National Environment Protection (Air Toxics) Measure

Mid-term Review Report

May 2010

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1 EXECUTIVE SUMMARY

The National Environment Protection (Air Toxics) Measure was made by the National Environment Protection Council in April 2004 and its purpose is:

- to provide a nationally consistent framework for the monitoring and reporting on air toxics;
- to provide information that will enable NEPC to establish national air quality standards in the future which are protective of human health; and
- to enable jurisdictions to assess air quality in a consistent manner.

The NEPM contains a clause to conduct a mid-term review of the NEPM to evaluate the data collected and identify any problems that the jurisdictions were having in implementing the NEPM. A full review of the NEPM is due to commence in 2012.

The terms of reference for the mid-term review include:

- A summary of air toxics monitoring conducted to date and any proposed until the full review of the NEPM
- What the data collected to date indicates about air toxics in Australia
- What difficulties or issues jurisdictions faced in the implementation of the NEPM
- What changes might be required to the NEPM at this time noting that this is not a full review of the NEPM.

1.1 KEY FINDINGS

The key findings of the mid-term review are that, overall, there has been significant progress towards achieving the goal of the NEPM *to improve the information base regarding ambient air toxics in the Australia environment.* There is a significant increase in the information available since the NEPM was made in 2004, but further information is needed for some pollutants to enable an assessment of population exposure.

Issues were raised around the desktop analysis procedure for identifying sites for monitoring. Jurisdictions proposed a number of improvements to the current desktop analysis procedures:

- The procedure should be revised to better account for available monitoring data.
- The results of the desktop analysis should be validated with air monitoring data and modified if necessary.
- Threshold tables should be updated to ensure that they are airshed specific.
- The emission inventories used to support the desktop analyses need to be improved and updated.
- The procedure should be more flexible so a representative desktop analysis can be applied either directly or extrapolated to another similar location.

Analysis of the monitoring data revealed that:

- Benzene is at or below the MIL for nearly all sites measured. The data obtained using non-NEPM methods showed that levels of benzene near heavily trafficked roads and in an area that was a mixed industrial area were close to or exceeded the MIL. The higher values found using these methods may be due to a range of factors including differences in the site location of monitoring equipment and differences in the

methods used and in particular their detection limits. No clear trend over time could be observed.

- Toluene concentrations are about one tenth of the MIL with two exceptions. There is some evidence of a downward trend
- Xylene concentrations were generally well below the MIL except for one site which showed some evidence of a downward trend.
- Formaldehyde measurements were all below the MIL generally significantly but much less monitoring has been conducted than for BTX.
- Benzo (a) pyrene results were inconclusive due to the amount of monitoring conducted, so more monitoring is warranted to determine the levels of this pollutant. Monitoring costs could be reduced if only benzo (a) pyrene were tested for.
- Data at many sites had low numbers of samples, especially for benzo (a) pyrene so that additional monitoring is warranted. This also means that conclusions should be treated with caution.

Investigation of the monitoring methods revealed that:

- Monitoring costs are significantly less for methods other than those recommended in the NEPM. There are some issues of detection limits that need to be resolved to ensure comparability of data.
- A nationally sponsored and funded review of monitoring methods would allow the use of appropriate alternate methods.

1.2 RECOMMENDATIONS

NEPM recommendations

Recommendation 1:
Amend the NEPM Schedule 2, Section 3 (vi) and Section 4 (v) that requires the 4 year repeat of the desktop analysis be undertaken using the same methodology as that used in the year 1 desktop analysis. The amendment is to also allow qualitative assessment tools to be used according to the Guidance Paper for Desktop Analysis as described in recommendation 6.

Recommendation 2:
Amend the NEPM Schedule 3 Part 3 Table 1 to allow the use of any monitoring method for measuring ambient air toxics that has been endorsed by recognised national and international agencies.

Recommendation 3:
Amend the NEPM Schedule 3 Part 5 Monitoring Investigation Levels, to allow cut off levels of the MILs below which further monitoring is not required.

Recommendation 4:
Amend the NEPM Schedule 4 Part 2 Section (iv) Reporting Proforma Table 2 to require a description of the methods used and their applicability to collect the data.

Recommendation 5:

Amend the NEPM Schedule 4 Part 2 Section (iii) Reporting Proforma Table 1 to require reporting of data to include an accurate description of siting in accordance with AS 2922-1987.

Non-NEPM recommendations

Recommendation 6:
Amend the Guidance Paper for Desktop Analysis by adding Section 7 Qualitative Analysis to provide guidance on an alternative qualitative desktop analysis procedure.

Recommendation 7:
Amend Tables 5.2a, 5.2b, 6.2a and 6.2b in the Guidance Paper for Desktop Analysis by revising the threshold values for rank 1, 2, 3 and 4 to > 75%, 50-75%, 25-50% and 0-25% of the MIL.

Recommendation 8:
Initiate a review of monitoring methods available for use in the Air Toxics NEPM.

Recommendation 9:
Initiate discussions with laboratories to facilitate processes to ensure analysis detection limits are appropriate for measuring the environmental levels.

2 THE AIR TOXICS NEPM

The National Environment Protection (Air Toxics) Measure was made by the National Environment Protection Council in April 2004.

The purpose of the National Environment Protection (Air Toxics) Measure is:

- to provide a nationally consistent framework for the monitoring and reporting on air toxics;
- to provide information that will enable NEPC to establish national air quality standards in the future which are protective of human health; and
- to enable jurisdictions to assess air quality in a consistent manner.

At the time of making the NEPM there were no nationally consistent ambient air quality standards for air toxics in Australia. The schedule in the NEPM incorporates monitoring investigation levels (MILs) for each of the following toxic compounds found in the air ("air toxics"): benzene, formaldehyde, benzo(a)pyrene as a marker for polycyclic aromatic hydrocarbons (PAHs), toluene and xylenes. These were designed to provide nationally consistent benchmarks to assess the results of monitoring data generated under the NEPM.

