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Department of the Environment, Water, Heritage and the Arts

NATIONAL POLLUTANT INVENTORY

EMISSION ESTIMATION TECHNIQUE MANUAL FOR

FUEL AND ORGANIC LIQUID STORAGE

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Disclaimer

The manual was prepared in conjunction with Australian states and territories according to the *National Environment Protection (National Pollutant Inventory) Measure.*
While reasonable efforts have been made to ensure the contents of this manual are factually correct, the Australian Government does not accept responsibility for the accuracy or completeness of the contents and shall not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance on, the contents of this manual.

EMISSION ESTIMATION TECHNIQUES FOR FUEL AND ORGANIC LIQUID STORAGE TABLE OF CONTENTS

FUEL AND ORGANIC LIQUID STORAGE

LIST OF TABLES, EXAMPLES, FIGURES AND EQUATIONS

1 Introduction

The purpose of all emission estimation technique (EET) manuals is to assist Australian manufacturing, industrial and service facilities to report emissions of listed substances to the National Pollutant Inventory (NPI). This manual describes the procedures and recommended approaches for estimating emissions from facilities engaged in the storage of liquid fuels, including petroleum and petroleum-based liquids, and organic liquids.

EET MANUAL	Fuel and organic liquid storage
ANZSIC (2006) CODE	3321: Petroleum product wholesaling Any industry sector where fuel or organic liquids are stored and used.

Note that the ANZSIC code is part of NPI reporting requirements. The NPI Guide contains an explanation of ANZSIC codes.

This manual has been developed through a process of national consultation involving state and territory environmental agencies and key industry stakeholders. Particular thanks are due to Environmental Consultancy Services (ECS) for their assistance in developing this manual.

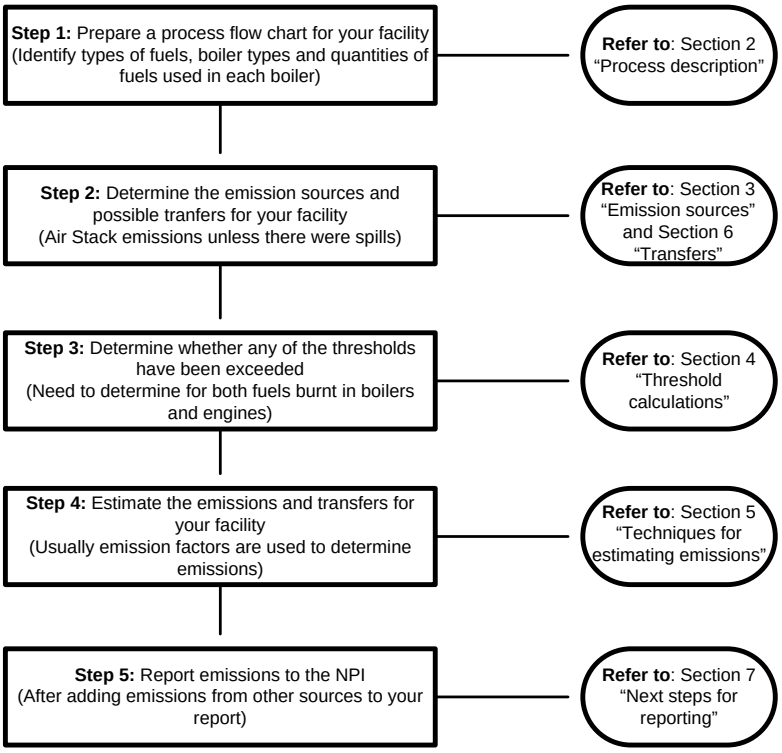
Facilities may use a variety of techniques to estimate their emissions as a result of fuel and organic liquid storage. Facilities with detailed information on their storage practices may use the USEPA TANKS software to estimate emissions from fuel and organic liquid storage. USEPA TANKS is available from the USEPA website: http://www.epa.gov/ttn/chief/software/tanks/

Additional instructions have been developed by KMH Environmental to assist users in using the USEAP TANKS software and can be found in Appendix G.

Please note that if you do use TANKS, emissions will be presented in imperial units. A conversion table to metric units of measure is given in Appendix C.

1.1 The process for NPI reporting

The process for NPI reporting can be seen in the following flow chart:



1.2 Information required to produce an annual NPI report

The following data will need to be collated for the reporting period to determine the emissions from fuel and organic liquid storage:

- type of fuel or organic liquid stored
- tank working volume (or storage capacity)
- throughput of the tank (e.g. how many times a week/month/year the tank is refilled)
- starting volume of liquid in the tank.

1.3 Additional reporting materials

This manual is written to reflect the common processes employed in fuel and organic liquid storage. In many cases it will be necessary to refer to other EET manuals to ensure that a complete report of the emissions for the facility can be made. Other applicable EET manuals may include, but are not limited to:

- Combustion in boilers
- Combustion in engines
- Fugitive emissions, and
- industry-specific emission estimation technique manuals.

2 Process description

The first step in estimating emissions of NPI substances from your facility is creating a process flow diagram to highlight points where emissions may occur.

In the case of fuel and organic liquid storage this involves identifying the fuel and organic liquids stored on site and determining the type of tank used for storage.

2.1 Fuels and organic liquids

The storage of the following fuels and organic liquids should be considered:

Fuels

- Crude oil
- Fuel oil
- Heating oil
- Jet Kerosene
- Avgas 100
- Avgas LL
- Diesel
- Leaded petrol (LP)
- Unleaded petrol (ULP)
- Premium unleaded petrol (PULP)
- RON 98
- E10

Organic liquids

- Acetaldehyde (ethanal)
- Acetic acid
- Acetone
- Acetonitrile
- Acrylamide
- Acrylic acid
- Acrylonitrile
- Aniline
- Benzene
- Carbon disulfide
- Chloroform
- Cumene (isopropyl benzene)
- Chloroethane (ethyl chloride)
- Cyclohexane
- 1,2-Dibromoethane
- 1,2-Dichloroethane
- Dichloromethane
- Ethanol (ethyl alcohol)
- 2-Ethoxyethanol
- 2-Ethoxyethanol acetate
- Ethyl acetate
- Ethyl butyl ketone
- Ethylbenzene
- Ethylene oxide
- Formaldehyde
- Glutaraldehyde
- *n*-Hexane
- Methanol (methyl alcohol)
- 2-Methoxyethanol
- 2-Methoxyethanol acetate
- Methyl ethyl ketone
- Methyl isobutyl ketone
- Methyl methacrylate
- Styrene
- 1,1,2,2-Tetrachloroethane
- Tetrachloroethylene
- Toluene (methyl benzene)
- 1,1,2-Trichloroethane
- Trichloroethylene
- Vinyl chloride monomer
- Xylene (-m)
- Xylene (-o)
- Xylenes (mixture)

RON 98 corresponds to fuel with a Research Octane Number (RON) of 98, PULP is nominally rated at RON 95 and ULP is nominally rated at RON 91.

2.2.1 Bio-fuels

Ethanol replacement petrol (E10) is based on sugar-derived ethanol. Data in this review were obtained from several Australian manufacturers. The quoted lead content

is based on a single manufacturer which offers an E10 leaded fuel on the Australian market.

Data on biodiesel (B20) blended fuels, based on vegetable oil-derived methyl ester, are not considered in this manual, due to a lack of current information from Australian sources. Emissions from storage of biodiesel must be considered if a threshold is exceeded. Reporters should attempt to estimate emissions from B20 using an alternative estimation technique where possible.

2.2 Tank types

Fuels and pure organic liquids are generally quite volatile and, as such, the storage tanks used are designed to reduce their evaporation to air. The five basic tank configurations, and the liquids typically stored in them are:

1. Fixed roof tanks - vertical (diesel and fuel oil), horizontal including underground (diesel, ULP, PULP)
2. External floating roof tanks (domed and standard) – avgas, ULP, PULP
3. Internal floating roof tanks – organic liquids
4. Pressure tanks (high and low pressure) - LPG
5. Variable vapour space tanks.

Please note that this manual does not consider emissions from the storage of fuels in a highly pressurised environment (such as LPG). If an emission occurs from pressurised storage, the emission must be reported to the NPI in the event a threshold is exceeded. Contact the relevant jurisdiction for additional assistance.

A brief description of these tank types can be found in Appendix D.

3 Emission sources

General information regarding emission sources can be located in *The NPI Guide.* Emissions from fuel or organic liquid storage will generally be fugitive emissions to air unless there is a spill, in which case there may also be emissions to land and/or water.

3.1 Emissions to air

Air emissions may be categorised as fugitive emissions or point source emissions.

3.1.1 Fugitive emissions

Emissions from storage tanks can be categorised as working and standing losses.

Working losses are the combined loss from filling and emptying a tank. As the liquid level increases, the pressure inside the tank increases and vapours are expelled from the tank. A loss during emptying occurs when air drawn into the tank becomes saturated with organic vapour and expands, thus exceeding the capacity of the vapour space.

Standing losses occur through the expulsion of vapour from a tank due to the vapour expansion and contraction as a result of changes in temperature and barometric pressure. This loss occurs without any change in the liquid level in the tank.

3.1.2 Point source emissions

Point source emissions are directed into a vent or stack and emitted through a single point source into the atmosphere.

3.2 Emissions to water

Leaks from fuel and organic liquid storage facilities should not enter waterways.

If this does happen you are legally required to immediately contact your state or territory environment agency for guidance. Any such emissions are also reportable to the NPI.

3.3 Emissions to land

Emissions of substances to land include slurries, spills and leaks, and such emissions may contain NPI listed substances. Emission sources can be categorised as:

- surface impoundments of liquids and slurries
- unintentional leaks and spills.

4 Threshold calculations

For fuel and organic liquid storage, the relevant NPI thresholds are Category 1 and Category 1a. The usage of each of the substances listed as Category 1 and 1a under the NPI must be estimated. Usage is defined as the storage, handling, manufacture, import, processing, coincidental production or other uses of an NPI listed substance.

If a facility has 'used' a total of 10 tonnes or more of any Category 1 NPI substance or 25 tonnes or more of Total VOCs (NPI Category 1a substance) in a reporting year, you must report the emissions of each substance that has tripped the threshold. Note: in determining the emissions for a substance, **all** sources of the emissions from the operations/processes relating to the facility must be included, not just those related to fuel and organic liquid storage. For example: if your facility exceeds the reporting threshold for Total VOC, reporting is required for all emissions of Total VOC from all sources at the facility.

4.1 Fuel storage

Tables 1 and 2 show the minimum amount of fuel stored in a year that would trip the reporting Category 1a (Total VOC) threshold, and the Category 1 threshold for individual substance in the fuel composition respectively.

This is to be used as guidance only and total usage figures should still be determined, especially when multiple fuels are stored on site.

Note: The data shown in Tables 1 and 2 was collected from a variety of sources including Australian refineries and material safety data sheets. It is important to note that the compositions represent averages.

Table 1: Minimum amount of fuel stored to trip the Category 1a (Total VOC) reporting threshold (25 tonnes)

Product	Liquid density (kg/L)	Typical VOC composition (%)	Reporting threshold (L)[2]
Crude oil	0.848	3[1]	983,000
Fuel oil	0.848	3	983,000
Heating oil	0.836	12	250,000
Jet kerosene	0.837	38	79,000
Avgas 100	0.695	100	36,000
Avgas LL	0.718	100	35,000
Diesel	0.836	7.6	394,000
Leaded petrol (LP)	0.739	99	35,000
Unleaded petrol (ULP)	0.735	99	34,000
Premium unleaded petrol (PULP)	0.75	99	34,000
RON 98	0.75	99[1]	34,000
E10	0.743	99[1]	34,000

1. Approximated
2. Calculated by: 25 000 kg ÷ liquid density (kg/L) ÷ typical composition (%)
   Rounded up to the nearest thousand

Table 2: Minimum amount of individual substances in fuel stored to trip the Category 1 reporting threshold (10 tonnes)

Substance	Crude oil		Fuel oil		Heating oil		Jet kerosene		Avgas 100		Avgas LL	
	Typical composition (%)	Reporting threshold (L)[1]	Typical composition (%)	Reporting threshold (L)	Typical composition (%)	Reporting threshold (L)	Typical composition (%)	Reporting threshold (L)	Typical composition (%)	Reporting threshold (L)	Typical composition (%)	Reporting threshold (L)
Benzene	0.090	13,103,000	0.010	117,925,000	-	ND	0.367	3,256,000	1.300	1,107,000	4.000	349, 000
Cumene	0.040	29,482,000	0.215	5,485,000	-	ND	2.830	423,000	0.011	130,805,000	0.025	55,711,000
Cyclohexane	0.760	1,552,000	-	ND	-	ND	1.200	996,000	0.483	2,979,000	0.002	696,379,000
Ethylbenzene	0.160	7,371,000	0.010	117,925,000	0.070	17,089,000	0.517	2,311,000	0.175	8,222,000	6.500	215,000
n-Hexane	2.060	573,000	0.010	117,925,000	-	ND	4.650	257,000	0.900	1,599,000	2.525	552,000
Lead	-	ND	-	ND	-	ND	-	ND	0.350	4,111,000	0.267	5,217,000
PAH [3]	0.300	Cat 2a / 2b	0.820	Cat 2a / 2b	0.800	Cat 2a / 2b	0.985	Cat 2a / 2b	0.125	Cat 2a / 2b	-	ND
Toluene	0.410	2,877,000	0.030	39,309,000	0.080	14,953,000	0.180	6,638,000	2.123	678,000	14.250	98,000
Xylenes	0.710	1,661,000	0.100	11,793,000	0.330	3,625,000	1.880	636,000	0.955	1,507,000	6.750	207,000
Ethanol	-	ND	-	ND	-	ND	-	ND	-	ND	-	ND
Other non-NPI listed VOCs	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Substance	Diesel		Leaded petrol		Unleaded petrol (ULP)		Premium unleaded petrol (PULP)		RON98		Ethanol blend (E10)	
	Typical composition (%)	Reporting threshold (L)	Typical composition (%)	Reporting threshold (L)	Typical composition (%)	Reporting threshold (L)	Typical composition (%)	Reporting threshold (L)	Typical composition (%)	Reporting threshold (L)	Typical composition (%)	Reporting threshold (L)
Benzene	0.030	39,872,000	0.903	1,499,000	0.933	1,458,000	1.003	1,356,000	1.007	1,351,000	0.990	1,360,000
Cumene	0.975	1,227,000	0.110	12,302,000	0.100	13,605,000	0.120	11,338,000	0.170	8,003,000	-	ND
Cyclohexane	0.010	119,617,000	0.805	1,681,000	0.765	1,778,000	0.990	1,374,000	1.100	1,237,000	-	ND
Ethylbenzene	0.110	10,874,000	1.600	846,000	1.533	888,000	1.763	772,000	1.805	754,000	2.000	673,000
n-Hexane	0.010	119,617,000	2.600	520,000	1.830	743,000	1.520	895,000	2.025	672,000	2.000	673,000
Lead	-	ND	0.505	ND	0.001	1,360,544,000	0.000	13,605,442,000	-	ND	0.060	22,447,000
PAH [3]	0.360	Cat 2a / 2b	0.570	Cat 2a / 2b	0.610	Cat 2a / 2b	0.380	Cat 2a / 2b	0.480	Cat 2a / 2b	-	ND
Toluene	0.100	11,962,000	7.927	171,000	5.603	243,000	7.093	192,000	19.650	69,000	7.500	180,000
Xylenes	0.345	3,467,000	8.170	166,000	7.747	176,000	8.980	152,000	9.730	140,000	10.000	135,000
Ethanol	-	ND	-	ND	-	ND	-	ND	-	ND	10.000	135,000
Other non-NPI listed VOCs	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

1. Calculated by: (10 000 kg ÷ liquid density (in Table 1) ÷ typical composition (%)
   Rounded up to the nearest thousand.
2. ND: Not Determined
3. Polycyclic Aromatic Hydrocarbons are Category 2a / 2b substances

4.1.1 Calculating usage (and thresholds) of stored fuels

To calculate the total usage of a stored fuel and determine if a threshold has been tripped:

1. Determine the type and characteristics of tank you have.

   Is your tank a:

   - vertical fixed roof (usually used for diesel and fuel oil)
   - internal floating roof (usually used for Avgas, ULP, PULP)
   - external floating roof (usually used for Avgas, ULP, PULP)
   - horizontal fixed roof (usually used for diesel, ULP, PULP), *or*
   - an underground fixed roof (usually used for diesel, ULP, PULP).

2. Determine the volume of fuel in the tank at the start of the reporting period.

3. Determine fuel usage:

   fuel use = starting volume (L) + (no. times tank filled × average volume filled (L));
   or
   fuel use = starting volume (L) + total volume filled (L)

4. Determine if a reporting threshold has been exceeded for any NPI substances.

   If one fuel stored on site: use volume required to trip threshold from Tables 1 and 2.
   If multiple fuels stored on site: use 'typical composition' information from Tables 1 and 2.

   Substance use = fuel use (1) x fuel density (1) x typical composition of substance in fuel (1)/100 + fuel use (2) x fuel density (2) x typical composition of substance in fuel (2)/100 etc.

   If the threshold for any NPI substance has been exceeded the emissions of that substance resulting from all activities must be reported to the NPI.

Example 1: Determine if a facility at an airport in Perth, WA needs to report to the NPI. The site stores Avgas LL in an internal floating roof tank and the tank is refilled eight times a year with an average of 200,000L added each time. At the beginning of the reporting period, the gauge indicated that there was approximately 500,000L (500kL) in the tank.

Step 1: Determine the type and characteristics of the tank:
Tank type Internal floating roof

Step 2: Determine the volume of fuel in the tank at the start of the reporting period
500,000 litres (500kL)

Step 3: Determine fuel usage
Annual use of Avgas LL = starting volume (L) + (no. times tank filled × average volume filled (L))

Annual use of Avgas LL = 500,000 + (8 × 200,000)
= 2,100,000 L

Step 4: Establish if reporting thresholds have been exceeded
Only one fuel was stored onsite thus the volume of fuel used can be directly compared to the 'volume required to trip threshold' column of Tables 1 and 2.

From Table 1: 2 100,000 L is greater than the Category 1a reporting threshold for Avgas LL (35,000 L), therefore an emission of Total VOC is reportable.

From Table 2: 2,100,000 L is greater than the Category 1 reporting threshold for Avgas LL for the following substances (for which reporting is required):

- Benzene (threshold for Avgas LL usage = 349,000 L)
- Ethylbenzene (threshold for Avgas LL usage = 215,000 L)
- n-Hexane (threshold for Avgas LL usage = 552,000 L)
- Toluene (threshold for Avgas LL usage = 98,000 L)
- Xylenes (threshold for Avgas LL usage = 207,000L)

The thresholds for the following NPI substances have not been exceeded, and as a result emissions are not reportable (unless thresholds for these substances have been exceeded as a result of other operations at the facility, in which case, emissions must be calculated for these substances):

- **Cumene (threshold for Avgas LL usage = 55,711,000)**
- **Cyclohexane (threshold for Avgas LL usage = 696,379,000)**

Example 2: Determine if a facility which is located in Zone 7 and stores diesel in an underground fixed roof tank and fuel oil in a vertical fixed roof tank needs to report to the NPI. Engineering records indicate that the diesel tank contained approximately 72,000L (72kL) of diesel at the start of the reporting period and was refilled fifty-two times during the year with an average of 20,000L added each time. The fuel oil tank was empty at the beginning of the year and was filled once with a volume of 10,000L.

Step 1: Determine the type and characteristics of the tank

Tank type (diesel) Horizontal fixed roof
Tank type (fuel oil) Vertical fixed roof

Step 2: Determine the volume of fuel in the tank at the start of the reporting period

Diesel: 72,000L (72 kL)
Fuel Oil: 0L

Step 3: Determine fuel usage

Annual use of diesel = starting volume (L) + (no. times tank filled × average volume filled (L))

Annual use of diesel = 72,000 + (52 × 20,000)
= 1,112,000 L

Annual use of fuel oil =0 + (1 x 10,000)
=10,000L

Step 4: Establish if reporting thresholds have been exceeded

As two fuels were stored onsite, the typical composition information needs to be used to determine if thresholds were tripped.

Substance use = fuel use (1) x fuel density (1) typical composition of substance in fuel (1)/100 + fuel use (2) x fuel density (2) typical composition of substance in fuel (2)/100

From Table 1 and 2 the typical composition of diesel and fuel oil is:

	Diesel	Fuel oil
Total VOC	7.6%	3%
Benzene	0.030%	0.010%
Cumene	0.975%	0.215%
Cyclohexane	0.010%	-
Ethylbenzene	0.110%	0.010%
n-Hexane	0.010%	0.010%
Lead	-	-
PAH	0.360%	0.820%
Toluene	0.100%	0.030%
Xylenes	0.345%	0.100%
Ethanol	-	-

Table 1 also gives the density of the liquids:
Diesel: 0.836 kg/L
Fuel Oil: 0.848 kg/L

Total VOC usage = diesel use x 0.836kg/L x 7.6/100 + fuel oil use x 0.848kg/L x 3/100
= 1 112 000L x 0.836 x 7.6/100 + 10 000L x 0.848kg/L x 3/100
= 70652kg + 254.4kg
= 70906.4kg (70.9 tonnes)

70.9 tonnes is greater than the Category 1a reporting threshold for Total VOC (25 tonnes), therefore reporting of Total VOC is required.

Repeating for the other substances gives the following usages:

Benzene	279.7kg
Cumene	9082.1kg
Cyclohexane	92.96kg
Ethylbenzene	1023.4kg
n-Hexane	93.81kg
Lead	0 kg
Toluene	932.2kg
Xylenes	3215.7kg
Ethanol	0kg

All of the above usages are less than the threshold for all Category 1 substances (10 tonnes) therefore no reporting for these substances is required.

4.2 Organic liquid storage

Table 3 shows the minimum amount of pure organic liquid stored in a year that would trip the reporting threshold. If the organic liquid is mixed in solution you will need to adjust the figures accordingly.

Table 3: Minimum of pure organic liquid stored to exceed the Category 1 (10 tonnes) reporting threshold

Substance	CAS No.	Liquid density at 20 °C (kg/L)	Reporting threshold (L)
Acetaldehyde (ethanal)	75-07-0	0.788	12,700
Acetic acid	64-19-7	1.048	9,600
Acetone	67-64-1	0.792	12,700
Acetonitrile	75-05-8	0.784	12,800
Acrylamide	79-06-1	1.119	9,000
Acrylic acid	79-10-7	1.059	9,500
Acrylonitrile	107-13-1	0.808	12,400
Aniline	62-53-3	1.021	9,800
Benzene	71-43-2	0.879	11,400
Carbon disulfide	75-15-0	1.262	8,000
Chloroethane(Ethyl chloride)	75-00-3	0.918	10,900
Chloroform	67-66-3	1.489	6,800
Cumene (isopropyl benzene)	98-82-8	0.792	12,700
Cyclohexane	110-82-7	0.779	12,900
1,2-Dibromoethane	106-93-4	1.255	8,000
1,2-Dichloroethane	107-06-2	1.253	8,000
Dichloromethane	75-09-2	1.362	7,400
Ethanol (ethyl alcohol)	64-17-5	0.772	13,000
2-Ethoxyethanol	110-80-5	0.930	10,800
2-Ethoxyethanol acetate	111-15-9	0.975	10,300
Ethyl acetate	141-78-6	0.905	11,100
Ethyl butyl ketone	106-35-4	0.818	12,300
Ethylbenzene	100-41-4	0.864	11,600
Ethylene oxide	75-21-8	0.864	11,600
Formaldehyde (37%, Formalin)	50-00-0	1.090	9,200
Glutaraldehyde (25%, Cidex)	111-03-8	1.106	9,100
n-Hexane	110-54-3	0.658	15,200
Methanol (methyl alcohol)	67-56-1	0.792	12,700
2-Methoxyethanol	109-86-4	0.965	10,400
2-Methoxyethanol acetate	110-49-6	0.975	10,300
Methyl ethyl ketone	78-93-3	0.806	12,500
Methyl isobutyl ketone	108-10-1	0.798	12,600
Methyl methacrylate	80-62-6	0.945	10,600
Styrene	100-42-5	0.926	10,800
1,1,2,2-Tetrachloroethane	79-34-5	1.593	6,300
Tetrachloroethylene	127-18-4	1.621	6,200
Toluene (methyl benzene)	108-88-3	0.867	11,600
1,1,2-Trichloroethane	79-00-5	1.334	7,500
Trichloroethylene	79-01-6	1.463	6,900
Vinyl chloride monomer	75-01-4	0.911	11,000
Xylenes (mixture of isomers)	1330-20-7	0.860	11,700

1. Calculated by: 10 000 kg ÷ liquid density, rounded up to the nearest hundred.

Table 4 shows the minimum amount of pure organic liquids (which are defined as volatile organic compounds under the NPI) stored to exceed the Category 1a threshold for reporting total volatile organic compounds (Total VOC). If both the Category 1 and Category 1a thresholds are exceeded for a substance, then an emission for both the substance and Total VOC will be reported. For example, if a facility uses 40 000 L of acetone in a year, an emission is required for both acetone and Total VOC. The emission is calculated by using the emission factor for acetone, and the results reported identically against both acetone and Total VOC.

