| Group No. | Members |
|---|---|
| 1 | TTC |
| 2 | TPMC |
| 3 | VTBEPC |

1

Chullora - Cement Stabilisation with control

SOURCE CHARACTERISTICS

INTEGRATED AREA SOURCE: TTC

| X0(m) | Y0(m) | Ground El | Length X | Length Y | Or. Angle | Ver. spread | Height |
|---|---|---|---|---|---|---|---|
| 320806 | 6248828 | 29m | 3m | 50m | 0deg | 5m | 0m |

(Constant) emission rate = 5.00E-04 grams/second per square metre
No gravitational settling or scavenging.

INTEGRATED AREA SOURCE: TPMC

| X0(m) | Y0(m) | Ground El | Length X | Length Y | Or. Angle | Ver. spread | Height |
|---|---|---|---|---|---|---|---|
| 320806 | 6248828 | 29m | 3m | 50m | 0deg | 5m | 0m |

(Constant) emission rate = 2.50E-04 grams/second per square metre
No gravitational settling or scavenging.

INTEGRATED AREA SOURCE: VTBEPC

| X0(m) | Y0(m) | Ground El | Length X | Length Y | Or. Angle | Ver. spread | Height |
|---|---|---|---|---|---|---|---|
| 320806 | 6248828 | 29m | 3m | 50m | 0deg | 5m | 0m |

(Constant) emission rate = 5.90E-06 grams/second per square metre
No gravitational settling or scavenging.

1

Chullora - Cement Stabilisation with control

RECEPTOR LOCATIONS

The Cartesian receptor grid has the following x-values (or eastings):
320665.m 320711.m 320755.m 320800.m 320844.m 320888.m 320931.m
320975.m 321018.m 321062.m 321107.m

and these y-values (or northings):
6248613.m 6248668.m 6248726.m 6248784.m 6248844.m 6248902.m 6248962.m
6249020.m 6249079.m 6249135.m 6249195.m

DISCRETE RECEPTOR LOCATIONS (in metres)

| No. | X | Y | ELEVN | HEIGHT | No. | X | Y | ELEVN | HEIGHT |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 321026 | 6248922 | 35.0 | 1.5 | 4 | 320949 | 6248674 | 35.0 | 1.5 |
| 2 | 321084 | 6249063 | 30.0 | 1.5 | 5 | 320208 | 6248352 | 30.0 | 1.5 |
| 3 | 320795 | 6249157 | 26.0 | 1.5 | | | | | |

METEOROLOGICAL DATA : DECCW Chullora AWS Data BoM SydneyAP Clouds SydneyAP

Soil Handling and Stockpiling with controls variable
1 ______________________________________________

Chullora - Soil handling with controls

______________________________________________

Concentration or deposition Concentration
Emission rate units grams/second
Concentration units microgram/m3
Units conversion factor 1.00E+06
Constant background concentration 0.00E+00
Terrain effects Egan method
Smooth stability class changes? No
Other stability class adjustments ("urban modes") None
Ignore building wake effects? No
Decay coefficient (unless overridden by met. file) 0.000
Anemometer height 10 m
Roughness height at the wind vane site 0.300 m

DISPERSION CURVES
Horizontal dispersion curves for sources <100m high Briggs Rural
Vertical dispersion curves for sources <100m high Briggs Rural
Horizontal dispersion curves for sources >100m high Pasquill-Gifford
Vertical dispersion curves for sources >100m high Pasquill-Gifford
Enhance horizontal plume spreads for buoyancy? Yes
Enhance vertical plume spreads for buoyancy? Yes
Adjust horizontal P-G formulae for roughness height? Yes
Adjust vertical P-G formulae for roughness height? Yes
Roughness height 0.800m
Adjustment for wind directional shear None

PLUME RISE OPTIONS
Gradual plume rise? Yes
Stack-tip downwash included? Yes
Building downwash algorithm: PRIME method.
Entrainment coeff. for neutral & stable lapse rates 0.60,0.60
Partial penetration of elevated inversions? No
Disregard temp. gradients in the hourly met. file? No

and in the absence of boundary-layer potential temperature gradients
given by the hourly met. file, a value from the following table
(in K/m) is used:

| Wind Speed Category | Stability Class A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | 0.000 | 0.000 | 0.000 | 0.000 | 0.020 | 0.035 |
| 2 | 0.000 | 0.000 | 0.000 | 0.000 | 0.020 | 0.035 |
| 3 | 0.000 | 0.000 | 0.000 | 0.000 | 0.020 | 0.035 |
| 4 | 0.000 | 0.000 | 0.000 | 0.000 | 0.020 | 0.035 |
| 5 | 0.000 | 0.000 | 0.000 | 0.000 | 0.020 | 0.035 |
| 6 | 0.000 | 0.000 | 0.000 | 0.000 | 0.020 | 0.035 |

WIND SPEED CATEGORIES
Boundaries between categories (in m/s) are: 1.54, 3.09, 5.14, 8.23, 10.80

WIND PROFILE EXPONENTS: "Irwin Urban" values (unless overridden by met. file)

AVERAGING TIMES
1 hour
24 hours
90 days

______________________________________________

Chullora - Soil handling with controls

SOURCE GROUPS

| Group No. | Members |
|---|---|
| 1 | VEXTC |
| 2 | VEXPC |
| 3 | VEXBEC |
| 4 | VEXBPC |

1

Chullora - Soil handling with controls

SOURCE CHARACTERISTICS

INTEGRATED AREA SOURCE: VEXTC

| X0(m) | Y0(m) | Ground El | Length X | Length Y | Or. Angle | Ver. spread | Height |
|---|---|---|---|---|---|---|---|
| 320806 | 6248828 | 29m | 10m | 15m | 0deg | 5m | 0m |

(Constant) emission rate = 4.70E-05 grams/second per square metre

Hourly multiplicative factors will be used with
this emission factor.
No gravitational settling or scavenging.

INTEGRATED AREA SOURCE: VEXPC

| X0(m) | Y0(m) | Ground El | Length X | Length Y | Or. Angle | Ver. spread | Height |
|---|---|---|---|---|---|---|---|
| 320806 | 6248828 | 29m | 3m | 50m | 0deg | 5m | 0m |

(Constant) emission rate = 2.20E-05 grams/second per square metre

Hourly multiplicative factors will be used with
this emission factor.
No gravitational settling or scavenging.

INTEGRATED AREA SOURCE: VEXBEC

| X0(m) | Y0(m) | Ground El | Length X | Length Y | Or. Angle | Ver. spread | Height |
|---|---|---|---|---|---|---|---|
| 320806 | 6248828 | 29m | 3m | 50m | 0deg | 5m | 0m |

(Constant) emission rate = 9.40E-06 grams/second per square metre

Hourly multiplicative factors will be used with
this emission factor.
No gravitational settling or scavenging.

INTEGRATED AREA SOURCE: VEXBPC

| X0(m) | Y0(m) | Ground El | Length X | Length Y | Or. Angle | Ver. spread | Height |
|---|---|---|---|---|---|---|---|
| 320806 | 6248828 | 29m | 3m | 50m | 0deg | 5m | 0m |

(Constant) emission rate = 2.10E-06 grams/second per square metre

Hourly multiplicative factors will be used with
this emission factor.
No gravitational settling or scavenging.

