fall protection equipment and PPE as specified by this standard, Task Specific Job Loss Analysis and in the site specific HASP.

### 4.2 ARCADIS Subcontractors

Subcontractors must comply with the following:

- Contractors working on behalf of ARCADIS are responsible for establishing, implementing and managing a fall protection program, which includes identification and elimination or control of fall hazards in compliance with OSHA requirements.

### 4.3 Task Managers, Project Managers and Principals In Charge

TMs, PMs, and PICs have the responsibility to know and follow applicable ARCADIS HS requirements and for ensuring work on their projects is conducted in accordance with policies/procedures established in this HSP.

Have the responsibility for:

- Reviewing and understanding this Elevated Work and Fall Protection Standard.

- Initiating and ensuring that a hazard analysis is conducted to identify, evaluate and control or eliminate elevated work/fall hazards.

- Communicating with and appropriately managing subcontractors, ensuring that employees have appropriate fall protection training and qualifications.

- Involving the appropriate ARCADIS H&S Staff and project staff, as necessary;

- Providing adequate resources and budget for necessary personal fall arrest system or other fall protection equipment.

- Verifying that employees under their direction adhere to the fall protection requirements of this standard, task specific JSA and procedures specified in the project specific HASP.

### 4.4 Corporate Health and Safety Staff

Have the responsibility for:

- Ensuring that staff are aware of this Standard.

- Ensuring this Standard is being implemented effectively;

- Providing and/or identifying required training or guidance on approved training options;

- Providing the necessary suppliers and criteria for selection of fall protection equipment.

### 4.5 Competent Person

The Competent Person will be responsible for determining and setting up the proper fall protection system and for continual observational safety checks so employees can be warned of fall hazards. This Competent Person can be an ARCADIS employee or other person meeting the designated Competent Person Requirements. The Competent Person:

- Must be capable of identifying existing or predictable hazards in surroundings and/or working conditions associated with elevated work and fall protection systems.
- Is authorized to take prompt corrective measures to eliminate hazardous conditions associated with elevated work and fall protection activities, including, but not limited to stopping work.
- Verify that the safety procedures identified in this Standard, the site specific HASP, and applicable regulatory requirements are utilized when required to protect employees during elevated work activities.
- Personal fall arrest systems and components subjected to impact loading shall be immediately removed from service and shall not be used again for employee protection until inspected and determined by a **competent person** to be undamaged and suitable for reuse.
- Develop and employ emergency procedures that include rescue and first aid.
- Verify that safety harness and equipment are regularly inspected and maintained, results of which are recorded in the appropriate documentation. The equipment inspection form can be utilized and kept with equipment for documentation purposes.
- Provide assistance in determining the correct equipment based upon the task and conditions. These staff members should be contacted during planning staging of proposed work to allow ample time to review the proposed work plan and conditions.
- Implement Fall Protection Plans under their Supervision (e.g. Leading edge work, preformed concrete, roofing work).
- Review and approve the Elevated Work Permit before ARCADIS employees proceed with elevated work.

ARCADIS employees must meet the following requirements to be considered a Competent Person:

- Attend a fall protection training course approved by Corporate Health and Safety or have equivalent training to that provided in the fall protection training course; and
- Approval by Corporate Health and Safety through demonstration of practical field experience and/or knowledge of the subject matter.

Non ARCADIS employees who are to be the Competent Person on behalf of ARCADIS employees, must provide their proof of competency to the ARCADIS Project Manager upon request (training records, experience, etc.).

## 5. STANDARDS AND PRACTICES

### 5.1 Procedure

ARCADIS projects may periodically require work on an elevated surface that could expose our staff to falling from those elevated surfaces. This can present a significant life-threatening hazard to employees if they are not properly protected from falling. To identify these hazards and establish appropriate fall protection measures, the following program and associated ARCADIS Elevated Work Permit have been provided. The purpose of this section is to accomplish the following:

- Evaluate operations for elevated work hazards and provide direction on activities that require use of a fall protection system;
- Identify appropriate fall protection measures, guards and control measures; and
- Maintain compliance with applicable ARCADIS and government regulations and guidelines.

### 5.2 General Safety Requirements

ARCADIS will generally not have the authority to control the selection or condition of the fall protection system used at some job sites, but employees will be aware of what fall protection measures are compatible with the type of work they are doing. If an employee judges a fall protection system to be unsafe, inadequate or inappropriate, the employee will use their Stop Work Authority and immediately inform his/her supervisor and/or the client and **not utilize the system** until the problem has been corrected.

The general requirements under this Standard for Elevated Work Activities are as follows:

- To the extent feasible, all elevated work surfaces must be protected with an approved method; guardrail, warning line system or cover to protect employees and equipment. Protection from falling objects on elevated work surfaces (4 inch toe board and hard hats) must also be provided.
- All fall restraint systems must be reviewed and approved for use by a "Competent Person" as part of the elevated work permit process. In addition, fall restraint systems must be constructed of approved materials and used according to the manufacturer's instructions.
- Employees must be trained in fall protection system use and in the specific equipment being used and inspect all equipment prior to use.
- Fall protection must be addressed in the site-specific JSA or HASP.

- If work must be performed on an unprotected elevated work area, an approved fall protection system shall be used.

- Skylights on roofs must be addressed as a potential fall hazard. Added protection such as guardrails, covers, and restraints shall be provided to prevent employees from falling through the skylight.

With regards to Construction activities, ARCADIS employees on a walking/working surface with an unprotected side or edge which is 6 feet or more above a lower level shall be protected from falling by the use of guardrail systems, safety net systems, or personal fall arrest systems. In addition, if there is a possibility of a fall from any height onto dangerous equipment, into hazardous environment (including water), or onto an impalement hazard then ARCADIS staff shall be protected from falling by the use of guardrail systems, safety net systems, or personal fall arrest systems. There are some exceptions to this general 6 feet statement. First, if employees are working in a situation where they could fall into or onto dangerous equipment, like a vat of acid or a crane, then the employee must be protected regardless of the fall height. Also, there are other sections of the construction standards that contain a requirement to have fall-protection when working on specific types of equipment or in specific operations (e.g., scaffolds, ladders, ramps and catwalks).

With regards to General Industry activities, every stairway and floor opening shall be guarded by a standard railing. The railing shall be provided on all exposed sides (except at entrance to stairway). For infrequently used stairways where traffic across the opening prevents the use of fixed standard railing (as when located in aisle spaces, etc.), the guard shall consist of a hinged floor opening cover of standard strength and construction and removable standard railings on all exposed sides (except at entrance to stairway). Every wall opening from which there is a drop of more than 4 feet shall be guarded by one of the following: roller, picket fence, half door, or equivalent barrier. Where there is exposure below to falling materials, a removable toe board or the equivalent shall also be provided. When the opening is not in use for handling materials, the guard shall be kept in position regardless of a door on the opening. In addition, a grab handle shall be provided on each side of the opening with its center approximately 4 feet above floor level and of standard strength and mounting. Every open-sided floor or platform 4 feet or more above adjacent floor or ground level shall be guarded by a standard railing on all open sides except where there is entrance to a ramp, stairway, or fixed ladder. The railing shall be provided with a toeboard wherever, beneath the open sides, persons can pass, there is moving machinery, or there is equipment with which falling materials could create a hazard. Because ARCADIS employees work at many client locations which may or may not be compliant with regards to General Industry Fall Protection requirements, guardrail installation may not be feasible requiring ARCADIS employees and subcontractors to use personal fall arrest systems (PFAS), work positioning systems, travel restricting systems (fall restraint), fixed ladder climbing systems, hole covers, safety nets, etc. to control fall hazards.

Requirements related to fall protection in regards to other OSHA standards such as telecommunications and powered platforms/manlifts are not covered by this standard or discussed in this manual section.