If a facility uses multiple VOCs (in Table 4), then the usage of each should be added together to determine if the 25 tonnes per year threshold has been exceeded. In the event the threshold is exceeded, emissions for each individual substance should be calculated, and then added together for the emission of Total VOC. Emissions will be reported for both individual substances as well as Total VOC in this case.

Table 4: Minimum of pure organic liquid stored to exceed the Category 1a (25 tonnes) reporting threshold (Total VOC)

Substance	CAS No.	Liquid density at 20 °C (kg/L)	Reporting threshold (L)
Acetaldehyde (ethanal)	75-07-0	0.788	31,800
Acetic acid	64-19-7	1.048	23,900
Acetone	67-64-1	0.792	31,600
Acetonitrile	75-05-8	0.784	31,900
Acrylic acid	79-10-7	1.059	23,700
Acrylonitrile	107-13-1	0.808	31,000
Aniline	62-53-3	1.021	24,500
Benzene	71-43-2	0.879	28,500
Carbon disulfide	75-15-0	1.262	19,900
Chloroform	67-66-3	1.489	16,800
Cumene (isopropyl benzene)	98-82-8	0.792	31,600
Cyclohexane	110-82-7	0.779	32,100
1,2-Dibromoethane	106-93-4	1.255	20,000
1,2-Dichloroethane	107-06-2	1.253	20,000
Dichloromethane	75-09-2	1.362	18,400
Ethanol (ethyl alcohol)	64-17-5	0.772	32,400
2-Ethoxyethanol	110-80-5	0.93	26,900
2-Ethoxyethanol acetate	111-15-9	0.975	25,700
Ethyl acetate	141-78-6	0.905	27,700
Ethylbenzene	100-41-4	0.864	29,000
Ethyl butyl ketone	106-35-4	0.818	30,600
Ethyl chloride (Chloroethane)	75-00-3	0.918	27,300
Ethylene oxide	75-21-8	0.864	29,000
Formaldehyde (37%, Formalin)	50-00-0	1.09	23,000
Glutaraldehyde (25%, Cidex)	111-03-8	1.106	22,700
n-Hexane	110-54-3	0.658	38,000
Methanol (methyl alcohol)	67-56-1	0.792	31,600
2-Methoxyethanol	109-86-4	0.965	26,000
2-Methoxyethanol acetate	110-49-6	0.975	25,700
Methyl ethyl ketone	78-93-3	0.806	31,100

Substance	CAS No.	Liquid density at 20 °C (kg/L)	Reporting threshold (L)
Methyl isobutyl ketone	108-10-1	0.798	31,400
Methyl methacrylate	80-62-6	0.945	26,500
Styrene	100-42-5	0.926	27,000
1,1,2,2-Tetrachloroethane	79-34-5	1.593	15,700
Tetrachloroethylene	127-18-4	1.621	15,500
Toluene (methyl benzene)	108-88-3	0.867	28,900
1,1,2-Trichloroethane	79-00-5	1.334	18,800
Trichloroethylene	79-01-6	1.463	17,100
Vinyl chloride monomer	75-01-4	0.911	27,500
Xylenes (mixture of isomers)	1330-20-7	0.86	29,100

1. Calculated by: 25 000 kg ÷ liquid density
   Rounded up to the nearest hundred.

4.2.1 Calculating usage (and thresholds) of stored organic liquids

To calculate the total emission of a stored organic liquid:

1. Determine the type and characteristics of the storage tank you have.

2. Determine the volume of organic liquid in the tank at the start of the reporting period.

3. Determine organic liquid usage:

   use = starting volume (L) + (no. times tank filled × average volume filled (L));
   or
   use = starting volume (L) + total volume filled (L).

4. Determine if a reporting threshold has been exceeded (for both the individual substance and Total VOC)

   Note: if multiple liquids are used, you will need to convert L of organic liquid to kgs to determine if the Total VOC threshold has been tripped
   Usage (kg) = Usage (L) x density (kg/L).

If the quantity of any individual organic liquid used exceeds 10 tonnes (10,000 kg) or 25 tonnes for Total VOC you will need to report the emissions of the substance, and any other emissions of the substance resulting from other activities on your facility to the NPI.

Example 3: Determine if a facility that stores acetone in a floating roof tank in Victoria (Zone 11) needs to report to the NPI. The tank is refilled monthly (12 times a year) with an average of 2,000L added each time. Records indicate that there was approximately 5,000 L in the tank at the start of the reporting period.

Step 1: Determine the type and characteristics of the tank
Tank type Floating roof

Step 2: Determine the volume of organic liquid in the tank at the start of the reporting period
5,000 L

Step 3: Determine organic liquid usage
Annual use of acetone = starting volume (L) + (no. times tank filled × average volume filled (L))

Annual use of acetone = 5,000 + (12 × 2,000)
= 29,000 L

Step 4: Establish if reporting thresholds have been exceeded

From Table 3: 29,000 L is greater than the Category 1 reporting threshold for acetone (12 700 L), therefore reporting of emissions for this substance is required.

From Table 4: 29,000 L is less than the threshold for reporting of Total VOC (31,600 L) from acetone, therefore emissions of Total VOC are not reportable in this example.

Example 4: Determine which thresholds have been tripped for a facility that stores benzene and toluene separately in floating roof tanks in Zone 1. The benzene tank is filled monthly (12 times a year) with an average 2,000L added each time. The toluene tank is filled fortnightly (26 times a year) with an average of 2,000L added each time. Records indicate that there was approximately 1,000L in both tanks at the start of the reporting period.

Step 1: Determine the type and characteristics of the tank

Tank type (benzene)	Floating roof
Tank type (toluene)	Floating roof

Step 2: Determine the volume of fuel in the tank at the start of the reporting period

Benzene: 1,000L
Toluene: 1,000L

Step 3: Determine organic liquid usage

Annual use of benzene = starting volume (L) + (no. times tank filled × average volume filled (L))
Annual use of benzene = 1,000 + (12 × 2,000)
= 25,000 L

Annual use of toluene = starting volume (L) + (no. times tank filled × average volume filled (L))
Annual use of toluene = 1,000 + (26 × 2,000)
= 53,000 L

Step 4: Establish if reporting thresholds have been exceeded

Benzene: from Table 3: 25,000 L is greater than the Category 1 reporting threshold for benzene (11 400 L), therefore reporting of emissions for this substance is required.

Toluene: from Table 3: 53,000 L is greater than the Category 1 reporting threshold for toluene (11 600 L), therefore reporting of emissions for this substance is required.

Total VOC: As multiple organic liquids are stored, need to determine the total usage in kg. Thus need the densities of the liquids from Table 1.
Liquid density (kg/L) 0.879 (benzene) and 0.867 (toluene)

Annual use of Total VOC (kg) = benzene use (kg) + toluene use (kg)
= benzene use (L) x benzene density (kg/L) + toluene use (L) x toluene density (kg/L)
= 25,000L x 0.879kg/L + 53,000L x 0.867kg/L
= 67,926kg (67.9 tonnes)

67.9 tonnes is greater than the Category 1a reporting threshold for Total VOC (25 tonnes), therefore reporting of Total VOC is required.

5 Emission calculations

The emissions to air, land and water for every NPI substance that trips a threshold must be reported from all point and fugitive sources on the facility. *The NPI Guide* outlines detailed information on thresholds and identifying emission sources.

There are five emission estimation techniques (EETs) that may be used to calculate emissions from your facility. These are:

- sampling data or direct measurement
- mass balance
- fuel analysis or engineering calculations
- emission factors, and,
- an approved alternative.

Using one of these techniques will result in your data being displayed on the NPI database as being of 'acceptable reliability'.

Generally, facilities with fuel and organic liquid storage report emissions for relevant substances using the emission factor method however mass balance or fuel analysis may also be used. Emission factors, mass balance and fuel analysis (engineering calculations) methodologies are described in this section, but other emission estimation techniques can be found in *The NPI Guide.*

This manual seeks to provide the most effective emission estimation techniques for the NPI substances relevant to the storage of fuels and organic liquids. However, the absence of an EET for a substance in the manual does not imply that an emission should not be reported to the NPI. Reporters should make the best attempt to estimate emissions using an alternative estimation technique in these situations.

You should note that the EETs presented in this manual relate principally to average process emissions. Emissions resulting from non routine events are rarely discussed in the literature, and there is a general lack of EETs for such events. However, it is important to recognise that emissions resulting from significant operating excursions and/or accidental situations (e.g. spills) will also need to be estimated. Emissions to land, air and water from spills must be estimated and added to process emissions when calculating total emissions for reporting purposes. The emission resulting from a spill is the net emission, i.e. the quantity of the NPI reportable substance spilled, less the quantity recovered or consumed immediately (within 24 hours) during clean up operations.

5.1 Emission factors

An emission factor is a tool that is used to estimate emissions to the environment. In this manual, it relates the quantity of substances emitted from a source to some common activity associated with those emissions. Emission factors are usually expressed as the mass of a substance emitted multiplied by the unit mass, volume, distance or duration of the activity emitting the substance (e.g. kilograms of benzene per tonne of unleaded petrol stored).

When using emission factors, you should be aware of the associated emission factor rating (EFR) code and what the rating implies. An A or B rating indicates a greater degree of certainty than a D or E rating. The main criterion affecting the uncertainty of an emission factor remains the degree of similarity between the equipment/process selected in applying the factor and the target equipment/process from which the factor was derived.

The EFR system is:

A	Excellent
B	Above average
C	Average
D	Below average
E	Poor
U	Unrated

Emission factors are used to estimate a facility's emissions by the general equation:

Equation 1

$$E_{kpy,\,i} = (A \times OpHrs) \times EF_i \times [1 - (CE_i \div 100)]$$

Where:

$E_{kpy,\,I}$	=	emission rate of pollutant i, kg/yr
A	=	activity rate, t/hr
OpHrs	=	operating hours, hr/yr
EF_i	=	uncontrolled emission factor for pollutant i, kg/t
CE_i	=	overall control efficiency of pollutant i, %

Emission factors applicable to this manual are listed in Appendix F.

You must ensure that you estimate emissions for all substances relevant to your process, including activities not related to fuel or organic liquid storage.

Emission factors developed from measurements for a specific process may sometimes by used to estimate emissions at other sites. For example, a company may have several units of similar model and size. If emissions were measured from one facility, an emission factor could be developed and applied to similar sources. If you wish to use a site-specific emission factor, you should be mindful of the climate conditions of each facility. You should also seek approval from your state or territory environment agency before its use for estimating emissions.

5.2 Approved alternative

You are permitted to use emission estimation techniques that are not outlined in this document. However, you must seek the consent of your state or territory environmental agency. For example, if your company has developed site-specific emission factors, you may only use these if they have been approved by your local environmental agency.

5.3 Emissions from fuel storage

To calculate the total emission of a stored fuel:

1. Determine the fuel usage (previously done through the threshold calculations).

2. Convert litres to kilograms
   Mass = use × liquid density.

3. Convert kilograms to tonnes
   Tonnes = use (kg) divided by 1000.

4. Determine the zone for the facility (Appendix E).

5. Get the emission factors (Appendix F).

6. Calculate the emissions of the stored fuel.
   Emission = Mass × emission factor for the tank type and substance.

Note: If a threshold has been exceeded for a substance for which no emission factor is noted in Appendix F (for example PAH), the reporter is advised to consider using one of the other emission estimation techniques described in this manual. For further advice the reporter should contact the contact the NPI in the state or territory in which the facility is based.

Example 5 (continued from example 1): Calculate the emissions from an airport in Perth, WA. The site stores Avgas LL in an internal floating roof tank and the tank is refilled eight times a year with an average of 200 000L added each time. At the beginning of the reporting period, the gauge indicated that there was approximately 500,000L (500kL) in the tank.

Step 1: Determine the fuel usage
From Example 1 the annual use of Avgas LL is 2,100,000L

Step 2: Convert litres to kilograms
From Table 1: Liquid density (kg/L) 0.718

Use (kg) = Use (L) x density
= 2,100,000 x 0.718
= 1,507,800 kg

Step 3: Convert kilograms to tonnes
= 1,507,800 kg/1000

= 1,508 tonnes

Step 4: Determine the zone for the facility
Perth, WA is located in Zone 2

Step 5: Get the emission factors
Tank type (internal floating roof) and Zone 2

Emission factors (kg/tonne) Appendix F:

Benzene	0.00263
Cumene	0.00001
Cyclohexane	<0.00001
Ethylbenzene	0.00284
n-Hexane	0.00204
Lead	0.00011
Toluene	0.00690
Xylenes	0.00299
Total VOC	0.06915

Step 6: Estimate emissions for the substances identified as tripping the threshold (See Example 1).

$Emissions_{(substance)}$ kg = Use (tonnes) × emission factor

$Emissions_{(Benzene)}$ = Use × emission factor = 1 508 × 0.00263
$Emissions_{(Benzene)}$ = 3.97 kg

$Emissions_{(Ethylbenzene)}$ = Use × emission factor = 1 508 × 0.00284
$Emissions_{(Ethylbenzene)}$ = 4 .28 kg

$Emissions_{(n\text{-Hexane})}$ = Use × emission factor = 1 508 × 0.00204
$Emissions_{(n\text{-Hexane})}$ = 3.07 kg

$Emissions_{(Toluene)}$ = Use × emission factor = 1 508 × 0.00690
$Emissions_{(Toluene)}$ = 10.4 kg

$Emissions_{(Xylenes)}$ = Use × emission factor = 1 508 × 0.00299
$Emissions_{(Xylenes)}$ = 4.509 kg

$Emissions_{(Total\ VOC)}$ = Use × emission factor = 1 508 × 0.06915
$Emissions_{(Total\ VOC)}$ = 104.28 kg

The above substances and their emissions in kg must be reported to the NPI.

Example 6 (continued from Example 2): Calculate the emissions for a facility which is located in Zone 7 and stores diesel in an underground fixed roof tank and fuel oil in a vertical fixed roof tank. Engineering records indicate that the diesel tank contained approximately 72,000L (72kL) of diesel at the start of the reporting period and was refilled fifty-two times during the year with an average of 20,000L added each time. The fuel oil tank was empty at the beginning of the year and was filled once with a volume of 10,000L.

Step 1: Determine the fuel usage
From example 2 the annual use of diesel is 1 112 000L and the annual use of fuel oil is 10 000L.

Step 2: Convert litres to kilograms
From Table 1: Liquid density (kg/L) 0.836 (diesel) and 0.848 (fuel oil)

Diesel use (kg) = Use (L) x density
= 1,112,000 x 0.836
= 929,632 kg

Fuel oil use (kg) = Use (L) x density
= 10,000 x 0.848
= 8480 kg

Step 3: Convert kilograms to tonnes
Diesel use = 929,632 kg/1000
= 929.63 tonnes

Fuel oil use = 8,480 kg/1000
= 8.48 tonnes

Step 4: Determine the zone for the facility
Zone 7

Step 5: Get the emission factors
Zone 7 and tank type: horizontal fixed roof (diesel) and vertical fixed roof (fuel oil)

Diesel emission factors (kg/tonne):

Total VOC	0.73810

Fuel oil emission factors (kg/tonne):

Total VOC	0.13333

Step 5: Estimate emissions for the substances identified as tripping the threshold (See Example 2)
$Emissions_{(Total\ VOC)}$ = Use × emission factor (for each fuel type)
= 929.63 × 0.73810 + 8.48 x 0.13333
$Emissions_{(Total\ VOC)}$ = 687.29 kg
An emission for Total VOC of 687.29 kg must be reported to the NPI.

5.4 Emissions from organic liquid storage

To calculate the total emission of a stored organic liquid:

1. Determine the organic liquid usage (previously done through the threshold calculations).

2. Convert litres to kilograms
   Mass = use × liquid density

3. Convert kilograms to tonnes
   Tonnes = use(kg) divided by 1000.

4. Determine the zone for the facility (Appendix E).

5. Get the emission factors (Appendix F).

6. Calculate the emissions of the stored organic liquid.
   Emission = Mass × emission factor for the tank type and substance

Note: If a threshold has been exceeded for a substance for which no emission factor is noted in Appendix F, the reporter is advised to consider using one of the other emission estimation techniques described in this manual. For advice, the reporter should contact the contact the NPI in the state or territory in which the facility is based.

Example 7 (continued from Example 3): Calculate the emissions for a facility that stores acetone in a floating roof tank in Victoria (Zone 11). The tank is refilled monthly (12 times a year) with an average of 2,000L added each time. Records indicate that there was approximately 5,000 L in the tank at the start of the reporting period.

Step 1: Determine the organic liquid usage
Acetone usage: 29,000 L

Step 2: Convert litres to kilograms
Use (kg) = Use (L) × density
= 29,000 × 0.792
= 22,968 kg

Step 3: Convert kilograms to tonnes
Acetone use = 22 968 kg/1000
= 22.968 tonnes

Step 4: Determine the zone for the facility
Zone 11

Step 5: Get the emission factors
Zone 11, Floating roof tank

Emission factor (kg/tonne): 0.253

Step 6: Calculate the emissions for acetone

$\text{Emissions}_{(\text{acetone})}$ = Use × emission factor

= 22.968 × 0.253

$\text{Emissions}_{(\text{acetone})}$ = 5.81 kg

An emission for acetone of 5.81 kg must be reported to the NPI.

Example 8 (continued from Example 4): Calculate the emissions for a facility that stores benzene and toluene separately in floating roof tanks in Zone 1. The benzene tank is filled monthly (12 times a year) with an average 2,000L added each time. The toluene tank is filled fortnightly (26 times a year) with an average of 2,000L added each time. Records indicate that there was approximately 1,000L in both tanks at the start of the reporting period.

Step 1: Determine the organic liquid usage
Annual use of benzene – 25,000L
Annual use of toluene – 53,000L

Step 2: Convert litres to kilograms
Liquid density (kg/L) 0.879 (benzene) 0.867 (toluene)
Benzene use (kg) = Benzene (L) × density
= 25,000 × 0.879
= 21,975 kg
Toluene use (kg) = Toluene (L) × density
= 53,000 × 0.867
= 45,951 kg

Step 3: Convert kilograms to tonnes
Benzene use = 21,975 kg/1000
= 21.975 tonnes

Toluene use = 45,951 kg/1000
= 45.951 tonnes

Step 4: Determine the zone for the facility
Zone 1

Step 5: Get the emission factors
Zone 1, floating roof tank
Emission factor (kg/tonne) 0.037 (benzene) 0.171 (toluene)

Step 6: Calculate the emissions for each substance
Emissions $_{(benzene)}$ = Use × emission factor
= 21.975 × 0.037
= 0.81308 kg

Emissions $_{(toluene)}$ = Use × emission factor
= 45.951 × 0.171
= 7.858 kg

As Total VOC emissions are reportable as a result of the combined usage of both substances, and individual use of Total VOC, the Total VOC emission is estimated as follows:

Emissions $_{(Total\ VOC)}$ = Emissions $_{(benzene)}$ +Emissions $_{(toluene)}$
= 0.81308 kg + 7.858 kg
= 8.67 kg
The emissions for benzene, toluene and Total VOC must be reported to the NPI.

6 Transfers of NPI substances in waste

The NPI requires the mandatory reporting of NPI substances that are transferred as waste to a final destination. Transfers are required to be reported if a Category 1, Category 1b or Category 3 reporting threshold is exceeded. For example, if the threshold has been exceeded for the Category 1 substance benzene as a result of use of this substance on site, transfers to final destination of benzene as well as emissions are reportable.

There is no requirement to report transfers of substances that are exclusively Category 2a or 2b in the event that they have been tripped only by the fuel and energy use threshold (i.e. there is no requirement to report transfers of oxides of nitrogen, particulate matter ≤10 μm, particulate matter ≤ 2.5 μm, polychlorinated dioxins and furans, or polycyclic aromatic hydrocarbons).

Both emissions and transfers are reportable in kilograms.

In the specific context of fuel and organic liquid storage operations, the quantities of NPI substances contained in waste moved onsite or offsite to landfill or other final destination will need to be reported as a transfer. These also include waste containing NPI substances that are also discharged to the sewerage system as part of an industrial disposal system.

Currently there are no generic transfer factors that are available for estimation of transfers from fuel and organic liquid storage operations. Reporters are advised to estimate transfers based on monitoring, licensing arrangements (such as those for discharge to sewer), engineering calculations, or an appropriate alternative technique for the operation.

The transfer of NPI substances to a destination for reuse, recycling, reprocessing, purification, partial purification, immobilisation, remediation or energy recovery can be reported voluntarily. This is an opportune way for facilities to promote good news stories to their local community.

Further information regarding transfers of waste can be located in *The NPI Guide*.

7 Next steps for reporting

This manual has been written to reflect the common processes employed in fuel and organic liquid storage. To ensure a complete report of the emissions for your facility, it may be necessary to refer to other EET manuals. These include:

- Combustion in boilers
- Combustion in engines
- Fugitive emissions, and
- industry-specific emission estimation technique manuals.

When you have a complete record of substance emissions from your facility, report these emissions according to the instructions in *The NPI Guide.*

The NPI website (www.npi.gov.au) may have additional reporting materials, including calculation tools, for fuel and organic liquid storage.

8 References

Department of the Environment and Heritage. National Pollutant Inventory. 21 October 2004. *Emissions Estimation Technique Manual for Fuel and Organic Liquid Storage. Version 2.5*.

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United States Environmental Protection Agency. September 2006. *Emission Factor Documentation for AP-42. Section 7.1 Organic Liquid Storage Tanks. Final Report*. United States Environmental Protection Agency, Office of Air Quality Planning and Standards Emission Factor and Inventory Group. Research Triangle Park, NC, USA.

Appendix A: Definitions and abbreviations

	Definition
°C	degrees Celsius
API	American Petroleum Institute
Avgas	Avgas is a high-octane fuel used for aircraft. Avgas is an abbreviation for aviation gasoline, and is only used in aircraft that use piston engines. Jet aircraft and turboprops use kerosene jet fuel.
Avgas 100	Avgas 100 is a high octane grade aviation gasoline, containing a maximum of 1.12 grams of lead/litre.
Avgas LL	Avgas low lead
CAS	Chemical Abstracts Service
E10	Ethanol replacement petrol is based on sugar-derived ethanol. Data in this review are based on several Australian manufacturers. The quoted lead content is based on a single manufacturer which offers an E10 leaded fuel on the Australian market. Reports indicate that although E10 is marketed as a clean fuel, above 16 °C it possessed a higher Reid Vapour Pressure than standard US gasoline and increase acetaldehyde emissions.
EET	Emission Estimation Technique
Jet kerosene	Also known as Avtur, Jet-A, Jet-A1, Jet-B, JP-4, JP-5, JP-7 or JP-8
kg/L	kilograms (of substance) per litre
LP	leaded petrol
m	metres
m^3	cubic metre = 1,000 litres
MSDS	Material Safety Data Sheet
π	The ratio of the circumference to the diameter of a circle; approximately equal to 3.14
psi	pounds per square inch
PULP	Premium unleaded petrol is a special blend of petrol designed to bring high octane, and hence high engine power, as well as knock- free performance to unleaded cars with a high-octane requirement.
RON 98	Also known as 98 RON, it is a high-octane unleaded fuel.
SI Units	System International Units, also referred to as ‘metric units’.
tonnes	= 1000 kilograms
ULP	Unleaded petrol

Appendix B:
Modifications to the fuel and organic liquid storage emission estimation technique manual (Version 3.3 May 2012)

Page	Outline of alteration
Appendix G	TANKS User Manual

Modifications to the fuel and organic liquid storage emission estimation technique manual (Version 3.2 February 2010)

Page	Outline of alteration
Appendix F	Corrected emission factors for Total VOC
11	Updated fuel densities based for ULP, PULP, RON98 and E10
22	Corrected example 7, based on updates to Appendix F

Modifications to the fuel and organic liquid storage emission estimation technique manual (Version 3.1 May 2008)

Page	Outline of alteration
Throughout	Removed specific guidance or instructions relating to the use of TANKS 4.09.
4	Included discussion on biofuels
6-16	Updated threshold calculations for determining fuel storage
17-23	Updated emission estimation techniques relevant to fuel and organic liquid storage
24	Included section on next steps for reporting.
28	Appendix C: Transferred unit conversion factors
29	Appendix D: Reviewed tank types
36	Appendix F: New emission factors for fuel types and organic liquid types for different tank types These include obtaining emission factors for the NPI-listed volatile organic compounds.
Appendix F	Correct emission factors for the substance Total VOC to incorporate non-NPI listed VOC components for the fuels LP, ULP, PULP, RON98 and E10.
Throughout	References to “Kerosene” corrected to “Jet Kerosene”.