1

Chullora - Soil handling with controls

RECEPTOR LOCATIONS

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The Cartesian receptor grid has the following x-values (or eastings):
320665.m 320711.m 320755.m 320800.m 320844.m 320888.m 320931.m
320975.m 321018.m 321062.m 321107.m

and these y-values (or northings):
6248613.m 6248668.m 6248726.m 6248784.m 6248844.m 6248902.m 6248962.m
6249020.m 6249079.m 6249135.m 6249195.m

DISCRETE RECEPTOR LOCATIONS (in metres)

| No. | X | Y | ELEVN | HEIGHT | No. | X | Y | ELEVN | HEIGHT |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 321026 | 6248922 | 35.0 | 1.5 | 4 | 320949 | 6248674 | 35.0 | 1.5 |
| 2 | 321084 | 6249063 | 30.0 | 1.5 | 5 | 320208 | 6248352 | 30.0 | 1.5 |
| 3 | 320795 | 6249157 | 26.0 | 1.5 | | | | | |

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METEOROLOGICAL DATA : DECCW Chullora AWS Data BoM SydneyAP Clouds SydneyAP

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HOURLY VARIABLE EMISSION FACTOR INFORMATION

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The input emission rates specfied above will be multiplied by hourly varying
factors entered via the input file:
C:\Users\sdorairaj\Ausplume\Chulvar.csv
For each stack source, hourly values within this file will be added to each
declared exit velocity (m/sec) and temperature (K).

Title of input hourly emission factor file is:
Variable Emissions,,

HOURLY EMISSION FACTOR SOURCE TYPE ALLOCATION

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Prefix V allocated: VEXTC VEXPC VEXBEC VEXBPC

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Cement Stabilisation With Controls Variable Emissions

1

Chullora - Cement Stabilisation Variable with controls

Concentration or deposition Concentration
Emission rate units grams/second
Concentration units microgram/m3
Units conversion factor 1.00E+06
Constant background concentration 0.00E+00
Terrain effects Egan method
Smooth stability class changes? No
Other stability class adjustments ("urban modes") None
Ignore building wake effects? No
Decay coefficient (unless overridden by met. file) 0.000
Anemometer height 10 m
Roughness height at the wind vane site 0.300 m

DISPERSION CURVES
Horizontal dispersion curves for sources <100m high Briggs Rural
Vertical dispersion curves for sources <100m high Briggs Rural
Horizontal dispersion curves for sources >100m high Pasquill-Gifford
Vertical dispersion curves for sources >100m high Pasquill-Gifford
Enhance horizontal plume spreads for buoyancy? Yes
Enhance vertical plume spreads for buoyancy? Yes
Adjust horizontal P-G formulae for roughness height? Yes
Adjust vertical P-G formulae for roughness height? Yes
Roughness height 0.800m
Adjustment for wind directional shear None

PLUME RISE OPTIONS
Gradual plume rise? Yes
Stack-tip downwash included? Yes
Building downwash algorithm: PRIME method.
Entrainment coeff. for neutral & stable lapse rates 0.60,0.60
Partial penetration of elevated inversions? No
Disregard temp. gradients in the hourly met. file? No

and in the absence of boundary-layer potential temperature gradients
given by the hourly met. file, a value from the following table
(in K/m) is used:

| Wind Speed Category | Stability Class A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | 0.000 | 0.000 | 0.000 | 0.000 | 0.020 | 0.035 |
| 2 | 0.000 | 0.000 | 0.000 | 0.000 | 0.020 | 0.035 |
| 3 | 0.000 | 0.000 | 0.000 | 0.000 | 0.020 | 0.035 |
| 4 | 0.000 | 0.000 | 0.000 | 0.000 | 0.020 | 0.035 |
| 5 | 0.000 | 0.000 | 0.000 | 0.000 | 0.020 | 0.035 |
| 6 | 0.000 | 0.000 | 0.000 | 0.000 | 0.020 | 0.035 |

WIND SPEED CATEGORIES
Boundaries between categories (in m/s) are: 1.54, 3.09, 5.14, 8.23, 10.80

WIND PROFILE EXPONENTS: "Irwin Urban" values (unless overridden by met. file)

AVERAGING TIMES
1 hour
24 hours
90 days

Chullora - Cement Stabilisation Variable with controls

SOURCE GROUPS

| Group No. | Members |
|---|---|
| 1 | VTTC |
| 2 | VTPMC |
| 3 | VTBPC |

1

Chullora - Cement Stabilisation Variable with controls

SOURCE CHARACTERISTICS

INTEGRATED AREA SOURCE: VTTC

| X0(m) | Y0(m) | Ground El | Length X | Length Y | Or. Angle | Ver. spread | Height |
|---|---|---|---|---|---|---|---|
| 320806 | 6248828 | 29m | 3m | 50m | 0deg | 5m | 0m |

(Constant) emission rate = 2.90E-04 grams/second per square metre

Hourly multiplicative factors will be used with
this emission factor.
No gravitational settling or scavenging.

INTEGRATED AREA SOURCE: VTPMC

| X0(m) | Y0(m) | Ground El | Length X | Length Y | Or. Angle | Ver. spread | Height |
|---|---|---|---|---|---|---|---|
| 320806 | 6248828 | 29m | 3m | 50m | 0deg | 5m | 0m |

(Constant) emission rate = 1.40E-04 grams/second per square metre

Hourly multiplicative factors will be used with
this emission factor.
No gravitational settling or scavenging.

INTEGRATED AREA SOURCE: VTBPC

| X0(m) | Y0(m) | Ground El | Length X | Length Y | Or. Angle | Ver. spread | Height |
|---|---|---|---|---|---|---|---|
| 320806 | 6248828 | 29m | 3m | 50m | 0deg | 5m | 0m |

(Constant) emission rate = 1.30E-06 grams/second per square metre

Hourly multiplicative factors will be used with
this emission factor.
No gravitational settling or scavenging.

1

Chullora - Cement Stabilisation Variable with controls

RECEPTOR LOCATIONS

The Cartesian receptor grid has the following x-values (or eastings):
320665.m 320711.m 320755.m 320800.m 320844.m 320888.m 320931.m
320975.m 321018.m 321062.m 321107.m

and these y-values (or northings):
6248613.m 6248668.m 6248726.m 6248784.m 6248844.m 6248902.m 6248962.m
6249020.m 6249079.m 6249135.m 6249195.m

DISCRETE RECEPTOR LOCATIONS (in metres)

| No. | X | Y | ELEVN | HEIGHT | No. | X | Y | ELEVN | HEIGHT |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 321026 | 6248922 | 35.0 | 1.5 | 4 | 320949 | 6248674 | 35.0 | 1.5 |
| 2 | 321084 | 6249063 | 30.0 | 1.5 | 5 | 320208 | 6248352 | 30.0 | 1.5 |
| 3 | 320795 | 6249157 | 26.0 | 1.5 | | | | | |

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METEOROLOGICAL DATA : DECCW Chullora AWS Data BoM SydneyAP Clouds SydneyAP

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HOURLY VARIABLE EMISSION FACTOR INFORMATION
-------------------------------------------

The input emission rates specfied above will be multiplied by hourly varying
factors entered via the input file:
C:\Users\sdorairaj\Ausplume\Chulvar.csv
For each stack source, hourly values within this file will be added to each
declared exit velocity (m/sec) and temperature (K).