### 5.3 Fall Prevention Measures - 3 Step Approach

Potential falls shall be controlled by using this three-step systematic approach that is explained in the following subsections:

Step 1: Eliminating Fall Hazards

To eliminate fall hazards, carefully assess the work place and the work itself in the earliest engineering and planning stages of the project. The objective is to eliminate all fall hazards. This assessment of the site and the work not only helps eliminate hazards, but also identifies alternative approaches to the work that can measurably enhance productivity.

Step 2: Minimizing Fall Exposure (Safety by Design Concept)

If fall hazards cannot be completely eliminated during the first step, attempt to prevent falls by improving the work place. Avoid relying on a worker's behavior or fall-arresting equipment to prevent injuries. Early installation of stairs, guardrails, barriers and travel-restriction systems can provide fixed fall protection measures and a safe work environment.

Step 3: Using Proper Fall-Arrest Equipment

Fall-arrest equipment shall be utilized only after determining that potential falls cannot be eliminated by changing work procedures or the work place. Equipment such as harnesses, lanyards, shock absorbers, fall arresters, lifelines and anchorages may reduce the risk of injury if a fall occurs. Carefully assess the work place and work processes to select the most appropriate equipment for the job, and assess how to install and use it correctly.

### 5.4 Elevated Work Permit

**ARCADIS Elevated Work Permit**

When an ARCADIS employee has the potential to be exposed to a fall hazard, an Elevated Work Permit must be completed prior to the beginning of a project, task or work action. If there are any changes in the job conditions that alter the use of fall protection, the permit must be revised and approved prior to beginning work.

The ARCADIS employee who approves the Permit must be competent in the identification, mitigation, and control of the hazards associated with elevated work.

Upon completion of the permit, it must be reviewed and signed off by an ARCADIS Competent Person prior to beginning work. An onsite Competent Person shall verify that the permit has been reviewed prior to beginning work.

### 5.5 Guidelines for the Application of Fall Protection Systems

This section is to be used only as a guide for selecting the appropriate fall protection system. It is a brief outline of how fall protection systems can be applied to typical ARCADIS work situations. Ultimately, it is the responsibility of the Competent Person to determine which system is most appropriate for a specific project or task.

| Elevated Work Situation | Fall Protection System |
|---|---|
| Unprotected sides and edges over 6'. | Guardrail, Safety Net, or PFAS. |
| Leading edge under construction. | Fall Protection System or PFAS |
| Hoist areas | Guardrail, PFAS, Positioning Device System. |
| Holes, Wall Openings, Skylights | Guardrail, Covers or PFAS, |
| Formwork/ Reinforcing Steel | PFAS, Safety Net, Positioning Device System. |
| Ramps, Runways, Walkways. | Guardrail |
| Wells, pits, shafts, excavations. | Guardrail, Fences, Barricades, Covers. |
| Roofs: Steep and Low Slope. | Guardrail, PFAS, Warning Line System. |
| Precast Concrete Erection | Guardrail, PFAS. |
| Stack Testing | PFAS, Cage Ladder System, and Rigid Rail or Wire Rail System. |

### 5.6 Fall Protection Measures

Prior to the start of work where new facilities will be constructed and/or where work will be performed at an existing facility, ARCADIS shall make an initial job survey using the TRACK process. The use of TRACK will help identify the types of fall hazards that are expected to be encountered, and develop a plan to identify the kind and number of safeguards that are needed to protect against these fall hazards. The fall protection measures selected shall be compatible with the type of work being performed.

The ARCADIS Elevated Work Permit shall be used to assess the hazards, identify fall protection system/equipment requirements, outline training requirements/documentation and identifying methods for prompt, safe rescue and removal of a fallen or injured worker.

The fall protection system selected must be used by each employee who is working at an elevated level in which the potential exists for a free fall of more than 6 feet. These fall protection systems may include the types described in the following sections.

#### 5.6.1 Guardrail Systems

Guardrails can be used to protect the open edges of a working surface. They create a physical barrier that prevents falling to lower levels. They can be used at any height, and can be a permanent or temporary system.

Guardrail systems must meet the following requirements:

- The top edge height of top rails or equivalent guardrail system members shall be 42" plus or minus 3" above the walking/working level. When conditions warrant, the height of the top edge may exceed the 45" height.

- Midrails shall be installed at a height midway between the top edge of the guardrail system and the walking/working level.

- Screens and mesh, when used, shall extend from the top rail to the walking/working level and along the entire opening between top rail supports.

- When used between posts, intermediate members (such as balusters) shall not be more than 19" apart.

- Other structural members (such as additional midrails and architectural panels) shall be installed such that there are no openings in the guardrail system that are more than 19" wide.

- Guardrail systems shall be capable of withstanding a force of at least 200lbs applied within 2" of the top edge in any outward or downward direction at any point along the top edge.

- When the 200-lb test load is applied in a downward direction, the top edge of the guardrail shall not deflect to a height less than 39" above the walking/working level.

- Midrails, screens, mesh, intermediate vertical members, solid panels and equivalent structural members shall be capable of withstanding a force of at least 150lbs applied in any downward or outward direction at any point along the midrail or other member.

- Material being used for top rails or midrails shall be inspected as frequently as necessary to verify that it continues to meet a force of at least 200-lbs applied within 2" of the top edge in any outward or downward direction at any point along the top edge.

- Guardrail systems shall be surfaced as to prevent injury to a person from punctures or lacerations and to prevent snagging of clothing.

- The ends of all top rails and midrails shall not overhang the terminal posts except where such overhang does not constitute a projection hazard.

- Steel banding and plastic banding shall not be used as top rails or midrails.

- Top rails and midrails shall be at least ¼" nominal diameter or thickness to prevent cuts and lacerations. If wire rope is used for top rails, it shall be flagged at not more than 6' intervals with high-visibility material.

- When guardrail systems are used at hoisting areas, a chain, gate or removable guardrail section shall be placed across the access opening between guardrail sections when hoisting operations are not taking place.

- When guardrail systems are used at holes, they shall be erected on all unprotected sides or edges of the hole.

- When guardrail systems are used around holes that are used for the passage of materials, the hole shall not have more than two sides equipped with removable guardrail sections to allow the passage of materials. When the hole is not in use, it shall be closed with a cover, or a guardrail system shall be installed along all unprotected sides or edges.

- When guardrail systems are used around holes that are used as points of access (such as ladder ways), they shall be installed with gates or be offset so that people cannot walk directly into the holes.

- Guardrail systems used on ramps and runways shall be erected along each unprotected side or edge.

5.6.2 Safety Net Systems

When used, surface safety nets shall be installed as close as practical under the walking/working surface on which employees are working, but not more than 30 feet below such level, and must extend outward 8 feet from the edge of the working surface with up to 5 feet of vertical distance from the working level to the horizontal plane of the net (**Note: Net must extend further out from the working surface when the vertical distance from the working level to the horizontal plane of net exceeds 5 feet**). Safety nets must be capable of withstanding a drop test of 400 pounds and shall have a border rope for webbing that has a minimum breaking strength of 5,000 pounds. Mesh openings cannot exceed 36 square inches nor be longer than 6 inches (15 cm) on any side, and the opening of mesh ropes or webbing, measured center-to-center, shall not be longer than 6 inches (15 cm). Connections between safety net panels shall be as strong as integral net components and shall be spaced not more than 6 inches (15 cm) apart.

Safety nets must be inspected at least once a week for wear, damage, and other deterioration.

5.6.3 Positioning Device Systems

A positioning device system is a body harness system rigged to allow an employee to be supported on an elevated surface, and work with both hands free while leaning.

Positioning devices cannot be used for fall protection; their primary purpose is to provide stationary support.

Positioning devices must be rigged such that an employee cannot free fall more than 2 feet.

They can only be secured to an anchorage capable of withstanding an impact load of two times the potential impact of a fall or 3,000 pounds, whichever is greater.

Only double-locking snap hooks should be used.

Positioning device systems shall be inspected prior to each use for wear, damage, and other deterioration, and defective components shall be removed from service.

5.6.4 Warning Line Systems

Warning line systems only apply to roofing work on low-slope roofs.