Appendix C: Unit conversion factors for use with TANKS 4.09b

COLUMN 1 To convert from	COLUMN 2 To convert to	COLUMN 3 Multiply by
Mass		
Kilogram (kg)	Pound (lb)	2.204
Pound (lb)	Kilogram (kg)	0.454
Tonne (metric)	Ton (US~2 000lb)	1.102
Ton (US~2 000lb)	Tonne (metric)	0.907
Tonnes (t)	Kilograms (kg)	1000
Kilograms (kg)	Tonnes (t)	0.001
Volume		
US gallon^3	Cubic metres (m^3)	0.003 785
Cubic metres (m^3)	US gallon	264.200
US gallons	Litres (L)	3.785
Litres (L)	US gallons	0.2642
Litres (L)	Cubic foot (ft^3)	0.0353
Cubic foot (ft^3)	Litres (L)	28.33
Length		
Metres (m)	Foot (ft)	3.280
Foot (ft)	Metres (m)	0.304
Temperature		
Celsius (^oC)	Fahrenheit (^oF)	$9/5 \times {}^oC + 32$
Fahrenheit (^oF)	Celsius (^oC)	$({}^oF - 32) \times 5/9$
Pressure		
lb per square inch (psi)	Hectopascal (hPa)	69
Hectopascal (hPa)	lb per square inch (psi)	0.01450
Millibar	Hectopascal	1

Note:

1. The unit psi is either psig (pound per square inch gauge) or psia (pounds per square inch absolute). Gauge is in reference to 1 atmosphere pressure (14.7 psia or 101.3 kPa)
2. Note US gallons are **not** the same as UK gallons.
3. In relation to any work involving TANKS the unit gallon or gal refers to US gallons.

Appendix D: Tank types

D.1 Fixed roof tanks

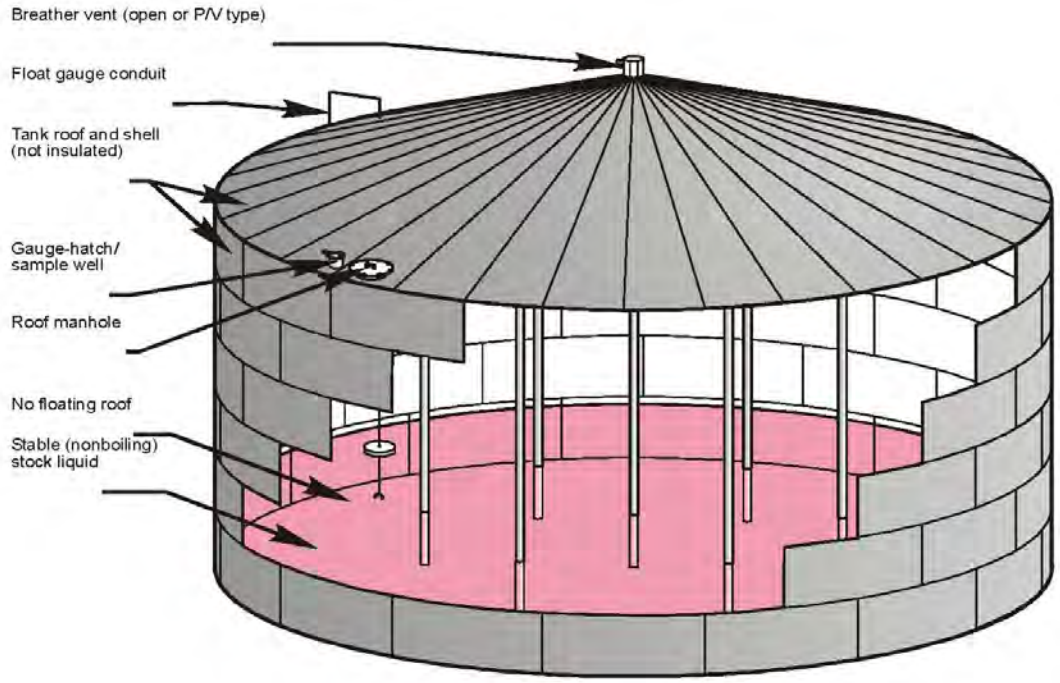
Fixed roof tanks consist of a cylindrical shell capped with a permanently fixed roof that may be flat, conical or dome-shaped. The tank is generally allowed to vent freely to the atmosphere, or will have pressure/vacuum vents (or a breather valve) installed. The vents allow the formation of internal working pressure to minimise losses caused by changes in temperature, pressure and liquid level.

The major differences between horizontal and vertical tanks are the orientation, and the use of the tank as either an above ground or submerged (below ground) tank. Vertical tanks are only constructed above ground. As with vertical tanks, horizontal tanks are equipped with pressure/vacuum vents. The general rule of thumb in designing horizontal tanks is to ensure that the length of the shell is no more than six times its diameter. This design reduces the chance of structural failure; however this restricts horizontal tanks to smaller capacities.

Several methods are used to control emissions from fixed-roof tanks:

- installation of an internal floating roof and adjusting seals to minimize evaporation of the product being stored
- vapour balancing, where vapours expelled are directed to the emptying petroleum tanker truck. The truck then transports the vapours to a central station where a vapour recovery or control system is used to control emissions, or
- vapour-recovery systems, where emissions are collected from storage vessels and converted to the liquid product. Several vapour-recovery procedures may be used, including vapour/liquid absorption, vapour compression, vapour cooling, vapour/solid adsorption, or a combination of these.

Figure 1: Vertical fixed roof tank
(Source: USEPA, September 2006)



D.1.1 Horizontal fixed roof

Horizontal fixed roof tanks are constructed for both above-ground and underground service and are usually built of steel, steel with a fibreglass overlay or fibreglass-reinforced polyester. They are usually equipped with pressure-vacuum vents, gauge hatches, sample wells and access points. Underground tanks may be protected to prevent corrosion of the tank shell. Capacity is generally less than 150 000 litres.

Emission sources for above-ground fixed roof tanks are the same as those for vertical fixed roof tanks.

Emissions from underground fixed roof storage tanks are associated mainly with changes in the liquid level in the tank. Losses caused by changes in temperature or barometric pressure are minimised for underground tanks because the surrounding earth limits diurnal temperature change; changes in barometric pressure result in only small losses.

D.2 Floating roof tanks

There are two distinct types of floating roof tank designs utilised for storage of fuel and organic liquids. These are internal and external floating roof tanks, both of which can have variations in their final design.

Emissions from floating roof tanks may be considered as the sum of standing storage losses and withdrawal losses. Withdrawal losses occur as the liquid level, and thus the floating roof, is lowered. Some liquid remains on the inner tank wall surface and evaporates. For an internal floating roof tank that has a column supported fixed roof,

some liquid also clings to the columns and evaporates. Evaporative loss occurs until the tank is filled and the exposed surfaces are again covered. Standing storage losses from floating roof tanks include rim seal deck fitting losses, and deck seam losses for constructions other than welded decks. Other potential standing storage loss mechanisms include breathing losses as a result of temperature and pressure changes.

D.2.1 Internal floating roof tanks

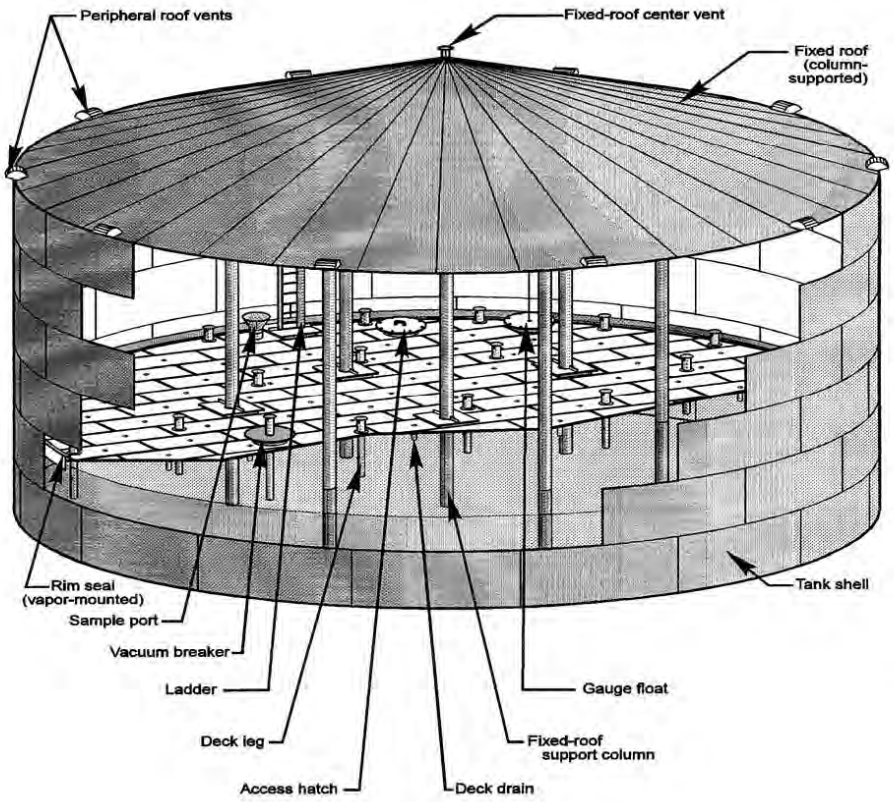
An internal floating roof tank has a permanent fixed roof on the tank and a floating roof on top of the stored liquid. The floating roof can either rest directly on the liquid surface (a contact deck) or on pontoons, resting several centimetres above the liquid surface (a non contact deck).

Non contact decks are the most common type currently in use. Typical non contact decks are constructed of an aluminium deck and an aluminium grid framework supported above the liquid surface by tubular aluminium pontoons or some other buoyant structure.

Contact type decks include: aluminium sandwich panels with a honeycombed aluminium core floating in contact with the liquid; resin-coated, fibreglass-reinforced polyester (FRP), buoyant panels floating in contact with the liquid; and pan-type steel roofs, floating in contact with the liquid with our without the aid of pontoons. Most contact internal floating decks are pan-type steel or aluminium sandwich panel type. FRP deck types are less common.

Evaporative losses from floating roofs may come from deck fittings, non welded deck seams and the annular space between the deck and tank wall. In addition, these tanks are freely vented by circulation vents at the top of the fixed roof. The vents minimise the possibility of organic vapour accumulation (a “no vapour” zone) in the tank vapour space in concentrations approaching the flammable range.

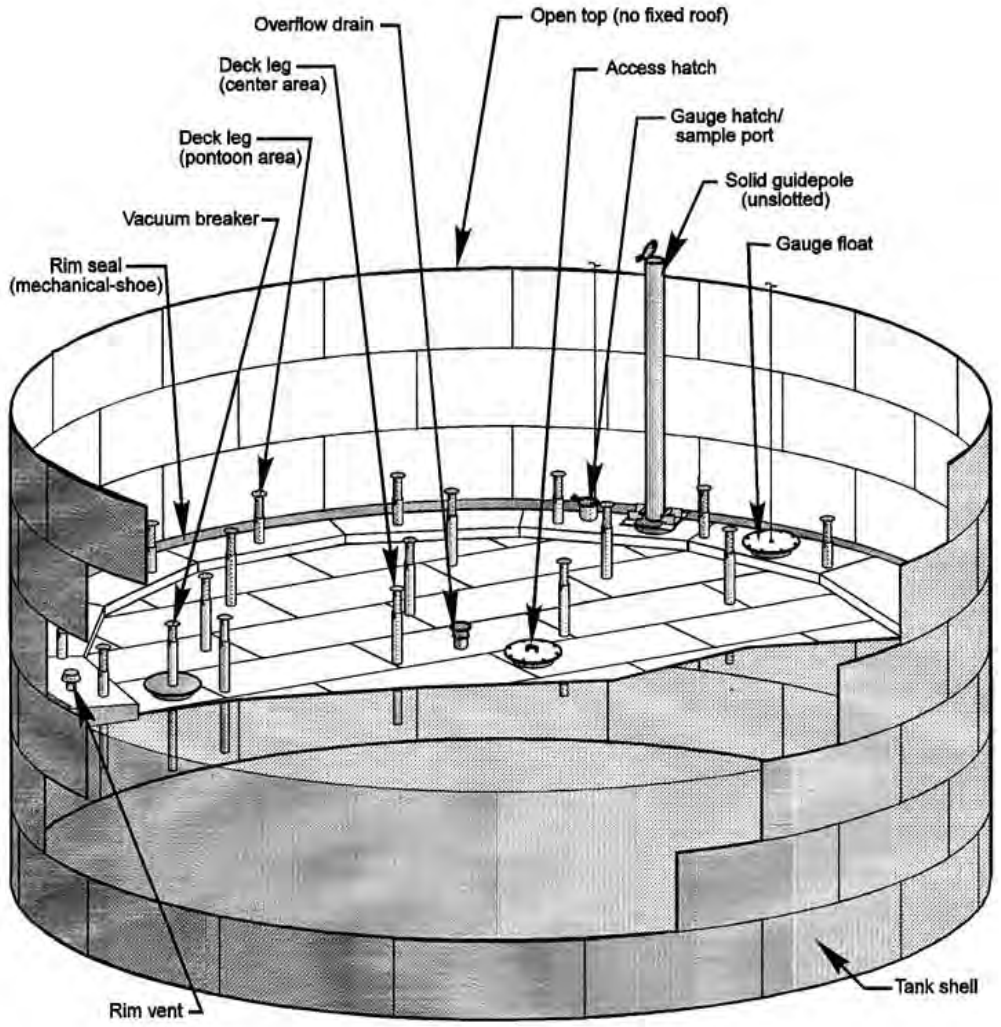
Figure 2: Internal floating roof tank
(Source: USEPA, September 2006)



D.2.2 External floating roof

A typical external floating roof tank consists of an open-topped cylindrical steel shell equipped with a roof that floats on the surface of the stored liquid. The floating roof consists of a deck, fittings and rim seal system. The floating decks are usually constructed of welded steel plate and are of two general types – pontoon and double-deck. With all types of external floating roof tanks, the roof rises and falls with the liquid level in the tank. External floating decks are equipped with a rim seal system attached to the deck perimeter and in contact with the tank wall. The purpose of the floating roof and rim seal system is to reduce evaporative loss of the stored liquid. Some annular space remains between the seal system and the tank wall. The seal system slides against the tank wall as the roof is raised and lowered. The floating deck is also equipped with fittings that penetrate the deck and serve operational functions. The external floating roof design is such that evaporative losses from the stored liquid are limited to losses from the rim seal system and deck fittings (standing storage loss) and any exposed liquid on the tank walls (withdrawal loss).

Figure 3: External floating roof tank
(Source: USEPA, September 2006)



Domed external floating roof tanks have the heavier type of deck used in external floating roof tanks, as well as a fixed roof at the top of the shell, as for the internal floating roof tank. The function of the fixed roof is as a weather barrier; however the tanks are freely vented by circulation vents at the top of the fixed roof. Deck fittings and rim seals are basically identical to those on external roof tanks.

D.3 Other tank types

D.3.1 Pressure tanks

Two classes of pressure tanks exist, low pressure and high pressure. These tanks are generally used for storing liquids with high vapour pressures. Pressure tanks are fitted with a pressure/vacuum vent that is set to prevent venting loss from boiling and breathing loss from daily temperature or barometric pressure changes. Under ideal operating conditions, high pressure tanks can be used with little or no working losses, whereas low pressure tanks exhibit working losses from atmospheric venting.

D.3.2 Variable vapour space tanks

Variable vapour space tanks are equipped with expandable vapour reservoirs to accommodate vapour volume fluctuations resulting from temperature and pressure changes. These tanks are usually connected to the vapour spaces of fixed roof tanks. The two most common types of variable vapour space tanks are lifter roof tanks and flexible diaphragm tanks.

Lifter roof tanks have a telescoping roof that fits loosely around the tank wall. The space between the roof and the wall is closed by a wet seal, a trough filled with liquid, or a dry seal, using a flexible coated fabric.

Flexible diaphragm tanks use flexible membranes to provide expandable volume. These may either be separate gasholder units or integral units mounted on top of fixed roof tanks.

Losses from variable vapour space tanks occur during tank filling when the vapour is displaced by the liquid. Loss of vapour occurs only when the tank's vapour storage capacity is exceeded.

Appendix E: Climatic zones

The storage of fuels and organic liquids in differing Australian climatic zones will contribute to variance in emissions from storage tanks. Default meteorological data has been developed using averaged data for various locations within each of 12 regions identified in the Australian Standard for automotive diesel fuel. These data can be used in the absence of specific meteorological data for a given location.

The 12 regions outlined on the map are South Australia South (1), Western Australia South (2), Western Australia Central (3), Australia North (4), Australia Central (5), Queensland Far North East (6), Queensland Central North (7), Queensland Central (8), Queensland South (9), New South Wales (10), Victoria (11), and Tasmania (12).

Figure 4: 12 climatic zones in Australia

Appendix F: Emission factors

The emission factors in this manual were developed through the modelling of raw data, assumptions and averages for Australian facilities, using the USEPA TANKS software application. It is assumed that the storage tanks are in excellent condition, well maintained, and that best practice is followed in filling and extracting. Moreover, the emission factors assume that there is throughput through the tank during the year. In the event you exceed a threshold as a result of storage (use), but the tank does not have any throughput, there will still be an emission as a result of venting. In these circumstances you should consider using an alternative emission estimation technique, or a comprehensive tool such as the USEPA TANKS application.

The emission factors are developed based on typical operations that occur within Australia. You may wish to adjust your emissions to reflect additional controls that are in use at your facility. For example, if your facility employs a vapour recovery mechanism on a venting tank, you should adjust the calculated emission by the efficiency of the device.

If the storage tanks operated by your facility do not fall within these parameters you may wish to use the US EPA TANKS application or an alternative approach to determine the most appropriate emissions estimates.

All emission factors are rated U as they are based on models using assumptions and averages, rather than actual measured emissions data.

Appendix F.1: Fuel storage- vertical fixed roof tank

	Zone (kg/tonne)											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
	South SA	South WA	Central WA	Northern Australia	Central Australia	Cape York	Central North Qld	Central Qld	South Qld	NSW	Vic	Tas
Crude oil												
Benzene	0.00103	0.00115	0.00178	0.00174	0.00151	0.00164	0.00160	0.00156	0.00133	0.00114	0.00099	0.00078
Cumene	0.00002	0.00002	0.00004	0.00004	0.00003	0.00004	0.00004	0.00004	0.00003	0.00002	0.00002	0.00001
Cyclohexane	0.00896	0.01002	0.01541	0.01507	0.01312	0.01421	0.01385	0.01354	0.01160	0.00991	0.00865	0.00685
Ethylbenzene	0.00017	0.00020	0.00033	0.00034	0.00027	0.00031	0.00030	0.00029	0.00024	0.00020	0.00017	0.00012
n-Hexane	0.03823	0.04257	0.06471	0.06304	0.05543	0.05953	0.05817	0.05702	0.04906	0.04213	0.03697	0.02946
Lead	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	0.00133	0.00151	0.00244	0.00242	0.00203	0.00227	0.00219	0.00212	0.00178	0.00150	0.00128	0.00099
Xylenes	0.00064	0.00074	0.00125	0.00101	0.00111	0.00107	0.00073	0.00061	0.00124	0.00116	0.00088	0.00046
Total VOC	0.05038	0.05621	0.08596	0.08366	0.07350	0.07907	0.07687	0.07517	0.06528	0.05606	0.04896	0.03867
Fuel oil												
Benzene	0.00026	0.00029	0.00043	0.00043	0.00037	0.00041	0.00039	0.00038	0.00033	0.00028	0.00025	0.00020
Cumene	0.00025	0.00029	0.00048	0.00050	0.00039	0.00047	0.00044	0.00042	0.00035	0.00029	0.00024	0.00018
Cyclohexane	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	0.00002	0.00003	0.00005	0.00005	0.00004	0.00004	0.00004	0.00004	0.00003	0.00003	0.00002	0.00002
n-Hexane	0.00042	0.00047	0.00068	0.00067	0.00059	0.00065	0.00063	0.00061	0.00053	0.00046	0.00041	0.00033
Lead	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	0.00022	0.00025	0.00039	0.00039	0.00032	0.00037	0.00035	0.00034	0.00029	0.00025	0.00021	0.00017
Xylenes	0.00021	0.00023	0.00038	0.00039	0.00031	0.00037	0.00035	0.00033	0.00028	0.00023	0.00020	0.00015
Total VOC	0.07576	0.08788	0.14545	0.15152	0.11818	0.14242	0.13333	0.12727	0.10606	0.08788	0.07273	0.05455
Heating oil												
Benzene	-	-	-	-	-	-	-	-	-	-	-	-
Cumene	-	-	-	-	-	-	-	-	-	-	-	-
Cyclohexane	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	0.00009	0.00010	0.00016	0.00016	0.00013	0.00015	0.00014	0.00014	0.00012	0.00010	0.00008	0.00006
n-Hexane	-	-	-	-	-	-	-	-	-	-	-	-
Lead	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	0.00029	0.00033	0.00051	0.00052	0.00043	0.00049	0.00047	0.00045	0.00039	0.00033	0.00028	0.00022
Xylenes	0.00034	0.00038	0.00062	0.00063	0.00051	0.00060	0.00057	0.00054	0.00046	0.00038	0.00032	0.00024
Total VOC	0.34940	0.39759	0.61446	0.62651	0.51807	0.59036	0.56627	0.54217	0.46988	0.39759	0.33735	0.26506

	Zone (kg/tonne)											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
	South SA	South WA	Central WA	Northern Australia	Central Australia	Cape York	Central North Qld	Central Qld	South Qld	NSW	Vic	Tas
Kerosene												
Benzene	0.00475	0.00528	0.00787	0.00784	0.00674	0.00748	0.00721	0.00704	0.00608	0.00522	0.00457	0.00365
Cumene	0.00166	0.00191	0.00317	0.00326	0.00257	0.00307	0.00289	0.00276	0.00229	0.00188	0.00157	0.00118
Cyclohexane	0.01607	0.01782	0.02640	0.02624	0.02268	0.02505	0.02419	0.02365	0.02048	0.01762	0.01549	0.01243
Ethylbenzene	0.00064	0.00073	0.00117	0.00119	0.00096	0.00113	0.00107	0.00103	0.00086	0.00072	0.00061	0.00046
n-Hexane	0.09805	0.10826	0.15852	0.15695	0.13698	0.15009	0.14532	0.14244	0.12384	0.10709	0.09466	0.07646
Lead	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	0.00067	0.00075	0.00116	0.00117	0.00097	0.00111	0.00106	0.00103	0.00088	0.00074	0.00064	0.00050
Xylenes	0.00193	0.00220	0.00357	0.00365	0.00293	0.00344	0.00326	0.00312	0.00262	0.00218	0.00183	0.00140
Total VOC	0.60909	0.68182	1.05455	1.06364	0.88182	1.00909	0.96364	0.93636	0.80000	0.67273	0.58182	0.45455
Avgas 100												
Benzene	0.01296	0.01429	0.02162	0.02189	0.01796	0.01626	0.02068	0.01972	0.01895	0.01415	0.01254	0.01018
Cumene	<0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	<0.00001	<0.00001
Cyclohexane	0.00498	0.00548	0.00824	0.00832	0.00787	0.00543	0.00687	0.00751	0.00723	0.00622	0.00483	0.00394
Ethylbenzene	0.00017	0.00019	0.00031	0.00032	0.00030	0.00026	0.00019	0.00025	0.00028	0.00022	0.00016	0.00012
n-Hexane	0.01462	0.01602	0.02379	0.02394	0.02267	0.02094	0.01587	0.01418	0.01994	0.02171	0.01809	0.01164
Lead	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	0.00605	0.00675	0.01061	0.01087	0.01023	0.00921	0.00669	0.00582	0.00865	0.00967	0.00780	0.00463
Xylenes	0.00075	0.00085	0.00140	0.00146	0.00137	0.00121	0.00085	0.00072	0.00112	0.00128	0.00100	0.00056
Total VOC	1.32909	1.45636	2.16273	2.17636	2.06091	1.90364	1.44273	1.28909	1.81273	1.97364	1.64455	1.05818
Avgas LL												
Benzene	0.03859	0.04256	0.06440	0.06519	0.05348	0.06161	0.05873	0.05643	0.04843	0.04215	0.03734	0.03032
Cumene	0.00001	0.00001	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00001	0.00001	0.00001	0.00001
Cyclohexane	0.00002	0.00002	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003	0.00002	0.00002	0.00002	0.00002
Ethylbenzene	0.00596	0.00675	0.01104	0.01146	0.00881	0.01072	0.01005	0.00949	0.00792	0.00668	0.00570	0.00443
n-Hexane	0.03969	0.04350	0.06460	0.06500	0.05415	0.06157	0.05894	0.05687	0.04914	0.04308	0.03851	0.03161
Lead	0.00001	0.00001	0.00002	0.00002	0.00001	0.00002	0.00002	0.00001	0.00001	0.00001	0.00001	<0.00001
Toluene	0.03930	0.04388	0.06897	0.07065	0.05618	0.06646	0.06282	0.05985	0.05068	0.04344	0.03781	0.03005
Xylenes	0.00516	0.00585	0.00961	0.00998	0.00765	0.00934	0.00874	0.00825	0.00687	0.00579	0.00494	0.00383
Total VOC	1.345	1.475	2.190	2.203	1.836	2.087	1.998	1.928	1.666	1.460	1.305	1.072