Title of input hourly emission factor file is:
Variable Emissions,,

HOURLY EMISSION FACTOR SOURCE TYPE ALLOCATION
---------------------------------------------

Prefix V      allocated: VTTC   VTPMC  VTBPC

---

Soil handling fugitive with controls

Chullora - Soil handling fugitive with controls

Concentration or deposition Concentration
Emission rate units grams/second
Concentration units microgram/m3
Units conversion factor 1.00E+06
Constant background concentration 0.00E+00
Terrain effects Egan method
Smooth stability class changes? No
Other stability class adjustments ("urban modes") None
Ignore building wake effects? No
Decay coefficient (unless overridden by met. file) 0.000
Anemometer height 10 m
Roughness height at the wind vane site 0.300 m

DISPERSION CURVES
Horizontal dispersion curves for sources <100m high Briggs Rural
Vertical dispersion curves for sources <100m high Briggs Rural
Horizontal dispersion curves for sources >100m high Pasquill-Gifford
Vertical dispersion curves for sources >100m high Pasquill-Gifford
Enhance horizontal plume spreads for buoyancy? Yes
Enhance vertical plume spreads for buoyancy? Yes
Adjust horizontal P-G formulae for roughness height? Yes
Adjust vertical P-G formulae for roughness height? Yes
Roughness height 0.800m
Adjustment for wind directional shear None

PLUME RISE OPTIONS
Gradual plume rise? Yes
Stack-tip downwash included? Yes
Building downwash algorithm: PRIME method.
Entrainment coeff. for neutral & stable lapse rates 0.60,0.60
Partial penetration of elevated inversions? No
Disregard temp. gradients in the hourly met. file? No

and in the absence of boundary-layer potential temperature gradients
given by the hourly met. file, a value from the following table
(in K/m) is used:

| Wind Speed Category | Stability Class A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | 0.000 | 0.000 | 0.000 | 0.000 | 0.020 | 0.035 |
| 2 | 0.000 | 0.000 | 0.000 | 0.000 | 0.020 | 0.035 |
| 3 | 0.000 | 0.000 | 0.000 | 0.000 | 0.020 | 0.035 |
| 4 | 0.000 | 0.000 | 0.000 | 0.000 | 0.020 | 0.035 |
| 5 | 0.000 | 0.000 | 0.000 | 0.000 | 0.020 | 0.035 |
| 6 | 0.000 | 0.000 | 0.000 | 0.000 | 0.020 | 0.035 |

WIND SPEED CATEGORIES
Boundaries between categories (in m/s) are: 1.54, 3.09, 5.14, 8.23, 10.80

WIND PROFILE EXPONENTS: "Irwin Urban" values (unless overridden by met. file)

AVERAGING TIMES
1 hour
24 hours
90 days

Chullora - Soil handling fugitive with controls

SOURCE GROUPS

| Group No. | Members |
|---|---|
| 1 | FTC |
| 2 | FPC |
| 3 | FBEPC |
| 4 | FBPPC |

1

Chullora - Soil handling fugitive with controls

SOURCE CHARACTERISTICS

INTEGRATED AREA SOURCE: FTC

| X0(m) | Y0(m) | Ground El | Length X | Length Y | Or. Angle | Ver. spread | Height |
|---|---|---|---|---|---|---|---|
| 320806 | 6248828 | 29m | 10m | 15m | 0deg | 5m | 0m |

(Constant) emission rate = 2.70E-06 grams/second per square metre
No gravitational settling or scavenging.

INTEGRATED AREA SOURCE: FPC

| X0(m) | Y0(m) | Ground El | Length X | Length Y | Or. Angle | Ver. spread | Height |
|---|---|---|---|---|---|---|---|
| 320806 | 6248828 | 29m | 3m | 50m | 0deg | 5m | 0m |

(Constant) emission rate = 1.40E-06 grams/second per square metre
No gravitational settling or scavenging.

INTEGRATED AREA SOURCE: FBEPC

| X0(m) | Y0(m) | Ground El | Length X | Length Y | Or. Angle | Ver. spread | Height |
|---|---|---|---|---|---|---|---|
| 320806 | 6248828 | 29m | 3m | 50m | 0deg | 5m | 0m |

(Constant) emission rate = 5.40E-06 grams/second per square metre
No gravitational settling or scavenging.

INTEGRATED AREA SOURCE: FBPPC

| X0(m) | Y0(m) | Ground El | Length X | Length Y | Or. Angle | Ver. spread | Height |
|---|---|---|---|---|---|---|---|
| 320806 | 6248828 | 29m | 3m | 50m | 0deg | 5m | 0m |

(Constant) emission rate = 1.20E-06 grams/second per square metre
No gravitational settling or scavenging.

1

Chullora - Soil handling fugitive with controls

RECEPTOR LOCATIONS

The Cartesian receptor grid has the following x-values (or eastings):
320665.m 320711.m 320755.m 320800.m 320844.m 320888.m 320931.m
320975.m 321018.m 321062.m 321107.m

and these y-values (or northings):
6248613.m 6248668.m 6248726.m 6248784.m 6248844.m 6248902.m 6248962.m
6249020.m 6249079.m 6249135.m 6249195.m

DISCRETE RECEPTOR LOCATIONS (in metres)

| No. | X | Y | ELEVN | HEIGHT | No. | X | Y | ELEVN | HEIGHT |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 321026 | 6248922 | 35.0 | 1.5 | 4 | 320949 | 6248674 | 35.0 | 1.5 |
| 2 | 321084 | 6249063 | 30.0 | 1.5 | 5 | 320208 | 6248352 | 30.0 | 1.5 |
| 3 | 320795 | 6249157 | 26.0 | 1.5 | | | | | |

METEOROLOGICAL DATA : DECCW Chullora AWS Data BoM SydneyAP Clouds SydneyAP

**Appendix F**

**Calculations of Speciated Constituent Monitoring Thresholds**

A PID action level has been required to be derived for the assessment of coal tar emissions during the remediation of the Macdonaldtown site. This has been undertaken by a review of the likely constituents of coal tar vapours and an assessment of potentially toxic effects of constituents at nearby potentially sensitive receptors.

**Characterisation of Constituents of Coal Tar**

Analysis of free coal tar has been reported in CH2M Hill (March 2007) 'Delineation & Characterisation Sampling and Review of Remedial Options Former Macdonaldtown Gasworks – Burren Street, Erskineville NSW' (CH2M Hill 2007). The coal tar was sampled from coal identified within a pipe on the former Macdonaldtown gasworks being assessed. Though these coal tar results have not been collected from the Barangaroo site, the Macdonaldtown gasworks operated over a similar period and undertook similar processes.

The results of analysis are summarised following for each substance reported above laboratory detection limits at a significant concentration.

**Table F1: Summary of Published Coal Tar Constituents**

| Coal Tar Constituent | Reported Concentration (W%) |
|---|---|
| Phenol | 0.206% |
| 2-Methylphenol | 0.173% |
| 3- & 4-Methylphenol | 0.359% |
| 2,4-Dimethylphenol | 0.249% |
| Naphthalene | 0.975% |
| Acenaphthylene | 0.226% |
| Acenaphthene | 0.0355% |
| Fluorene | 0.172% |
| Phenanthrene | 0.392% |
| Anthracene | 0.138% |
| Fluoranthene | 0.177% |
| Pyrene | 0.187% |
| Benz(a)anthracene | 0.0921% |
| Chrysene | 0.0765% |
| Benzo(b)fluoranthene | 0.0364% |
| Benzo(k)fluoranthene | 0.0545% |
| Benzo(a)pyrene | 0.0595% |
| Indeno(1,2,3-c,d)pyrene | 0.0241% |
| Dibenz(a,h)anthracene | 0.0099% |
| Benzo(g,h,i)perylene | 0.025% |
| Benzene | 0.0576% |
| Toluene | 0.121% |
| Ethylbenzene | 0.0156% |
| Xylene | 0.151% |
| TPH $C_6$-$C_9$ | 0.377% |
| TPH $C_{10}$-$C_{14}$ | 40.2% |
| TPH $C_{15}$-$C_{28}$ | 65.4% |
| TPH $C_{29}$-$C_{36}$ | 12.4% |

By review of **Table F1**, 4% of the constituents of coal tar have been speciated. It is considered that the reported speciated constituents represent the most potentially toxic coal tar constituents.