When mechanical equipment is not being used, the warning line shall be erected around all open sides of the roof work area and not less than 6 feet from the roof edge. When mechanical equipment is being used, the warning line shall be erected not less than 6 feet (1.8 m) from the roof edge that is parallel to the direction of mechanical equipment operation, and not less than 10 feet (3.1 m) from the roof edge that is perpendicular to the direction of mechanical equipment operation.

Points of access, materials handling areas, storage areas, and hoisting areas shall be connected to the work area by an access path formed by two warning lines.

When the path to a point of access is not in use, a rope, wire, chain, or other barricade, equivalent in strength and height to the warning line, shall be placed across the path at the point where the path intersects the warning line erected around the work area, or the path shall be offset such that a person cannot walk directly into the work area.

Warning lines can consist of ropes, wires, or chains and their supporting stanchions, and once erected, must be capable of resisting, without tipping over, a horizontal force of 16 pounds. Lines must be flagged at not more than 6-foot intervals with a high-visibility material.

5.6.5 Controlled Access Zones

Controlled access zones only apply to overhead bricklaying and related leading-edge work. Steel erection allows other applications.

A controlled access zone means an area designated and clearly marked, in which leading edge work may take place without the use of guardrail, safety net, or personal fall arrest systems to protect the employees in the area. Control zone systems shall comply with the following provisions:

1. When used to control access to areas where leading edge and other operations are taking place the controlled access zone shall be defined by a control line or by any other means that restricts access. When control lines are used, they shall be erected not less than 6 feet (l.8 m) nor more than 60 feet (18 m) or half the length of the member being erected, whichever is less, from the leading edge.

2. The control line shall extend along the entire length of the unprotected or leading edge and shall be approximately parallel to the unprotected or leading edge.

3. The control line shall be connected on each side to a guardrail system or wall.

4. Control lines shall consist of ropes, wires, tapes, or equivalent materials, and supporting stanchions as follows:

    - Each line shall be flagged or otherwise clearly marked at not more than 6-foot (1.8 m) intervals with high-visibility material.

- Each line shall be rigged and supported in such a way that its lowest point (including sag) is not less than 39 inches (1 m) from the walking/working surface and its highest point is not more than 45 inches (1.3 m) from the walking/working surface.

- Each line shall have a minimum breaking strength of 200 pounds (890 N).

5.6.6 Safety Monitoring System

The Safety Monitoring System is prohibited at ARCADIS.

5.6.7 Fall Protection System

This option is available only to employees engaged in leading edge work, precast concrete erection work, or residential construction work who can demonstrate (and document) that it is infeasible or it creates a greater safety hazard to use conventional fall protection equipment. The plan must be location specific, prepared by a Qualified Person, and implemented under the supervision of a Competent Person. The plan must identify, by name, each worker designated to work in the controlled access zone.

The fall protection plan shall document the reasons why the use of conventional fall protection systems (guardrail systems, personal fall arrest systems, or safety nets systems) are infeasible or why their use would create a greater hazard.

The fall protection plan shall include a written discussion of other measures that will be taken to reduce or eliminate the fall hazard for employees who cannot be provided with protection from the conventional fall protection systems. For example, the Competent Person must discuss the extent to which scaffolds, ladders, or vehicle mounted work platforms can be used to provide a safer working surface and thereby reduce the hazard of falling.

The fall protection plan shall identify each location where conventional fall protection methods cannot be used. These locations shall then be classified as controlled access zones.

Where no other alternative measure has been implemented, ARCADIS may implement a safety monitoring system.

The fall protection plan must include a statement which provides the name or other method of identification for each employee who is designated to work in controlled access zones. No other employees may enter controlled access zones.

If an employee falls, some other related, serious incident occurs or an employee reports a Near Loss, ARCADIS will investigate the circumstances of the fall or other incident to determine whether the fall protection plan needs to be changed (e.g. new practices, procedures, or training). Any changes shall be implemented to prevent similar types of falls or incidents.

5.6.8 Non-Conforming Guardrail (Construction Work)

The following guidance is based upon a *de minimis* policy established by a Letter of Interpretation issued by Federal OSHA.

At 15 feet from the edge or hole (in the case of a hole, measured from the nearest edge of the hole), a warning line, combined with effective work rules, can be expected to prevent workers from going past the line and approaching the edge. Also, at that distance, the failure of a barrier to restrain a worker from unintentionally crossing it would not place the worker in immediate risk of falling off the edge. Therefore, OSHA applies a de minimis policy for non-conforming guardrails 15 or more feet from the edge under certain circumstances. Specifically, OSHA considers the use of certain physical barriers that fail to meet the criteria for a guardrail a de minimis violation of the guardrail criteria where all of the following conditions are met:

- A warning line is used 15 feet or more from the edge (or nearest edge of a hole);
- The warning line meets or exceeds the requirements in §1926.502(f)(2);
- No work or work-related activity is to take place in the area between the warning line and the hole or edge; and
- The employer effectively implements a work rule prohibiting the employees from going past the warning line.

5.6.9 Designated Area (General Industry Operations and Maintenance Work)

In May 2003 OSHA republished the proposed Part 1910 rulemaking that included a General Industry “designated area” [proposed 29 CFR 1910.28(d)]. Compliance with a proposed amendment in lieu of compliance with an existing rule is considered a de minimis violation by OSHA. The designated area is similar to the 6-ft warning line for roofers, but several additional conditions must be met for it to apply. The designated area criteria consists of:

- roof slope 4:12 [10 degrees or less (a low-slope roof)];
- constructed with ropes, wires or chains of 500-lb tensile strength (no barrier tape);
- horizontal members within the dimensions of 34 in. to 39 in.;
- must withstand a horizontal force of 16 lb, 30 in. above the base;
- complies with the provisions of proposed rulemaking 29 CFR 1910.28(d);

Several conditions differ from the warning line criteria stated in 29 CFR 1926.502(f)(2) as well:

- work must be of a temporary nature;
- is to be erected as close to the work area as permitted by the task;
- perimeter to be no less than 6 ft from an unprotected edge; and
- access to designated area by a clear path formed by two lines, same criteria for lines and stanchions as in the basic standard.

### 5.7 Covers

Covers must be capable of supporting at least twice the weight of employees, equipment, and materials that may be imposed on the cover at any one time.

Covers shall be secured when installed so as to prevent displacement, and either color-coded or plainly marked with the word “COVER” or “HOLE” to provide warning of the hazard.

### 5.8 Personal Fall Arrest System (PFAS)

Fall hazards at heights should be engineered out if possible. A personal fall arrest system should only be used as a backup for those hazards still remaining. Personal fall arrest systems and components, subjected to impact loading, must be removed from service immediately. Personal fall arrest systems must limit the arresting force to 1,800 pounds when using a full body harness.

A personal fall arrest system is used to arrest an employee in a fall from a working level. It consists of an anchorage, connectors and body harness, and may include a lanyard, deceleration device, lifeline, or suitable combinations of these.

The entire system must be inspected prior to each use for wear, damage and/or deterioration. If a system is subject to impact loading, it must not be used again until inspected by a Competent Person.

The following represents the various parts that comprise the PFAS designed to arrest the fall of one person.

#### 5.8.1 Anchorages

The critical requirement in all fall protection is the anchorage point. It is the position on an independent structure to which the fall arrest device, lifeline, or lanyard is securely attached. Anchorages used for attachment of personal fall arrest equipment shall be independent of any anchorage being used to support or suspend platforms and shall be capable of supporting at least 5,000 pounds (2,220 N) per employee attached, or shall be designed, installed, and used as follows:

- As part of a complete personal fall arrest system which maintains a safety factor of at least two; and
- Under the supervision of a qualified person.

A fixture point above head height should always be planned where feasible.

#### 5.8.2 Hardware Connectors

Hardware connectors consist of bolts, shackles, D-rings, snap hooks, and metal links that connect parts of the lifeline system.