	Zone (kg/tonne)											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
	South SA	South WA	Central WA	Northern Australia	Central Australia	Cape York	Central North Qld	Central Qld	South Qld	NSW	Vic	Tas
Diesel												
Benzene	0.00038	0.00043	0.00063	0.00063	0.00054	0.00060	0.00058	0.00057	0.00049	0.00042	0.00037	0.00029
Cumene	0.00056	0.00065	0.00107	0.00111	0.00087	0.00104	0.00098	0.00094	0.00078	0.00064	0.00053	0.00040
Cyclohexane	0.00013	0.00015	0.00022	0.00022	0.00019	0.00021	0.00020	0.00019	0.00017	0.00014	0.00013	0.00010
Ethylbenzene	0.00013	0.00015	0.00025	0.00025	0.00020	0.00024	0.00022	0.00022	0.00018	0.00015	0.00013	0.00010
n-Hexane	0.00021	0.00023	0.00034	0.00033	0.00029	0.00032	0.00031	0.00030	0.00026	0.00023	0.00020	0.00016
Lead	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	0.00036	0.00041	0.00063	0.00064	0.00053	0.00061	0.00058	0.00056	0.00048	0.00041	0.00035	0.00027
Xylenes	0.00035	0.00040	0.00064	0.00066	0.00053	0.00062	0.00059	0.00057	0.00047	0.00039	0.00033	0.00025
Total VOC	0.03231	0.03538	0.05231	0.05077	0.04462	0.04923	0.02000	0.04615	0.04000	0.03538	0.03077	0.02462
LP												
Benzene	0.00704	0.008	0.01311	0.01308	0.01076	0.01209	0.01168	0.0112	0.00942	0.00793	0.00677	0.00529
Cumene	0.00004	0.00005	0.00008	0.00009	0.00006	0.00008	0.00007	0.00007	0.00006	0.00005	0.00004	0.00003
Cyclohexane	0.0065	0.00737	0.01198	0.01193	0.00988	0.01104	0.01068	0.01026	0.00865	0.0073	0.00625	0.00491
Ethylbenzene	0.00119	0.00138	0.00245	0.00251	0.00193	0.0023	0.00218	0.00205	0.00168	0.00137	0.00113	0.00084
n-Hexane	0.03304	0.0373	0.05996	0.05947	0.04972	0.05512	0.05348	0.05148	0.04358	0.03699	0.03185	0.02516
Lead	0.00001	0.00001	0.00003	0.00003	0.00002	0.00003	0.00003	0.00002	0.00002	0.00001	0.00001	0.00001
Toluene	0.01767	0.02033	0.03459	0.03492	0.02786	0.03214	0.03079	0.02927	0.02428	0.02015	0.01689	0.01292
Xylenes	0.00505	0.0059	0.01049	0.01074	0.00826	0.00983	0.00932	0.00878	0.00716	0.00584	0.0048	0.00358
Total VOC	2.54154	2.86923	4.61231	4.57462	3.82462	4.24000	4.11385	3.96000	3.35231	2.84538	2.45000	1.93538
ULP												
Benzene	0.00804	0.00895	0.01248	0.01327	0.01073	0.01264	0.01203	0.01133	0.0101	0.00894	0.00773	0.00643
Cumene	0.00004	0.00004	0.00007	0.00008	0.00006	0.00007	0.00007	0.00006	0.00005	0.00004	0.00004	0.00003
Cyclohexane	0.00853	0.00682	0.00758	0.01049	0.01114	0.00906	0.01061	0.01012	0.00954	0.00757	0.00657	0.00549
Ethylbenzene	0.00167	0.00126	0.00143	0.00216	0.00236	0.00179	0.00222	0.00208	0.00193	0.00143	0.00119	0.00095
n-Hexane	0.03183	0.02569	0.02842	0.03889	0.04112	0.03377	0.03924	0.03751	0.03548	0.0284	0.02479	0.02084
Lead	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Toluene	0.0138	0.01555	0.02252	0.02425	0.019	0.02298	0.02169	0.02026	0.01781	0.01554	0.0132	0.01075
Xylenes	0.00529	0.00605	0.00916	0.01	0.00756	0.00943	0.00881	0.00815	0.00705	0.00604	0.00503	0.00399
Total VOC	2.44846	1.97615	2.18615	2.99154	3.16308	2.59769	3.01846	2.88538	2.72923	2.18462	1.90692	1.60308

	Zone (kg/tonne)											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
	South SA	South WA	Central WA	Northern Australia	Central Australia	Cape York	Central North Qld	Central Qld	South Qld	NSW	Vic	Tas
PULP												
Benzene	0.00804	0.00895	0.01248	0.01327	0.01073	0.01264	0.01203	0.01133	0.0101	0.00894	0.00773	0.00643
Cumene	0.00004	0.00004	0.00007	0.00008	0.00006	0.00007	0.00007	0.00006	0.00005	0.00004	0.00004	0.00003
Cyclohexane	0.00682	0.00758	0.01049	0.01114	0.00906	0.01061	0.01012	0.00954	0.00853	0.00757	0.00657	0.00549
Ethylbenzene	0.00126	0.00143	0.00216	0.00236	0.00179	0.00222	0.00208	0.00193	0.00167	0.00143	0.00119	0.00095
n-Hexane	0.02569	0.02842	0.03889	0.04112	0.03377	0.03924	0.03751	0.03548	0.03183	0.0284	0.02479	0.02084
Lead	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Toluene	0.0138	0.01555	0.02252	0.02425	0.019	0.02298	0.02169	0.02026	0.01781	0.01554	0.0132	0.01075
Xylenes	0.00529	0.00605	0.00916	0.01	0.00756	0.00943	0.00881	0.00815	0.00705	0.00604	0.00503	0.00399
Total VOC	1.97615	2.18615	2.99154	3.16308	2.59769	3.01846	2.88538	2.72923	2.44846	2.18462	1.90692	1.60308
RON98												
Benzene	0.00868	0.00966	0.01347	0.01433	0.01158	0.01364	0.01298	0.01223	0.0109	0.00965	0.00835	0.00694
Cumene	0.00007	0.00008	0.00012	0.00013	0.0001	0.00012	0.00011	0.0001	0.00009	0.00008	0.00006	0.00005
Cyclohexane	0.00981	0.0109	0.01509	0.01601	0.01302	0.01526	0.01455	0.01372	0.01226	0.01089	0.00945	0.00789
Ethylbenzene	0.00148	0.00169	0.00255	0.00278	0.00211	0.00262	0.00245	0.00227	0.00196	0.00169	0.00141	0.00112
n-Hexane	0.02843	0.03145	0.04303	0.0455	0.03737	0.04342	0.04151	0.03927	0.03522	0.03143	0.02743	0.02306
Lead	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	0.04839	0.05454	0.079	0.08504	0.06665	0.08059	0.07606	0.07105	0.06245	0.05448	0.0463	0.0377
Xylenes	0.00664	0.0076	0.01151	0.01256	0.00949	0.01184	0.01106	0.01023	0.00885	0.00759	0.00632	0.00502
Total VOC	2.18692	2.41923	3.31000	3.50000	2.87462	3.34000	3.19308	3.02077	2.70923	2.41769	2.11000	1.77385
E10												
Benzene	0.00853	0.0095	0.01324	0.01408	0.01139	0.01341	0.01276	0.01202	0.01071	0.00949	0.00821	0.00683
Ethylbenzene	0.00164	0.00187	0.00282	0.00308	0.00233	0.0029	0.00271	0.00251	0.00218	0.00187	0.00156	0.00124
n-Hexane	0.02808	0.03106	0.0425	0.04494	0.03691	0.04288	0.04099	0.03878	0.03479	0.03104	0.02709	0.02278
Lead	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Toluene	0.01847	0.02082	0.03015	0.03246	0.02544	0.03076	0.02903	0.02712	0.02384	0.0208	0.01767	0.01439
Xylenes	0.00683	0.00781	0.01183	0.01291	0.00976	0.01217	0.01137	0.01052	0.0091	0.0078	0.00649	0.00516
Ethanol	0.04872	0.05567	0.08409	0.09173	0.06945	0.08649	0.08085	0.07482	0.06479	0.0556	0.04635	0.03688
Total VOC	2.16000	2.38923	3.26923	3.45692	2.83923	3.29846	3.15308	2.98308	2.67615	2.38769	2.08385	1.75231

Appendix F.2: Fuel storage- internal floating roof tank

	Zone (kg/tonne)											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
	South SA	South WA	Central WA	Northern Australia	Central Australia	Cape York	Central North Qld	Central Qld	South Qld	NSW	Vic	Tas
Crude oil												
Benzene	0.00015	0.00015	0.00016	0.00016	0.00015	0.00016	0.00016	0.00016	0.00015	0.00015	0.00015	0.00015
Cumene	0.00006	0.00006	0.00006	0.00006	0.00006	0.00006	0.00006	0.00006	0.00006	0.00006	0.00006	0.00006
Cyclohexane	0.00127	0.00129	0.00133	0.00135	0.00131	0.00134	0.00133	0.00132	0.00130	0.00129	0.00127	0.00125
Ethylbenzene	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025
n-Hexane	0.00361	0.00366	0.00386	0.00392	0.00376	0.00388	0.00384	0.00379	0.00373	0.00367	0.00359	0.00353
Lead	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	0.00065	0.00065	0.00066	0.00066	0.00065	0.00066	0.00066	0.00066	0.00065	0.00065	0.00065	0.00065
Xylenes	0.00110	0.00111	0.00111	0.00111	0.00111	0.00111	0.00111	0.00111	0.00111	0.00111	0.00110	0.00110
Total VOC	0.00710	0.00717	0.00743	0.00752	0.00730	0.00746	0.00741	0.00734	0.00725	0.00718	0.00708	0.00699
Fuel oil												
Benzene	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
Cumene	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010
Cyclohexane	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	<0.00001	<0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	<0.00001	<0.00001	<0.00001
n-Hexane	0.00001	0.00001	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00001	0.00001	0.00001
Lead	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002
Xylenes	0.04308	0.04308	0.04308	0.04308	0.04308	0.04308	0.04308	0.04308	0.04308	0.04308	0.04308	0.04308
Total VOC	0.03030	0.03030	0.03030	0.03030	0.03030	0.03030	0.03030	0.03030	0.03030	0.03030	0.03030	0.03030
Heating oil												
Benzene	-	-	-	-	-	-	-	-	-	-	-	-
Cumene	-	-	-	-	-	-	-	-	-	-	-	-
Cyclohexane	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003
n-Hexane	-	-	-	-	-	-	-	-	-	-	-	-
Lead	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004
Xylenes	0.00014	0.00014	0.00014	0.00014	0.00014	0.00014	0.00014	0.00014	0.00014	0.00014	0.00014	0.00013
Total VOC	0.04819	0.04819	0.04819	0.04819	0.04819	0.04819	0.04819	0.04819	0.04819	0.04819	0.04819	0.04819

	Zone (kg/tonne)											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
	South SA	South WA	Central WA	Northern Australia	Central Australia	Cape York	Central North Qld	Central Qld	South Qld	NSW	Vic	Tas
Kerosene												
Benzene	0.00027	0.00028	0.00032	0.00034	0.00030	0.00033	0.00032	0.00031	0.00029	0.00028	0.00026	0.00025
Cumene	0.00134	0.00135	0.00137	0.00138	0.00136	0.00137	0.00137	0.00136	0.00136	0.00135	0.00134	0.00133
Cyclohexane	0.00089	0.00093	0.00107	0.00111	0.00100	0.00108	0.00106	0.00102	0.00097	0.00093	0.00088	0.00082
Ethylbenzene	0.00025	0.00025	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00025	0.00025	0.00025
n-Hexane	0.00418	0.00442	0.00522	0.00549	0.00481	0.00530	0.00516	0.00494	0.00468	0.00443	0.00411	0.00381
Lead	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	0.00010	0.00010	0.00011	0.00011	0.00010	0.00011	0.00011	0.00010	0.00010	0.00010	0.00010	0.00009
Xylenes	0.00091	0.00092	0.00094	0.00095	0.00093	0.00094	0.00094	0.00093	0.00092	0.00092	0.00091	0.00090
Total VOC	0.09091	0.09091	0.10000	0.10000	0.09091	0.10000	0.10000	0.09091	0.09091	0.09091	0.09091	0.08182
Avgas 100												
Benzene	0.00085	0.00088	0.00101	0.00105	0.00094	0.00102	0.00100	0.00096	0.00092	0.00088	0.00084	0.00079
Cumene	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Cyclohexane	0.00032	0.00033	0.00038	0.00039	0.00035	0.00038	0.00037	0.00036	0.00035	0.00033	0.00031	0.00030
Ethylbenzene	0.00008	0.00008	0.00008	0.00008	0.00008	0.00008	0.00008	0.00008	0.00008	0.00008	0.00008	0.00008
n-Hexane	0.00071	0.00075	0.00088	0.00092	0.00081	0.00089	0.00087	0.00083	0.00079	0.00075	0.00070	0.00065
Lead	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	0.00104	0.00106	0.00113	0.00115	0.00109	0.00114	0.00112	0.00111	0.00108	0.00106	0.00104	0.00101
Xylenes	0.00043	0.00043	0.00044	0.00044	0.00043	0.00044	0.00044	0.00043	0.00043	0.00043	0.00042	0.00042
Total VOC	0.06455	0.06818	0.08000	0.08364	0.07364	0.08091	0.07909	0.07545	0.07182	0.06818	0.06364	0.05909
Avgas LL												
Benzene	0.00252	0.00263	0.00300	0.00312	0.00281	0.00303	0.00297	0.00287	0.00275	0.00263	0.00249	0.00235
Cumene	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
Cyclohexane	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Ethylbenzene	0.00282	0.00284	0.00292	0.00295	0.00288	0.00293	0.00291	0.00289	0.00287	0.00285	0.00282	0.00279
n-Hexane	0.00194	0.00204	0.00239	0.00250	0.00221	0.00242	0.00236	0.00227	0.00215	0.00204	0.00190	0.00177
Lead	0.00011	0.00011	0.00011	0.00011	0.00011	0.00011	0.00011	0.00011	0.00011	0.00011	0.00011	0.00011
Toluene	0.00678	0.00690	0.00733	0.00748	0.00711	0.00738	0.00730	0.00718	0.00704	0.00691	0.00674	0.00659
Xylenes	0.00291	0.00299	0.00302	0.00296	0.00300	0.00299	0.00297	0.00295	0.00293	0.00293	0.00290	0.00288
Total VOC	0.06576	0.06915	0.08102	0.08475	0.07492	0.08203	0.08000	0.07695	0.07288	0.06915	0.06441	0.06000

	Zone (kg/tonne)											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
	South SA	South WA	Central WA	Northern Australia	Central Australia	Cape York	Central North Qld	Central Qld	South Qld	NSW	Vic	Tas
Diesel												
Benzene	0.00002	0.00002	0.00002	0.00003	0.00002	0.00003	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002
Cumene	0.00040	0.00040	0.00041	0.00041	0.00040	0.00041	0.00041	0.00040	0.00040	0.00040	0.00040	0.00039
Cyclohexane	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
Ethylbenzene	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005
n-Hexane	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
Lead	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005
Xylenes	0.00014	0.00014	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00014	0.00014	0.00014
Total VOC	0.00154	0.00154	0.00154	0.00154	0.00154	0.00154	0.00154	0.00154	0.00154	0.00154	0.00154	0.00154
LP												
Benzene	0.00049	0.00051	0.00059	0.00061	0.00055	0.00059	0.00058	0.00056	0.00054	0.00051	0.00048	0.00046
Cumene	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004
Cyclohexane	0.00044	0.00046	0.00053	0.00055	0.0005	0.00053	0.00052	0.00051	0.00048	0.00046	0.00044	0.00041
Ethylbenzene	0.00059	0.0006	0.00061	0.00062	0.0006	0.00062	0.00061	0.00061	0.0006	0.0006	0.00059	0.00059
n-Hexane	0.00173	0.00182	0.00215	0.00225	0.00199	0.00217	0.00212	0.00203	0.00193	0.00183	0.0017	0.00158
Lead	0.00018	0.00018	0.00018	0.00018	0.00018	0.00018	0.00018	0.00018	0.00018	0.00018	0.00018	0.00018
Toluene	0.00322	0.00328	0.0035	0.00357	0.00339	0.00352	0.00348	0.00342	0.00335	0.00329	0.00321	0.00313
Xylenes	0.003	0.00302	0.00309	0.00312	0.00305	0.0031	0.00308	0.00306	0.00304	0.00302	0.00299	0.00297
Total VOC	0.13308	0.14000	0.16538	0.17308	0.15308	0.16692	0.16308	0.15615	0.14846	0.14077	0.13077	0.12154
ULP												
Benzene	0.00056	0.00059	0.00067	0.0007	0.00063	0.00068	0.00066	0.00064	0.00061	0.00059	0.00055	0.00052
Cumene	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004
Cyclohexane	0.00047	0.00049	0.00056	0.00058	0.00052	0.00056	0.00055	0.00053	0.00051	0.00049	0.00046	0.00043
Ethylbenzene	0.00063	0.00063	0.00065	0.00066	0.00064	0.00065	0.00065	0.00064	0.00064	0.00063	0.00063	0.00062
n-Hexane	0.00134	0.00142	0.00167	0.00175	0.00154	0.00169	0.00165	0.00158	0.0015	0.00142	0.00132	0.00123
Lead	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Toluene	0.00252	0.00256	0.00273	0.00279	0.00265	0.00275	0.00272	0.00267	0.00262	0.00257	0.0025	0.00244
Xylenes	0.00314	0.00316	0.00324	0.00326	0.0032	0.00325	0.00323	0.00321	0.00319	0.00316	0.00314	0.00311
Total VOC	0.10308	0.10923	0.12846	0.13462	0.11846	0.13000	0.12692	0.12154	0.11538	0.10923	0.10154	0.09462

	Zone (kg/tonne)											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
	South SA	South WA	Central WA	Northern Australia	Central Australia	Cape York	Central North Qld	Central Qld	South Qld	NSW	Vic	Tas
PULP												
Benzene	0.0006	0.00063	0.00072	0.00075	0.00067	0.00073	0.00071	0.00069	0.00066	0.00063	0.00059	0.00056
Cumene	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005
Cyclohexane	0.0006	0.00063	0.00072	0.00075	0.00067	0.00073	0.00071	0.00069	0.00066	0.00063	0.00059	0.00056
Ethylbenzene	0.00072	0.00073	0.00075	0.00075	0.00074	0.00075	0.00074	0.00074	0.00073	0.00073	0.00072	0.00071
n-Hexane	0.00112	0.00118	0.00139	0.00145	0.00128	0.0014	0.00137	0.00131	0.00124	0.00118	0.0011	0.00102
Lead	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Toluene	0.00319	0.00325	0.00346	0.00353	0.00335	0.00348	0.00344	0.00338	0.00331	0.00325	0.00317	0.00309
Xylenes	0.00364	0.00366	0.00375	0.00378	0.00371	0.00376	0.00375	0.00372	0.00369	0.00367	0.00363	0.00361
Total VOC	0.08615	0.09077	0.10692	0.11154	0.09846	0.10769	0.10538	0.10077	0.09538	0.09077	0.08462	0.07846
RON98												
Benzene	0.0006	0.00063	0.00072	0.00075	0.00068	0.00073	0.00072	0.00069	0.00066	0.00063	0.0006	0.00056
Cumene	0.00007	0.00007	0.00007	0.00007	0.00007	0.00007	0.00007	0.00007	0.00007	0.00007	0.00007	0.00007
Cyclohexane	0.00067	0.0007	0.0008	0.00083	0.00075	0.00081	0.00079	0.00076	0.00073	0.0007	0.00066	0.00062
Ethylbenzene	0.00074	0.00074	0.00076	0.00077	0.00075	0.00077	0.00076	0.00076	0.00075	0.00074	0.00074	0.00073
n-Hexane	0.00149	0.00157	0.00185	0.00193	0.00171	0.00187	0.00182	0.00175	0.00166	0.00158	0.00146	0.00136
Lead	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	0.00883	0.009	0.00959	0.00978	0.00928	0.00964	0.00954	0.00937	0.00918	0.009	0.00878	0.00857
Xylenes	0.00395	0.00397	0.00407	0.0041	0.00402	0.00408	0.00406	0.00403	0.004	0.00397	0.00394	0.00391
Total VOC	0.11462	0.12077	0.14231	0.14846	0.13154	0.14385	0.14000	0.13462	0.12769	0.12154	0.11231	0.10462
E10												
Benzene	0.00059	0.00062	0.00071	0.00074	0.00067	0.00072	0.0007	0.00068	0.00065	0.00062	0.00059	0.00055
Cumene	-	-	-	-	-	-	-	-	-	-	-	-
Cyclohexane	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	0.00082	0.00082	0.00085	0.00085	0.00083	0.00085	0.00085	0.00084	0.00083	0.00082	0.00082	0.00081
n-Hexane	0.00147	0.00155	0.00183	0.00191	0.00169	0.00184	0.0018	0.00173	0.00164	0.00156	0.00145	0.00132
Lead	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002
Toluene	0.00337	0.00343	0.00366	0.00373	0.00354	0.00368	0.00364	0.00358	0.0035	0.00344	0.00335	0.00326
Xylenes	0.00405	0.00408	0.00418	0.00421	0.00413	0.00419	0.00417	0.00414	0.00411	0.00408	0.00405	0.00401
Ethanol	0.00508	0.00527	0.00596	0.0062	0.0056	0.00603	0.00591	0.00572	0.00549	0.00528	0.00503	0.00477
Total VOC	0.11308	0.11923	0.14077	0.14692	0.13000	0.14154	0.13846	0.13308	0.12615	0.12000	0.11154	0.10154

Appendix F.3: Fuel storage- external floating roof tank

	Zone (kg/tonne)											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
	South SA	South WA	Central WA	Northern Australia	Central Australia	Cape York	Central North Qld	Central Qld	South Qld	NSW	Vic	Tas
Crude oil												
Benzene	0.00019	0.00020	0.00022	0.00023	0.00019	0.00019	0.00019	0.00018	0.00018	0.00020	0.00018	0.00017
Cumene	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005
Cyclohexane	0.00184	0.00167	0.00164	0.00164	0.00173	0.00194	0.00162	0.00157	0.00171	0.00150	0.00155	0.00144
Ethylbenzene	0.00022	0.00021	0.00021	0.00021	0.00021	0.00022	0.00021	0.00021	0.00021	0.00021	0.00021	0.00020
n-Hexane	0.00636	0.00563	0.00549	0.00556	0.00492	0.00517	0.00593	0.00676	0.00542	0.00520	0.00583	0.00472
Lead	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	0.00061	0.00059	0.00059	0.00062	0.00065	0.00066	0.00061	0.00061	0.00061	0.00060	0.00062	0.00057
Xylenes	0.00092	0.00091	0.00091	0.00093	0.00094	0.00095	0.00092	0.00092	0.00092	0.00092	0.00092	0.00090
Total VOC	0.01018	0.00926	0.00911	0.00924	0.00870	0.00919	0.00954	0.01030	0.00910	0.00868	0.00936	0.00806
Fuel oil												
Benzene	0.00004	0.00005	0.00005	0.00006	0.00004	0.00004	0.00004	0.00004	0.00003	0.00005	0.00004	0.00003
Cumene	0.00011	0.00013	0.00012	0.00012	0.00014	0.00012	0.00012	0.00011	0.00011	0.00012	0.00011	0.00010
Cyclohexane	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
n-Hexane	0.00008	0.00007	0.00006	0.00007	0.00008	0.00009	0.00006	0.00006	0.00007	0.00005	0.00006	0.00005
Lead	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	0.00005	0.00005	0.00004	0.00004	0.00005	0.00006	0.00004	0.00004	0.00004	0.00005	0.00004	0.00003
Xylenes	0.00008	0.00007	0.00007	0.00008	0.00007	0.00006	0.00007	0.00007	0.00007	0.00006	0.00006	0.00006
Total VOC	0.03333	0.03939	0.03636	0.03636	0.04242	0.03636	0.03636	0.03333	0.03333	0.03636	0.03333	0.03030
Heating oil												
Benzene	-	-	-	-	-	-	-	-	-	-	-	-
Cumene	-	-	-	-	-	-	-	-	-	-	-	-
Cyclohexane	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	0.00003	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00003	0.00003	0.00004	0.00003	0.00003
n-Hexane	-	-	-	-	-	-	-	-	-	-	-	-
Lead	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	0.00007	0.00008	0.00008	0.00009	0.00007	0.00007	0.00007	0.00007	0.00006	0.00007	0.00006	0.00006
Xylenes	0.00015	0.00016	0.00017	0.00018	0.00016	0.00016	0.00016	0.00015	0.00015	0.00016	0.00015	0.00014
Total VOC	0.08434	0.09639	0.09639	0.10843	0.08434	0.08434	0.08434	0.08434	0.07229	0.08434	0.07229	0.07229