**Chemical Properties and PID Detection Characteristics of Coal Tar Constituents**

**Table F2** following summarises the reported vapour pressures for each of the speciated constituents in **Table F1**. Vapour pressures have been sourced from accessing the Risk Assessment Information System database on the 1st November 2011.

It is anticipated that a photo-ionization detector (PID) will be used to assess vapour levels during the works. PID ionization potentials and correction factors are also reported in **Table F2**. PID ionization potentials have been based on RAE Systems Inc (2010) 'Technical Note TN-106 Correction factors, Ionization Energies and Calibration

Characteristics' as based on the results provided for a 10.6 eV bulb and calibration to isobutylene.

**Table F2: Summary of Vapour Pressure and PID Measurement Parameters for Identified Coal Tar Constituents**

| Coal Tar Constituent | Vapour Pressure (mm Hg) | Ionization Energy (eV) | Correction Factor |
|---|---|---|---|
| Phenol | 0.35 | 8.51 | 1.0 |
| 2-Methylphenol | 0.11 | 8.29 | 0.5 |
| 3- & 4-Methylphenol | 0.11-0.17 | 8.35-8.5 | 1-1.4 |
| 2,4-Dimethylphenol | 0.10 | - | - |
| Naphthalene | $8.50*10^{-2}$ | 8.13 | 0.42 |
| Acenaphthylene | $6.68*10^{-3}$ | - | - |
| Acenaphthene | $2.15*10^{-3}$ | - | - |
| Fluorene | $6.00*10^{-4}$ | - | - |
| Phenanthrene | $1.21*10^{-4}$ | - | - |
| Anthracene | $6.53*10^{-6}$ | - | - |
| Fluoranthene | $9.22*10^{-6}$ | - | - |
| Pyrene | $4.50*10^{-6}$ | - | - |
| Benz(a)anthracene | $2.10*10^{-7}$ | - | - |
| Chrysene | $6.23*10^{-9}$ | - | - |
| Benzo(b)fluoranthene | $5.00*10^{-7}$ | - | - |
| Benzo(k)fluoranthene | $9.65*10^{-10}$ | - | - |
| Benzo(a)pyrene | $5.49*10^{-9}$ | - | - |
| Indeno(1,2,3-c,d)pyrene | $1.25*10^{-10}$ | - | - |
| Dibenz(a,h)anthracene | $9.55*10^{-10}$ | - | - |
| Benzo(g,h,i)perylene | $1.00*10^{-10}$ | - | - |
| Benzene | 94.8 | 9.25 | 0.53 |
| Toluene | 28.4 | 8.82 | 0.5 |
| Ethylbenzene | 9.6 | 8.77 | 0.52 |
| Xylene | 7.99 | 8.44-8.56 | 0.39-0.46 |

As per the relationship for vapours above liquids as provided in ASTM (2002) 'Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites', the extent of vapour that would be anticipated to occur above coal tar will be linearly related to constituent vapour pressure and mole fraction (taken to be equivalent to weight percentage).

For the purposes of assessing coal tar emissions as may be detected by a photo-ionisation detector (PID), it has been assumed that detectable concentration of coal tar constituents as may be recorded by a PID will consist solely of constituents which have been identified by the speciated analysis and have PID correction factors recorded. This is a conservative assumption as vapour emissions would consist of substantially higher concentrations of aliphatic constituents (by comparison of the sum of 4% of speciated constituents to the reported level of TPH $C_6$-$C_9$ and $C_{10}$-$C_{14}$). This will cause the level of the more toxic constituents as may be present in PID sampled vapours, particularly including benzene, to be substantially overpredicted.

Using the reported weight percentage, vapour pressure and PID correction factor, the anticipated relative levels of constituents in PID assessed vapours is summarised in **Table F3** following:

**Table F3: Summary of Anticipated Relative Level of Constituents in PID Readings**

| Coal Tar Constituent | Mass Fraction (%) | Vapour Pressure (mm Hg) | Correction Factor | Anticipated Fraction of PID Reading |
|---|---|---|---|---|
| Phenol | 0.206 | 0.35 | 1.0 | 0.01 |
| 2-Methylphenol | 0.173 | 0.11 | 0.5 | 0.002 |
| 3- & 4-Methylphenol | 0.359 | 0.11-0.17 | 1-1.4 | 0.01 |
| Naphthalene | 0.975 | $8.50*10^{-2}$ | 0.42 | 0.006 |
| Benzene | 0.0576 | 94.8 | 0.53 | 0.54 |
| Toluene | 0.121 | 28.4 | 0.5 | 0.32 |
| Ethylbenzene | 0.0156 | 9.6 | 0.52 | 0.01 |
| Xylene | 0.151 | 7.99 | 0.39-0.46 | 0.09 |

Based on **Table F3**, it has been assumed that benzene will compose a significant proportion of potential coal tar vapour emissions. From review of the health risk assessment (HRA) as performed with the air quality impact assessment (AQIA), benzene is also found to be the most potentially toxic constituent of those identified in vapour.

Where it is assumed that benzene comprises half the reported PID readings, it is considered that assessment of coal tar emissions on the basis of benzene emissions will be suitably protective of potentially toxic effects of other constituents that may be present.

### Toxicological Review of Benzene and Setting Site Specific Action Criteria

The risk assessment parameters as provided to the HRA have been used to derive a risk based criteria for benzene. As noted in the HRA ATSDR (August 2007) 'Toxicological Profile for Benzene' provides a chronic duration inhalation exposure MRL of 10µg/m$^3$ (0.003ppm). Exposure parameters on the basis of the anticipated duration of the works require to be applied to the adopted benzene threshold to determine a criteria that requires to be complied with at the site boundary. These are summarised following:

- Conversion of 6 days working for a seven day week; and
- Conversion of 11 hour work day (7am to 6pm) for 24 hour day.

Based on these corrections, the benzene action criteria is set at 0.008ppm. On the basis that benzene is anticipated to comprise 50% of a vapour measurement as taken using the PID, this is a PID action level of 0.016ppm. This level will require to be satisfied at the site boundary. This level is observed to be well below the typical PID detection limit of 0.1ppm.

### Assessment of Dispersion of Emissions from Source to Receptors

PID measurements will require to be undertaken at the source of the potential volatile emissions (i.e. the work zone). Emissions at the work zone will be subject to dispersion processes prior to discharge from the site boundary. GRI (1996) 'Management of Manufactured Gas Plant Sites' provides a near field box model for the ready estimation of contaminant dispersion over near field distances. The model is relatively simple and easy to apply, making it appropriate for use here and later inclusion in the AQMP. The model is further reported to be conservative.