One of the major problems with forged safety snap hooks is their susceptibility to “rolling out,” or unlatching during shock or static loading by a twisting process. Care must be taken to ensure the use of “as new” safety locking snap hooks or Carabiner-type snap

hooks with an automatic twist-lock arm. Snap hooks should only be attached to compatible hardware and never to each other.

Connectors shall be drop-forged, pressed or formed steel or made of equivalent materials.

Connectors shall have a corrosion-resistant finish, and all surfaces and edges shall be smooth to prevent damage to interfacing parts of the system.

D-rings and snaphooks shall have a minimum tensile strength of 5,000lbs (22.2kN).

D-rings and snaphooks shall be proof-tested to a minimum tensile load of 3,600lbs (16kN) without cracking, breaking or taking permanent deformation.

Snaphooks shall be a locking-type snaphook designed and used to prevent disengagement or “rolling out” of the snaphook, which may occur when the connected member has contact with the snaphook keeper.

Snaphooks shall not be engaged unless they are a locking type and designed for the following connections:

- Directly to webbing, rope or wire rope.
- To other snaphooks.
- To a D-ring to which another snaphook or other connector is attached.
- To a horizontal lifeline.
- To any object that is incompatibly shaped or dimensioned in relation to the snaphook such that unintentional.

5.8.3 Horizontal Lifeline

A horizontal lifeline is an anchorage cable designed to be rigged between two fixed anchorage points on the same level, which are independent of the work surface. The purpose is to provide a continuous anchorage point for the attachment of lanyards and/or retractable lifelines when no supporting steel or existing structural anchorage points are available.

- Cable-type lifelines must be at least 0.5 inch in diameter and be capable of supporting a 5,000-pound deadweight load per person at the center of the lifeline.
- Anchorage points must also be capable of supporting 5,000 pounds per employee attached.
- A minimum safety factor of 2:1 is required.
- The cable must have an adequate degree of sag. The OSHA Fall Protection regulation and guidance documents discuss the appropriate degree of sag.

- The cable must have supports every 20 to 50 feet. The OSHA Fall Protection regulation and guidance documents discuss appropriate supports.

- The cable must have sufficient shock absorption and design strength at least twice the force calculated for the dynamic fall of an anticipated number of workers who may use the line.

- Appropriate engineering is required for all horizontal lifelines.

- The devices used to connect to a horizontal lifeline shall be capable of locking in both directions on the lifeline.

5.8.4 Vertical Lifeline

A vertical lifeline is a line which extends from an independent anchorage point and to which a lanyard is attached using a grabbing device. This line should be at least 5/8 inch-diameter nylon or 5/8-inch- or 3/8-inch-diameter steel cable, and must have a minimum breaking strength of 5,000 pounds.

NOTE: When vertical lifelines are used, only one employee can be attached to each line.

5.8.5 Lanyards

The lanyard is a short, flexible rope, steel cable, or length of strap webbing, having a minimum strength of 5,000 pounds, that is used to connect a worker's safety harness to either an anchorage point or a grabbing device on a lifeline. The lanyard is designed to permit limited freedom of movement on the job and absorb the shock of a free fall up to 6 feet. As little slack as possible is vital to limit the free fall distance to which the worker is exposed. Only professionally manufactured lanyards with deceleration or shock absorbing devices, which can significantly reduce fall arrest forces on the body and can reduce the potential for compounding injuries, will be used by ARCADIS staff.

To remove the possibility of "roll-out" or of producing a shear point on the lanyard, the practice of looping a lanyard over a pipe or piece of structural steel and then hooking it back onto itself is prohibited. Most lanyard manufacturers have available, in varying lengths, items that are made specifically for this purpose. These are the items that will be used. These may be referred to by any number of names, such as crossover straps, anchorage connector straps, or tie-off adapters. These items are generally similar. Each is made up of a length of 2- to 3-inch-wide webbing with a D-ring on each end. The strap is looped one or more times around the pipe or structural steel and then the lanyard is anchored into both of the D-rings. This is the prescribed method to be used by ARCADIS staff.

5.8.6 Self-Retracting Lifeline Devices

These portable, self-contained devices are fixed to an anchorage point above the work area. The lifeline rope, webbing, or cable is attached directly to the worker's safety harness. The rope pays out of the device as distance increases and retracts as the worker moves closer. At the moment a fall occurs, a centrifugal locking mechanism is activated to arrest the movement, thereby reducing the potential shock load. A good

application can be found on sloping roofs or other areas where the rope is never slack and it does not interfere with the work surface.

NOTE: Because this device is an enclosed, self-retracting mechanism, consideration should be given to the fact that requirements for inspection and maintenance will be much greater and more difficult than with other fall protection systems.

5.8.7 Body Harness

A body harness is the only authorized safety support for employees to wear with a lifeline fall protection system. The body harness shall be used in all applications where a personal fall arrest system is used.

The body harness should be a nylon or web belt system designed to spread the shock load of an arrested fall over the shoulders, thighs and seat area. The D-ring must be positioned on the upper back straps, where it will also provide a practical means of raising or lowering the wearer in a rescue operation.

The body belt, which is a device worn around the waist to which a lanyard or lifeline grabbing device is attached, and the chest harness, which is only used for restraint or positioning, are not authorized for fall protection applications at ARCADIS. The bosun chair may only be used for suspension and positioning where free falls are not anticipated.

5.8.8 Rope Grab Device

This is a grabbing device which connects the worker's safety harness or lanyard to the lifeline and is designed to arrest a fall mechanically, bringing the worker to a full stop. There are two types of mechanical cable or rope grabbing devices that may be used by ARCADIS personnel:

- Manually Operated Grab. The worker moves this device by hand, up and down the lifeline. Preferably, it should be positioned above the work level. This device actuates during a fall by either squeezing the rope, or by tipping in such a way as to lock onto the lifeline by friction.

- Mobile Grab. This grab device is designed to travel freely on the lifeline, helping to provide vertical freedom of movement, but to lock automatically should a fall occur. Most mobile grabs are activated by the inertial and/or frictional forces generated by a fall.

**5.9 Fixed Ladder Climbing Protection Systems**

Climbing protection is required on all fixed ladders more than 20 feet high or deep. Climbing protection devices offer a personal fall protection system designed to positively limit a worker's fall. Even when a worker is climbing a ladder protected by caging (e.g., metal hoops installed around fixed ladders), some type of climbing protection device must be used. All ladder safety devices must meet the design requirements of the ladders they serve. The two main types of permanently attached climbing safety devices that may be used by ARCADIS personnel are presented below.

5.9.1 Rigid Rail Carrier

The rail, or cable, is called a carrier. In the rigid system, the rail runs the entire length of the ladder and is a permanent part of the ladder. The rigid carrier system is the only climbing system that should be used by ARCADIS personnel for ascending or descending a tall ladder, because fittings every few feet attaching the ladder to the structure make these systems inherently safer and more maintenance free than the cable-type climbing systems.

A sliding device (Saf-T-Lok sleeve or similar) is attach to the rigid rail and a carabiner connected to the sleeve is attached to the ARCADIS worker's safety harness to allow climbing freedom. Should a fall occur, the device must be of the type that is designed to either lock onto the carrier or to limit the descent velocity. Safety harness used with these systems should include a front D-ring if the rail or cable is in the center of the ladder, or side D-rings if the rail or cable is located on the side of the ladder.

5.9.2 Flexible Cable Carrier

The flexible cable-type climbing safety system should only be used for lower heights (generally lower than 100 feet). This type of system must be secured to the ladder at the top and bottom, must be kept taut by tightening devices to prevent damage caused by wind vibration, and should have guides placed every 25 to 40 feet to provide protection from wind whipping and also to control bowing as the climber ascends or descends. Because of the weathering properties of steel cable outdoors, and the reliance on a single upper fixture point, this type of climbing protection system must be thoroughly inspected and maintenance records reviewed and approval granted by ARCADIS Corporate Health & Safety Director before ARCADIS personnel are allowed to use it.