The desired environmental outcome of the NEPM is to facilitate management of air toxics in ambient air that allows for the equivalent protection of human health and well being, by:-

1) providing for the generation of comparable, reliable information on the levels of toxic air pollutants ("air toxics") at sites where significantly elevated concentrations of one or more of these pollutants are likely to occur ("Stage 1 sites") and where the potential for significant population exposure to air toxics exists ("Stage 2 sites").

2) establishing a consistent approach to the identification of such sites for use by jurisdictions.

3) establishing a consistent frame of reference ("investigation levels") for use by jurisdictions in assessing the likely significance of levels of air toxics measured at Stage 2 sites.

4) adopting a nationally consistent approach to monitoring air toxics at a range of locations (e.g. major industrial sites, major roads, areas affected by wood smoke).

It was intended that the NEPM would allow jurisdictions to flexibly implement monitoring, as resources become available. The goal of the NEPM is to improve the information base regarding ambient air toxics within the Australian environment in order to facilitate the development of standards through a health risk assessment following a review of the NEPM within eight years of its making.

2.1 BACKGROUND TO THE MID-TERM REVIEW

When the NEPM was made in 2004 it was agreed to conduct a mid-term review of the NEPM to evaluate the data collected and identify any problems that the jurisdictions were having in implementing the NEPM. The review was due to commence in late 2008. A full review of the NEPM is due to commence in 2012.

Due to delays in implementation of the NEPM by several jurisdictions, NEPC agreed, in November 2008, to postpone the mid-term review for 12 months to late 2009 to enable sufficient information to be collected to inform the mid-term review.

The terms of reference for the mid-term review include:

- A summary of air toxics monitoring conducted to date and any proposed until the full review of the NEPM
- What the data collected to date indicates about air toxics in Australia
- What difficulties or issues jurisdictions faced in the implementation of the NEPM
- What changes might be required to the NEPM at this time noting that this is not a full review of the NEPM.

2.2 PROCESS FOR THE REVIEW

The mid-term review commenced in November 2009 and was completed in April 2010. The review process comprised the following components:

- Establishment of Review Team and JRN
- Development of a questionnaire and monitoring data collection tools
- Analysis of responses to questionnaire
- Analysis of desktop analysis and data collected under the NEPM
- Production of draft report
- Discussion with JRN on findings of the report
- Transmission of the review report and recommendations to NEPC.

2.2.1 Review team and JRN

A Review Team was established, chaired by Victoria, and comprising members from Victoria, New South Wales and South Australia. The NEPC Service Corporation provided a Project Manager. A Jurisdictional Reference Network (JRN) comprising a representative from each jurisdiction was established to provide policy, technical and operational advice and information.

2.2.2 Questionnaire for desktop analysis and monitoring data collection

To inform the mid-term review of the NEPM, jurisdictions were surveyed between 15 December 2009 and 1 February 2010. The survey sought feedback from jurisdictions about key components of the NEPM, including: desktop analysis; monitoring data; implementation issues; expectations of the NEPM; and emerging issues.

A questionnaire was developed by the review team to collect and evaluate the air toxics desktop analysis process, monitoring data collected by jurisdictions under the NEPM, and to survey jurisdictions on their experiences in implementing the NEPM to identify any problems (see Appendix A for questionnaire and data collection spreadsheets).

2.2.3 Process for analysis of desktop exercise

Responses to each of the questions relating to the desktop analysis have been reviewed, analysed and tabulated. Where a jurisdiction did not respond to the questionnaire or the information was incomplete, additional information has been obtained from various NEPC annual reports to supplement the survey questionnaire responses. Footnotes to the tabulated responses to the survey questions indicate the information was derived from a source other than the survey questionnaire.

2.2.4 Process for analysis of monitoring data

An initial examination of data was undertaken which revealed that jurisdictions used a wide variety of methods. Sampling density was not as high as desirable in many cases and siting was not necessarily in line with the NEPM requirement for peak sites although many would fit this description.

Thus comparison of this type of data was difficult. It was decided to take a generalised approach and so data have been bulked to allow general comments to be made.

Some sites had many samples below the limit of detection. To allow comparison of these data the common practice of substituting a value of half the detectable limit was used as this prevents the upward bias on averages if these data were deleted.

Although the practice of requiring the presence of 75% of required data is usual to calculate valid averages (as for the Ambient Air NEPM) it was not used here as this would mean much of the data would be rejected. In this vein it is noteworthy that of the sites that exceeded the MIL for benzo (a) pyrene none had more than one third of the possible annual samples.

To examine the concentrations of various site types the description provided by jurisdictions was used to form a consistent site description to enable sorting. For one jurisdiction an examination of the area using Google Earth and their web site was conducted as no information was supplied on the site type. Site type refers to the surrounding location and possible sources of emissions e.g. residential, rural, wood smoke impacted.

Some data were provided as micrograms/m^3 but without corresponding conditions of temperature and pressure. To convert these data to parts per million by volume it was assumed that the data were calculated at 1 atmosphere pressure and 25 degrees Celsius as required for benzo (a) pyrene, as in the available time it was not possible to obtain the information. Conversion factors are summarised in Table 1.

Table 1: Conversion factors used to convert from μg/m^3 to ppm.

Pollutant	Factor to convert from micrograms per cubic meter at 1 Atmosphere pressure and 25 degrees Celsius to ppm assuming ideal gas
Benzene	0.00031321
Toluene	0.00026555
Xylene	0.00023046
Formaldehyde	0.00081469
Benzo (a) pyrene	0.00009696

3 RESULTS OF THE MID-TERM REVIEW

3.1 REQUIREMENTS OF THE NEPM

The effects of benzene, toluene, xylenes, formaldehyde and PAHs on health are well documented (see Air Toxics Impact Statement 2004). The results of studies have shown that these air toxics are associated with a variety of adverse health impacts including cancer, central nervous system (CNS) effects, respiratory irritation and eye irritation.

At the time of making the NEPM, the national database of ambient monitoring data for air toxics was limited, making it impractical to compile meaningful estimates of population exposures and health risks associated with current ambient levels of air toxics in Australia. Furthermore, there was no consistently applied methodology for monitoring and reporting on air toxics in ambient air in Australia, and there were no national ambient air quality standards against which the quality of ambient air could be assessed.

