# PHILIP SERVICES
## CORP.
Industrial Services Group

November 14, 1997
Project 18745

Andrew Frierdich, E.I.T.
Site Remediation Program, Bureau of Land
Illinois Environmental Protection Agency
1021 N. Grand Avenue E.
P.O. Box 19276
Springfield, Illinois 62794

**Subject:** **Addendum to the "Ambient Air Monitoring Plan" for Champaign MGP Interim Remedial Measures (IRM)**

Dear Mr. Frierdich:

On behalf of Brian Martin of Illinois Power Company (IP), we are submitting this addendum to the "Ambient Air Monitoring Plan, Former Champaign Manufactured Gas Plant, Interim Remedial Measures - Source Removal" (Philip Services Corporation, October 1, 1997). This addendum is intended to further clarify the procedures by which IRM activities at the site will be suspended and resumed, based on real-time air monitoring of benzene. The criteria and procedures for both shut-down and start-up of site operations are presented. In addition, the table of "Acceptable Benzene Concentration at Monitoring Point" (Section 2.5) has been amended as follows, to correspond to the action levels presented in Appendix A.

| Monitoring Point | Acceptable Benzene Concentration at Monitoring Point | | | |
| --- | --- | --- | --- | --- |
| | Stable Wind Speed (less than 10 mph) | | Average Wind Speed (10 mph or greater) | |
| along: | mg/m³ | ppmv | mg/m³ | ppmv |
| North Fenceline | 0.9 | 0.28 | 1.2 | 0.38 |
| West Fenceline | 0.3 | 0.09 | 0.3 | 0.09 |
| South Fenceline | 0.3 | 0.09 | 0.3 | 0.09 |
| East Fenceline | 0.5 | 0.16 | 0.7 | 0.22 |

During our review, we discovered that some of the values presented in the Section 2.5 table were incorrect. However, we have been using correct action levels as presented in Appendix A in our real-time monitoring throughout the project.

The action levels presented in the Appendix A are air concentrations of benzene to which a resident may be exposed for the anticipated duration of the project (2.5 months). They represent benzene levels at the four fencelines that a resident may be exposed to for 10 hours a day for a 2.5-month period, at a target risk level of $10^{-6}$.

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These action levels are based on a 2.5-month exposure, not an instantaneous or short-term exposure. Therefore, the procedures for shut-down and start-up were further defined using short-term criteria. The procedures presented below do not change these action levels. They present a short-term action level for benzene and the length of time the level can persist before site operations are shut down.
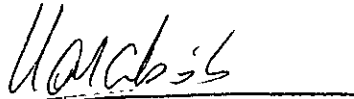
Due to the lack of USEPA-approved short-term exposure limits, the National Institute of Occupational Health and Safety (NIOSH) Short Term Exposure Limit (STEL) for benzene (5 ppm benzene for 15 minutes) was used to define shut-down criteria. The STEL was further adjusted (using NIOSH guidelines) to reflect the level that is acceptable at the fenceline. The following criteria were developed:

> When three consecutive downwind gas chromatograph (GC) readings of benzene exceed 2 ppm greater than upwind levels, operations will be shut down. Three consecutive GC readings require approximately seven minutes.

> Operations can resume when average (consecutive) GC readings of benzene above background are reduced to the action levels (Appendix A) at each fenceline for 30 minutes.

Very truly yours,

PHILIP ENVIRONMENTAL
SERVICES CORPORATION

Lucia Casabó, Ph.D.
Project Manager

Barrie Selcoe
Risk Assessment Group Leader

LC/BCS/rbt/Frierdich:P18745

cc:   Brian Martin

**REVISED APPENDIX A**

Calculation of Ambient Air Action Levels

**PHILIP**
**ENVIRONMENTAL**

Columbia, Illinois
(618) 281-7173

Title: **Calculation of Risk-Based Ambient Air Action Levels for Soil Removal Activities**

Project No.: 17995
File Name:
By: Dotti Ramey
Check by: Lucia Casabo

Project Name: **IP Carlinville**

Phase: **2009.77**
File No.:
Date: **10/5/97**
Date: **10/6/97**

Page 1

## Selection of Benzene as Indicator Chemical

For this remediation project, action levels are needed for only the carcinogenic risk of benzene exposure because of benzene's high toxicity relative to other site-related contaminants. Based upon the experience of Philip and other firms at other MGP sites, concentrations of benzene will be high relative to those of other carcinogenic site-related contaminants.