A sliding device attaches the worker's safety harness to the carrier and allows climbing freedom. Should a fall occur, the device must be of the type that is designed to either lock onto the carrier or to limit the descent velocity. Safety harness used with these systems should include a front D-ring if the rail or cable is in the center of the ladder, or side D-rings if the rail or cable is located on the side of the ladder.

Employees must review and comply with rigid rail carrier manufacturer instruction manual and any applicable technical alerts issued by the manufacturer.

## 5.10 Inspection and Maintenance of Equipment

Before a fall protection system is used, trained workers who will be using the equipment must conduct a detailed inspection of the fall protection system and its equipment to ensure that it meets the requirements of the job and is acceptable to the workers. This type of inspection must be repeated at regular intervals as part of a maintenance program.

Users of fall protection equipment will be taught how to conduct a visual inspection of each part of their equipment, including the webbing harness, buckles, D-rings, lanyards, and anchor points, what they should be looking for, and whom they should immediately notify in the event they believe they have a problem. ARCADIS staff will be informed that they are required to conduct these visual inspections each time before they use the equipment, and that any indication of tearing, rubbing, weather corrosion, dry rot, damage, cuts, pinching, etc, will be sufficient cause to have the equipment immediately removed from service and marked as unusable.

Fall protection equipment that is found to be defective, damaged, or in need of repair, regardless of the extent of the problem, must be immediately marked as unusable and removed from service.

5.10.1 Formal Inspection

PFAS must be regularly inspected. Any component with any significant defect, such as cuts, tears, abrasions, mold, or undue stretching; alterations or additions that might affect its efficiency; damage due to deterioration; contact with fire, acids, or other corrosives; distorted hooks or faulty hook springs; tongues unfitted to the shoulders of buckles; loose or damaged mountings; non-functioning parts; or wearing or internal deterioration in the ropes must be withdrawn from service immediately, and should be tagged or marked as unusable, or destroyed.

The following sections explain how to inspect each portion of the personal fall arrest system.

*5.10.1.1 Safety Harness*

Beginning at one end, holding the body side of the harness toward you, grasp the harness with your hands 6 to 8 inches apart. Bend the harness in an inverted “U.” The surface tension resulting will make damaged fibers or cuts much easier to see. Do this, a small section at a time, over the entire harness. Inspect for frayed or broken strands. Broken webbing strands generally appear as tufts on the webbing surface. Any broken, cut, or burned stitches will be readily seen.

Special attention should be given to the attachment of buckles and D-rings to webbing. Note any unusual wear, frayed or cut fibers, or distortion of the buckles or D-rings. Buckle tongues should be free of distortion and should overlap the buckle frames and move freely back and forth in their sockets. The tongue or billet of the harness receives heavy wear from repeated buckling and unbuckling. Inspect for loose, distorted, or broken grommets. Rivets should be tight and unmovable with the fingers. Body side rivet bases and outside rivet burrs should be flat against material.

*5.10.1.2 Lanyard and Hardware*

When inspecting lanyards, begin at one end and work to the opposite end. Slowly rotate the lanyard so that the entire circumference is checked. Spliced ends require particular attention.

Steel Lanyards. While rotating the steel lanyard watch for cuts, frayed areas, or unusual wearing patterns on the wire. Broken strands will separate from the body of the lanyard.

Webbing Lanyards. While bending webbing over a pipe or mandrel, observe each side of the webbing lanyard. This will reveal any cuts or breaks. Swelling, discoloration, cracks, or charring are obvious signs of chemical or heat damage.

Rope Lanyards. Rotation of the rope lanyard while inspecting from end to end will reveal any fuzzy, worn, broken, or cut fibers. Weakened areas from extreme loads will appear as a noticeable change in the original diameter.

Snap Hooks. Carefully inspect snap hook latching mechanisms for deformation, corrosion, dirt, damage, or abuse. Damaged hooks almost always indicate lack of proper use. Snap hooks that become ineffective because of these problems must be destroyed. Only snap hooks that operate in as-new condition can be used.

5.10.2 Cleaning the Equipment

Wipe all surface dirt from the harness with a sponge dampened in plain water. Squeeze sponge dry and dip sponge into mild solution of water and commercial soap or detergent. Apply to the harness and work up a lather with a vigorous back-and-forth motion. Wipe the harness dry with a clean cloth and hang freely to dry. Do not place near excessive heat.

Basic care of the harness and lanyards will prolong the life of the unit and will contribute to the performance of its vital safety function. Proper storage and maintenance after use are as important as cleansing the equipment of dirt, corrosives, or contaminants. Storage areas should be clean, dry and free of exposure to fumes or corrosive elements.

Recordkeeping procedures will help determine the life and history of individual pieces of fall protection equipment.

5.10.3 Impact Loading

Most manufacturers will not guarantee that a harness or lanyard will provide adequate protection during a second fall. Therefore, ARCADIS policy mandates that equipment that has been subjected to impact loading or an actual fall, must be immediately removed from service and not used again.

### 5.11 Protection from Falling Objects

Material/equipment must be kept 6 feet from the edge, but the protection needed will depend on the material/equipment that present the hazard.

Employees must be protected from falling objects whenever an affected employee is 6 feet (1.8 meters) or more above a lower level.

Toe boards, when used as falling object protection, must be erected along the edge of the overhead walking/working surface and must be capable of withstanding a force of at least 50 pounds applied in a downward or outward direction. They must be solid, be a minimum of 3.5 inches high, and have not more than 0.25 inch clearance above the walking/working surface.

When materials are piled higher than the toe board, paneling or screening shall be erected from the toe board to the guardrail. Materials and equipment shall not be stored within 6 feet of a roof edge unless guardrails have been erected.

Guardrail systems, when used as falling object protection, shall have all openings small enough to prevent passage of potential falling objects.

No materials or equipment except masonry and mortar shall be stored within 4 feet of working edges. During roofing work, materials and equipment shall not be stored within 6

feet of a roof edge unless guardrails are erected at the edge, and materials piled, grouped, or stacked near a roof edge must be stable and self supporting.

### 5.12 Rescue Plan

When PFAS are used, ARCADIS must ensure that employees can be promptly rescued or can rescue themselves should a fall occur. The availability of rescue personnel, ladders, or other rescue equipment should be evaluated. In some situations, equipment that allows employees to rescue themselves after the fall has been arrested, such as devices with descent capability, may be desirable. The fallen worker must be rescued safely and quickly. No-one should be allowed to hang suspended by a full body harness for more than 5 minutes.Every effort shall be made for ARCADIS employees to not work alone when wearing a PFAS. If it is not feasible for a specific task and the employee will work alone, then they must have a cellular telephone on their person in order to self-initiate emergency rescue service notification, if an emergency arises.

#### 5.12.1 Advanced Planning

All good rescue systems require advanced planning. Before work begins, the necessary rescue equipment should be determined by the project team and made available at the job site. The client's rescue capabilities should be assessed, and the availability of client staff to assist in a rescue should be verified. The local fire department should be notified to determine whether it can assist in effecting a rescue. Once the plan is developed, training sessions in the use of the plan should be conducted.

#### 5.12.2 Suspension Trauma

Suspension trauma can occur when a person has an arrested fall and is suspended and caught upright in a vertical position that causes the harness straps to put pressure on the leg veins. Because the lower legs have a large storage capacity for blood and gravity pulls blood into them, suspension trauma can occur when a person's legs are immobile in an upright posture for a prolonged period of time. The returned blood flow to the heart is reduced as blood accumulates in the legs. Because the blood supply to the heart is then restricted, the body suddenly slows the heart, causing the person to faint.

Fainting, restriction of movement or loss of consciousness can occur within a few minutes. This can lead to renal failure and eventually death, depending on the person's susceptibility. The condition can be worsened by heat and dehydration.

Susceptibility is unrelated to fitness levels or other physical conditions. Therefore, quick rescue of a person suspended in a full-body harness as soon as possible is vital. Designated and trained workers shall be capable of conducting the rescue of a fallen worker and be familiar with on-site rescue equipment and procedures.