The box model is provided in GRI (1996) as:

$C_a = Q / (H_b.W_b.u_m)$

Where: $C_a$ – concentration of contaminant in ambient air (µg/m$^3$)

$Q$ – emission rate of contaminant (µg/s)

$H_b$ – Downwind height of box (m)

$W_b$ – width of box, crosswind dimension of area of contamination (m)

$U_m$ – wind speed through the box (m/s)

**Table F4** is provided in GRI (1996) to estimate the height of the box, and by function, the extent of dispersion.

**Table F4: Box Model Parameters**

| Length of Side of Box (m) | Box Height (m) |
|---|---|
| 10 | 1.4 |
| 20 | 2.1 |
| 30 | 2.7 |
| 40 | 3.3 |
| 50 | 3.8 |
| 60 | 4.3 |
| 70 | 4.8 |
| 80 | 5.3 |
| 90 | 5.8 |
| 100 | 6.2 |
| 150[1] | 7.9[1] |
| 200[1] | 9.6[1] |
| 250[1] | 11.1[1] |
| 300[1] | 12.5[1] |
| 350[1] | 13.8[1] |
| 400[1] | 15.0[1] |
| 450[1] | 16.2[1] |
| 500[1] | 17.4[1] |
| 600[1] | 19.6[1] |
| 700[1] | 21.6[1] |
| 800[1] | 23.6[1] |
| 900[1] | 25.5[1] |
| 1000[1] | 27.3[1] |

Note: 1. Estimated by extrapolation

PID measurements are proposed to be taken as close to the source of potentially volatile emissions as possible. It is estimated that field personnel would be able to take measurements within 2m downwind of the source of the volatile emissions based on the proximity of earthmoving equipment. These emissions would be anticipated to be diluted prior to the site boundary. By the use of the box model the rate of dilution will be a function of the distance of the source to the nearest downwind receptor. An equivalent box height of 0.47m is estimated at a distance of 2m. The extent of dilution is found to be the box height at 2m as divided by the box height of the distance of the nearest downwind receptor. The basis of this calculation is shown on **Figure F1**.

**Derivation of PID Action Level for Site Screening**

Criteria to the work zone measurements will require to be applied on the basis of the downwind distance to the nearest potentially exposed receptor. The distance to the nearest affected receptor will be on the basis on the wind direction as per **Figure F1**. The downwind distance requires to be measured as per the wind direction. Criteria, on the basis of separation distance, to be applied at the work zone for PID screening are summarised in **Table F5** following.

**Table F5: Work Zone Criteria on the Basis of Separation Distance**

| Separation Distance (m) | PID Screening Criteria (ppm) |
|---|---|
| 50 | 0.1 |
| 100 | 0.2 |
| 150 | 0.3 |
| 200 | 0.3 |
| 250 | 0.4 |
| 300 | 0.4 |
| 350 | 0.5 |
| 400 | 0.5 |
| 450 | 0.6 |
| 500 | 0.6 |
| 600 | 0.7 |
| 700 | 0.7 |
| 800 | 0.8 |
| 900 | 0.9 |
| 1000 | 0.9 |

Where this PID screening criteria is exceeded, compound specific monitoring shall require to be undertaken using alternate measurement techniques.

## Appendix G

## Greenhouse Gas Emissions Assessment

**Project No. 40913**
**Project: Former Macdonaldtown Gasworks**

## Greenhouse and Exhaust Emissions Assessment          Scope 1 Emissions Chullora Site

| 1 | List of Plant / Machinery Consuming Fuel | | |
|---|---|---|---|
| | excavator | 40 | L/hour |
| | truck and dog | 0.5 | L/km |
| | generator powered pug mill | 40 | L/hour |
| | water cart | 0.5 | L/km |

| 2 | Estimate of Fuel Consumption During Material Removal | | | |
|---|---|---|---|---|
| | Volume of Contaminated soil for Treatment | 16215 | m3 | |
| | Volume of soil after treatment (assume 20% cement addition for stabilisation) | 19458 | m3 | |
| | Mass of soil after treatment | 27241.2 | tonnes | EPA (2006) 1m3 material = 1.4 tonnes |
| | | | | |
| | Number of trips required to return treated soil to Macdonaldtown site | 908.04 | trips | assumes on average one truck + dog trailer trip transports 30 tonnes |
| | | | | |
| | Distance travelled to transfer treated soil to landfill | 90804 | km | (assume 100 km per trip) |
| | | | | |
| | Fuel consumed transfering soil to treatment site and back | 45402 | L | using 0.5L/km consumed by truck + dog trailer |

| 3 | Estimate of Fuel Consumption by On-site Equipment | | |
|---|---|---|---|
| | Number of site work days (assumes 3 months of 6 days/week) | 78 | days |
| | Number works hours (assumes 9 hours/day) | 702 | hours |
| | Fuel used by 1 Excavator (for project duration) | 28080 | Litres |
| | Fuel used by generator powere pug mill (x 1 for project duration) | 14040 | Litres |
| | Fuel used by water cart (assume 30 km of travel per day) | 1170 | Litres |

| 4 | Estimate of Total fuel Consumed by Project | | |
|---|---|---|---|
| | Estimated Volume of Fuel used (site equipment + material removal) | 88692 | Litres |

| 5 | Predicted Scope 1 Emissions | | | |
|---|---|---|---|---|
| | Estimated CO2 emission | 239.47 | (tonnes $CO_2$-e) | 2.7 tonnes CO2 equivalent per kL of diesel fuel consumed (NECC 2009) |

| Estimated Exhaust Emissions | | | |
|---|---|---|---|
| Constituent | Fuel Used | Emission Factor | Emission (kg) |
| VOCs | 88692 | 0.0018 | 159.65 |
| NOx | 88692 | 0.023 | 2039.92 |
| CO | 88692 | 0.0068 | 603.11 |
| PM10 | 88692 | 0.0018 | 159.65 |
| SO2 | 88692 | 0.000017 | 1.51 |

**Project No. 40913**
**Project: Former Macdonaldtown Gasworks - treatment works at CRW Facility**

## Greenhouse and Exhaust Emissions Assessment — Scope 2 Emissions Chullora Treatment Area

### 3.1 Cement clinker production

$$E_{ij} = \left(EF_{ij} + EF_{toc,j}\right) \times \left(A_i + A_{ckd} \times F_{ckd}\right)$$

where:

$E_{ij}$ is the emissions of $CO_2$ released from the production of cement clinker ($CO_2$ -e tonnes)

$EF_{ij}$ is the emission factor for cement clinker (tonnes of $CO_2$ emissions per tonne of clinker produced). See Table 19.

$A_i$ is the quantity of cement clinker produced (tonnes)

$A_{ckd}$ is the quantity of cement kiln dust (CKD) produced (tonnes)

$EF_{toc,j}$ is the emission factor for carbon-bearing non-fuel raw material (tonnes of $CO_2$ emissions per tonne of clinker produced). See Table 19.

$F_{ckd}$ is the degree of calcination of cement kiln dust (range from 0% to 100%). If the information is not available the degree is assumed to be 100%, that $F_{ckd} = 1$

Table 19: Clinker production emission factors

| Source | Emission factor (tonnes $CO_2$-e per tonne) |
|---|---|
| | $CO_2$ |
| $EF_{ij}$ | 0.534 |
| $EF_{toc,j}$ | 0.010 |

Source: National Greenhouse and Energy Reporting (Measurement) Determination 2008 (Section 4.4).