## Reference Exposure Level for Lifetime Benzene Exposure Limits

A 0.22 microgram per cubic meter ($\mu g/m^3$) average benzene concentration for residential exposure for 30 years represents a $10^{-6}$ cancer risk. (Reference: USEPA Region III Risk-Based Concentration Tables, January–June 1996.)

## Modeled Equivalent Exposure Level for 2-Month Project Duration

Since remediation activities are anticipated to require no more than 2 months, a child resident would have to be exposed to an average benzene concentration of approximately 22 $\mu g/m^3$ to equal $10^{-6}$ cancer risk (Table 2: Cancer Risk Estimates for Benzene).

## Adjustment for 10-Hour per Day Emission/Exposure Duration

The duration of potential exposure each day will be only 10 hours because remediation work at the site will last only 10 hours each day. The 22 $\mu g/m^3$ acceptable exposure concentration represents a 24-hour average concentration. Emissions will be unlikely during the non-work period because significant emissions occur only when the material is being disturbed. During non-work periods, the excavation and stockpiles will be covered. Therefore, the 24-hour acceptable exposure concentration should be adjusted to a 10-hour exposure concentration as follows:

$$\text{Real-Time Action Level (10-hour average)} = 22 \; \mu g/m^3 \times \frac{24 \; hr / day}{10 \; hr / day} \cong 53 \; \mu g/m^3$$

## Adjustment for Variability in Wind Direction

The highest exposed receptor is likely to be downwind of the site no more than 25 percent of the 2-month project duration (a reasonable assumption based upon local historical wind direction data which indicates wind blows from any one 22.5-degree direction sector for less than 12 percent of the time during October through December in Carlinville).

$$\text{Adjusted Real-Time Action Level (10-hour average)} = 53 \; \mu g/m^3 \times \frac{1 \; day}{0.25 \; day} \cong 211 \; \mu g/m^3$$

Therefore, 211 $\mu g/m^3$ represents the acceptable benzene concentration at the receptor for a 10-hour daily period of remediation.

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Page 2

## Calculation of Measuring Point Action Level Equivalent to Receptor Action Level

Ambient air will be monitored at the fenceline; however, the nearest off-site receptors reasonably expected to have more than an instantaneous exposure are located further away from the source of benzene. Benzene originating from the site will disperse naturally as it moves away from the site. Modeling was performed to estimate the dispersion between the fenceline and the receptors. Modeling results are shown on Tables 3 & 4.

The Carlinville site has a rectangular shape as shown on the neighborhood map. The gas holder, where the remedial activities will be conducted, is located near the center of the site. Each fenceline will have unique action levels dependent upon the modeled dispersion between the fenceline and the nearest receptor in that direction. The action levels will be protective of the closest residences to the site.

Several monitoring points were modeled, as indicated on Tables 3 and 4. The action levels calculated from each modeling point will be applicable to the entire corresponding fenceline since they are based on the modeled worst-case conditions. The following subsections calculate the real-time action level for each of the fencelines.

### North Fenceline (Modeling Point M-1)

Based upon the modeling results for stable and average wind speeds to the northwest, which are the most conservative for this fenceline, the concentrations at the north fenceline are, respectively, 1.8 and 2.1 times higher than at the nearest receptors during these conditions. Average wind speed is 10 miles per hour (mph). Stable wind speed action levels will apply to wind speeds less than 10 mph. Application of these dispersion factors to calculate the fenceline concentrations corresponding to the acceptable off-site receptor level yields the following:

Adjusted Real-Time Action Level (10-hour avg) for Stable Wind Speed = 211 $\mu g/m^3$ × 1.8 $\cong$ 380 $\mu g/m^3$ = 0.38 $mg/m^3$

Adjusted Real-Time Action Level (10-hour avg) for Avg Wind Speed = 211 $\mu g/m^3$ × 2.1 $\cong$ 440 $\mu g/m^3$ = 0.44 $mg/m^3$

### West Fenceline (Modeling Point M-4)

Based upon the modeling results for stable and average wind speeds, the concentrations at the west fenceline are, respectively, 1.6 and 1.8 times higher than at the receptor during these conditions. Average wind speed is 10 mph. Stable wind speed action levels will apply to wind speeds less than 10 mph. Application of these dispersion factors to calculate the fenceline concentrations corresponding to the acceptable off-site receptor level yields the following:

Adjusted Real-Time Action Level (10-hour avg) for Stable Wind Speed = 211 $\mu g/m^3$ × 1.6 $\cong$ 340 $\mu g/m^3$ = 0.34 $mg/m^3$

Adjusted Real-Time Action Level (10-hour avg) for Avg Wind Speed = 211 $\mu g/m^3$ × 1.8 $\cong$ 380 $\mu g/m^3$ = 0.38 $mg/m^3$