	Zone (kg/tonne)											
	1	2	3	4	5	6	7	8	9	10	11	12
	South SA	South WA	Central WA	Northern Australia	Central Australia	Cape York	Central North Qld	Central Qld	South Qld	NSW	Vic	Tas
Kerosene												
Benzene	0.00069	0.00076	0.00083	0.00091	0.00070	0.00066	0.00067	0.00062	0.00057	0.00074	0.00062	0.00053
Cumene	0.00106	0.00109	0.00115	0.00119	0.00108	0.00108	0.00108	0.00106	0.00103	0.00109	0.00103	0.00100
Cyclohexane	0.00234	0.00257	0.00279	0.00302	0.00235	0.00220	0.00225	0.00208	0.00191	0.00250	0.00209	0.00180
Ethylbenzene	0.00023	0.00025	0.00026	0.00028	0.00024	0.00024	0.00024	0.00023	0.00022	0.00024	0.00022	0.00021
n-Hexane	0.01345	0.01478	0.01597	0.01732	0.01341	0.01240	0.01273	0.01172	0.01074	0.01438	0.01195	0.01027
Lead	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	0.00014	0.00015	0.00016	0.00017	0.00014	0.00014	0.00014	0.00013	0.00012	0.00014	0.00013	0.00011
Xylenes	0.00081	0.00084	0.00090	0.00094	0.00083	0.00082	0.00082	0.00080	0.00077	0.00083	0.00077	0.00073
Total VOC	0.12727	0.13636	0.14545	0.15455	0.12727	0.12727	0.12727	0.11818	0.10909	0.12727	0.11818	0.10000
Avgas 100												
Benzene	0.00252	0.00276	0.00301	0.00326	0.00254	0.00238	0.00243	0.00225	0.00207	0.00269	0.00225	0.00195
Cumene	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Cyclohexane	0.00096	0.00105	0.00114	0.00123	0.00097	0.00090	0.00092	0.00085	0.00079	0.00103	0.00086	0.00075
Ethylbenzene	0.00009	0.00009	0.00010	0.00010	0.00009	0.00009	0.00009	0.00008	0.00008	0.00009	0.00008	0.00008
n-Hexane	0.00265	0.00290	0.00313	0.00339	0.00264	0.00243	0.00250	0.00230	0.00212	0.00283	0.00236	0.00203
Lead	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	0.00169	0.00181	0.00198	0.00212	0.00173	0.00168	0.00170	0.00160	0.00150	0.00178	0.00156	0.00140
Xylenes	0.00044	0.00046	0.00049	0.00051	0.00045	0.00045	0.00045	0.00044	0.00042	0.00046	0.00043	0.00041
Total VOC	0.24091	0.26364	0.28455	0.30818	0.24000	0.22091	0.22727	0.20909	0.19273	0.25727	0.21455	0.18455
Avgas LL												
Benzene	0.00749	0.00822	0.00895	0.00970	0.00756	0.00709	0.00725	0.00670	0.00616	0.00801	0.00671	0.00580
Cumene	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
Cyclohexane	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Ethylbenzene	0.00308	0.00322	0.00344	0.00360	0.00316	0.00313	0.00314	0.00303	0.00292	0.00319	0.00295	0.00278
n-Hexane	0.00719	0.00789	0.00849	0.00919	0.00716	0.00660	0.00679	0.00626	0.00575	0.00768	0.00640	0.00551
Lead	0.00009	0.00009	0.00009	0.00009	0.00009	0.00009	0.00009	0.00009	0.00009	0.00009	0.00009	0.00009
Toluene	0.01096	0.01178	0.01284	0.01375	0.01123	0.01089	0.01101	0.01037	0.00973	0.01157	0.01013	0.00912
Xylenes	0.00303	0.00316	0.00335	0.00349	0.00310	0.00308	0.00309	0.00299	0.00290	0.00313	0.00292	0.00277
Total VOC	0.24373	0.26746	0.28780	0.31153	0.24271	0.22373	0.23017	0.21220	0.19492	0.26034	0.21695	0.18678

	Zone (kg/tonne)											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
	South SA	South WA	Central WA	Northern Australia	Central Australia	Cape York	Central North Qld	Central Qld	South Qld	NSW	Vic	Tas
Diesel												
Benzene	0.00007	0.00007	0.00009	0.00008	0.00007	0.00006	0.00007	0.00006	0.00006	0.00007	0.00006	0.00005
Cumene	0.00039	0.00043	0.00040	0.00040	0.00044	0.00040	0.00040	0.00039	0.00038	0.00040	0.00038	0.00036
Cyclohexane	0.00002	0.00003	0.00002	0.00003	0.00003	0.00002	0.00002	0.00002	0.00002	0.00003	0.00002	0.00002
Ethylbenzene	0.00005	0.00006	0.00006	0.00006	0.00007	0.00006	0.00006	0.00005	0.00005	0.00006	0.00005	0.00005
n-Hexane	0.00004	0.00004	0.00003	0.00004	0.00005	0.00003	0.00003	0.00003	0.00003	0.00004	0.00003	0.00003
Lead	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	0.00009	0.00010	0.00009	0.00009	0.00011	0.00009	0.00009	0.00008	0.00008	0.00009	0.00008	0.00007
Xylenes	0.00016	0.00018	0.00017	0.00017	0.00019	0.00016	0.00016	0.00016	0.00015	0.00017	0.00015	0.00014
Total VOC	0.00615	0.00615	0.00462	0.00615	0.00769	0.00462	0.00462	0.00462	0.00462	0.00615	0.00462	0.00462
LP												
Benzene	0.00149	0.00164	0.00179	0.00194	0.00151	0.00141	0.00144	0.00133	0.00122	0.0016	0.00133	0.00115
Cumene	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004
Cyclohexane	0.00137	0.0015	0.00163	0.00176	0.00138	0.00128	0.00131	0.00121	0.00112	0.00146	0.00122	0.00106
Ethylbenzene	0.00065	0.00068	0.00073	0.00077	0.00067	0.00066	0.00067	0.00064	0.00062	0.00068	0.00063	0.00059
n-Hexane	0.00653	0.00719	0.00776	0.00838	0.00654	0.00599	0.00618	0.00568	0.00522	0.007	0.00581	0.005
Lead	0.00014	0.00014	0.00014	0.00014	0.00014	0.00014	0.00014	0.00014	0.00014	0.00014	0.00014	0.00014
Toluene	0.00531	0.00573	0.00626	0.0067	0.00546	0.00527	0.00535	0.00502	0.00471	0.00562	0.0049	0.0044
Xylenes	0.00316	0.00329	0.0035	0.00365	0.00324	0.00321	0.00322	0.00312	0.00301	0.00326	0.00304	0.00288
Total VOC	0.50231	0.55308	0.59692	0.64462	0.50308	0.46077	0.47538	0.43692	0.40154	0.53846	0.44692	0.38462
ULP												
Benzene	0.0017	0.00187	0.00204	0.00221	0.00172	0.0016	0.00165	0.00152	0.0014	0.00182	0.00152	0.00131
Cumene	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004
Cyclohexane	0.00143	0.00157	0.00171	0.00185	0.00145	0.00134	0.00138	0.00127	0.00117	0.00154	0.00128	0.00111
Ethylbenzene	0.00069	0.00072	0.00078	0.00081	0.00071	0.0007	0.00071	0.00068	0.00065	0.00072	0.00066	0.00062
n-Hexane	0.00507	0.00559	0.00603	0.00652	0.00508	0.00465	0.0048	0.00442	0.00406	0.00544	0.00452	0.00389
Lead	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Toluene	0.00414	0.00447	0.00489	0.00523	0.00427	0.00412	0.00417	0.00392	0.00368	0.00439	0.00383	0.00344
Xylenes	0.00331	0.00345	0.00367	0.00383	0.00339	0.00336	0.00338	0.00326	0.00315	0.00342	0.00318	0.00302
Total VOC	0.39000	0.43000	0.46385	0.50154	0.39077	0.35769	0.36923	0.34000	0.31231	0.41846	0.34769	0.29923

	Zone (kg/tonne)											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
	South SA	South WA	Central WA	Northern Australia	Central Australia	Cape York	Central North Qld	Central Qld	South Qld	NSW	Vic	Tas
PULP												
Benzene	0.00183	0.00201	0.00219	0.00237	0.00185	0.00172	0.00177	0.00163	0.0015	0.00196	0.00164	0.00141
Cumene	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00004	0.00004	0.00005	0.00004	0.00004
Cyclohexane	0.00185	0.00204	0.00221	0.00239	0.00187	0.00174	0.00178	0.00165	0.00152	0.00199	0.00166	0.00144
Ethylbenzene	0.0008	0.00083	0.00089	0.00093	0.00082	0.00081	0.00081	0.00078	0.00075	0.00082	0.00076	0.00072
n-Hexane	0.00421	0.00464	0.00501	0.00541	0.00422	0.00387	0.00399	0.00367	0.00337	0.00452	0.00375	0.00323
Lead	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Toluene	0.00525	0.00566	0.00619	0.00662	0.0054	0.00521	0.00528	0.00497	0.00466	0.00556	0.00485	0.00435
Xylenes	0.00383	0.004	0.00425	0.00444	0.00393	0.0039	0.00391	0.00378	0.00366	0.00396	0.00369	0.0035
Total VOC	0.32385	0.35692	0.38538	0.41615	0.32462	0.29769	0.30692	0.28231	0.25923	0.34769	0.28846	0.24846
RON98												
Benzene	0.00183	0.00202	0.0022	0.00238	0.00186	0.00173	0.00178	0.00164	0.00151	0.00197	0.00164	0.00142
Cumene	0.00006	0.00007	0.00007	0.00007	0.00007	0.00006	0.00007	0.00006	0.00006	0.00007	0.00006	0.00006
Cyclohexane	0.00206	0.00226	0.00246	0.00266	0.00208	0.00193	0.00198	0.00183	0.00168	0.00221	0.00185	0.0016
Ethylbenzene	0.00081	0.00085	0.00091	0.00096	0.00084	0.00083	0.00083	0.0008	0.00077	0.00084	0.00078	0.00073
n-Hexane	0.00561	0.00618	0.00667	0.00721	0.00563	0.00515	0.00532	0.00489	0.00449	0.00603	0.005	0.0043
Lead	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	0.01453	0.01568	0.01714	0.01835	0.01496	0.01444	0.01464	0.01376	0.0129	0.0154	0.01343	0.01205
Xylenes	0.00416	0.00433	0.00461	0.00481	0.00426	0.00422	0.00424	0.0041	0.00396	0.00429	0.004	0.00379
Total VOC	0.43154	0.47538	0.51308	0.55462	0.43308	0.39615	0.40923	0.37615	0.34538	0.46385	0.38462	0.33077
E10												
Benzene	0.0018	0.00198	0.00217	0.00234	0.00183	0.0017	0.00175	0.00161	0.00148	0.00194	0.00161	0.00139
Cumene	-	-	-	-	-	-	-	-	-	-	-	-
Cyclohexane	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	0.0009	0.00095	0.00101	0.00106	0.00093	0.00092	0.00092	0.00089	0.00085	0.00094	0.00086	0.00081
n-Hexane	0.00555	0.00611	0.00659	0.00712	0.00556	0.00509	0.00525	0.00483	0.00444	0.00595	0.00494	0.00425
Lead	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002
Toluene	0.00555	0.00598	0.00654	0.007	0.00571	0.00551	0.00559	0.00525	0.00492	0.00588	0.00513	0.0046
Xylenes	0.00427	0.00445	0.00473	0.00494	0.00438	0.00434	0.00436	0.00421	0.00407	0.00441	0.00411	0.00389
Ethanol	0.01163	0.01292	0.0149	0.01635	0.01237	0.01209	0.01222	0.0112	0.01019	0.01263	0.01047	0.00896
Total VOC	0.42692	0.47000	0.50692	0.54769	0.42769	0.39154	0.40385	0.37154	0.34154	0.45769	0.38000	0.32692

Appendix F.4: Fuel storage- above ground horizontal fixed roof tank

	Zone (kg/tonne)											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
	South SA	South WA	Central WA	Northern Australia	Central Australia	Cape York	Central North Qld	Central Qld	South Qld	NSW	Vic	Tas
Crude oil												
Benzene	0.00061	0.00068	0.00102	0.00104	0.00086	0.00098	0.00094	0.00091	0.00078	0.00067	0.00058	0.00047
Cumene	0.00001	0.00001	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00001	0.00001	0.00001
Cyclohexane	0.00529	0.00591	0.00885	0.00897	0.00751	0.00851	0.00817	0.00787	0.00681	0.00587	0.00509	0.00410
Ethylbenzene	0.00010	0.00012	0.00019	0.00020	0.00016	0.00019	0.00018	0.00017	0.00014	0.00012	0.00010	0.00007
n-Hexane	0.02258	0.02513	0.03716	0.03755	0.03172	0.03565	0.03433	0.03314	0.02880	0.02493	0.02175	0.01763
Lead	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	0.00079	0.00089	0.00140	0.00144	0.00116	0.00136	0.00129	0.00123	0.00105	0.00089	0.00075	0.00059
Xylenes	0.00038	0.00044	0.00071	0.00074	0.00058	0.00070	0.00066	0.00062	0.00052	0.00043	0.00036	0.00028
Total VOC	0.02977	0.03318	0.04935	0.04997	0.04200	0.04741	0.04559	0.04395	0.03812	0.03292	0.02865	0.02314
Fuel oil												
Benzene	0.00015	0.00017	0.00024	0.00025	0.00021	0.00024	0.00023	0.00022	0.00019	0.00017	0.00015	0.00012
Cumene	0.00015	0.00017	0.00027	0.00029	0.00022	0.00028	0.00026	0.00024	0.00020	0.00017	0.00014	0.00011
Cyclohexane	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	0.00001	0.00002	0.00003	0.00003	0.00002	0.00003	0.00002	0.00002	0.00002	0.00002	0.00001	0.00001
n-Hexane	0.00025	0.00027	0.00038	0.00040	0.00033	0.00038	0.00036	0.00035	0.00031	0.00027	0.00024	0.00020
Lead	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	0.00013	0.00015	0.00022	0.00023	0.00018	0.00022	0.00021	0.00019	0.00017	0.00014	0.00012	0.00010
Xylenes	0.00012	0.00014	0.00021	0.00023	0.00017	0.00022	0.00020	0.00019	0.00016	0.00014	0.00011	0.00009
Total VOC	0.04545	0.05152	0.08182	0.08788	0.06667	0.08485	0.07879	0.07273	0.06061	0.05152	0.04242	0.03333
Heating oil												
Benzene	-	-	-	-	-	-	-	-	-	-	-	-
Cumene	-	-	-	-	-	-	-	-	-	-	-	-
Cyclohexane	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	0.00005	0.00006	0.00009	0.00009	0.00007	0.00009	0.00008	0.00008	0.00007	0.00006	0.00005	0.00004
n-Hexane	-	-	-	-	-	-	-	-	-	-	-	-
Lead	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	0.00017	0.00019	0.00029	0.00030	0.00024	0.00029	0.00027	0.00026	0.00022	0.00019	0.00016	0.00013
Xylenes	0.00020	0.00022	0.00035	0.00037	0.00029	0.00035	0.00033	0.00031	0.00026	0.00022	0.00019	0.00015
Total VOC	0.20482	0.22892	0.34940	0.36145	0.28916	0.34940	0.32530	0.31325	0.26506	0.22892	0.19277	0.15663

	Zone (kg/tonne)											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
	South SA	South WA	Central WA	Northern Australia	Central Australia	Cape York	Central North Qld	Central Qld	South Qld	NSW	Vic	Tas
Kerosene												
Benzene	0.00223	0.00247	0.00356	0.00371	0.00304	0.00355	0.00337	0.00322	0.00283	0.00246	0.00214	0.00175
Cumene	0.00078	0.00089	0.00143	0.00154	0.00116	0.00146	0.00135	0.00126	0.00106	0.00089	0.00073	0.00056
Cyclohexane	0.00754	0.00835	0.01192	0.01240	0.01022	0.01189	0.01130	0.01083	0.00951	0.00829	0.00724	0.00594
Ethylbenzene	0.00030	0.00034	0.00053	0.00056	0.00043	0.00054	0.00050	0.00047	0.00040	0.00034	0.00028	0.00022
n-Hexane	0.04599	0.05074	0.07159	0.07417	0.06172	0.07121	0.06788	0.06519	0.05753	0.05039	0.04425	0.03656
Lead	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	0.00031	0.00035	0.00052	0.00055	0.00044	0.00053	0.00050	0.00047	0.00041	0.00035	0.00030	0.00024
Xylenes	0.00090	0.00103	0.00161	0.00172	0.00132	0.00163	0.00152	0.00143	0.00122	0.00102	0.00086	0.00067
Total VOC	0.28182	0.31818	0.47273	0.50000	0.40000	0.48182	0.45455	0.42727	0.37273	0.31818	0.27273	0.21818
Avgas 100												
Benzene	0.00782	0.00868	0.01222	0.01294	0.01047	0.01241	0.01174	0.01114	0.00985	0.00864	0.00751	0.00620
Cumene	<0.00001	<0.00001	0.00001	0.00001	<0.00001	0.00001	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Cyclohexane	0.00301	0.00333	0.00466	0.00492	0.00400	0.00472	0.00447	0.00425	0.00377	0.00331	0.00289	0.00240
Ethylbenzene	0.00010	0.00011	0.00017	0.00019	0.00014	0.00018	0.00017	0.00016	0.00013	0.00011	0.00009	0.00008
n-Hexane	0.00883	0.00973	0.01344	0.01415	0.01163	0.01360	0.01292	0.01232	0.01096	0.00968	0.00849	0.00709
Lead	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	0.00365	0.00410	0.00600	0.00643	0.00504	0.00614	0.00576	0.00542	0.00473	0.00408	0.00348	0.00282
Xylenes	0.00046	0.00052	0.00079	0.00086	0.00065	0.00082	0.00076	0.00071	0.00061	0.00052	0.00043	0.00034
Total VOC	0.80273	0.88455	1.22182	1.28636	1.05727	1.23636	1.17455	1.12000	0.99636	0.88000	0.77182	0.64455
Avgas LL												
Benzene	0.02330	0.02584	0.03640	0.03855	0.03118	0.03696	0.03496	0.03319	0.02934	0.02572	0.02236	0.01847
Cumene	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	<0.00001
Cyclohexane	0.00001	0.00001	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00001	0.00001	0.00001
Ethylbenzene	0.00360	0.00410	0.00624	0.00677	0.00514	0.00643	0.00598	0.00558	0.00480	0.00408	0.00342	0.00270
n-Hexane	0.02397	0.02641	0.03651	0.03844	0.03157	0.03693	0.03509	0.03344	0.02977	0.02629	0.02306	0.01925
Lead	<0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	<0.00001	<0.00001
Toluene	0.02373	0.02664	0.03898	0.04177	0.03275	0.03986	0.03739	0.03520	0.03070	0.02651	0.02264	0.01831
Xylenes	0.00312	0.00355	0.00543	0.00590	0.00446	0.00560	0.00520	0.00485	0.00416	0.00353	0.00295	0.00233
Total VOC	0.81254	0.89525	1.23763	1.30305	1.07017	1.25186	1.18949	1.13356	1.00915	0.89119	0.78169	0.65254

	Zone (kg/tonne)											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
	South SA	South WA	Central WA	Northern Australia	Central Australia	Cape York	Central North Qld	Central Qld	South Qld	NSW	Vic	Tas
Diesel												
Benzene	0.00022	0.00025	0.00036	0.00037	0.00030	0.00036	0.00034	0.00032	0.00028	0.00025	0.00021	0.00018
Cumene	0.00033	0.00038	0.00060	0.00065	0.00049	0.00062	0.00057	0.00053	0.00045	0.00038	0.00031	0.00024
Cyclohexane	0.00008	0.00009	0.00012	0.00013	0.00010	0.00012	0.00012	0.00011	0.00010	0.00008	0.00007	0.00006
Ethylbenzene	0.00008	0.00009	0.00014	0.00015	0.00011	0.00014	0.00013	0.00012	0.00010	0.00009	0.00007	0.00006
n-Hexane	0.00012	0.00013	0.00019	0.00020	0.00016	0.00019	0.00018	0.00017	0.00015	0.00013	0.00012	0.00010
Lead	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	0.00021	0.00024	0.00036	0.00038	0.00030	0.00036	0.00034	0.00032	0.00028	0.00024	0.00020	0.00016
Xylenes	0.00020	0.00023	0.00036	0.00039	0.00030	0.00037	0.00034	0.00032	0.00027	0.00023	0.00019	0.00015
Total VOC	0.01846	0.02000	0.02923	0.03077	0.02462	0.02923	0.02769	0.02615	0.02308	0.02000	0.01846	0.01538
LP												
Benzene	0.00433	0.00481	0.00666	0.00716	0.00572	0.00684	0.00647	0.00608	0.00542	0.0048	0.00415	0.00347
Cumene	0.00002	0.00003	0.00004	0.00005	0.00003	0.00004	0.00004	0.00004	0.00003	0.00003	0.00002	0.00002
Cyclohexane	0.00399	0.00443	0.00609	0.00653	0.00525	0.00624	0.00592	0.00557	0.00498	0.00442	0.00384	0.00322
Ethylbenzene	0.00073	0.00083	0.00125	0.00137	0.00103	0.0013	0.00121	0.00111	0.00097	0.00083	0.00069	0.00055
n-Hexane	0.02029	0.02241	0.03047	0.03255	0.02641	0.03117	0.02961	0.02794	0.0251	0.02239	0.01954	0.01648
Lead	0.00001	0.00001	0.00001	0.00002	0.00001	0.00002	0.00001	0.00001	0.00001	0.00001	0.00001	<0.00001
Toluene	0.01085	0.01221	0.01757	0.01911	0.0148	0.01817	0.01705	0.01588	0.01398	0.0122	0.01037	0.00847
Xylenes	0.0031	0.00354	0.00533	0.00588	0.00439	0.00556	0.00516	0.00476	0.00413	0.00354	0.00294	0.00235
Total VOC	1.56077	1.72385	2.34385	2.50385	2.03154	2.39769	2.27769	2.14923	1.93077	1.72231	1.50308	1.26769
ULP												
Benzene	0.00494	0.00549	0.0076	0.00817	0.00653	0.0078	0.00738	0.00694	0.00619	0.00548	0.00474	0.00396
Cumene	0.00002	0.00003	0.00004	0.00005	0.00003	0.00004	0.00004	0.00004	0.00003	0.00003	0.00002	0.00002
Cyclohexane	0.00419	0.00465	0.00639	0.00685	0.00551	0.00655	0.00621	0.00584	0.00523	0.00464	0.00403	0.00338
Ethylbenzene	0.00077	0.00088	0.00132	0.00145	0.00109	0.00137	0.00128	0.00118	0.00102	0.00088	0.00073	0.00058
n-Hexane	0.01578	0.01743	0.02369	0.02531	0.02053	0.02423	0.02302	0.02172	0.01951	0.01741	0.0152	0.01282
Lead	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Toluene	0.00847	0.00954	0.01372	0.01492	0.01156	0.01419	0.01331	0.0124	0.01092	0.00952	0.00809	0.00661
Xylenes	0.00325	0.00371	0.00558	0.00615	0.0046	0.00582	0.00541	0.00499	0.00432	0.0037	0.00308	0.00246
Total VOC	1.21385	1.34077	1.82231	1.94692	1.57923	1.86385	1.77077	1.67077	1.50077	1.33923	1.16923	0.98615