**Estimate of Soil Requiring Treatment**

| | | | |
|---|---|---|---|
| Contaminated soil for Treatment | 16215 | $m^3$ | |
| | 22701 | tonnes | EPA (2006) $1m^3$ material = 1.4 ton |

**Estimate of Cement Required for Treatment**

| | | | |
|---|---|---|---|
| Treatment ratio: % soil to % cement | 5:1 | | |
| Cement required for treatment (Ai) | 4540.2 | tonnes | |
| Quantity of CKD produced (Ackd) | 771.834 | tonnes | (assuming produced at a rate of 1 |
| $F_{ckd}$ (%) | 100 | | default value in absence of measu |

**Predicted Scope 2 Emissions**

| | | |
|---|---|---|
| Estimated $CO_2$ emission (tonnes $CO_2$) | 2889.75 | tonnes $CO_2$-e |

**Appendix H**

**Risk Assessment Calculations**

**Calculation of Chemical Concentration in Air**
**(AUSPLUME highest value based on 24h Averaging time)**
Assumes all controls on place as per AQMP
assumes area of exposed material limtied to 150m$^2$

| **AUSPLUME SOURCE ID** | | | | | | |
|---|---|---|---|---|---|---|
| | **Receptor Location** | | | | | |
| **Benzene** | **1** | **2** | **3** | **4** | **5** | **6** |
| VEXBE | 2.45E-04 | 2.21E-04 | 5.63E-04 | 1.12E-04 | 3.73E-05 | 4.68E-04 |
| FBEP+FBEV | 1.50E-04 | 1.07E-04 | 1.64E-04 | 7.00E-05 | 2.38E-05 | 2.68E-03 |
| VTBEP | 3.44E-03 | 2.91E-03 | 5.01E-03 | 2.54E-03 | 8.35E-04 | 0.00826 |
| | | | | | | |
| SUM (micro-g/m3) | 3.84E-03 | 3.24E-03 | 5.74E-03 | 2.72E-03 | 8.96E-04 | 1.14E-02 |
| SUM (milli-g/m3) | 3.84E-06 | 3.24E-06 | 5.74E-06 | 2.72E-06 | 8.96E-07 | 1.14E-05 |
| | | | | | | |
| **Benzo(a)pyrene** | | | | | | |
| VEXBEP | 5.50E-03 | 4.98E-03 | 1.27E-02 | 2.53E-03 | 8.37E-04 | 1.05E-02 |
| FBPP | 1.08E-03 | 9.12E-04 | 2.14E-03 | 6.28E-04 | 1.91E-04 | 3.06E-03 |
| VTBP | 1.08E-03 | 9.12E-04 | 2.14E-03 | 6.28E-04 | 1.91E-04 | 3.06E-03 |
| | | | | | | |
| SUM (micro-g/m3) | 7.66E-03 | 6.80E-03 | 1.70E-02 | 3.79E-03 | 1.22E-03 | 1.66E-02 |
| SUM (milli-g/m3) | 7.66E-06 | 6.80E-06 | 1.70E-05 | 3.79E-06 | 1.22E-06 | 1.66E-05 |

**Calculation of Health Risk - Receptor Location 1**

CDI = (C * IR * ET * EF * ED) / (365 * AT * BW)

**Benzene**

| | **Child 0-5** | **Child 6-15** | **Adult 16 - 70** | | **Construction Worker** |
|---|---|---|---|---|---|
| C | 0.000003835 | 0.000003835 | 0.000003835 | | 0.000003835 |
| IR | 0.63 | 0.78 | 1.2 | | 1.33 |
| ET | 10 | 10 | 10 | | 8 |
| EF | 182.5 | 182.5 | 182.5 | | 120 |
| ED | 0.5 | 0.5 | 0.5 | | 0.5 |
| | | | | | |
| AT non threshold | 70 | 70 | 70 | | 70 |
| AT threshold | 1 | 1 | 1 | | 1 |
| BW | 13.2 | 34.5 | 70 | | 70 |
| | | | | | |
| | | | | | |
| CDI non threshold | 6.54E-09 | 3.10E-09 | 2.35E-09 | | 1.37E-09 |
| CDI threshold | 4.58E-07 | 2.17E-07 | 1.64E-07 | | 9.58E-08 |
| | | | | | |
| SF benzene | 2.10E-02 | 2.10E-02 | 2.10E-02 | | 2.10E-02 |
| risk | 1.37E-10 | 6.50E-11 | 4.93E-11 | | 2.87E-11 |
| | | | | | |
| RfD benzene | 2.90E-03 | 2.90E-03 | 2.90E-03 | | 2.90E-03 |
| Hazard Index | 1.58E-04 | 7.47E-05 | 5.67E-05 | **1.58E-04** | 3.30E-05 |

**Benzo(a)pyrene**

| | **Child 0-5** | **Child 6-15** | **Adult 16 - 70** | | **Construction Worker** |
|---|---|---|---|---|---|
| C | 7.66E-06 | 0.00000766 | 0.00000766 | | 0.00000766 |
| IR | 0.63 | 0.78 | 1.2 | | 1.33 |
| ET | 10 | 10 | 10 | | 8 |
| EF | 182.5 | 182.5 | 182.5 | | 120 |
| ED | 0.5 | 0.5 | 0.5 | | 0.5 |
| | | | | | |
| AT non threshold | 70 | 70 | 70 | | 70 |
| AT threshold | 1 | 1 | 1 | | 1 |
| BW | 13.2 | 34.5 | 70 | | 70 |
| | | | | | |
| | | | | | |
| CDI non threshold | 1.31E-08 | 6.19E-09 | 4.69E-09 | | 2.73E-09 |
| CDI threshold | 9.14E-07 | 4.33E-07 | 3.28E-07 | | 1.91E-07 |
| | | | | | |
| SF benzo(a)pyrene | 3.04E+02 | 3.04E+02 | 3.04E+02 | | 3.04E+02 |
| risk | 3.97E-06 | 1.88E-06 | 1.43E-06 | | 8.31E-07 |

**Calculation of Health Risk - Receptor Location 2**

CDI = (C * IR * ET * EF * ED) / (365 * AT * BW)

**Benzene**

| | Child 0-5 | Child 6-15 | Adult 16 - 70 | | Construction Worker |
|---|---|---|---|---|---|
| C | 3.24E-06 | 3.24E-06 | 3.24E-06 | | 3.24E-06 |
| IR | 6.30E-01 | 7.80E-01 | 1.20E+00 | | 1.33E+00 |
| ET | 1.00E+01 | 1.00E+01 | 1.00E+01 | | 8.00E+00 |
| EF | 182.5 | 182.5 | 182.5 | | 120 |
| ED | 0.5 | 0.5 | 0.5 | | 0.5 |
| | | | | | |
| AT non threshold | 7.00E+01 | 7.00E+01 | 7.00E+01 | | 7.00E+01 |
| AT threshold | 1.00E+00 | 1.00E+00 | 1.00E+00 | | 1.00E+00 |
| BW | 1.32E+01 | 3.45E+01 | 7.00E+01 | | 7.00E+01 |
| | | | | | |
| | | | | | |
| CDI non threshold | 5.52E-09 | 2.61E-09 | 1.98E-09 | | 1.16E-09 |
| CDI threshold | 3.86E-07 | 1.83E-07 | 1.39E-07 | | 8.09E-08 |
| | | | | | |
| SF benzene | 2.10E-02 | 2.10E-02 | 2.10E-02 | | 2.10E-02 |
| risk | 1.16E-10 | 5.49E-11 | 4.16E-11 | | 2.43E-11 |
| | | | | | |
| RfD benzene | 2.90E-03 | 2.90E-03 | 2.90E-03 | | 2.90E-03 |
| Hazard Index | 1.33E-04 | 6.31E-05 | 4.79E-05 | **1.33E-04** | 2.79E-05 |