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Page 3

## South Fenceline (Modeling Point M-3)

Based upon the modeling results for stable and average wind speeds to the southeast, which are the most conservative for this fenceline, the concentrations at the south fenceline are, respectively, 3.8 and 5.0 times higher than at the receptor during these conditions. Average wind speed is 10 mph. Stable wind speed action levels will apply to wind speeds less than 10 mph. Application of these dispersion factors to calculate the fenceline concentrations corresponding to the acceptable off-site receptor level yields the following:

Adjusted Real-Time Action Level (10-hour avg) for Stable Wind Speed = $211 \, \mu g/m^3 \times 3.8 \cong 800 \, \mu g/m^3 = 0.80 \, mg/m^3$

Adjusted Real-Time Action Level (10-hour avg) for Avg Wind Speed = $211 \, \mu g/m^3 \times 5.0 \cong 1{,}050 \, \mu g/m^3 = 1.05 \, mg/m^3$

## East Fenceline (Monitoring Point M-2)

Based upon the modeling results for stable and average wind speeds, the concentrations at the east fenceline are, respectively, 3.1 and 4.3 times higher than at the receptor during these conditions. Average wind speed is 10 mph. Stable wind speed action levels will apply to wind speeds less than 10 mph. Application of these dispersion factors to calculate the fenceline concentrations corresponding to the acceptable off-site receptor level yields the following:

Adjusted Real-Time Action Level (10-hour avg) for Stable Wind Speed = $211 \, \mu g/m^3 \times 3.1 \cong 650 \, \mu g/m^3 = 0.65 \, mg/m^3$

Adjusted Real-Time Action Level (10-hour avg) for Avg Wind Speed = $211 \, \mu g/m^3 \times 4.3 \cong 900 \, \mu g/m^3 = 0.91 \, mg/m^3$

## Summary

| Monitoring Point | Acceptable Benzene Concentration at Monitoring Point | | | |
| --- | --- | --- | --- | --- |
| | Stable Wind Speed | | Average Wind Speed | |
| along: | mg/m$^3$ | ppm$_v$ | mg/m$^3$ | ppm$_v$ |
| North Fenceline | 0.38 | 0.12 | 0.44 | 0.14 |
| West Fenceline | 0.34 | 0.11 | 0.38 | 0.12 |
| South Fenceline | 0.80 | 0.25 | 1.05 | 0.33 |
| East Fenceline | 0.65 | 0.20 | 0.91 | 0.29 |

Conversion of mg/m$^3$ to ppm$_v$ for benzene (molecular weight = 78):

$$\text{ppm}_v = (\text{mg/m}^3) \times 24.5 / 78$$

## Table 1
## Intakes from Air Exposures to Benzene

### Illinois Power
### Carlinville, IL

| CA | IR | FI | EF | ED | BW | AT | Intake |
|---|---|---|---|---|---|---|---|
| Test to evaluate 0.22 ug/m3 for residential | | | | | | | |
| 0.00022 | 20 | 1 | 350 | 30 | 70 | 25550 | 2.58E-05 |
| 2-Month Residential - Adult | | | | | | | |
| 0.00022 | 20 | 1 | 260 | 0.167 | 70 | 25550 | 1.07E-07 |
| 0.0022 | 20 | 1 | 260 | 0.167 | 70 | 25550 | 1.07E-06 |
| 0.022 | 20 | 1 | 260 | 0.167 | 70 | 25550 | 1.07E-05 |
| 0.10 | 20 | 1 | 260 | 0.167 | 70 | 25550 | 4.86E-05 |
| 1 | 20 | 1 | 260 | 0.167 | 70 | 25550 | 4.86E-04 |
| 5 | 20 | 1 | 260 | 0.167 | 70 | 25550 | 2.43E-03 |
| 2-Month Residential - Child | | | | | | | |
| 0.00022 | 15 | 1 | 260 | 0.167 | 15 | 25550 | 3.74E-07 |
| 0.0022 | 15 | 1 | 260 | 0.167 | 15 | 25550 | 3.74E-06 |
| 0.022 | 15 | 1 | 260 | 0.167 | 15 | 25550 | 3.74E-05 |
| 0.10 | 15 | 1 | 260 | 0.167 | 15 | 25550 | 1.70E-04 |
| 1 | 15 | 1 | 260 | 0.167 | 15 | 25550 | 1.70E-03 |
| 5 | 15 | 1 | 260 | 0.167 | 15 | 25550 | 8.50E-03 |

CA = Chemical concentration in air $(mg/m^3)$

IR = Inhalation rate $(m^3/day)$

FI = Fraction inhaled from a potentially impacted source (unitless)

EF = Exposure frequency (days/year).