	Zone (kg/tonne)											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
	South SA	South WA	Central WA	Northern Australia	Central Australia	Cape York	Central North Qld	Central Qld	South Qld	NSW	Vic	Tas
PULP												
Benzene	0.00531	0.0059	0.00817	0.00878	0.00702	0.00839	0.00794	0.00746	0.00665	0.00589	0.0051	0.00425
Cumene	0.00003	0.00003	0.00005	0.00006	0.00004	0.00005	0.00005	0.00005	0.00004	0.00003	0.00003	0.00002
Cyclohexane	0.00542	0.00601	0.00827	0.00887	0.00713	0.00848	0.00804	0.00756	0.00676	0.00601	0.00521	0.00437
Ethylbenzene	0.00089	0.00101	0.00152	0.00167	0.00125	0.00158	0.00147	0.00136	0.00118	0.00101	0.00084	0.00067
n-Hexane	0.0131	0.01447	0.01967	0.02102	0.01705	0.02013	0.01912	0.01804	0.01621	0.01446	0.01262	0.01065
Lead	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Toluene	0.01073	0.01207	0.01737	0.01889	0.01463	0.01796	0.01685	0.0157	0.01382	0.01205	0.01025	0.00837
Xylenes	0.00377	0.0043	0.00647	0.00713	0.00533	0.00675	0.00627	0.00578	0.00501	0.00429	0.00357	0.00285
Total VOC	1.00769	1.11308	1.51308	1.61692	1.31154	1.54846	1.47077	1.38769	1.24692	1.11231	0.97077	0.81923
RON98												
Benzene	0.00533	0.00592	0.0082	0.00882	0.00704	0.00842	0.00797	0.00749	0.00668	0.00592	0.00512	0.00427
Cumene	0.00004	0.00005	0.00007	0.00008	0.00006	0.00008	0.00007	0.00006	0.00006	0.00005	0.00004	0.00003
Cyclohexane	0.00602	0.00668	0.00919	0.00985	0.00792	0.00942	0.00893	0.0084	0.00752	0.00667	0.00579	0.00485
Ethylbenzene	0.00091	0.00104	0.00155	0.00171	0.00128	0.00162	0.0015	0.00139	0.0012	0.00103	0.00086	0.00069
n-Hexane	0.01746	0.01928	0.02621	0.028	0.02272	0.02681	0.02548	0.02404	0.02159	0.01926	0.01681	0.01418
Lead	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	0.02972	0.03344	0.04812	0.05233	0.04053	0.04977	0.04669	0.04349	0.03829	0.0334	0.02839	0.02319
Xylenes	0.00408	0.00466	0.00701	0.00773	0.00577	0.00731	0.00679	0.00626	0.00543	0.00465	0.00387	0.00309
Total VOC	1.34308	1.48308	2.01615	2.15385	1.74769	2.06231	1.96000	1.84923	1.66077	1.48154	1.29308	1.09077
E10												
Benzene	0.00524	0.00582	0.00806	0.00867	0.00692	0.00828	0.00783	0.00736	0.00657	0.00582	0.00503	0.0042
Cumene	-	-	-	-	-	-	-	-	-	-	-	-
Cyclohexane	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	0.00101	0.00115	0.00172	0.00189	0.00142	0.00179	0.00167	0.00154	0.00133	0.00115	0.00096	0.00076
n-Hexane	0.01724	0.01904	0.02589	0.02766	0.02244	0.02648	0.02516	0.02374	0.02133	0.01902	0.01661	0.01401
Lead	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
Toluene	0.01134	0.01276	0.01837	0.01997	0.01547	0.01899	0.01782	0.0166	0.01461	0.01275	0.01083	0.00885
Xylenes	0.00419	0.00479	0.0072	0.00794	0.00593	0.00751	0.00698	0.00644	0.00558	0.00478	0.00398	0.00317
Ethanol	0.02992	0.03414	0.05122	0.05645	0.04223	0.05341	0.04963	0.0458	0.03972	0.03408	0.02841	0.02268
Total VOC	1.32615	1.46462	1.99154	2.12769	1.72615	2.03692	1.93538	1.82615	1.64077	1.46308	1.27769	1.07769

Appendix F.5: Fuel storage- underground horizontal fixed roof tank

	Zone (kg/tonne)											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
	South SA	South WA	Central WA	Northern Australia	Central Australia	Cape York	Central North Qld	Central Qld	South Qld	NSW	Vic	Tas
Crude oil												
Benzene	0.00039	0.00043	0.00059	0.00065	0.00050	0.00063	0.00058	0.00054	0.00049	0.00043	0.00038	0.00032
Cumene	0.00001	0.00001	0.00001	0.00002	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
Cyclohexane	0.00344	0.00380	0.00509	0.00562	0.00438	0.00543	0.00506	0.00474	0.00426	0.00380	0.00330	0.00280
Ethylbenzene	0.00007	0.00007	0.00011	0.00012	0.00009	0.00012	0.00011	0.00010	0.00009	0.00007	0.00006	0.00005
n-Hexane	0.01473	0.01618	0.02146	0.02360	0.01854	0.02282	0.02133	0.02001	0.01806	0.01618	0.01415	0.01209
Lead	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	0.00051	0.00057	0.00080	0.00089	0.00067	0.00086	0.00079	0.00073	0.00065	0.00057	0.00048	0.00040
Xylenes	0.00024	0.00027	0.00040	0.00046	0.00033	0.00044	0.00040	0.00036	0.00032	0.00027	0.00023	0.00018
Total VOC	0.01939	0.02133	0.02846	0.03135	0.02452	0.03030	0.02828	0.02649	0.02387	0.02134	0.01861	0.01586
Fuel oil												
Benzene	0.00011	0.00013	0.00017	0.00019	0.00015	0.00018	0.00017	0.00016	0.00014	0.00013	0.00011	0.00009
Cumene	0.00011	0.00012	0.00019	0.00021	0.00015	0.00020	0.00018	0.00017	0.00014	0.00012	0.00010	0.00008
Cyclohexane	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	0.00001	0.00001	0.00002	0.00002	0.00001	0.00002	0.00002	0.00002	0.00001	0.00001	0.00001	0.00001
n-Hexane	0.00019	0.00020	0.00027	0.00030	0.00023	0.00029	0.00027	0.00025	0.00023	0.00020	0.00018	0.00015
Lead	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	0.00010	0.00011	0.00015	0.00017	0.00013	0.00016	0.00015	0.00014	0.00012	0.00011	0.00009	0.00008
Xylenes	0.00009	0.00010	0.00015	0.00017	0.00012	0.00016	0.00015	0.00013	0.00012	0.00010	0.00008	0.00007
Total VOC	0.03333	0.03636	0.05758	0.06364	0.04545	0.06061	0.05455	0.05152	0.04242	0.03636	0.03030	0.02424
Heating oil												
Benzene	-	-	-	-	-	-	-	-	-	-	-	-
Cumene	-	-	-	-	-	-	-	-	-	-	-	-
Cyclohexane	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	0.00004	0.00004	0.00006	0.00007	0.00005	0.00007	0.00006	0.00006	0.00005	0.00004	0.00003	0.00003
n-Hexane	-	-	-	-	-	-	-	-	-	-	-	-
Lead	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	0.00013	0.00014	0.00020	0.00022	0.00017	0.00022	0.00020	0.00018	0.00016	0.00014	0.00012	0.00010
Xylenes	0.00014	0.00016	0.00024	0.00027	0.00020	0.00026	0.00024	0.00022	0.00019	0.00016	0.00014	0.00011
Total VOC	0.15663	0.16867	0.24096	0.26506	0.20482	0.26506	0.24096	0.21687	0.19277	0.16867	0.14458	0.12048

	Zone (kg/tonne)											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
	South SA	South WA	Central WA	Northern Australia	Central Australia	Cape York	Central North Qld	Central Qld	South Qld	NSW	Vic	Tas
Kerosene												
Benzene	0.00166	0.00183	0.00247	0.00274	0.00212	0.00264	0.00246	0.00230	0.00206	0.00183	0.00159	0.00134
Cumene	0.00056	0.00064	0.00097	0.00111	0.00078	0.00106	0.00096	0.00087	0.00075	0.00064	0.00053	0.00042
Cyclohexane	0.00562	0.00619	0.00831	0.00917	0.00714	0.00886	0.00826	0.00772	0.00694	0.00619	0.00539	0.00457
Ethylbenzene	0.00022	0.00025	0.00036	0.00041	0.00030	0.00039	0.00036	0.00033	0.00029	0.00025	0.00021	0.00017
n-Hexane	0.03436	0.03772	0.05005	0.05503	0.04324	0.05322	0.04974	0.04666	0.04212	0.03774	0.03300	0.02820
Lead	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	0.00023	0.00026	0.00036	0.00040	0.00030	0.00039	0.00036	0.00033	0.00029	0.00026	0.00022	0.00018
Xylenes	0.00066	0.00075	0.00110	0.00125	0.00090	0.00119	0.00109	0.00100	0.00087	0.00075	0.00062	0.00051
Total VOC	0.20909	0.23636	0.32727	0.36364	0.27273	0.35455	0.32727	0.30000	0.26364	0.23636	0.20000	0.16364
Avgas 100												
Benzene	0.00565	0.00624	0.00844	0.00934	0.00722	0.00901	0.00838	0.00783	0.00702	0.00625	0.00541	0.00458
Cumene	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Cyclohexane	0.00218	0.00240	0.00322	0.00356	0.00277	0.00343	0.00320	0.00299	0.00269	0.00240	0.00209	0.00177
Ethylbenzene	0.00007	0.00008	0.00012	0.00013	0.00010	0.00013	0.00012	0.00011	0.00009	0.00008	0.00007	0.00005
n-Hexane	0.00641	0.00703	0.00933	0.01026	0.00806	0.00992	0.00927	0.00870	0.00785	0.00704	0.00615	0.00526
Lead	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	0.00261	0.00292	0.00410	0.00459	0.00344	0.00441	0.00407	0.00377	0.00334	0.00293	0.00249	0.00206
Xylenes	0.00032	0.00037	0.00054	0.00061	0.00044	0.00058	0.00053	0.00049	0.00042	0.00037	0.00031	0.00025
Total VOC	0.58273	0.63909	0.84818	0.93273	0.73273	0.90182	0.84273	0.79091	0.71364	0.64000	0.55909	0.47818
Avgas LL												
Benzene	0.01684	0.01860	0.02513	0.02781	0.02151	0.02683	0.02497	0.02333	0.02092	0.01861	0.01613	0.01364
Cumene	<0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	<0.00001	<0.00001
Cyclohexane	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
Ethylbenzene	0.00255	0.00289	0.00422	0.00479	0.00347	0.00458	0.00419	0.00384	0.00335	0.00289	0.00242	0.00196
n-Hexane	0.01739	0.01910	0.02534	0.02786	0.02189	0.02694	0.02519	0.02362	0.02133	0.01911	0.01671	0.01428
Lead	<0.00001	<0.00001	0.00001	0.00001	<0.00001	<0.00001	0.00001	0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Toluene	0.01699	0.01900	0.02664	0.02984	0.02237	0.02867	0.02645	0.02450	0.02168	0.01901	0.01619	0.01341
Xylenes	0.00221	0.00251	0.00367	0.00417	0.00301	0.00398	0.00364	0.00334	0.00291	0.00251	0.00209	0.00169
Total VOC	0.58949	0.64746	0.85898	0.94441	0.74203	0.91322	0.85390	0.80068	0.72305	0.64780	0.56644	0.48407

	Zone (kg/tonne)											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
	South SA	South WA	Central WA	Northern Australia	Central Australia	Cape York	Central North Qld	Central Qld	South Qld	NSW	Vic	Tas
Diesel												
Benzene	0.00017	0.00019	0.00025	0.00028	0.00021	0.00027	0.00025	0.00023	0.00021	0.00019	0.00016	0.00014
Cumene	0.00024	0.00028	0.00041	0.00047	0.00034	0.00045	0.00041	0.00037	0.00032	0.00028	0.00023	0.00018
Cyclohexane	0.00006	0.00006	0.00009	0.00009	0.00007	0.00009	0.00009	0.00008	0.00007	0.00006	0.00006	0.00005
Ethylbenzene	0.00006	0.00007	0.00010	0.00011	0.00008	0.00010	0.00009	0.00009	0.00008	0.00007	0.00005	0.00004
n-Hexane	0.00009	0.00010	0.00013	0.00015	0.00012	0.00014	0.00013	0.00012	0.00011	0.00010	0.00009	0.00008
Lead	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	0.00016	0.00018	0.00025	0.00028	0.00021	0.00027	0.00025	0.00023	0.00020	0.00018	0.00015	0.00013
Xylenes	0.00015	0.00017	0.00025	0.00028	0.00020	0.00027	0.00025	0.00023	0.00020	0.00017	0.00014	0.00012
Total VOC	0.01385	0.01538	0.02000	0.02308	0.01846	0.02154	0.02000	0.01846	0.01692	0.01538	0.01385	0.01231
LP												
Benzene	0.00283	0.00313	0.00423	0.00468	0.00362	0.00451	0.0042	0.00392	0.00352	0.00313	0.00271	0.00229
Cumene	0.00002	0.00002	0.00003	0.00003	0.00002	0.00003	0.00003	0.00002	0.00002	0.00002	0.00001	0.00001
Cyclohexane	0.00262	0.00288	0.00387	0.00427	0.00332	0.00413	0.00385	0.0036	0.00324	0.00289	0.00251	0.00213
Ethylbenzene	0.00047	0.00053	0.00077	0.00088	0.00064	0.00084	0.00077	0.0007	0.00061	0.00053	0.00044	0.00036
n-Hexane	0.01334	0.01465	0.01943	0.02137	0.01679	0.02067	0.01932	0.01812	0.01636	0.01466	0.01281	0.01095
Lead	<0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	<0.00001	<0.00001
Toluene	0.00704	0.00787	0.01104	0.01236	0.00927	0.01188	0.01096	0.01015	0.00898	0.00788	0.00671	0.00556
Xylenes	0.00199	0.00226	0.00331	0.00376	0.00272	0.00359	0.00328	0.00301	0.00262	0.00226	0.00189	0.00152
Total VOC	1.02615	1.12692	1.49462	1.64385	1.29154	1.59000	1.48615	1.39385	1.25846	1.12769	0.98538	0.84231
ULP												
Benzene	0.00323	0.00357	0.00482	0.00534	0.00413	0.00515	0.00479	0.00448	0.00401	0.00357	0.0031	0.00262
Cumene	0.00002	0.00002	0.00003	0.00003	0.00002	0.00003	0.00003	0.00002	0.00002	0.00002	0.00001	0.00001
Cyclohexane	0.00275	0.00303	0.00406	0.00449	0.00349	0.00433	0.00404	0.00378	0.0034	0.00303	0.00263	0.00224
Ethylbenzene	0.0005	0.00056	0.00082	0.00093	0.00067	0.00089	0.00081	0.00075	0.00065	0.00056	0.00047	0.00038
n-Hexane	0.01037	0.01139	0.01511	0.01661	0.01306	0.01607	0.01502	0.01409	0.01272	0.01139	0.00996	0.00852
Lead	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Toluene	0.0055	0.00615	0.00862	0.00965	0.00724	0.00928	0.00856	0.00793	0.00701	0.00615	0.00524	0.00434
Xylenes	0.00209	0.00237	0.00346	0.00394	0.00284	0.00376	0.00344	0.00315	0.00275	0.00237	0.00197	0.0016
Total VOC	0.79769	0.87615	1.16231	1.27769	1.00462	1.23615	1.15538	1.08385	0.97846	0.87615	0.76615	0.65538

	Zone (kg/tonne)											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
	South SA	South WA	Central WA	Northern Australia	Central Australia	Cape York	Central North Qld	Central Qld	South Qld	NSW	Vic	Tas
PULP												
Benzene	0.00347	0.00384	0.00519	0.00574	0.00444	0.00554	0.00515	0.00481	0.00432	0.00384	0.00333	0.00281
Cumene	0.00002	0.00002	0.00003	0.00004	0.00003	0.00003	0.00003	0.00003	0.00002	0.00002	0.00002	0.00001
Cyclohexane	0.00356	0.00392	0.00526	0.0058	0.00452	0.00561	0.00523	0.00489	0.0044	0.00392	0.00341	0.00289
Ethylbenzene	0.00057	0.00065	0.00094	0.00107	0.00077	0.00102	0.00093	0.00086	0.00075	0.00065	0.00054	0.00044
n-Hexane	0.00862	0.00946	0.01255	0.0138	0.01084	0.01335	0.01247	0.0117	0.01056	0.00946	0.00828	0.00707
Lead	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Toluene	0.00696	0.00778	0.01091	0.01222	0.00916	0.01174	0.01083	0.01003	0.00888	0.00779	0.00663	0.00549
Xylenes	0.00242	0.00274	0.00402	0.00456	0.0033	0.00436	0.00398	0.00365	0.00318	0.00274	0.00229	0.00185
Total VOC	0.66308	0.72769	0.96538	1.06154	0.83385	1.02692	0.95923	0.90000	0.81231	0.72769	0.63692	0.54385
RON98												
Benzene	0.00349	0.00385	0.00521	0.00576	0.00446	0.00556	0.00517	0.00483	0.00433	0.00385	0.00334	0.00283
Cumene	0.00003	0.00003	0.00004	0.00005	0.00004	0.00005	0.00004	0.00004	0.00003	0.00003	0.00002	0.00002
Cyclohexane	0.00395	0.00435	0.00584	0.00645	0.00502	0.00623	0.00581	0.00543	0.00488	0.00436	0.00379	0.00322
Ethylbenzene	0.00058	0.00066	0.00096	0.00109	0.00079	0.00105	0.00096	0.00088	0.00077	0.00066	0.00055	0.00045
n-Hexane	0.01148	0.0126	0.01672	0.01838	0.01445	0.01778	0.01662	0.01559	0.01407	0.01261	0.01102	0.00942
Lead	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	0.01928	0.02156	0.03023	0.03386	0.02538	0.03253	0.03001	0.0278	0.0246	0.02157	0.01837	0.01522
Xylenes	0.00262	0.00297	0.00435	0.00494	0.00357	0.00473	0.00432	0.00396	0.00345	0.00297	0.00248	0.00201
Total VOC	0.88308	0.96923	1.28615	1.41385	1.11154	1.36769	1.27846	1.19923	1.08231	0.97000	0.84769	0.72462
E10												
Benzene	0.00343	0.00379	0.00512	0.00566	0.00438	0.00546	0.00509	0.00475	0.00426	0.00379	0.00328	0.00278
Cumene	-	-	-	-	-	-	-	-	-	-	-	-
Cyclohexane	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	0.00065	0.00073	0.00107	0.00121	0.00088	0.00116	0.00106	0.00097	0.00085	0.00073	0.00061	0.0005
n-Hexane	0.01134	0.01245	0.01651	0.01816	0.01427	0.01756	0.01641	0.0154	0.0139	0.01245	0.01089	0.00931
Lead	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Toluene	0.00736	0.00823	0.01154	0.01292	0.00969	0.01242	0.01145	0.01061	0.00939	0.00823	0.00701	0.00581
Xylenes	0.00269	0.00305	0.00447	0.00508	0.00367	0.00486	0.00444	0.00407	0.00354	0.00306	0.00255	0.00206
Ethanol	0.01922	0.02178	0.03181	0.03612	0.02615	0.03454	0.03155	0.02896	0.02525	0.0218	0.01821	0.01476
Total VOC	0.87231	0.95769	1.27000	1.39692	1.09769	1.35077	1.26231	1.18462	1.06923	0.95769	0.83769	0.71615

Appendix F.6: Organic liquid storage- floating roof tank

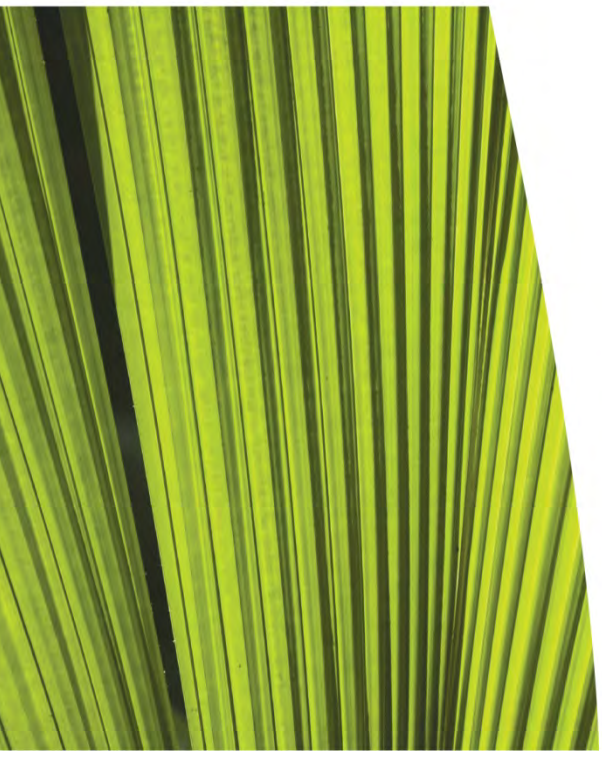
Substance	CAS No.	Liquid density at 20 °C (kg/L)	Zone (kg/tonne)											
			1	2	3	4	5	6	7	8	9	10	11	12
			South SA	South WA	Central WA	Northern Australia	Central Australia	Cape York	Central North Qld	Central Qld	South Qld	NSW	Vic	Tas
Acetaldehyde (ethanal)	75-07-0	0.788	-	-	-	-	-	-	-	-	-	-	0.747	0.583
Acetic acid	64-19-7	1.048	0.160	0.161	0.163	0.164	0.162	0.163	0.163	0.162	0.161	0.161	0.160	0.159
Acetone	67-64-1	0.792	0.257	0.270	0.319	0.324	0.336	0.293	0.315	0.301	0.285	0.271	0.253	0.237
Acetonitrile	75-05-8	0.784	0.182	0.185	0.197	0.198	0.201	0.191	0.196	0.193	0.189	0.185	0.180	0.176
Acrylamide	79-06-1	1.119	0.155	0.155	0.155	0.155	0.155	0.155	0.155	0.155	0.155	0.155	0.155	0.155
Acrylic acid	79-10-7	1.059	0.157	0.157	0.158	0.158	0.158	0.157	0.158	0.158	0.157	0.157	0.157	0.156
Acrylonitrile	107-13-1	0.808	0.196	0.202	0.221	0.223	0.228	0.211	0.220	0.214	0.208	0.202	0.195	0.188
Aniline	62-53-3	1.021	0.070	0.072	0.079	0.080	0.082	0.076	0.079	0.077	0.075	0.072	0.070	0.068
Benzene	71-43-2	0.879	0.037	0.038	0.042	0.042	0.043	0.040	0.041	0.041	0.039	0.038	0.037	0.036
Carbon disulfide	75-15-0	1.262	0.304	0.323	0.395	0.401	0.420	0.357	0.388	0.368	0.345	0.324	0.298	0.276
Chloroform	67-66-3	1.489	0.246	0.258	0.301	0.305	0.316	0.279	0.298	0.286	0.272	0.259	0.243	0.228
Cumene (isopropyl benzene)	98-82-8	0.792	0.172	0.173	0.175	0.175	0.176	0.174	0.175	0.174	0.174	0.173	0.172	0.172
Cyclohexane	110-82-7	0.779	0.213	0.221	0.246	0.255	0.233	0.249	0.244	0.237	0.229	0.221	0.211	0.202
Dibromoethane (1,2)	106-93-4	1.255	0.281	0.281	0.283	0.283	0.282	0.282	0.282	0.282	0.282	0.282	0.281	0.280
Dichloroethane (1,2)	107-06-2	1.253	0.188	0.193	0.208	0.213	0.200	0.210	0.207	0.203	0.198	0.193	0.187	0.182
Dichloromethane	75-09-2	1.362	0.340	0.367	0.474	0.515	0.416	0.484	0.464	0.433	0.398	0.368	0.332	0.301
2-Ethoxyethanol	110-80-5	0.930	0.157	0.157	0.158	0.159	0.158	0.158	0.158	0.158	0.158	0.157	0.157	0.156
2-Ethoxyethanol acetate	111-15-9	0.975	0.156	0.157	0.157	0.157	0.157	0.157	0.157	0.157	0.157	0.157	0.156	0.156
Ethyl acetate	141-78-6	0.905	0.204	0.210	0.234	0.243	0.222	0.237	0.233	0.226	0.218	0.211	0.202	0.194
Ethyl alcohol (ethanol)	64-17-5	0.772	0.176	0.179	0.189	0.193	0.183	0.190	0.188	0.185	0.182	0.179	0.175	0.172
Ethylbenzene	100-41-4	0.864	0.161	0.162	0.165	0.167	0.164	0.166	0.165	0.164	0.163	0.162	0.161	0.160
Ethyl butyl ketone	106-35-4	0.818	0.156	0.157	0.157	0.157	0.157	0.157	0.157	0.157	0.157	0.157	0.156	0.156
Formaldehyde (37%)	50-00-0	1.090	0.159	0.159	0.161	0.162	0.160	0.161	0.161	0.160	0.160	0.159	0.158	0.158
Glutaraldehyde (25%)	111-03-8	1.106	0.165	0.166	0.170	0.171	0.168	0.170	0.170	0.169	0.167	0.166	0.165	0.164
Hexane (-n)	110-54-3	0.658	0.269	0.284	0.334	0.351	0.308	0.339	0.330	0.316	0.300	0.284	0.265	0.247
2-Methoxyethanol	109-86-4	0.965	0.158	0.159	0.162	0.163	0.160	0.162	0.162	0.161	0.160	0.159	0.158	0.157
2-Methoxyethanol acetate	110-49-6	0.975	0.157	0.157	0.161	0.165	0.159	0.163	0.161	0.160	0.158	0.157	0.156	0.156
Methyl alcohol (methanol)	67-56-1	0.792	0.182	0.186	0.200	0.202	0.206	0.193	0.199	0.195	0.190	0.186	0.181	0.176
Methyl ethyl ketone	78-93-3	0.806	0.198	0.204	0.225	0.227	0.232	0.214	0.223	0.218	0.211	0.204	0.197	0.190
Methyl isobutyl ketone	108-10-1	0.798	0.167	0.169	0.175	0.176	0.178	0.172	0.175	0.173	0.171	0.169	0.166	0.164