The following shall be considered for preventing suspension trauma as a result of an arrested fall:

- Workers shall never work alone when using a harness for fall protection.
- Suspension-trauma safety straps shall be used. They are an effective way to prevent the effects of suspension trauma after a fall because they allow the worker who is suspended to stand up in the harness to relieve pressure.

- Workers spending time hanging in a harness shall use a 'sit-type' harness, which allows legs to be kept at least partially horizontal.
- The length of time a worker spends in suspension after a fall should be limited to five minutes. When suspension is longer than five minutes, foothold straps or a way of placing weight on the legs shall be provided.
- Workers shall try to use their legs and push against any footholds when these movements are possible.
- Workers shall try to place the legs as high as possible and the head as horizontal as possible.
- Harnesses shall be selected for specific applications with consideration given to comfort, potential injuries and suspension trauma.
- If a person falls, he or she shall be moved by a person who is trained in rescue procedures from suspension in stages. (i.e., the procedure should take 30-40 minutes with the victim moved first into kneeling position, then sitting and finally horizontal; sudden movement to a horizontal position can be potentially fatal).

5.10.3 Type of Rescue

The following questions should be considered when evaluating the type of rescue:

- Will the fallen worker be able, both physically and mentally, to affect his/her own rescue, or will a rescue team be needed to assist him/her?
- Are there devices with descent capability quickly available at the job site, and have employees been trained in their use?
- Will the fallen worker need to be lifted to a landing level where he/she can be rescued or will he/she need to be lowered to the ground?

5.10.4 Communication in the Event of an Emergency

Employees must know who to call and the fastest way to contact them. The Elevated Work Permit contains emergency contact information. As part of the project planning process, emergency responders must be notified of the time/date of planned elevated work. Emergency telephone numbers must be posted in the project Health & Safety Plan or at the work site where they will be readily accessible, and some type of communication link, such as a mobile phone, must be available at the work site. While awaiting help, other employees should communicate frequently with the fallen worker and monitor him/her constantly. The fallen worker should be kept from panicking, and should know that others are working to affect his/her rescue.

## 6. TRAINING

Fall Protection General Awareness Training by a Competent Person is required for all staff who work on elevated surfaces and where fall hazards may be present.

Project specific fall protection training is to be completed prior to start of those projects requiring the use of fall protection.

### 6.1 ARCADIS Fall Protection "Competent Person" Training

ARCADIS employees must meet the following requirements to be considered a Competent Person:

- Attend a fall protection training course approved by Corporate Health and Safety or have equivalent training to that provided in the fall protectoin training course; and
- Approval by Corporate Health and Safety through demonstrating practical field experience and/or knowledge of the subject matter.

Practical field experience and knowledge for Fall Protection includes the following, at a minimum:

1. Elevated work and fall hazard identification and assessment.
2. Fall Hazard Controls: fall protection systems; personal fall restraint, guardrails, covers and warning line systems.
3. Regulatory requirements.
4. Procedures for addressing elevated work and fall hazards.
5. Fall protection equipment maintenance and inspection procedures.
6. Emergency procedures for elevated work.
7. Responsibilities of a Competent Person.
8. Correct usage of Elevated Work Permit.

### 6.2 Project Specific Training

Project Specific Training must include the following, at a minimum:

1. Fall protection procedures.
2. Review of this “Elevated Work and Fall Protection Standard”.
3. Use of fall protection systems and equipment.
4. Inspection of PFAS equipment.
5. Use of the Elevated Work Permit.
6. Daily Safety Tailgate Meetings that address fall protection specific to the project.

### 6.3 Employee Training Certification

A written certification record, which contains the name of the employee trained, the dates of the training, the subject and type of training, and the signature of the Competent Person who performed the training will be documented by the ARCADIS Training Group.

### 6.4 Retraining

Retraining must be performed whenever ARCADIS has reason to believe that any affected employee, who has already been trained, is still lacking in the understanding required by the Fall Protection standard. Retraining will also be performed when any of the following occurs:

- changes in the work place render the previous training obsolete
- inadequacies in the employee's knowledge of fall protection
- changes in the type of fall protection equipment

## 7. REFERENCES

***Consensus Standards***

*29 CFR 1910 Subpart D – Walking-Working Surfaces*

*29 CFR 1926: Subpart M - Fall Protection*

ANSI Z359.1 Safety Requirements for Personal Fall Protection

## 8. RECORDS

**Record Maintenance** –All records regarding fall protection permits and inspections must be maintained in the project files. Employee training records will be maintained per ARCADIS training recordkeeping requirements.

## 9. APPROVALS AND HISTORY OF CHANGE

Approved By: Tony Tremblay, CSP – Infrastructure Division Director of H&S

### History of Change

| Revision Date | Revision Number | Reason for change |
|---|---|---|
| 24 February 2011 | 1 | Conversion to current format; Update standard to include description of fall protection systems and use of elevated work permit |

| | | |
|---|---|---|
| 13 April 2012 | 2 | Changed terminology JLA-JSA; LPO-TIP<br>Added Approval line |
| | | |

**Exhibit 1- Definitions**

**Anchorage-** a secure point of attachment for lifelines, lanyards or deceleration devices.

**Buckle-** any device for holding the body belt or body harness closed around the employee's body.

**Competent Person-** one who, through education, training, and/or experience, is capable of identifying existing and predictable hazards or working conditions which are unsanitary, hazardous, or dangerous to employees and who has authorization to take prompt corrective measures to eliminate them.

The Competent Person will be “Qualified” in the following areas:

- the nature of fall hazards in the work area
- the correct procedures for erecting, maintaining, disassembling, and inspecting the fall protection systems to be used
- the use and operation of guardrail systems, personal fall arrest systems, safety net systems, warning line systems, safety monitoring systems, controlled access zones, and other protection to be used
- the role of each employee in the safety monitoring system when this system is used

- the limitations on the use of mechanical equipment during the performance of roofing work on low-sloped roofs
- the correct procedures for the handling and storage of equipment and materials and the erection of overhead protection
- the role of employees in fall protection plans
- familiar with the OSHA Regulations pertaining to Fall Protection.

**Connector-** a device which is used to couple (connect) parts of the personal fall arrest system and positioning device systems together. It may be an independent component of the system, such as a carabiner, or it may be an integral component of part of the system (such as a buckle or D-ring sewn into a body belt or body harness, or a snap-hook spliced or sewn to a lanyard or self-retracting lanyard).

**Construction Work-** construction, alteration, and/or repair, including roofing, painting and decorating and demolition. Section 1910.12(a) further provides that OSHA's construction industry standards apply "to every employment and place of employment of every employee engaged in construction work. Definition Interpretations: Construction work is not limited to new construction, but can include the repair of existing facilities or the replacement of structures and their components. For example, the replacement of one utility pole with a new, identical pole would be maintenance; however, if it were replaced with an improved pole or equipment, it would be considered construction. In addition to the concept of one-for-one replacement versus improvement, the scale and complexity of the project are relevant. This takes into consideration concepts such as the amount of time and material required to complete the job. For example, if a steel beam in a building had deteriorated and was to be replaced by a new, but identical beam, the project would be considered a construction repair rather than maintenance because of the replacement project's scale and complexity. Also, if a bridge was to be stripped and re-painted, that would be considered construction work even if the repainting were done on a scheduled basis. Replacement of a section of limestone cladding on a building, though not necessarily a large project in terms of scale, would typically be considered construction because it is a complex task in view of the steps involved and tools and equipment needed to do the work.

**Deceleration device-** any mechanism, such as a rope grab, rip-stitch lanyard, specially-woven lanyard, tearing or deforming lanyards, automatic self-retracting lifelines/lanyards, etc., which serves to dissipate a substantial amount of energy during a fall arrest, or otherwise limit the energy imposed on an employee during fall arrest.