**Benzo(a)pyrene**

| | Child 0-5 | Child 6-15 | Adult 16 - 70 | | Construction Worker |
|---|---|---|---|---|---|
| C | 6.80E-06 | 6.80E-06 | 6.80E-06 | | 6.80E-06 |
| IR | 6.30E-01 | 7.80E-01 | 1.20E+00 | | 1.33E+00 |
| ET | 1.00E+01 | 1.00E+01 | 1.00E+01 | | 8.00E+00 |
| EF | 182.5 | 182.5 | 182.5 | | 120 |
| ED | 0.5 | 0.5 | 0.5 | | 0.5 |
| | | | | | |
| AT non threshold | 7.00E+01 | 7.00E+01 | 7.00E+01 | | 7.00E+01 |
| AT threshold | 1.00E+00 | 1.00E+00 | 1.00E+00 | | 1.00E+00 |
| BW | 1.32E+01 | 3.45E+01 | 7.00E+01 | | 7.00E+01 |
| | | | | | |
| | | | | | |
| CDI non threshold | 1.16E-08 | 5.49E-09 | 4.17E-09 | | 2.43E-09 |
| CDI threshold | 8.12E-07 | 3.85E-07 | 2.92E-07 | | 1.70E-07 |
| | | | | | |
| SF benzo(a)pyrene | 3.04E+02 | 3.04E+02 | 3.04E+02 | | 3.04E+02 |
| risk | 3.53E-06 | 1.67E-06 | 1.27E-06 | | 7.38E-07 |

**Calculation of Health Risk - Receptor Location 3**

CDI = (C * IR * ET * EF * ED) / (365 * AT * BW)

**Benzene**

| | **Child 0-5** | **Child 6-15** | **Adult 16 - 70** | | **Construction Worker** |
|---|---|---|---|---|---|
| C | 5.74E-06 | 5.74E-06 | 5.74E-06 | | 5.74E-06 |
| IR | 6.30E-01 | 7.80E-01 | 1.20E+00 | | 1.33E+00 |
| ET | 1.00E+01 | 1.00E+01 | 1.00E+01 | | 8.00E+00 |
| EF | 182.5 | 182.5 | 182.5 | | 120 |
| ED | 0.5 | 0.5 | 0.5 | | 0.5 |
| | | | | | |
| AT non threshold | 7.00E+01 | 7.00E+01 | 7.00E+01 | | 7.00E+01 |
| AT threshold | 1.00E+00 | 1.00E+00 | 1.00E+00 | | 1.00E+00 |
| BW | 1.32E+01 | 3.45E+01 | 7.00E+01 | | 7.00E+01 |
| | | | | | |
| | | | | | |
| CDI non threshold | 9.78E-09 | 4.63E-09 | 3.51E-09 | | 2.05E-09 |
| CDI threshold | 6.85E-07 | 3.24E-07 | 2.46E-07 | | 1.43E-07 |
| | | | | | |
| SF benzene | 2.10E-02 | 2.10E-02 | 2.10E-02 | | 2.10E-02 |
| risk | 2.05E-10 | 9.73E-11 | 7.38E-11 | **3.76E-10** | 4.30E-11 |
| | | | | | |
| RfD benzene | 2.90E-03 | 2.90E-03 | 2.90E-03 | | 2.90E-03 |
| Hazard Index | 2.36E-04 | 1.12E-04 | 8.48E-05 | **2.36E-04** | 4.94E-05 |

| **Benzo(a)pyrene** | | | | | |
|---|---|---|---|---|---|
| | **Child 0-5** | **Child 6-15** | **Adult 16 - 70** | | **Construction Worker** |
| C | 1.70E-05 | 1.70E-05 | 1.70E-05 | | 1.70E-05 |
| IR | 6.30E-01 | 7.80E-01 | 1.20E+00 | | 1.33E+00 |
| ET | 1.00E+01 | 1.00E+01 | 1.00E+01 | | 8.00E+00 |
| EF | 182.5 | 182.5 | 182.5 | | 120 |
| ED | 0.5 | 0.5 | 0.5 | | 0.5 |
| | | | | | |
| AT non threshold | 7.00E+01 | 7.00E+01 | 7.00E+01 | | 7.00E+01 |
| AT threshold | 1.00E+00 | 1.00E+00 | 1.00E+00 | | 1.00E+00 |
| BW | 1.32E+01 | 3.45E+01 | 7.00E+01 | | 7.00E+01 |
| | | | | | |
| | | | | | |
| CDI non threshold | 2.89E-08 | 1.37E-08 | 1.04E-08 | | 6.06E-09 |
| CDI threshold | 2.03E-06 | 9.60E-07 | 7.28E-07 | | 4.24E-07 |
| | | | | | |
| SF benzo(a)pyrene | 3.04E+02 | 3.04E+02 | 3.04E+02 | | 3.04E+02 |
| risk | 8.80E-06 | 4.17E-06 | 3.16E-06 | | 1.84E-06 |

**Calculation of Health Risk - Receptor Location 4**

CDI = (C * IR * ET * EF * ED) / (365 * AT * BW)

**Benzene**

| | **Child 0-5** | **Child 6-15** | **Adult 16 - 70** | | **Construction Worker** |
|---|---|---|---|---|---|
| C | 2.72E-06 | 5.74E-06 | 5.74E-06 | | 5.74E-06 |
| IR | 6.30E-01 | 7.80E-01 | 1.20E+00 | | 1.33E+00 |
| ET | 1.00E+01 | 1.00E+01 | 1.00E+01 | | 8.00E+00 |
| EF | 182.5 | 182.5 | 182.5 | | 2.40E+02 |
| ED | 0.5 | 0.5 | 0.5 | | 0.5 |
| | | | | | |
| AT non threshold | 7.00E+01 | 7.00E+01 | 7.00E+01 | | 7.00E+01 |
| AT threshold | 1.00E+00 | 1.00E+00 | 1.00E+00 | | 1.00E+00 |
| BW | 1.32E+01 | 3.45E+01 | 7.00E+01 | | 7.00E+01 |
| | | | | | |
| | | | | | |
| CDI non threshold | 4.64E-09 | 4.63E-09 | 3.51E-09 | | 4.10E-09 |
| CDI threshold | 3.25E-07 | 3.24E-07 | 2.46E-07 | | 2.87E-07 |
| | | | | | |
| SF benzene | 2.10E-02 | 2.10E-02 | 2.10E-02 | | 2.10E-02 |
| risk | 9.74E-11 | 9.73E-11 | 7.38E-11 | | 8.60E-11 |
| | | | | | |
| RfD benzene | 2.90E-03 | 2.90E-03 | 2.90E-03 | | 2.90E-03 |
| Hazard Index | 1.12E-04 | 1.12E-04 | 8.48E-05 | **1.12E-04** | 9.89E-05 |

**Benzo(a)pyrene**

| | **Child 0-5** | **Child 6-15** | **Adult 16 - 70** | | **Construction Worker** |
|---|---|---|---|---|---|
| C | 3.79E-06 | 3.79E-06 | 3.79E-06 | | 3.79E-06 |
| IR | 6.30E-01 | 7.80E-01 | 1.20E+00 | | 1.33E+00 |
| ET | 1.00E+01 | 1.00E+01 | 1.00E+01 | | 8.00E+00 |
| EF | 182.5 | 182.5 | 182.5 | | 2.40E+02 |
| ED | 0.5 | 0.5 | 0.5 | | 0.5 |
| | | | | | |
| AT non threshold | 7.00E+01 | 7.00E+01 | 7.00E+01 | | 7.00E+01 |
| AT threshold | 1.00E+00 | 1.00E+00 | 1.00E+00 | | 1.00E+00 |
| BW | 1.32E+01 | 3.45E+01 | 7.00E+01 | | 7.00E+01 |
| | | | | | |
| | | | | | |
| CDI non threshold | 6.45E-09 | 3.06E-09 | 2.32E-09 | | 2.70E-09 |
| CDI threshold | 4.52E-07 | 2.14E-07 | 1.62E-07 | | 1.89E-07 |
| | | | | | |
| SF benzo(a)pyrene | 3.04E+02 | 3.04E+02 | 3.04E+02 | | 3.04E+02 |
| risk | 1.96E-06 | 9.29E-07 | 7.05E-07 | **3.60E-06** | 8.22E-07 |