It was intended to address these issues through the NEPM by standardising the collection and reporting of ambient air quality data for the nominated air toxics and providing benchmarks against which ambient air quality data could be assessed.

The objectives of the NEPM are to:

- facilitate collection of monitoring data for ambient air toxics in order to inform future risk assessments and the development of standards;
- establish a set of investigation levels which can be applied nationally to the air toxics benzene, toluene, xylenes, formaldehyde and benzo(a)pyrene as a marker for PAHs, as benchmarks against which the quality of ambient air can be assessed; and,
- Establish nationally agreed methodologies for determining appropriate locations for monitoring these air toxics, conducting monitoring, and reporting results of monitoring.

The goal of the NEPM is to "improve the information base regarding ambient air toxics within the Australian environment in order to facilitate the development of standards following a Review of the NEPM within eight years of its making".

The NEPM establishes processes that include a desktop assessment process to be used by jurisdictions to determine locations where significantly elevated ambient concentrations are more likely to occur (these locations are referred to as "Stage 1 sites"). Jurisdictions may then prioritise their monitoring activities at sites ("Stage 2 sites") based on the results of a further desktop assessment focussing on the likely extent and significance of human exposure, and on available resources.

Jurisdictions monitoring for air toxics under the NEPM assess the results of monitoring air quality at their sites using the investigation levels as benchmarks. If jurisdictions find that ambient concentrations at Stage 2 sites are above investigation levels, then it was intended that they investigate the reasons for, and the circumstances surrounding, the significantly elevated concentrations. Based on the results of the investigations, jurisdictions may undertake further investigation or implement appropriate management actions.

Under the NEPM, jurisdictions are required to report to NEPC:

- the results of desktop assessments;
- locations of Stage 1 and Stage 2 sites
- the extent of monitoring undertaken or planned;
- the results of any monitoring;
- sites where ambient concentrations exceed the investigation levels;
- the number of exceedances of the investigation levels at Stage 2 sites;
- the results of investigations into these exceedences; and
- any action taken in response to results of investigations.

3.2 IMPLEMENTATION

Responses on the questionnaire show that all jurisdictions have been able to implement the NEPM. Implementation of the NEPM is essentially in 5 parts:

1. Desktop analysis to identify any sites that may have elevated levels of air toxics (Stage 1 sites) through modelling and analysis of inventory data.
2. Further desktop analysis to identify potential monitoring locations (Stage 2 sites) based on exposure of population to elevated levels of these pollutants.
3. Monitoring at selected Stage 2 sites.
4. Annual reporting to NEPC.
5. Review of the desktop analysis in Year 4 of the NEPM.

All jurisdictions undertook the initial desktop analysis. This is discussed further in Section 3.3. The review of the desktop analysis in Year 4 was only undertaken by one jurisdiction.

Stage 1 sites were identified through the desktop analysis and potential Stage 2 sites were identified in some jurisdictions. The pollutants that were most important varied between jurisdictions. The pollutants identified in most jurisdictions were benzene, formaldehyde and PAHs although not all were important in all jurisdictions.

Stage 1 sites were identified for a range of locations including near roads, industry, airports, and residential areas impacted by wood smoke. Potential Stage 2 sites were identified in most jurisdictions although monitoring was not always conducted. The barriers to conducting monitoring were primarily lack of resources, competing priorities within a jurisdiction and the complexity of the monitoring methods included in the NEPM. Some jurisdictions conducted monitoring with alternative methods, which although does not strictly comply with NEPM requirements, does provide further information on air toxics in Australia.

The data collected to date shows that ambient benzene levels are at or below the MIL for nearly all sites measured and in some cases exceeding the monitoring investigation level in some jurisdictions. If the MIL were reduced to be consistent with current international standards, this situation would be more widespread. There is only limited data for BaP (as a marker for PAHs) however the data collected indicate that ambient levels of BaP are close to or exceed the MIL. For formaldehyde where data are also limited, levels are below the MIL in most cases although some exceedances of the MIL have been observed in CBD areas. In all but one or two locations, toluene and xylene levels have been well below the MIL.

Some jurisdictions have undertaken preliminary monitoring as set out in Schedule 2 of the NEPM except that equivalency of the methods used has not been undertaken. However, the results of the monitoring have allowed jurisdictions to identify if air toxics are of concern and where those areas of concern might be. Jurisdictions have identified a need for a full review of currently available methods to be undertaken.

All jurisdictions identified that lack of resources (both funding and people) will make further monitoring for the NEPM difficult. This is in part due to the resource intensive methods that are currently required by the NEPM. Only one jurisdiction has future monitoring planned at this time and this will be further preliminary monitoring to get an understanding of air toxics in that jurisdiction. Competing priorities have also been identified as an issue making it difficult to get resources to conduct the monitoring. In jurisdictions where monitoring data shows very low levels jurisdictions have commented that there does not seem to be a case to continue monitoring for these pollutants. This is the case particularly for toluene and xylenes where monitored levels are typically less than a tenth of the monitoring investigation levels.

3.3 DESKTOP ANALYSIS

As previously discussed the first stage of implementation of the NEPM was to conduct a desktop analysis to identify sites where elevated levels of the air toxics might be found and where populations might be exposed to these levels i.e. potential Stage 1 and Stage 2 sites. To assist in this process a small working group from NSW, Victoria and South Australia, in consultation with other jurisdictions, developed a methodology to guide this assessment. The methodology can be found in Appendix A of this review report.

The methodology identifies 2 approaches to the identification of potential Stage 1 and 2 sites:

1. Use of emission inventory, ambient air monitoring and population data
2. Use of emission inventory modelling data, ambient air monitoring and population data

The methodology uses a threshold ranking process where the sites are ranked relative to the MILs. The threshold ranking process is shown in Table 2.