**Deceleration distance-** the additional vertical distance a falling employee travels, excluding lifeline elongation and free fall distance, before stopping, from the point at which the deceleration device begins to operate. It is measured as the distance between the location of an employee's body belt or body harness attachment point at the moment of activation (at the onset of fall arrest forces) of the deceleration device during a fall, and the location of that attachment point after the employee comes to a full stop.

**Elevated Work-** any work that is done over another level or surface at heights above 6 feet, or work that is done over a hazardous situation.

**Elevated Work Surface-** any surface upon which work is conducted above another level or surface.

**Equivalent-** alternative designs, materials, or methods to protect against a hazard which the employer can demonstrate will provide an equal or greater degree of safety for employees than the methods, materials or designs specified in the standard.

**Failure-** load refusal, breakage, or separation of component parts. Load refusal is the point where the ultimate strength is exceeded.

**Fall Restraint-** a system that prevents a worker from reaching an exposed edge of a working surface, by means of tying off or connecting a lifeline to an anchorage point.

**Free fall distance-** the vertical displacement of the fall arrest attachment point on the employee's body belt or body harness between onset of the fall and just before the system begins to apply force to arrest the fall. This distance excludes deceleration distance, and lifeline/lanyard elongation, but includes any deceleration device slide distance or self-retracting lifeline/lanyard extension before they operate and fall arrest forces occur.

**Guardrail system-** a barrier erected to prevent employees from falling to lower levels.

**Hole** means a gap or void 2 inches (5.1 cm) or more in its least dimension, in a floor, roof, or other walking/working surface.

**Infeasible-** that it is impossible to perform the construction work using a conventional fall protection system (i.e., guardrail system, safety net system, or personal fall arrest system) or that it is technologically impossible to use any one of these systems to provide fall protection.

**Lanyard-** a flexible line of rope, wire rope, or strap which generally has a connector at each end for connecting the body belt or body harness to a deceleration device, lifeline, or anchorage.

**Leading edge-** the edge of a floor, roof, or formwork for a floor or other walking/working surface (such as the deck) which changes location as additional floor, roof, decking, or formwork sections are placed, formed, or constructed. A leading edge is considered to be an "unprotected side and edge" during periods when it is not actively and continuously under construction.

**Lifeline-** a component consisting of a flexible line for connection to an anchorage at one end to hang vertically (vertical lifeline), or for connection to anchorages at both ends to stretch horizontally (horizontal lifeline), and which serves as a means for connecting other components of a personal fall arrest system to the anchorage.

**Lower levels** - those areas or surfaces to which an employee can fall. Such areas or surfaces include, but are not limited to, ground levels, floors, platforms, ramps, runways, excavations, pits, tanks, material, water, equipment, structures, or portions thereof.

**Maintenance-** there is no regulatory definition for "maintenance," nor a specified distinction between terms such as "maintenance," "repair," or "refurbishment." "Maintenance activities" have commonly been defined in dictionaries as making or keeping a structure, fixture or foundation (substrates) in proper condition in a routine, scheduled, or anticipated fashion. In OSHA's directive on the general industry confined space standard, the Agency stated that maintenance involves "keeping equipment working in its existing state, i.e., preventing its failure or decline".

Work that is anticipated, routine and done on a regularly scheduled/periodic basis to help maintain the original condition of the component, will be suggestive of "maintenance," although this must be considered in light of the scale of the project.

**Opening-** a gap or void 30 inches (76 cm) or more high and 18 inches (48 cm) or more wide, in a wall or partition, through which employees can fall to a lower level.

**Qualified-** one who by possession of a recognized degree, certificate, professional standing, or extensive knowledge, training and experience has successfully demonstrated their ability to solve or resolve problems relating to the subject matter, the work, or the project.

**Rope grab-** a deceleration device which travels on a lifeline and automatically, by friction, engages the lifeline and locks so as to arrest the fall of an employee. A rope grab usually employs the principle of inertial locking, cam/level locking, or both.

**Roof-** the exterior surface on the top of a building. This does not include floors or formwork which, because a building has not been completed, temporarily become the top surface of a building.

**Roofing work-** the hoisting, storage, application, and removal of roofing materials and equipment, including related insulation, sheet metal, and vapor barrier work, but not including the construction of the roof deck.

**Self-retracting lifeline/lanyard-** a deceleration device containing a drum-wound line which can be slowly extracted from, or retracted onto, the drum under slight tension during normal employee movement, and which, after onset of a fall, automatically locks the drum and arrests the fall.

**Snaphook**-a connector comprised of a hook-shaped member with a normally closed keeper, or similar arrangement, which may be opened to permit the hook to receive an object and, when released, automatically closes to retain the object. Snaphooks are generally one of two types:

- The locking type with a self-closing, self-locking keeper which remains closed and locked until unlocked and pressed open for connection or disconnection; or

- The non-locking type with a self-closing keeper which remains closed until pressed open for connection or disconnection. As of January 1, 1998, the use of a non-locking snaphook as part of personal fall arrest systems and positioning device systems is prohibited.

**Toeboard-** a low protective barrier that will prevent the fall of materials and equipment to lower levels and provide protection from falls for personnel.

**Walking/working surface-** any surface, whether horizontal or vertical on which an employee walks or works, including, but not limited to, floors, roofs, ramps, bridges, runways, formwork and concrete reinforcing steel but not including ladders, vehicles, or trailers, on which employees must be located in order to perform their job duties.

**Work area-** that portion of a walking/working surface where job duties are being performed.

Elevated Work Permit

ARCADIS

## ELEVATED WORK PERMIT

| | | | |
|---|---|---|---|
| **Project Name:** | | **Project Location:** | |
| **Permit Developed By:** | | **Date:** | |
| **Project Start Date:** | | **Project Completion Date:** | |
| **Client:** | | **Client Contact:** | |
| **Subcontractor Companies** | | | |

## TRACKing the Elevated Work Permit

### THINK THROUGH THE TASK

**Job Task**: (Summary of what elevated work is proposed)

| WORKFORCE INVOLVED IN ELEVATED WORK | | Check all the apply | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Name** | **Company** | Elevated Work Qualified | Competent Person | Experienced | Can Work Alone | Short Service Employee | Training Required | Supervision Required |
| | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

Comments/Additional Details:

### RECOGNIZE THE HAZARDS (check those that apply) and ASSESS THE RISK (Low - Moderate - High)

| YES | NO | | SELECT ↓ | YES | NO | | SELECT |
|---|---|---|---|---|---|---|---|
| ☐ | ☐ | FRAGILE ROOF OR SURFACES | | ☐ | ☐ | POSSIBLE FALL FROM A HEIGHT BELOW 6' (1.83M) | |
| ☐ | ☐ | MATERIALS OR TOOLS AT HEIGHTS | | ☐ | ☐ | POSSIBLE FALL FROM A HEIGHT OF 6' (1.83M) OR MORE | |
| ☐ | ☐ | LIFTING, PUSHING OR PULLING | | ☐ | ☐ | POSSIBLE FALL FROM A LADDER | |
| ☐ | ☐ | WORK NEAR ELECTRICAL LINES | | ☐ | ☐ | POSSIBLE FALL FROM A WORK PLATFORM | |
| ☐ | ☐ | MANUAL HANDLING MATERIALS | | ☐ | ☐ | POSSIBLE FALL INTO A HAZARDOUS SUBSTAN | |
| ☐ | ☐ | GROUND LEVEL OBSTRUCTION | | ☐ | ☐ | POSSIBLE FALL INTO EXCAVATION | |
| ☐ | ☐ | MOVING MATERIALS | | ☐ | ☐ | POSSIBLE FALL INTO WATER | |
| ☐ | ☐ | OVERHEAD OBSTRUCTIONS | | ☐ | ☐ | RESTRICTED SPACE | |
| ☐ | ☐ | FALLING OBJECTS | | ☐ | ☐ | VEHICLES OR TRAFFIC | |
| ☐ | ☐ | SLIPS, TRIPS, FALLS | | ☐ | ☐ | WEATHER OR TEMPERATURE | |
| ☐ | ☐ | WORKING ALONE | | ☐ | ☐ | FALLING OBJECTS | |
| ☐ | ☐ | UNGUARDED EDGES | | ☐ | ☐ | LACK OF SPACE | |
| ☐ | ☐ | UNEVEN FLOOR SURFACES | | ☐ | ☐ | WORKING ABOVE A HAZARD | |