**Calculation of Health Risk - Receptor Location 5**

CDI = (C * IR * ET * EF * ED) / (365 * AT * BW)

**Benzene**

| | **Child 0-5** | **Child 6-15** | **Adult 16 - 70** | | **Construction Worker** |
|---|---|---|---|---|---|
| C | 8.96E-07 | 8.96E-07 | 8.96E-07 | | 8.96E-07 |
| IR | 6.30E-01 | 7.80E-01 | 1.20E+00 | | 1.33E+00 |
| ET | 1.00E+01 | 1.00E+01 | 1.00E+01 | | 8.00E+00 |
| EF | 182.5 | 182.5 | 182.5 | | 2.40E+02 |
| ED | 0.5 | 0.5 | 0.5 | | 0.5 |
| | | | | | |
| AT non threshold | 7.00E+01 | 7.00E+01 | 7.00E+01 | | 7.00E+01 |
| AT threshold | 1.00E+00 | 1.00E+00 | 1.00E+00 | | 1.00E+00 |
| BW | 1.32E+01 | 3.45E+01 | 7.00E+01 | | 7.00E+01 |
| | | | | | |
| | | | | | |
| CDI non threshold | 1.53E-09 | 7.24E-10 | 5.49E-10 | | 6.40E-10 |
| CDI threshold | 1.07E-07 | 5.06E-08 | 3.84E-08 | | 4.48E-08 |
| | | | | | |
| SF benzene | 2.10E-02 | 2.10E-02 | 2.10E-02 | | 2.10E-02 |
| risk | 3.21E-11 | 1.52E-11 | 1.15E-11 | | 1.34E-11 |
| | | | | | |
| RfD benzene | 2.90E-03 | 2.90E-03 | 2.90E-03 | | 2.90E-03 |
| Hazard Index | 3.69E-05 | 1.75E-05 | 1.32E-05 | **3.69E-05** | 1.54E-05 |

**Benzo(a)pyrene**

| | **Child 0-5** | **Child 6-15** | **Adult 16 - 70** | | **Construction Worker** |
|---|---|---|---|---|---|
| C | 1.22E-06 | 1.22E-06 | 1.22E-06 | | 1.22E-06 |
| IR | 6.30E-01 | 7.80E-01 | 1.20E+00 | | 1.33E+00 |
| ET | 1.00E+01 | 1.00E+01 | 1.00E+01 | | 8.00E+00 |
| EF | 182.5 | 182.5 | 182.5 | | 2.40E+02 |
| ED | 0.5 | 0.5 | 0.5 | | 0.5 |
| | | | | | |
| AT non threshold | 7.00E+01 | 7.00E+01 | 7.00E+01 | | 7.00E+01 |
| AT threshold | 1.00E+00 | 1.00E+00 | 1.00E+00 | | 1.00E+00 |
| BW | 1.32E+01 | 3.45E+01 | 7.00E+01 | | 7.00E+01 |
| | | | | | |
| | | | | | |
| CDI non threshold | 2.08E-09 | 9.84E-10 | 7.46E-10 | | 8.70E-10 |
| CDI threshold | 1.45E-07 | 6.89E-08 | 5.22E-08 | | 6.09E-08 |
| | | | | | |
| SF benzo(a)pyrene | 3.04E+02 | 3.04E+02 | 3.04E+02 | | 3.04E+02 |
| risk | 6.32E-07 | 2.99E-07 | 2.27E-07 | | 2.65E-07 |

**Calculation of Health Risk - Receptor Location 6**

CDI = (C * IR * ET * EF * ED) / (365 * AT * BW)

**Benzene**

| | Child 0-5 | Child 6-15 | Adult 16 - 70 | | Construction Worker |
|---|---|---|---|---|---|
| C | 1.14E-05 | 1.14E-05 | 1.14E-05 | | 1.14E-05 |
| IR | 6.30E-01 | 7.80E-01 | 1.20E+00 | | 1.33E+00 |
| ET | 1.00E+01 | 1.00E+01 | 1.00E+01 | | 8.00E+00 |
| EF | 182.5 | 182.5 | 182.5 | | 2.40E+02 |
| ED | 0.5 | 0.5 | 0.5 | | 0.5 |
| | | | | | |
| AT non threshold | 7.00E+01 | 7.00E+01 | 7.00E+01 | | 7.00E+01 |
| AT threshold | 1.00E+00 | 1.00E+00 | 1.00E+00 | | 1.00E+00 |
| BW | 1.32E+01 | 3.45E+01 | 7.00E+01 | | 7.00E+01 |
| | | | | | |
| | | | | | |
| CDI non threshold | 1.94E-08 | 9.21E-09 | 6.98E-09 | | 8.14E-09 |
| CDI threshold | 1.36E-06 | 6.45E-07 | 4.89E-07 | | 5.70E-07 |
| | | | | | |
| SF benzene | 2.10E-02 | 2.10E-02 | 2.10E-02 | | 2.10E-02 |
| risk | 4.08E-10 | 1.93E-10 | 1.47E-10 | | 1.71E-10 |
| | | | | | |
| RfD benzene | 2.90E-03 | 2.90E-03 | 2.90E-03 | | 2.90E-03 |
| Hazard Index | 4.69E-04 | 2.22E-04 | 1.69E-04 | **4.69E-04** | 1.97E-04 |

**Benzo(a)pyrene**

| | Child 0-5 | Child 6-15 | Adult 16 - 70 | | Construction Worker |
|---|---|---|---|---|---|
| C | 1.66E-05 | 1.66E-05 | 1.66E-05 | | 1.66E-05 |
| IR | 6.30E-01 | 7.80E-01 | 1.20E+00 | | 1.33E+00 |
| ET | 1.00E+01 | 1.00E+01 | 1.00E+01 | | 8.00E+00 |
| EF | 182.5 | 182.5 | 182.5 | | 2.40E+02 |
| ED | 0.5 | 0.5 | 0.5 | | 0.5 |
| | | | | | |
| AT non threshold | 7.00E+01 | 7.00E+01 | 7.00E+01 | | 7.00E+01 |
| AT threshold | 1.00E+00 | 1.00E+00 | 1.00E+00 | | 1.00E+00 |
| BW | 1.32E+01 | 3.45E+01 | 7.00E+01 | | 7.00E+01 |
| | | | | | |
| | | | | | |
| CDI non threshold | 2.83E-08 | 1.34E-08 | 1.02E-08 | | 1.19E-08 |
| CDI threshold | 1.98E-06 | 9.39E-07 | 7.12E-07 | | 8.31E-07 |
| | | | | | |
| SF benzo(a)pyrene | 3.04E+02 | 3.04E+02 | 3.04E+02 | | 3.04E+02 |
| risk | 8.61E-06 | 4.08E-06 | 3.09E-06 | | 3.61E-06 |

**Document Status**

| Rev No. | Author(s) | Reviewer | Approved for Issue | | |
|---|---|---|---|---|---|
| | | Name | Name | Signature | Date |
| A | Matt Parkinson | Internal review | | | 8/6/10 |
| B | Matt Parkinson | Draft for client review | | | 10/6/10 |
| C | Matt Parkinson / Sumi Dorairaj | Internal Review | | | 16/08/10 |
| D | Matt Parkinson / Sumi Dorairaj | Draft for client review | | | 26/11/10 |
| E | Sumi Dorairaj | Draft for client review | | | 23/12/10 |
| F | Sumi Dorairaj | Matt Parkinson | | Draft for client review | 09/08/11 |

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