Table 2: Threshold Ranking Process in Desktop Analysis Methodology

Rank	Concentration $[C_i]$
1	$[C_i] > MIL$
2	$0.67\ MIL < [C_i] \leq MIL$
3	$0.33\ MIL < [C_i] \leq 0.67\ MIL$
4	$[C_i] \leq 0.33\ MIL$

On the basis of the assigned rankings, grid cells are identified which could be classified as Stage 1 sites in priority order, that is, "a site where significantly elevated concentrations of one or more air toxics are expected to occur". The methodology proposes that Stage 1 sites should include all sites ranked 1 and 2 if no monitoring data are available. If monitoring data are available then only sites ranked 1 should be considered as Stage 1 sites. This focuses any assessment on areas where air toxic levels are predicted to exceed the MILs.

The responses to the questionnaire showed that all jurisdictions were familiar with the desktop analysis procedure and had utilised it in some form to conduct their desktop assessment. All jurisdictions utilised inventory in the desktop analysis. Apart from 3 jurisdictions that used detailed emissions inventories for their jurisdiction, there was a heavy reliance on NPI data. Three jurisdictions used airshed modelling to inform the selection of Stage 1 and 2 sites. Monitoring data were used in 6 jurisdictions to inform the site selection process. Two jurisdictions relied solely on inventory data supplemented by data from EPA licenses, industrial, commercial and domestic surveys, and meteorological, population and Vehicle Kilometres Travelled (VKT) data. Most jurisdictions provided detailed reports to NEPC as part of the annual reporting required under the NEPM.

In terms of selection of potential stage 1 and 2 sites the threshold ranking procedure was applied differently across jurisdictions. Some jurisdictions strictly adhered to the ranking procedure screening out potential sites unless they were predicted to exceed the MILs. Other jurisdictions considered the highest ranked sites for each pollutant irrespective of whether the MIL was predicted to be exceeded. This approach acknowledges the inherent uncertainties in the desktop analysis methodology. In some jurisdictions final Stage 2 sites chosen for monitoring were based on other considerations, for example areas where there was significant community concern about the impact of industrial emissions on local communities.

Three jurisdictions did not identify any stage 2 sites in their desktop analysis based on the analysis against sites exceeding the MIL. No monitoring has been undertaken in these jurisdictions. Three jurisdictions have conducted monitoring at Stage 2 sites. Although Stage 2 sites were identified in a further 2 jurisdictions, lack of resources, both funding and people, have meant that monitoring has not been undertaken at this time.

One jurisdiction repeated the desktop analysis in Year 4 of the NEPM and found significant differences in the results of this analysis. Their initial assessment utilised only emission inventory, limited ambient air monitoring and population data whilst the repeat assessment utilised air dispersion modelling which takes into account the impact of meteorology on ambient concentrations of these pollutants.

The jurisdictions were asked to comment on whether they could suggest any improvements to the current desktop analysis procedures. Four jurisdictions responded with suggested improvements which included:

- The procedure should be revised to better account for monitoring data.
- The results of the desktop analysis should be validated with air monitoring data and modified if necessary.
- The emission inventories used to support the desktop analyses need to be improved.
- The procedure should be more flexible so a representative desktop analysis can be applied either directly or extrapolated to another similar location.

A number of jurisdictions highlighted that although the initial desktop assessment was completed, circumstances within their jurisdiction have changed making it difficult for future assessments to be conducted. Both lack of current modelling capacity and detailed emission inventories were identified as issues that would impact on the ability of jurisdictions to repeat the desktop analyses.

Only 2 jurisdictions have detailed emission inventories. Other jurisdictions are reliant largely on NPI data. Three jurisdictions have the capacity to conduct airshed modelling but 2 of those do not have detailed emission inventories and would have to rely on NPI. One jurisdiction estimated that it would cost $17,500 for modelling of all five air toxics for one year.

Jurisdictions were also asked to comment on the costs associated with conducting the initial desktop analysis. Estimates ranged from $15,000 to $50,000 taking into account staff time to conduct the analysis and report writing. The time estimated for conducting the analysis and reporting ranged from 2 months to 1 year.

3.4 MONITORING ASSESSMENT

Since the commencement of the NEPM jurisdictions have utilised a variety of sampling and analysis methods to obtain air toxics data. More data are available from jurisdictions than were available at the making of this NEPM and our knowledge about the levels of air toxics in Australia has increased. This allows a level of assessment not previously possible. However, the extent of monitoring indicates that resources are generally a problem as not all jurisdictions have conducted monitoring in accordance with Schedule 3 or sections 10 and 11 of the NEPM either of methods, extent or sampling density.

In addition jurisdictions have not been able to achieve quality accreditation to the same extent as for the Ambient Air NEPM. There are some long term data available but generally jurisdictions have not carried out long term monitoring that would enable the assessment of trends. Some jurisdictions have or are in the process of carrying out repeat monitoring at some previously tested sites. This has the benefit of allowing some evaluation of changes from one time period to the next.

Assessment has been made of the data collected under the NEPM. This information is presented in the following sections. In addition, assessment has been made of all data provided by the jurisdictions pre- and post-NEPM implementation to gain a wider understanding of air toxics in Australia. This additional information is presented in Appendix B.

3.4.1 Monitoring methods

The wide variety of methods that were used at both NEPM and non-NEPM sites suggests that jurisdictions have chosen methods that they were able to support and resource. Almost no data are available comparing these methods by jurisdictions so the comparison of data must be used with caution.

Five jurisdictions have utilised the standard methods in the NEPM (see Table 3) to obtain data. Most methods have limits of detection suitable for the MIL. However there is a range of detection limits for benzo (a) pyrene that warrants improvement to the use of the standard method. This would suggest that to continue this monitoring requires a program of inter-laboratory testing to assure the quality of analysis, as well as auditing, to ensure that the test methods are applied consistently.