Elevated Work Permit

**CONTROL THE WORKING ENVIRONMENT**

| | YES | NO | | YES | NO |
|---|---|---|---|---|---|
| GENERAL INDUSTRY PROJECT | ☐ | ☐ | CONSTRUCTION INDUSTRY PROJECT | ☐ | ☐ |
| CONES/BARRIERS | ☐ | ☐ | ISOLATE EQUIPMENT | ☐ | ☐ |
| EMERGENCY RESCUE PROCEDURES IN PLACE | ☐ | ☐ | THREE FEET OF LADDER ARE ABOVE STEPPING-OFF POINT | ☐ | ☐ |
| EQUIPMENT MAINTAINED | ☐ | ☐ | LADDER PLACED AT 4:1 ANGLE | ☐ | ☐ |
| FIRST AID PROVISION | ☐ | ☐ | WEATHER | ☐ | ☐ |
| RESCUE AT HEIGHTS AVAILABLE WITHIN FIVE MINUTES | ☐ | ☐ | LADDER SECCURED AT TOP AND ON LEVEL FIRM BASE TO SUPPORT LOAD | ☐ | ☐ |
| SAFE WORKING AREA | ☐ | ☐ | WORK EQUIPMENT INSPECTED | ☐ | ☐ |

**Note: General Industry requires fall protection at heights of 4 feet and greater, whearas Construction Industry requires protection at 6 feet and higher.**

**CONTROL THE HAZARDS: TYPE OF FALL PROTECTION SYSTEM TO BE USED**

| | YES | NO | | YES | NO |
|---|---|---|---|---|---|
| GUARDRAILS | ☐ | ☐ | FENCES | ☐ | ☐ |
| PFAS | ☐ | ☐ | BARRICADES | ☐ | ☐ |
| SAFETY NET | ☐ | ☐ | CAGE LADDER SYSTEM | ☐ | ☐ |
| POSITIONING DEVICE SYSTEM | ☐ | ☐ | RIGID RAIL | ☐ | ☐ |
| COVERS | ☐ | ☐ | WIRE RAIL SYSTEM | ☐ | ☐ |
| CONTROLLED ACCESS ZONE | ☐ | ☐ | WARNING LINE SYSTEM | ☐ | ☐ |

**EQUIPMENT REQUIRED**

| **Personal Fall Arrest System** | YES | NO | **Guardrail System** | YES | NO |
|---|---|---|---|---|---|
| 6' (1.83M) FALL-LIMITING LANYARD WITH SHOCK ABSORBER | ☐ | ☐ | MID-RAIL PLACED WITH NO GAP OF 19" (48cm) | ☐ | ☐ |
| ANCHORAGE POINTS DESIGNED | ☐ | ☐ | GUARD RAILS (DOUBLE ABOVE 6' | ☐ | ☐ |
| FALL ARREST (INSPECTED) | ☐ | ☐ | GUARD RAILS (TOP RAIL A MINIMUM OF 39" [1m] ABOVE PLATFORM) | ☐ | ☐ |
| HARNESS (INSPECTED) | ☐ | ☐ | TOE BOARDS | ☐ | ☐ |
| **Positioning/ Restraint System** | YES | NO | **Scaffolding** | YES | NO |
| DOUBLE LANYARD FOR 100% TIE-OFF | ☐ | ☐ | TAGGED | ☐ | ☐ |
| FALL RESTRAINT (INSPECTED) | ☐ | ☐ | FIXED SCAFFOLDING ERECTED BY CP | ☐ | ☐ |

| **Other Equipment** | YES | NO |
|---|---|---|
| LADDERS | ☐ | ☐ |
| AERIAL LIFT/ MAN LIFT/ SCISSOR LIFT | ☐ | ☐ |
| RAMPS/STAIRWAYS/STEPS | ☐ | ☐ |

**KEY ITEMS CHECKLIST**

| **Fall Protection Program** | YES | NO | N/A |
|---|---|---|---|
| Has a Competent Person been designated? | ☐ | ☐ | ☐ |
| Have employees received training (site specific as needed) by a Competent Person? | ☐ | ☐ | ☐ |
| Is a Qualified Person available for assistance if needed? | ☐ | ☐ | ☐ |
| **Fall Protection Systems** | YES | NO | N/A |
| Are midrails being used with guardrail systems? | ☐ | ☐ | ☐ |
| Are toeboards being used with guardrail systems? | ☐ | ☐ | ☐ |
| Will guardrails withstand a 200-pound force from an outward or downward direction? | ☐ | ☐ | ☐ |
| Are openings on safety nets no greater than 6-inch squares? | ☐ | ☐ | ☐ |
| Does warning line have a minimum tensile strength of 500 pounds (2,220 N)? | ☐ | ☐ | ☐ |
| Is warning line capable of supporting, without breaking, loads applied to the stanchions? | ☐ | ☐ | ☐ |

| Elevated Work Permit | ☐ | ☐ | ☐ |
|---|---|---|---|
| Are positioning devices used for fall protection? | ☐ | ☐ | ☐ |
| Are covers appropriately marked or adequately fastened? | ☐ | ☐ | ☐ |
| If a fall protection plan is in use, has it been developed by a Qualified Person? | ☐ | ☐ | ☐ |
| **Personal Fall Arrest System** | **YES** | **NO** | **N/A** |
| Are only full body harnesses being used? | ☐ | ☐ | ☐ |
| Are lanyards with a deceleration device being used? | ☐ | ☐ | ☐ |
| Are only double-locking safety-type snap hooks being used? | ☐ | ☐ | ☐ |
| Are anchorage points capable of supporting 5,000 pounds (22.2 kilonewtons)? | ☐ | ☐ | ☐ |
| Are horizontal lifelines engineered by a Qualified Person? | ☐ | ☐ | ☐ |
| Are horizontal lifelines designed to support 5,000 pounds for each employee attached? | ☐ | ☐ | ☐ |
| Is no more than one employee being attached to a single vertical lifeline? | ☐ | ☐ | ☐ |
| Are personal fall arrest systems being adequately inspected before each use? | ☐ | ☐ | ☐ |
| **Self-Retracting Lifelines** | **YES** | **NO** | **N/A** |
| Do they automatically limit free fall distances to 2 feet? | ☐ | ☐ | ☐ |
| Are they capable of sustaining a tensile load of 3,000 pounds (13.3 kilonewtons)? | ☐ | ☐ | ☐ |
| Are self-retracting systems being inspected before and after each use? | ☐ | ☐ | ☐ |
| **Rescue Plan** | **YES** | **NO** | **N/A** |
| Has an effective rescue plan been developed? | ☐ | ☐ | ☐ |
| Have personnel been trained in the rescue plan? | ☐ | ☐ | ☐ |

**EMERGENCY CONTACT LIST**

| Emergency Contact: | Phone 1: | Phone 2: | Location: |
|---|---|---|---|
| Local Police: | | | |
| Local Ambulance: | | | |
| Local Fire Dept. | | | |
| Project Manager: | | | |
| Site Manager: | | | |
| Client Contact: | | | |
| Site Safety Officer: | | | |
| H&S Manager: | | | |
| Work Care | 800-455-6155 | | |

***Include any Task Specific JLA's with this permit.**

**KEEP H&S FIRST IN ALL THINGS**

**I understand the nature of the work for this permit, and certify that this permit meets the requirements specified in the ARCADIS Elevated Work and Fall Protection Standard.**

**APPROVAL OF ELEVATED WORK PERMIT-** By ARCADIS Competent Person:

Name: _____

Title: _____

Office Location: _____

Date: _____