ED = Exposure duration (years)

BW = Body weight (kg)

AT = Averaging time (days)

Equation (USEPA, 1989):

$$\text{Intake (mg/kg-day)} = \frac{CA \times IR \times FI \times EF \times ED}{BW \times AT}$$

## Table 2
## Cancer Risk Estimates for Air Exposures to Benzene

### Illinois Power Company
### Carlinville, IL

|  | CDI (mg/kg-day) | SF (mg/kg-day)$^{-1}$ | Risk |
|---|---|---|---|
| **Test Residential** | | | |
| 0.00022 | 2.58E-05 | 2.9E-2 | 7E-7 |
| | | | |
| **2-Month Residential - Adult** | | | |
| 0.00022 | 1.07E-07 | 2.9E-2 | 3E-9 |
| 0.00220 | 1.07E-06 | 2.9E-2 | 3E-8 |
| 0.02200 | 1.07E-05 | 2.9E-2 | 3E-7 |
| 0.10 | 4.86E-05 | 2.9E-2 | 1E-6 |
| 1 | 4.86E-04 | 2.9E-2 | 1E-5 |
| 5 | 2.43E-03 | 2.9E-2 | 7E-5 |
| | | | |
| **2-Month Residential - Child** | | | |
| 0.00022 | 3.74E-07 | 2.9E-2 | 1E-8 |
| 0.0022 | 3.74E-06 | 2.9E-2 | 1E-7 |
| 0.022 | 3.74E-05 | 2.9E-2 | 1E-6 |
| 0.10 | 1.70E-04 | 2.9E-2 | 5E-6 |
| 1 | 1.70E-03 | 2.9E-2 | 5E-5 |
| 5 | 8.50E-03 | 2.9E-2 | 2E-4 |

Note; a risk of $1 \times 10^{-6}$ is acceptable.

Air concentrations in mg/m$^3$.

CDI = Chronic Daily Intake for carcinogenic effects.

SF = Slope Factor.

Equation (USEPA, 1989):

$$Risk = CDI \times SF$$

## Table 3
### *Worse-Case Condition (stable winds)*

| | Fenceline Concentration ($10^{-6}$g/m$^3$) | Receptor #1 Concentration ($10^{-6}$g/m$^3$) |
|---|---|---|
| M1 | 15,600,000 | 8,812,000 |
| M2 | 19,630,000 | 6,210,000 |
| M3 | 39,120,000 | 10,080,000 |
| M4 | 10,960,000 | 7,025,000 |

| | Fenceline Concentration (ppm)[1] | Receptor #1 Concentration (ppm) |
|---|---|---|
| M1 | 4,691 | 2,650 |
| M2 | 5,902 | 1,867 |
| M3 | 11,763 | 3,031 |
| M4 | 3,296 | 2,112 |

[1] Benzene used as reference molecular weight.

| | Fenceline Concentration (ppm) | Receptor #1 Concentration (ppm) |
|---|---|---|
| M1 | 1 | 0.56 |
| M2 | 1 | 0.32 |
| M3 | 1 | 0.26 |
| M4 | 1 | 0.64 |

Note: Emission Rate 1 g/s-m2

## Table 4
## Actual Case Condition (Average Winds)

| Monitoring Point | Location |
| --- | --- |
| M1 | Northwest property line |
| M2 | Eastern property line |
| M3 | Southeastern corner of property |
| M4 | Western corner of property |

| | Fenceline Concentration ($10^{-6}g/m^3$) | Receptor #1 Concentration ($10^{-6}g/m^3$) |
| --- | --- | --- |
| M1 | 1,618,000 | 779,200 |
| M2 | 2,135,000 | 487,800 |
| M3 | 4,727,000 | 931,200 |
| M4 | 1,037,000 | 575,300 |

| | Fenceline Concentration (ppm)[1] | Receptor #1 Concentration (ppm) |
| --- | --- | --- |
| M1 | 487 | 234 |
| M2 | 642 | 147 |
| M3 | 1,421 | 280 |
| M4 | 312 | 173 |

[1] Benzene used as reference molecular weight.

| | Fenceline Concentration (ppm) | Receptor #1 Concentration (ppm) |
| --- | --- | --- |
| M1 | 1 | 0.48 |
| M2 | 1 | 0.23 |
| M3 | 1 | 0.20 |
| M4 | 1 | 0.55 |