Table 3: Reference Methods for Monitoring of Air Toxics

Pollutant	Method title	Method number
Benzene	United States Environmental Protection Agency Compendium Method TO-14A. Determination Of Volatile Organic Compounds (VOCs) In Ambient Air Using Specially Prepared Canisters With Subsequent Analysis By Gas Chromatography – Jan 1999 **OR** United States Environmental Protection Agency Compendium Method TO-15. Determination Of Volatile Organic Compounds In Air Using Specially-Prepared Canisters And Analysed By Gas Chromatography/Mass Spectrometry (GC/MS) – Jan 1999	USEPA –TO14-A Note 1 Note 4 USEPA –TO15 Note 1 Note 4
Formaldehyde	United States Environmental Protection Agency Compendium Method TO-11A. Determination of Formaldehyde in Ambient Air Using Adsorbant Cartridge Followed by High Performance Liquid Chromatography (HPLC) [Active Sampling Methodology] –Jan 1999.	USEPA – TO11-A Note 1 Note 2 Note 3
Benzo(a)pyrene (as a marker for Polycyclic Aromatic Hydrocarbons)	United States Environmental Protection Agency Compendium Method TO-13A. Determination of Polycyclic Aromatic Hydrocarbons (PAHs) Using Gas Chromatography/Mass Spectrometry (GC/MS) – Jan 1999	USEPA - TO13-A Note 1
Toluene	United States Environmental Protection Agency Compendium Method TO-14A. Determination Of Volatile Organic Compounds (VOCs) In Ambient Air Using Specially Prepared Canisters With Subsequent Analysis By Gas Chromatography – Jan 1999 **OR** United States Environmental Protection Agency Compendium Method TO-15. Determination Of Volatile Organic Compounds (VOCs) In Air Using Specially-Prepared Canisters And Analysed By Gas Chromatography/Mass Spectrometry (GC/MS) – Jan 1999	USEPA –TO14-A Note 1 Note 4 USEPA –TO15 Note 1 Note 4
Xylenes (as total of ortho, meta and para isomers)	United States Environmental Protection Agency Compendium Method TO-14A. Determination Of Volatile Organic Compounds (VOCs) In Ambient Air Using Specially Prepared Canisters With Subsequent Analysis By Gas Chromatography – Jan 1999 **OR** United States Environmental Protection Agency Compendium Method TO-15. Determination Of Volatile Organic Compounds (VOCs) In Air Using Specially-Prepared Canisters And Analysed By Gas Chromatography/Mass Spectrometry (GC/MS) – Jan 1999	USEPA –TO14-A Note 1 Note 4 USEPA –TO15 Note 1 Note 4

Generally, jurisdictions used accredited laboratories for analyses, and it is essential for any further testing to maintain high quality data. Examination of passive sampler methods indicate reconciliation of detection limits and a response is warranted as part of a review.

One jurisdiction has used USEPA TO14 alongside passive sampling methods (in this case, Radiello method) but sampling to date has occurred on different days and does not allow for comparisons. Some sites have used Radiello 145 for BTX and others have used Radiello 130. Although the sites are different, those using Radiello 130 generally gave much lower results. This poses the question of whether the two methods are comparable or need reconciling through a formal process.

Benzo(a)pyrene was initially chosen as an indicator for PAHs due to its toxicity and its relatively low volatility enabling sampling by use of a filter as in the standard method. Jurisdictions that have conducted sampling for a wide spectrum of PAHs are commended and if this is relevant to their jurisdiction are encouraged to continue this practise in future monitoring. Jurisdictions yet to conduct PAH monitoring would strictly need to sample and test for Benzo (a) pyrene via filter. This would have the effects of reducing costs and increasing sensitivity as larger samples can be taken when breakthrough of canisters is not an issue. This aligns with the standard test methods.

Some jurisdictions have utilised the digital optical absorption spectrometer (DOAS) system which has a detection limit approximately 0.001ppm for volatile organic compounds (VOC's) for short term data. Provided there is sufficient variation in data or concentrations are sufficiently high these instruments can be utilised to provide more data useful for purposes in addition to comparison with longer term MILs. Results from these instruments appear to be higher than for other methods.

Table 4 summarises the methods that have been used by jurisdictions for monitoring air toxics as well as those proposed for future monitoring. Table 5 summarises the current detection limits used in the analysis for PAHs.

Table 4 – Methods used and proposed by jurisdictions

JURISDICTION	METHODS USED	PROPOSED METHODS
Tasmania	**Methods already used** Radiello 130 BTX Radiello 165 Formaldehyde Radiello 145 BTX USEPA TO-14A BTX PAH based on USEPA TO-13A	**Proposed Methods monitoring commenced** US EPA TO-14A BTX Radiello 130 BTX Radiello 165 Formaldehyde PAH based on US EPA TO-13A
Victoria	**Methods already used** US EPA TO-11A Formaldehyde US EPA TO-15 BTX PUF Benzo(a)pyrene XAD Benzo(a)pyrene	**Proposed Methods** N/A
New South Wales	**Methods already used** US EPA TO-14 BTX US EPA TO-13 PAHs	**Proposed monitoring – has now been completed** US EPA TO-11A formaldehyde US EPA TO-13A PAHs US EPA TO-15 BTX
Queensland	**Methods already used** DOAS BT p-Xylene, Formaldehyde US EPA TO-15 (benzene, toluene, xylenes) US EPA TO-11A (formaldehyde) US EPA TO-13A (benzo(a)pyrene)	**Proposed Methods** N/A
Northern Territory	**Methods already used** BTEX Chromosorb 106 Tubes (ISO 16017-2:2003)	**Proposed Methods** N/A
Western Australia	**Methods already used** USEPA TO-11a aldehydes USEPA TO-14A BTX and VOCs USEPA TO-13A aldehydes **Alternate methods** Radiello Passive samplers BTX and VOCs	**Proposed Methods** N/A
South Australia	**Alternate Methods** DOAS BTX, formaldehyde	**Proposed Methods** SA suggested that passive samplers, current and new methods developed since the NEPM was made should be investigated