Substance	CAS No.	Liquid density at 20 °C (kg/L)	Zone (kg/tonne)											
			1	2	3	4	5	6	7	8	9	10	11	12
			South SA	South WA	Central WA	Northern Australia	Central Australia	Cape York	Central North Qld	Central Qld	South Qld	NSW	Vic	Tas
Methyl methacrylate	80-62-6	0.945	0.175	0.177	0.187	0.189	0.191	0.182	0.187	0.184	0.181	0.178	0.174	0.171
Styrene	100-42-5	0.926	0.155	0.156	0.158	0.158	0.157	0.158	0.158	0.157	0.156	0.155	0.155	0.154
Tetrachloroethane (1,1,2,2)	79-34-5	1.593	0.162	0.162	0.166	0.167	0.164	0.166	0.166	0.165	0.164	0.162	0.161	0.160
Tetrachloroethylene	127-18-4	1.621	0.164	0.166	0.171	0.172	0.168	0.171	0.170	0.169	0.167	0.165	0.164	0.162
Toluene (methyl benzene)	108-88-3	0.867	0.171	0.173	0.180	0.183	0.176	0.181	0.180	0.178	0.175	0.172	0.170	0.167
Trichloroethane (1,1,2)	79-00-5	1.334	0.166	0.168	0.173	0.175	0.170	0.174	0.173	0.171	0.169	0.167	0.166	0.164
Trichloroethylene	79-01-6	1.463	0.188	0.192	0.208	0.214	0.200	0.210	0.207	0.203	0.198	0.190	0.187	0.181
Xylene (mixture of isomers)	1330-20-7	0.860	0.161	0.162	0.165	0.165	0.163	0.165	0.164	0.164	0.163	0.162	0.161	0.160

Appendix F.7: Organic liquid storage- vertical roof tank

Substance	CAS No.	Liquid density at 20 °C (kg/L)	Zone (kg/tonne)											
			1	2	3	4	5	6	7	8	9	10	11	12
			South SA	South WA	Central WA	Northern Australia	Central Australia	Cape York	Central North Qld	Central Qld	South Qld	NSW	Vic	Tas
Acetaldehyde (ethanal)	75-07-0	0.788	-	-	-	-	-	-	-	-	-	-	38.024	19.487
Acetic acid	64-19-7	1.048	0.197	0.225	0.365	0.372	0.300	0.352	0.333	0.319	0.268	0.222	0.188	0.143
Acetone	67-64-1	0.792	4.582	5.124	7.912	7.793	6.697	7.321	7.119	6.923	5.929	5.076	4.424	3.523
Acetonitrile	75-05-8	0.784	1.212	1.354	2.059	2.045	1.751	1.938	1.873	1.823	1.567	1.340	1.167	0.926
Acrylamide	79-06-1	1.119	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Acrylic acid	79-10-7	1.059	0.062	0.071	0.119	0.123	0.096	0.115	0.109	0.103	0.086	0.071	0.059	0.044
Acrylonitrile	107-13-1	0.808	1.903	2.129	3.250	3.224	2.761	3.052	2.952	2.872	2.465	2.107	1.833	1.453
Aniline	62-53-3	1.021	0.012	0.014	0.025	0.027	0.020	0.025	0.023	0.021	0.017	0.014	0.011	0.008
Benzene	71-43-2	0.879	2.126	2.374	3.600	3.573	3.067	3.388	3.277	3.191	2.745	2.350	2.048	1.627
Carbon disulfide	75-15-0	1.262	6.351	7.102	11.209	10.992	9.390	10.185	9.950	9.644	8.217	7.041	6.152	4.939
Chloroform	67-66-3	1.489	4.133	4.619	7.070	6.966	6.010	6.568	6.385	6.218	5.339	4.575	3.988	3.171
Cumene (isopropyl benzene)	98-82-8	0.792	0.158	0.182	0.303	0.313	0.246	0.294	0.277	0.264	0.219	0.180	0.150	0.113
Cyclohexane	110-82-7	0.779	2.669	2.973	4.471	4.428	3.823	4.203	4.072	3.971	3.426	2.943	2.574	2.054
Dibromoethane (1,2)	106-93-4	1.255	0.524	0.539	0.635	0.592	0.611	0.581	0.589	0.604	0.567	0.534	0.522	0.477
Dichloroethane (1,2)	107-06-2	1.253	1.530	1.713	2.620	2.609	2.221	2.473	2.385	2.319	1.988	1.695	1.471	1.163
Dichloromethane	75-09-2	1.362	8.194	9.319	16.094	16.100	12.864	14.503	14.012	13.332	11.032	9.240	7.905	6.209
2-Ethoxyethanol	110-80-5	0.930	0.067	0.085	0.143	0.148	0.119	0.139	0.131	0.127	0.106	0.084	0.060	0.043
2-Ethoxyethanol acetate	111-15-9	0.975	0.049	0.054	0.080	0.080	0.068	0.076	0.073	0.072	0.062	0.053	0.047	0.038
Ethyl acetate	141-78-6	0.905	2.289	2.571	3.980	3.967	3.357	3.751	3.615	3.508	2.995	2.545	2.199	1.728
Ethyl alcohol (ethanol)	64-17-5	0.772	0.816	0.936	1.552	1.578	1.264	1.481	1.405	1.345	1.120	0.926	0.776	0.587
Ethylbenzene	100-41-4	0.864	0.271	0.309	0.500	0.510	0.411	0.482	0.457	0.438	0.367	0.305	0.258	0.197
Ethyl butyl ketone	106-35-4	0.818	0.045	0.050	0.076	0.077	0.064	0.073	0.070	0.068	0.058	0.049	0.043	0.034
Formaldehyde (37%)	50-00-0	1.090	0.146	0.167	0.281	0.292	0.226	0.272	0.256	0.245	0.200	0.165	0.138	0.106
Glutaraldehyde (25%)	111-03-8	1.106	0.449	0.493	0.713	0.707	0.618	0.675	0.654	0.643	0.559	0.487	0.435	0.358
Hexane (-n)	110-54-3	0.658	5.172	5.754	8.652	8.531	7.408	8.078	7.852	7.664	6.618	5.698	4.995	4.002
2-Methoxyethanol	109-86-4	0.965	0.136	0.164	0.328	0.363	0.242	0.330	0.297	0.275	0.210	0.162	0.125	0.088
2-Methoxyethanol acetate	110-49-6	0.975	0.055	0.080	0.326	0.490	0.173	0.390	0.289	0.238	0.135	0.079	0.045	0.022
Methyl alcohol (methanol)	67-56-1	0.792	1.256	1.429	2.312	2.319	1.910	2.177	2.086	2.009	1.689	1.413	1.201	0.925
Methyl ethyl ketone	78-93-3	0.806	2.009	2.253	3.464	3.449	2.931	3.265	3.150	3.059	2.619	2.229	1.931	1.522

Substance	CAS No.	Liquid density at 20 °C (kg/L)	Zone (kg/tonne)											
			1	2	3	4	5	6	7	8	9	10	11	12
			South SA	South WA	Central WA	Northern Australia	Central Australia	Cape York	Central North Qld	Central Qld	South Qld	NSW	Vic	Tas
Methyl isobutyl ketone	108-10-1	0.798	0.545	0.622	1.008	1.025	0.828	0.968	0.919	0.882	0.740	0.615	0.519	0.395
Methyl methacrylate	80-62-6	0.945	0.907	1.024	1.613	1.626	1.345	1.538	1.470	1.419	1.203	1.013	0.868	0.676
Styrene	100-42-5	0.926	0.164	0.187	0.303	0.310	0.249	0.293	0.277	0.265	0.222	0.185	0.156	0.119
Tetrachloroethane (1,1,2,2)	79-34-5	1.593	0.283	0.323	0.520	0.530	0.428	0.501	0.475	0.456	0.383	0.319	0.270	0.206
Tetrachloroethylene	127-18-4	1.621	0.429	0.486	0.770	0.780	0.640	0.738	0.703	0.678	0.573	0.481	0.410	0.317
Toluene (methyl benzene)	108-88-3	0.867	0.711	0.801	1.250	1.258	1.047	1.192	1.141	1.104	0.938	0.792	0.680	0.531
Trichloroethane (1,1,2)	79-00-5	1.334	0.499	0.567	0.906	0.918	0.750	0.868	0.826	0.795	0.671	0.561	0.476	0.366
Trichloroethylene	79-01-6	1.463	1.516	1.702	2.639	2.636	2.225	2.496	2.402	2.330	1.989	1.687	1.454	1.139
Xylene (mixture of isomers)	1330-20-7	0.860	0.201	0.230	0.375	0.384	0.307	0.363	0.343	0.328	0.275	0.228	0.191	0.146



APPENDIX G

NPI Fuel and Organic Liquid Storage

TANKS User Manual

Australian Government
Department of Sustainability, Environment,
Water, Population and Communities

October 2011

Project No.3011-139a

KMH ENVIRONMENTAL

NPI Fuel and Organic Liquid Storage

TANKS User Manual

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1	Final submission to client post feedback	30/01/2012	OE	GL	GL

TABLE OF CONTENTS

FIGURES

TABLES

Glossary and Abbreviations

BOM	Australian Bureau of Meteorology
E	External Floating Roof Tank
H	Horizontal Fixed Roof Tank
HAP	Hazardous air pollutant
NPI	National Pollution Inventory
OAQPS	United States Office of Air Quality Planning and Standards
R	Internal Floating Roof Tank
RVP	Reid Vapour Pressure
U	Underground Horizontal Tank
US EPA	United States Environmental Protection Agency
V	Vertical Fixed Roof Tank
VOC	Volatile Organic Compound

1. About Tanks

TANKS 4.09d is a Windows-based computer software program that estimates volatile organic compound (VOC) and hazardous air pollutant (HAP) emissions from horizontal and vertical, fixed- and floating-roof storage tanks. The United States Environmental Protection Agency's (US EPA) Office of Air Quality Planning and Standards (OAQPS) develops and maintains emissions estimating tools to support Federal, State, and local agencies, consultants, and industry with estimating air emissions from various sources.

TANKS 4.09d allows users to enter specific information about a storage tank (dimensions, construction, paint condition, etc.), the liquid contents (chemical components and liquid temperature), and the location of the tank (nearest city, ambient temperature, etc.), and generate an air emissions report. Report features include estimates of monthly, annual, or partial year emissions for each chemical or mixture of chemicals stored in the tank. For National Pollutant Inventory (NPI) purposes only annual reports are required.

2. Where and How to Download

At the time of this report, TANKS 4.09D is available to download from the US EPA website.

http://www.epa.gov/ttnchie1/software/tanks/

The software is provided free of charge along with a comprehensive user manual *US EPA User Guide to Tanks* that should be used in conjunction with this manual as a technical guide.

2.1. Installation

To setup TANKS 4.09d on a personal computer, double-click on the downloaded file. The installation utility will guide the user through the setup process. Once the program is installed on the computer, it may be started by opening the file in the destination folder.

2.2. Downloading Australian Databases

As TANKS 4.09d is designed for use in the US, the databases provided with the software are not applicable for Australian users. Therefore alternative databases have been provided by NPI and provide information relevant to the Australian climate including meteorological data for major cities and regions, such as:

- Average, maximum and minimum temperature,
- Average wind speed,
- Annual average solar insulation factor; and,
- Atmospheric pressure

These databases are available to download from the NPI website

http://www.npi.gov.au/publications/emission-estimation-technique/fols.html

In addition to downloading TANKS 4.09d, it is necessary to download:

- The NPI TANKS Database: The “Tank Database” contains the chemical, meteorological, fitting, rim seal, deck seam, and profile information for the Australian context.
- The NPI Client Database: The “Client Database” stores the information used during data entry for each tank record. The data will be copied to the file location selected. This database is not required, however it does provide examples of default tanks at different locations around Australia

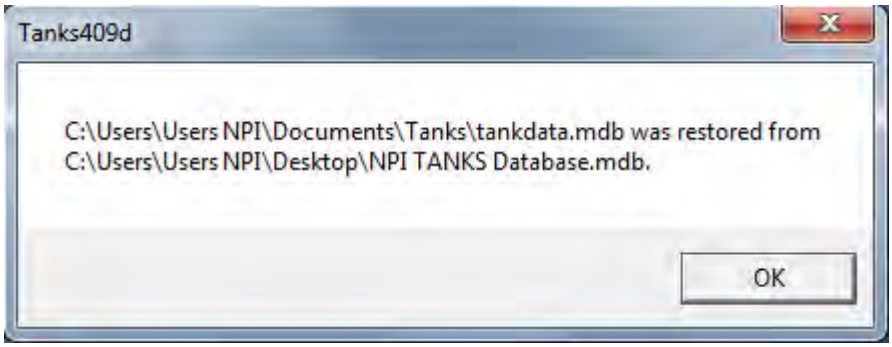
3. Accessing and Saving Databases

Once the NPI Tank database and client database (as required) have been downloaded it is necessary to ‘restore’ the databases in the TANKS 4.09d. To do this, follow the steps below:

3.1. To restore the Tank Database

1. Open TANKS 4.09d
2. Click on the ‘Backup’ drop down menu -> Restore Tank Database From Backup
3. Select the ‘NPI TANKS Database’ file that you previously downloaded from the NPI website and press open
4. If this has been done correctly the message in **Figure 1** will be displayed**.**

Figure 1 Confirmation message for correctly restoring databases



3.2. To restore the Client Database

1. Click on the ‘Backup’ drop down menu -> Restore Client Database from Backup
2. Select the ‘NPI Client Database’ file that you previously downloaded from the NPI website and press open.
3. Again, if this was done correctly you should receive a message similar to **Figure 1**

3.3. To save/backup the Client and Tank Database

1. Click on the ‘Backup’ drop down menu -> Backup Client or Tank Database

4. Site Information Required Prior to Use

Prior to using TANKS 4.09d to estimate emissions, you will need to gather the following information about the type of tank, geographical location and substances stored in the tank.

4.1. Tank Information

TANKS 4.09d is designed to calculate the estimates VOC and HAP emissions from the following types of tanks:

- External floating roof tank
- Horizontal tank
- Internal floating roof tank
- Underground horizontal tank
- Vertical fixed roof tank

The matrix below shows the information required for each tank type regarding the size and condition of tank is required prior to using TANKS 4.09d to estimate emissions:

Table 1 Essential tank information required for use of TANKS 4.09d

	External floating roof tank	Horizontal Tank	Internal floating roof tank	Underground horizontal tank	Vertical fixed roof tank
Shell length	×	✓	×	✓	✓
Tank diameter	✓	✓	✓	✓	✓
Tank volume	✓	✓	✓	✓	✓
Turnovers per year	✓	✓	✓	✓	✓

Note that TANKS requires inputs in imperial units. See Section 5 for further details.

The table below lists the default values that should be used in TANKS if no information is available. While these variables do affect the outcome of the report the extent is marginal when compared to the parameters above.

Table 2 Default variables for input into TANKS 4.09d

	External floating roof tank	Horizontal Tank	Internal floating roof tank	Underground horizontal tank	Vertical fixed roof tank
Internal Shell Condition	Gunite Lining	N/A	Gunite Lining	N/A	N/A
External Shell Colour/Shade	White/White	White/White	White/White	White/White	White/White
External Shell Condition	Good	Good	Good	Good	Good
Roof Colour/Shade	N/A	N/A	White/White	N/A	White/White
Roof Paint Conditions	N/A	N/A	Good	N/A	Good
Roof Type	Pontoon	N/A	N/A	N/A	Cone
Roof Fitting Category	Typical	N/A	N/A	N/A	N/A
Is tank heated	No	No	No	No	No
Vacuum Vent Setting	N/A	-0.03	N/A	-0.03	-0.3

	External floating roof tank	Horizontal Tank	Internal floating roof tank	Underground horizontal tank	Vertical fixed roof tank
Pressure Vent Setting	N/A	0.03	N/A	0.03	0.3
Primary Seal	Liquid Mounted	N/A	Liquid Mounted	N/A	N/A
Secondary Seal	Rim mounted	N/A	None	N/A	N/A
Deck Type	Welded	N/A	Welded	N/A	N/A
Deck Fitting Category	N/A	N/A	Typical	N/A	N/A

4.2. Location Information

As discussed in **Section 3**, NPI has provided a database that lists the meteorological information for many major cities and regions around Australia.

In addition, for users who are not located in the close vicinity of a major city, the average meteorological data has been compiled for specific major climatic zones in Australia (**Table 3** and **Figure 2)**.

Table 3 Default regions and their corresponding geographical locations

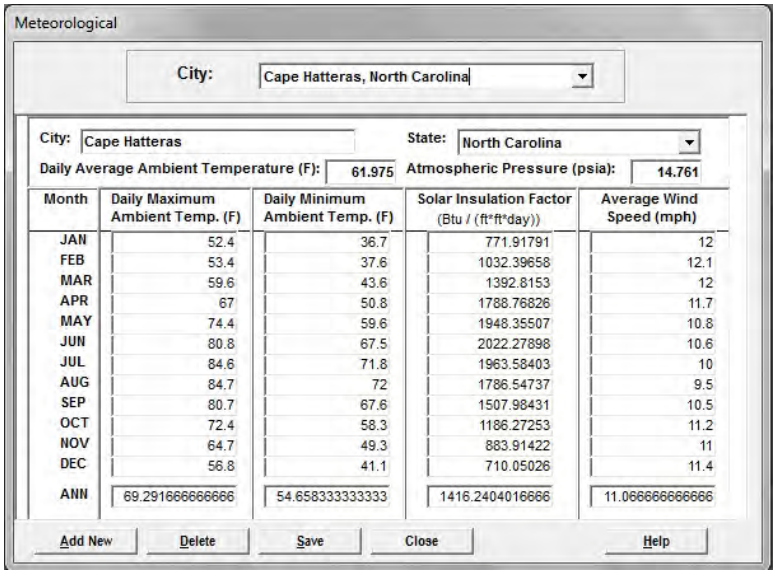
Name	Location
Region 01	South Australia South
Region 02	Western Australia South
Region 03	Western Australia Central
Region 04	Australia North
Region 05	Australia Central
Region 06	Queensland Far North East
Region 07	Queensland Central North
Region 08	Queensland Central
Region 09	Queensland South
Region 10	New South Wales
Region 11	Victoria
Region 12	Tasmania

Figure 2 Map of Australia showing breakup of default regions

Alternatively, it is possible to enter the meteorological information for the specific location of the tank. In some cases it is possible to obtain this data from Australian Bureau of Meteorology (BOM). If this approach is to be taken, the following information will be required.

- Daily Average Ambient Temperature (F)
- Annual Average Maximum Temperature (F)
- Annual Average Minimum Temperature (F)
- Average Wind Speed (mph)
- Annual Average Solar Insulation Factor (Btu/(ft'ft'day))
- Atmospheric Pressure (psia)

Figure 3 Meteorological data input screen



Month	Daily Maximum Ambient Temp. (F)	Daily Minimum Ambient Temp. (F)	Solar Insulation Factor (Btu / (ft*ft*day))	Average Wind Speed (mph)
JAN	52.4	36.7	771.91791	12
FEB	53.4	37.6	1032.39658	12.1
MAR	59.6	43.6	1392.8153	12
APR	67	50.8	1788.76826	11.7
MAY	74.4	59.6	1948.35507	10.8
JUN	80.8	67.5	2022.27898	10.6
JUL	84.6	71.8	1963.58403	10
AUG	84.7	72	1786.54737	9.5
SEP	80.7	67.6	1507.98431	10.5
OCT	72.4	58.3	1186.27253	11.2
NOV	64.7	49.3	883.91422	11
DEC	56.8	41.1	710.05026	11.4
ANN	69.291666666666	54.658333333333	1416.2404016666	11.066666666666

4.3. Substance Information

Finally, the liquid content of the tank is required. As with the meteorological data, information on the vast majority of fuels and organic liquids have been added to the databases and it will simply be a case of selecting the appropriate liquid from the dropdown. However, please note that if this is not the case, it may be necessary to manually enter information regarding the chemical into tanks. In this situation, please see **Section 4.5** of the *US EPA User Guide to Tanks*.

5. Conversion From Metric to Imperial

As TANKS 4.09d was originally designed for use in the US it is necessary to convert all measurements from metric to imperial prior to entering details of the tank and substance into the program.

It is expected that for the majority of cases, the only measurements that will need to be converted are:

- Length, height, width – from meters (m) to feet (ft)
- Volume – from litres (L) to US gallon (Gal)
- Temperature – from Celsius to Fahrenheit
- Pressure - hPa to psi

The table below provides conversion rates for all the units required in TANKS 4.09d.

Table 4 Metric / imperial conversions

To convert from	To convert to	Multiply by
Mass		
Kilogram (kg)	Pound (lb)	2.204
Pound (lb)	Kilogram (kg)	0.454
Volume		
US Gallons (gal)	Litres (L)	3.785
Litres (L)	US Gallons (gal)	0.2642
Length		
Metres (m)	Foot (ft)	3.280
Foot (ft)	Metres (m)	0.304
Temperature		
Celsius (°C)	Fahrenheit (°F)	9/5 × °C + 32
Fahrenheit (°F)	Celsius (°C)	(°F – 32) × 5/9
Pressure		
lb per square inch (psi)	Hectopascal (hPa)	69
Hectopascal (hPa)	lb per square inch (psi)	0.01450
Millibar	Hectopascal (hPa)	1

Note:

1. The unit psi is either psig (pound per square inch gauge) or psia (pounds per square inch absolute). Gauge is in reference to 1 atmosphere pressure (14.7 psia or 1013 hPa)
2. Note US gallons are **not** the same UK gallons.In relation to any work involving TANKS the unit gallon or gal refers to the US gallons.

6. Entering Data

TANKS 4.09d requires specific information about a storage tank (dimensions, construction, paint condition, etc.), the liquid contents (chemical components and liquid temperature), and the location of the tank (nearest city, ambient temperature, etc.) to generate an air emissions report. This information is entered into and stored in a tank record.

Users have the option of creating an entirely new tank record or, alternately, they can edit default tank records that the NPI has developed.