Table 5 Detection Limits and Comments on methods

Method	Air Toxics Measured	Detection limits provided	Detection limits observed	Comments provided
US EPA TO-11A	Formaldehyde	0.00075ppm 0.0007ppm	0.0025-0.0093ppm	
US EPA TO-13	PAHs	0.1ng/m^3 0.33ng/m3 0.00024ng/m^3 0.06ng/m^3	0.0018-0.003ng/m^3	Ambient concentrations are too low to sample for 24 hours
US EPA TO-14	Benzene Toluene Xylenes	0.0001, 0.0002, 0.0002ppm 0.0001, 0.0003, 0.0002ppm 0.0001, 0.0005, 0.0002ppm	0.0002 - 0.0003ppm	Easy to install, calibration not required, low training requirements, electricity not required. requires secure site and availability of staff for installation and collection
US EPA TO-15 xylenes	Benzene Toluene Xylenes	0.0004ppm 0.0004ppm 0.0008ppm	0.001-0.0023ppm	AVOC used requires infrastructure calibration and maintenance
Radiello 130	Benzene Toluene Xylenes	0.00029ppm 0.00002ppm 0.00002ppm	0.00029ppm 0.00002ppm 0.00002ppm	Convenient, easy to install, calibration not required, low training requirements, electricity not required. Averaging period is different to that required by the NEPM so that a conversion is required
Radiello 145	Benzene Toluene Xylenes	0.00001ppm 0.000002ppm 0.000002ppm	0.00001ppm 0.000002ppm 0.000002ppm	Convenient, easy to install, calibration not required, low training requirements, electricity not required. Used as a comparative technique to determine future directions. Averaging period is different to that required by the NEPM so that a conversion is required
Radiello 165	Formaldehyde	0.00075ppm	0.00075ppm	Convenient, easy to install, calibration not required, low training requirements, electricity not required. Averaging period is different to that required by the NEPM so that a conversion is required
DOAS	Benzene Toluene Xylenes Formaldehyde	0.001ppm for short term average	N/A	High capital and installation costs – continuous data limits of detection approach low ambient concentrations

Passive samplers are significantly cheaper for analysis costs and require little infrastructure. Comments suggest that to improve the detection limits and sensitivity may require longer sample times than the current MILs. For formaldehyde, toluene and xylenes detection limits are approximately one tenth of the MIL. This issue could be investigated as part of a thorough methods review.

A nationally funded and sponsored program to conduct such validation work would enable jurisdictions to proceed with the use of alternative methods. If all jurisdictions were to use such a methodology there would be compatibility between data across jurisdictions allowing national comparisons.

3.4.2 Monitoring data analysis results

To inform this review, jurisdictions were asked to provide data collected both pre and post the making of the NEPM in 2004. All data have been analysed and are summarised in Appendix B. Data are summarised and broken down into 5 categories:

- Data collected post 2004 – NEPM methods
- Data collected post 2004 – non-NEPM methods
- Data collected pre 2004 – NEPM methods
- Data collected pre 2004 – non-NEPM methods
- All data collected pre and post 2004 – all methods

Only the data collected as part of the implementation of the NEPM are presented below. Monitoring sites have been classified as NEPM or non-NEPM. This approach allows an assessment of the effectiveness of the NEPM in achieving the goal of the NEPM i.e. increasing the data available on air toxics in Australia. However, the information obtained by non-NEPM methods also provides valuable information that assists in meeting the NEPM goal.

3.4.2.1 Benzene

Of all the air toxics the benzene dataset is the most comprehensive. There has been a significant increase in data available collected as part of the implementation of NEPM by both NEPM and non-NEPM methods as shown in Tables 6 and 7.

Using NEPM methods data have been collected at 33 sites across jurisdictions. The data collected in strict accordance with the NEPM monitoring requirements showed that levels of benzene were lower than the MIL of 0.003ppm at the majority of sites but exceeded it at six sites.

The data obtained showing non-NEPM methods, a further 42 sites, showed that levels of benzene near heavily trafficked roads and in an area that was a mixed industrial area containing petrol storage tanks, some mixed traffic, and a nearby residential area were close to or exceeded the MIL.

If the current international objective for benzene of 0.001ppm was used to assess the data, a similar pattern emerges as most of the sites exceeding the objective are still heavily trafficked areas with the addition of two industrial sites from different jurisdictions.

Comparison of data pre and post NEPM has allowed a preliminary assessment of any trends that may be present in benzene levels over time. It should be noted that only two jurisdictions have data over significant periods of time. At the sites where data from one site was

available for several years, one jurisdiction shows a marked decrease in benzene levels at one site but in another jurisdiction no trend is apparent. This is not sufficient information to test the efficacy of national strategies for fuel or vehicle emissions especially when the effect of improved vehicle emissions can be negated by the increase in vehicle numbers.

Table 6: Summary of benzene data collected in accordance with NEPM requirements

Benzene NEPM Methods annual average data post 2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.001	0.000	0.001	0.000
std dev	0.001	0.000	0.000	0.000
No of individual samples at all sites	187	33	267	316
No of Sites	4	1	11	8
No of Sites where value > MIL	0	0	0	0
Max	0.002	0.000	0.001	0.001
Min	0.000	0.000	0.000	0.000
No values > MIL	0	0	0	0
MIL	0.003	0.003	0.003	0.003
units	ppm	ppm	ppm	ppm
95th percentile	0.002	0.000	0.001	0.001
90th percentile	0.001	0.000	0.001	0.001
75th percentile	0.001	0.000	0.001	0.001
50th percentile	0.001	0.000	0.001	0.000
25th percentile	0.001	0.000	0.000	0.000

Table 7: Summary of benzene data collected by non-NEPM methods

Benzene non-NEPM Methods annual average data post 2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.001	0.000	0.000	0.020
std dev	0.001	0.001	0.001	0.051
No of individual samples at all sites	174	58	3336	469
No of Sites	2	2	24	5
No of Sites where value > MIL	0	0	1	1
Max	0.003	0.001	0.008	0.167
Min	0.000	0.000	0.000	0.000
No values > MIL	0	0	1	2
MIL	0.003	0.003	0.003	0.003
units	ppm	ppm	ppm	ppm
95th percentile	0.003	0.001	0.001	0.108
90th percentile	0.003	0.001	0.001	0.050
75th percentile	0.003	0.001	0.000	0.002
50th percentile	0.002	0.000	0.000	0.000
25th percentile	0.000	0.000	0.000	0.000

As can be seen from the information presented above, there has been a significant increase in data available since the NEPM was made. The use of non-NEPM methods has also added valuable information that has increased our understanding of air toxics in the air environment in Australia and contributes to meeting the goal of the NEPM.