6.1. Using default tank records

To open a default tank record select Data -> Tanks -> Edit Record -> Choose the appropriate record from the drop down list -> Edit

6.2. Creating a new tank record

To create a new tank record select Data -> Tanks -> New record -> Select the appropriate tank type

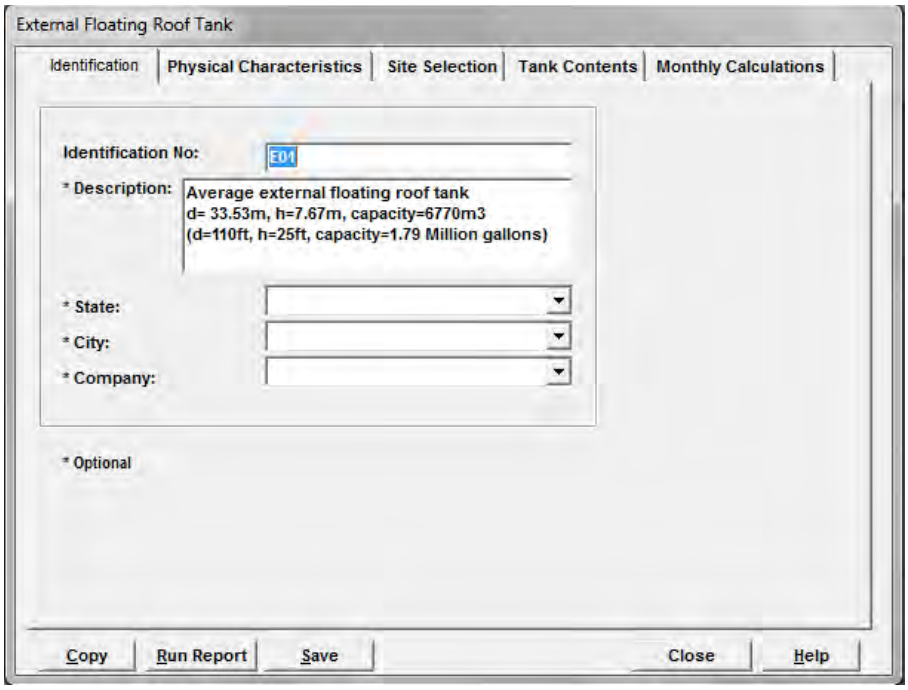
6.3. Tank Records

Tank records contain all the parameters for a specific tank such as its size, location, contents and condition. These details must be correctly entered prior to running an emission report.

6.3.1. Identification

Information contained within the Identification section is user-defined and is designed to provide a reference for users with multiple tank types. Each tank can be identified by five data fields: identification number, description, city, state and company. Information entered into this section of the Tank record does not affect the emission report.

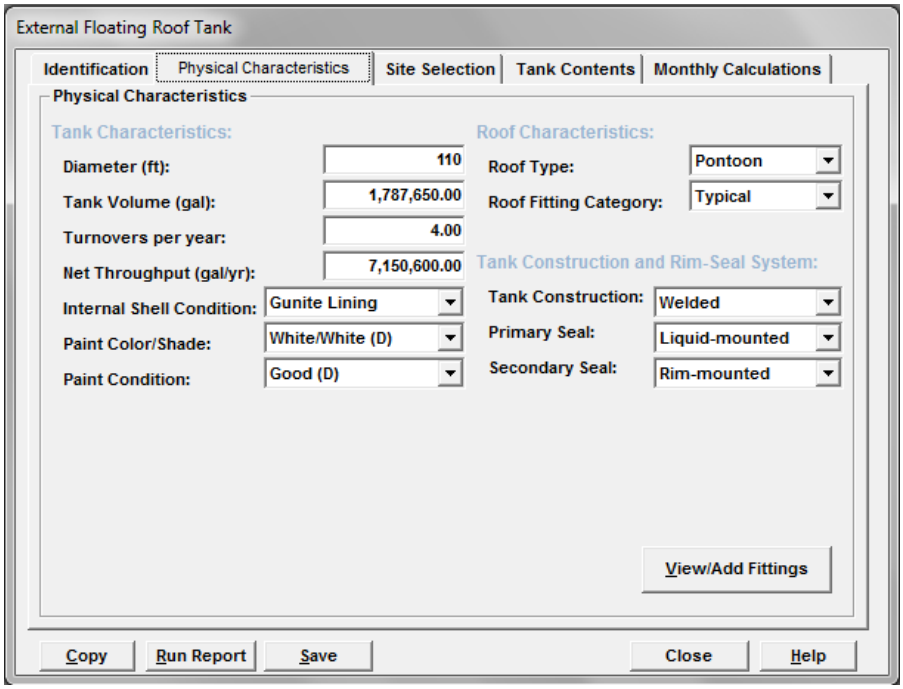
Figure 4 Identification tab



6.3.2. Physical Characteristics

The physical characteristics required by TANKS 4.09d to produce an emission report varies depending on the type of tank. The default entries should be left if the actual value/answer is unknown.

Figure 5 Physical Characteristics tab



The table below details the required physical characteristics for each tank type.

Table 5 Data requirements for tank types

External floating roof tank	Horizontal Tank	Internal floating roof tank	Underground horizontal tank	Vertical fixed roof tank
Diameter (ft)	Shell Length (ft)	Diameter (ft)	Shell Length (ft)	Shell Height (ft)
Tank Volume (gal)	Shell Diameter (ft)	Tank Volume (gal)	Shell Diameter (ft)	Shell Diameter (ft)
Turnovers per year	Working Volume (gal)	Turnover per year	Working Volume (gal)	Maximum Liquid Height (ft)
Net Throughput (gal/yr)	Turnovers per Year	Net Throughput (gal/yr)	Turnovers per Year	Average Liquid Height (ft)
Internal Shell Condition	Net Throughput (gal/yr)	Self-Supporting Roof?	Net Throughput (gal/yr)	Working Volume (gal)
Paint Colour/Shade	Is Tank Heated?	Number of Columns	Is Tank Heated?	Turnovers per Year
Paint Condition	Is the Tank Underground	Effective Column diameter	Is the Tank Underground	Net Throughput (gal/yr)
Roof Type	Shell Colour/Shade	Internal Shell Condition	Vacuum Settings (psig)	Is Tank Heated?
Roof Fitting Category	Shell Condition	External Shell Colour/Shade	Pressure Settings (psig)	Shell Colour/Shade
Tank Construction	Vacuum Setting (psig)	External Shell Condition		Shell Condition
Primary Seal	Pressure Setting (psig)	Roof Colour/Shade		Roof Colour/Shade
Secondary Seal		Roof Paint Condition		Roof Condition
		Primary Seal		Roof Type

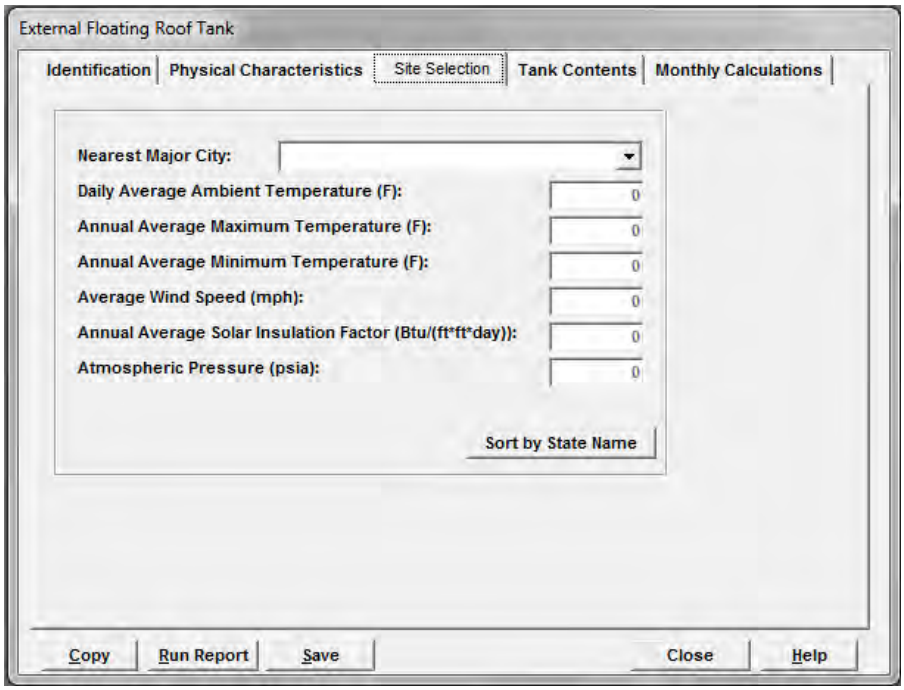
External floating roof tank	Horizontal Tank	Internal floating roof tank	Underground horizontal tank	Vertical fixed roof tank
		Secondary Seal		Roof Height
		Deck Type		Roof Slope (ft/ft) (Cone)
		Deck Fitting Category		Vacuum Setting (psig)
				Pressure Setting (psig)

For further information and descriptions of each requirement please see *Section 4.2* of the *US EPA User Guide to Tanks.*

6.3.3. Site Selection

The Site Selection screen is identical in all five tank types. As discussed in **Section 3 and 5.2**, the NPI database provided contains meteorological information for the major cities of Australia and also average data for 12 regions of Australia such as temperatures, wind speed, and solar insolation factors. If the user wishes to use one of the predetermined locations, it is simply a case of selecting the relevant one from the dropdown list.

Figure 6 Site Selection tab

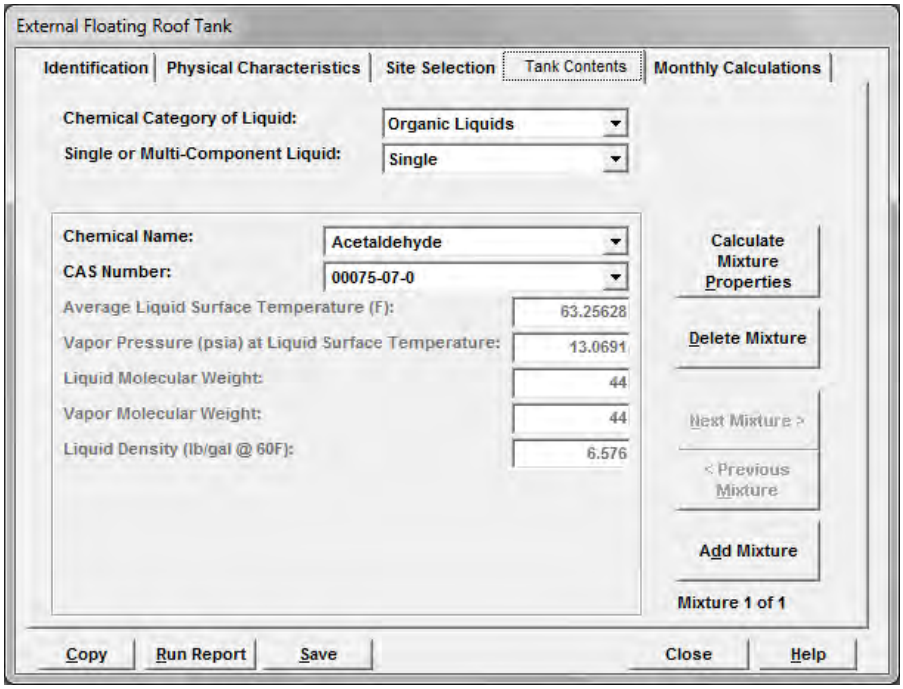


Alternatively, if more accurate or relevant information is available (such as BOM data), it is possible for users to create or edit a meteorological record. For more information on creating and editing meteorological data please see *Section 6.2* of the *US EPA User Guide to Tanks*.

6.3.4. Tank Contents

The fields shown on this screen vary according to the type of tank, whether the tank is heated, and the liquid contents.

Figure 7 Tank Contents tab



Chemical Category of Liquid

There are three chemical categories

- Petroleum Distillates – Unleaded petrol, diesel, jet fuels, AV gas etc.
- Crude oils – unrefined petroleum stocks
- Organic Liquids – All organic compounds and mixtures

Single – or Multi-Component Liquid

This field indicates whether the liquid stored in the tank consists of a single component or a mixture of components.

Petroleum distillates and crude oils may be entered as single-component liquids if the emissions estimates for individual chemicals are not needed. If a breakdown of emissions by underlying components is needed enter the liquid data as a Multi-Component Liquid. Note a breakdown is required if the mixture contains any NPI-listed chemicals (e.g., benzene emissions from storing petroleum).

Speciation Options

When a Multi-Component liquid is selected the Speciation Option field is displayed which gives 4 options to choose from as follows:

Full Speciation: This option can be used if you know the names of each substance in the mixture and their concentrations. The details of each substance can be added using the 'Add/View Components' option. The program will calculate the vapour pressure and other data for the entire mixture.

Partial Speciation: The TANKS program provides generic speciation profiles for fuels which can be used with the partial speciation option only to calculate emissions. The relevant fuel type or mixture should be selected from the mixture name option (e.g. Distillate fuel oil no 2). Then the 'Copy

Speciation Profile' button can be used to access a drop down menu where the generic fuel data can be selected and added (e.g. diesel). The percent of total liquid weight if known can be adjusted by using the 'View/Add Components' option. Substance data can also be added or removed if required in this Specify Components screen.

Vapour Weight Speciation: This option is similar to the partial speciation option but requires that the percentage of the total vapour weight is added for all individual substances.

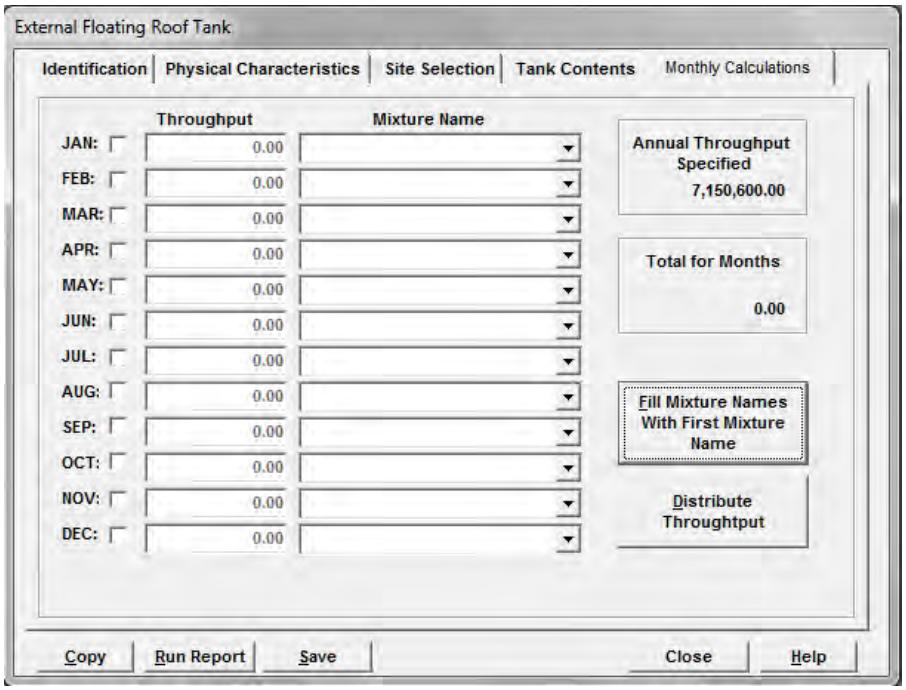
None: This option allows you to add specific chemical data for the mixture but will not give emissions for individual components/substances.

For more information on single and multiple speciations please see *Section 4.5* of the *US EPA User Guide to Tanks*

6.3.5. Monthly Calculations

The final tab of the Tank Record provides an option for calculating the emissions for particular months of the year. For the purpose of NPI reporting, annual emission data is required so it is important to make sure all months are selected.

Figure 8 Map of Australia showing breakup of default regions



7. Default Tank Types and Parameters

As mentioned in **Section 5.1,** TANKS 4.09d is designed to measure the emissions from five different types of tanks:

- **External Floating Roof Tank (E)**
- **Horizontal Fixed Roof Tanks (H)**
- **Internal Floating Roof Tank (R)**
- **Underground Horizontal Tank (U)**
- **Vertical Fixed Roof Tanks (V)**

The Australian tanks database has a number of default tanks programmed into it. The default tank type entries can be used as a basis for entering site-specific tank data, but it is recommended that users should avoid using these measurements unless no information on tank size is available. Tank size plays a significant role in determining the extent of emissions and therefore using incorrect measurements has the potential to under or overestimate emissions.

7.1. External floating roof tank

This type of tank consists of a cylindrical steel shell equipped with a roof that floats on the surface of the stored liquid.

Table 6 Default parameters for external floating roof tanks

Tank ID	Description	Diameter		Height		Volume	
		(m)	(ft)	(m)	(ft)	(m^3)	(gal)
E01	External Floating Roof Tank	33.53	110	7.67	25	6,770	1.79M

7.2. Horizontal fixed roof tanks

These tanks are constructed above-ground with the axis parallel to the foundation. Horizontal fixed roof shells may be steel, steel with a fiberglass overlay, or fiberglass-reinforced polyester. These tanks may be specified as “heated” in TANKS 4.0

Table 7 Default parameters for horizontal fixed roof tanks

Tank ID	Description	Diameter		Length		Volume	
		(m)	(ft)	(m)	(ft)	(m^3)	(gal)
H01	Horizontal Fixed Roof Tank	3.0	9.8	14.85	48.7	100	26,417

7.3. Internal floating roof tanks

This type of tank has both a permanent fixed roof and a floating deck.

Table 8 Default parameters for internal floating roof tanks

Tank ID	Description	Diameter		Height		Volume	
		(m)	(ft)	(m)	(ft)	(m^3)	(gal)
R01	Internal Floating Roof Tank	26.55	87	15.3	50	8,470	2.24M

7.4. Underground horizontal tank

These tanks are underground with the axis parallel to the foundation. Horizontal fixed roof shells may be steel, steel with a fiberglass overlay, or fiberglass-reinforced polyester. These tanks may be specified as “heated” in TANKS 4.0

Table 9 Default parameters for underground horizontal tanks

Tank ID	Description	Diameter		Length		Volume	
		(m)	(ft)	(m)	(ft)	(m^3)	(gal)
U01	Underground Horizontal Tank	3.0	9.8	14.85	48.7	100	26,417

7.5. Vertical fixed roof tanks

These tanks consist of cylindrical shells with permanently affixed roofs; the tank axis is perpendicular to the foundation. The fixed roof may be dome-shaped or cone shaped. Vertical fixed roof tank shells are usually constructed of steel. These tanks may be specified as “heated” in TANKS 4.0

Table 10 Default parameters for vertical fixed roof tanks

Tank ID	Description	Diameter		Height		Volume	
		(m)	(ft)	(m)	(ft)	(m^3)	(gal)
V01	Vertical Fixed Roof Tank	26.55	87	15.55	51	8,470	2.24M

8. Generating Reports

TANKS 4.09d is designed so reports can be tailored to provide as little or as much information as required. For the purpose of NPI reporting, it is recommended that the *Brief Report* option be used. This report provides emission totals for the fuel stored in the tanks as well as a breakdown of the emissions of the related compounds.

Table 11 Example of a brief emissions report for an external floating roof tank

TANKS 4.0.9d
Emissions Report - Brief Format
Individual Summaries

Emissions Report for: Annual

E05 - External Floating Roof Tank

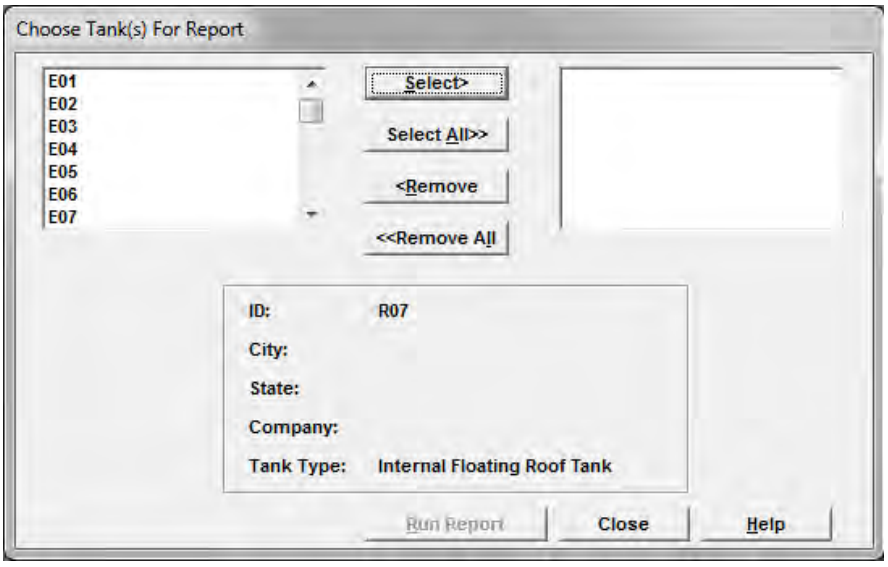
	Losses(lbs)				
Components	Rim Seal Loss	Withdrawl Loss	Deck Fitting Loss	Deck Seam Loss	Total Emissions
E10	1,239.62	1,226.00	13,549.03	0.00	16,014.65
Toluene	11.40	91.95	124.60	0.00	227.95
Ethanol	31.12	122.60	340.15	0.00	493.87
Gasoline (RVP 10)	1,000.01	826.94	10,930.05	0.00	12,757.00
Xylene (-m)	4.37	122.60	47.79	0.00	174.76
Tetraethyllead	0.00	0.74	0.01	0.00	0.75
Hexane (-n)	16.54	24.52	180.76	0.00	221.81
Ethyl benzene	1.05	24.52	11.43	0.00	36.99
Benzene	5.10	12.14	55.78	0.00	73.02

There are two ways to generate an emissions report using TANKS 4.0. You may use the Report menu on the main menu or you may run an emissions report while viewing a tank record. The advantage of using the Report option from the main menu is that you may generate reports for more than one tank at a time. The advantage of running reports from within the Tank Records data entry/edit screens is that you may immediately correct errors in the data.

8.1. Generating a report using the Report menu

This option is advantageous as it allows you to run a report for multiple tanks. However, prior to running a report using the report menu, the user must have previously entered the specific information for the tank e.g. location, substance etc. For instructions on how to do this, see **Section 7** of this manual.

Figure 9 Report selection screen from report menu



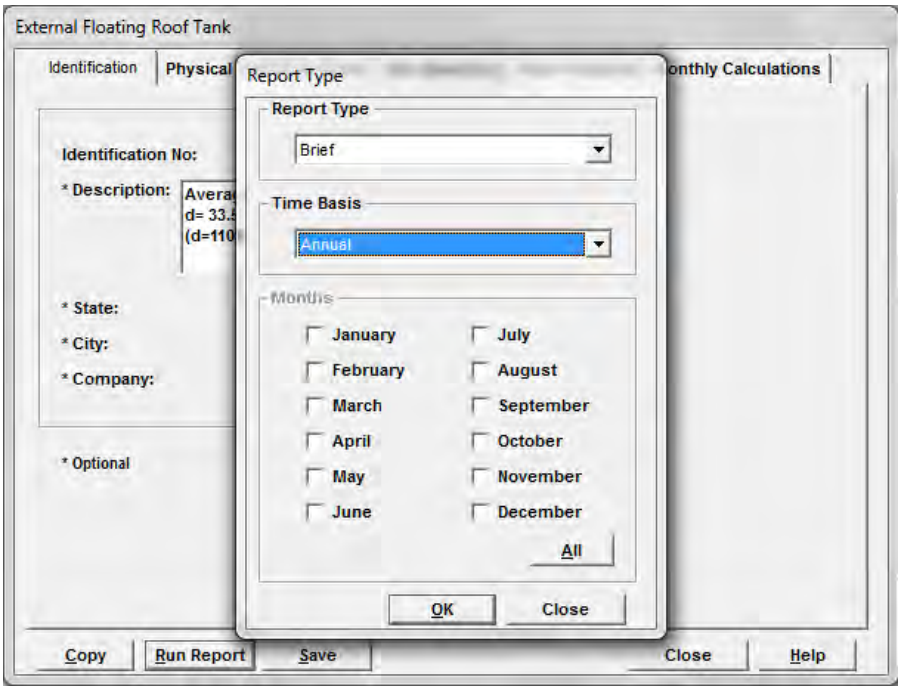
1. Choose Report menu -> Annual ->Brief
2. Select the tank(s) for which you wish to generate a report and press ‘Run Report’

3. Chose File -> Ok -> Windows/Printer -> Ok.
   Note: for ease of use it is recommended that users chose to view data in Windows/Printer. However, it is also possible to save the report as an excel file.

8.2. Generating a report while viewing a tank record

This option allows the user to run a report directly from the tank record and is useful as it allows users to conduct a final check that all the data entered in the tank record is accurate prior to running the report.

Figure 10 Report selection screen from tank record



1. Chose ‘Run Report’ from the Tank Record.
2. For report type select ‘Brief’
3. For the time basis select ‘Annual’
4. Chose File -> Ok -> Windows/Printer -> Ok.
   Note: for ease of use it is recommended that users chose to view data in Windows/Printer. However, it is also possible to save the report as an excel file.

9. Conversion from Imperial to Metric for NPI Reporting.

For NPI reporting purposes, it is necessary to convert the emission totals produced in the report from pounds (lb) to kilograms (kg).

$$E_{(lb)} \times 2.204 = E_{(kg)}$$

$E_{(lb)}$ = Emission total in pounds (lb)

$E_{(kg)}$ = Emission total in kilograms (kg)