3.4.2.2 Toluene

Data provided by the jurisdictions have been analysed into, pre – 2004 and post – 2004 to enable an assessment of the effect of the NEPM. Within these groups the data have been analysed as Total, sites where NEPM methods were used, and sites where non-NEPM methods were used and these have further been divided into different site types of Roadside, CBD, Industrial and residential dependent on information from jurisdictions or gathered elsewhere. Since toluene has a daily and annual MIL the analysis has been repeated for data as annual averages and daily values. The results for post 2004 are provided here with the remainder of the data summary provided in Appendix B. The data have been bulked together from all jurisdictions. No measurements of Toluene exceeded the MIL in data from post 2004 for either the annual or daily data.

As can be seen from the summary tables the maximum post 2004 value was 0.045ppm for a daily average (measured by non-NEPM methods) and 0.016ppm for an annual average by any method. These values are less than 50% and 20% of the MILs respectively. In examining percentiles, values drop away quite quickly so that most data are less than 10% of the MIL for daily and annual data. The high CBD site did show indications of a downward trend over time and would warrant retesting to determine the current concentrations of toluene. This downward trend is also seen at another long term CBD site in a separate jurisdiction but with generally lower values. From the available data toluene concentrations are generally well below the MIL for all data except a CBD site which was at kerbside and shows signs of decreasing.

It should be noted that the number of monitoring sites nationally post 2004 was 55 compared to 20 sites before this. Although monitoring was not conducted by NEPM methods at many recent sites, jurisdictions have increased the amount of data capture significantly to enable this assessment. The number of sites at which toluene was monitored post 2004 is similar to that for benzene. Most of these sites were industrial type sites. Of all data both pre and post 2004 only one site of a total of 70 showed results greater than the annual MIL. This was a CBD site, pre 2004 with both daily and annual values above the MIL.

Table 8: Summary of toluene daily data collected by NEPM methods

Toluene NEPM Methods daily data post 2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.002	0.001	0.003	0.001
std dev	0.003	0.001	0.003	0.001
No of individual samples at all sites	876	33	299	360
No of Sites	22	1	7	9
No of Sites where value > MIL	0	0	0	0
Max	0.015	0.004	0.015	0.007
Min	0.000	0.000	0.000	0.000
No values > MIL	0	0	0	0
MIL	1	1	1	1
Units	ppm	ppm	ppm	ppm
95th percentile	0.008	0.003	0.008	0.004
90th percentile	0.007	0.002	0.008	0.002
75th percentile	0.003	0.002	0.007	0.001
50th percentile	0.001	0.001	0.002	0.001
25th percentile	0.001	0.001	0.001	0.000

Table 9: Summary of toluene daily data collected by non-NEPM methods

Toluene non-NEPM Methods daily data post 2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.010	0.004	0.001	0.003
std dev	0.005	0.003	0.001	0.005
No of individual samples at all sites	190	286	1319	2069
No of Sites	2	2	23	6
No of Sites where value > MIL	0	0	0	0
Max	0.020	0.016	0.007	0.045
Min	0.000	0.000	0.000	0.000
No values > MIL	0	0	0	0
MIL	1	1	1	1
units	ppm	ppm	ppm	ppm
95th percentile	0.016	0.009	0.005	0.014
90th percentile	0.015	0.007	0.003	0.003
75th percentile	0.013	0.005	0.001	0.002
50th percentile	0.012	0.003	0.000	0.001
25th percentile	0.004	0.002	0.000	0.001

Table 10: Summary of toluene daily data collected by all methods

Toluene Daily data post 2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.006	0.003	0.001	0.002
std dev	0.005	0.003	0.002	0.004
No of individual samples at all sites	374	319	1618	2429
No of Sites	7	3	31	14
No of Sites where value > MIL	0	0	0	0
Max	0.020	0.016	0.015	0.045
Min	0.000	0.000	0.000	0.000
No values > MIL	0	0	0	0
MIL	1	1	1	1
Units	ppm	ppm	ppm	ppm
95th percentile	0.015	0.008	0.007	0.013
90th percentile	0.014	0.006	0.005	0.003
75th percentile	0.012	0.005	0.001	0.002
50th percentile	0.005	0.003	0.000	0.001
25th percentile	0.002	0.002	0.000	0.001

Table 11: Summary of toluene annual data collected by NEPM methods

Toluene NEPM Methods annual average data post 2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.003	0.001	0.002	0.001
std dev	0.002	0.000	0.002	0.001
No of individual samples at all sites	184	33	267	314
No of Sites	4	1	7	12
No of Sites where value > MIL	0	0	0	0
Max	0.006	0.002	0.006	0.003
Min	0.001	0.001	0.000	0.000
No values > MIL	0	0	0	0
MIL	0.1	0.1	0.1	0.1
Units	ppm	ppm	ppm	ppm
95th percentile	0.005	0.002	0.005	0.002
90th percentile	0.005	0.002	0.004	0.002
75th percentile	0.003	0.001	0.002	0.001
50th percentile	0.002	0.001	0.001	0.001
25th percentile	0.002	0.001	0.001	0.001

Table 12: Summary of toluene annual data collected by non-NEPM methods

Toluene non-NEPM Methods annual average data post 2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.007	0.002	0.000	0.001
std dev	0.006	0.002	0.000	0.001
No of individual samples at all sites	190	286	1179	314
No of Sites	2	2	21	12
No of Sites where value > MIL	0	0	0	0
Max	0.013	0.004	0.001	0.003
Min	0.001	0.000	0.000	0.000
No values > MIL	0	0	0	0
MIL	0.1	0.1	0.1	0.1
units	ppm	ppm	ppm	ppm
95th percentile	0.012	0.004	0.001	0.002
90th percentile	0.012	0.004	0.001	0.002
75th percentile	0.012	0.002	0.001	0.001
50th percentile	0.007	0.000	0.000	0.001
25th percentile	0.001	0.000	0.000	0.001

Table 13: Summary of toluene annual data collected by all methods

Toluene annual average data post 2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.004	0.002	0.001	0.002
std dev	0.004	0.002	0.001	0.003
No of individual samples at all sites	374	295	1446	2600
No of Sites	5	3	28	19
No of Sites where value > MIL	0	0	0	0
Max	0.013	0.004	0.006	0.016
Min	0.001	0.000	0.000	0.000
No values > MIL	0	0	0	0
MIL	0.1	0.1	0.1	0.1
units	ppm	ppm	ppm	ppm
95th percentile	0.012	0.004	0.002	0.005
90th percentile	0.012	0.004	0.001	0.003
75th percentile	0.005	0.002	0.001	0.001
50th percentile	0.002	0.001	0.000	0.001
25th percentile	0.002	0.000	0.000	0.001

3.4.2.3 Xylenes

Between 1996 and 2009 over 4,000 daily samples for total xylenes were taken at 61 sites around Australia. Data were provided from 7 jurisdictions. The daily MIL was only exceeded in one site a CBD type site, the same site where toluene exceeded its MILs. The annual average MIL was exceeded at this same site every year between 1996 and 2001. Both annual and daily data showed a downward trend towards the MIL at this site, but as monitoring ceased in 2001 a campaign to determine the current concentrations would be warranted.

Post 2004 there were no measured exceedance of either daily or annual MILs. The number of monitoring sites increased from 14 to 49. Although the number of sites in this period is similar to benzene and toluene the number of daily samples is substantially less. 17 of these sites had data capture rates at 75% of the required sample rate 40 sites had more than half of the required sample rate. Both daily and annual maximum values were about ¼ of the MIL in the post 2004 period. Most of the sites were industrial sites.

Wherever else xylenes were measured by jurisdictions concentrations were well below the MIL at all sites for all methods used over the period 1996 to 2009. This is reflected in the percentiles summary where concentrations drop rapidly below the 95th percentile illustrated in tables below for both daily and annual data.

Several continuous years of data were obtained in the mid to late 1990s but no discernable trend was observed in that period. At one site where both historic and recent measurements are available there is a marked decrease in concentrations to well below the MILs.

Apart from one exception xylenes did not exceed the MIL at any of the sites by any method or at any time. Data capture rates were quite good but data density was about half that of benzene and toluene. The data acquired have increased in the post 2004 period but with the

lower capture rates than for toluene or benzene is starting to show gaps such as individual jurisdictions or sites with low data rates.

Table 14: Summary of xylenes daily data collected by NEPM methods

Xylenes NEPM Methods daily data post 2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.001	0.001	0.000	0.001
std dev	0.001	0.001	0.000	0.001
No of individual samples at all sites	126	91	1641	318
No of Sites	3	2	32	9
No of Sites where value > MIL	0	0	0	0
Max	0.005	0.003	0.007	0.005
Min	0.000	0.000	0.000	0.000
No values > MIL	0	0	0	0
MIL	0.25	0.25	0.25	0.25
Units	ppm	ppm	ppm	ppm
95th percentile	0.003	0.002	0.001	0.002
90th percentile	0.002	0.002	0.001	0.001
75th percentile	0.002	0.001	0.000	0.001
50th percentile	0.001	0.001	0.000	0.001
25th percentile	0.000	0.000	0.000	0.000

Table 15: Summary of xylenes daily data collected by non-NEPM methods

Xylenes non-NEPM Methods daily data post 2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.001	0.000	0.000	0.000
std dev	0.000	0.000	0.000	0.000
No of individual samples at all sites	48	54	1177	284
No of Sites	1	1	21	4
No of Sites where value > MIL	0	0	0	0
Max	0.001	0.000	0.002	0.001
Min	0.000	0.000	0.000	0.000
No values > MIL	0	0	0	0
MIL	0.2	0.2	0.25	0.25
units	ppm	ppm	ppm	ppm
95th percentile	0.001	-	0.001	0.001
90th percentile	0.001	-	0.001	0.000
75th percentile	0.001	-	0.000	0.000
50th percentile	0.001	-	0.000	0.000
25th percentile	0.001	-	0.000	0.000

Table 16: Summary of xylenes annual data collected by NEPM methods

Xylenes NEPM Methods annual average data post 2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.001	0.001	0.001	0.001
std dev	0.001	0.000	0.000	0.000
No of individual samples at all sites	126	82	267	315
No of Sites	3	2	11	8
No of Sites where value > MIL	0	0	0	0
Max	0.002	0.001	0.001	0.001
Min	0.000	0.001	0.000	0.000
No values > MIL	0	0	0	0
MIL	0.2	0.2	0.2	0.2
Units	ppm	ppm	ppm	ppm
95th percentile	0.002	0.001	0.001	0.001
90th percentile	0.002	0.001	0.001	0.001
75th percentile	0.002	0.001	0.001	0.001
50th percentile	0.001	0.001	0.001	0.001
25th percentile	0.001	0.001	0.000	0.000

Table 17: Summary of xylenes annual data collected by non-NEPM methods

Xylenes non-NEPM Methods annual average data post 2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.001	0.000	0.000	0.012
std dev	0.000	0.000	0.000	0.024
No of individual samples at all sites	48	45	1179	284
No of Sites	1	1	21	4
No of Sites where value > MIL	0	0	0	0
Max	0.001	0.000	0.001	0.057
Min	0.000	0.000	0.000	0.000
No values > MIL	0	0	0	0
MIL	0.2	0.2	0.2	0.2
units	ppm	ppm	ppm	Ppm
95th percentile	0.001	0.000	0.000	0.054
90th percentile	0.001	-	0.000	0.051
75th percentile	0.001	-	0.000	0.001
50th percentile	0.001	-	0.000	0.000
25th percentile	0.001	-	0.000	0.000

Table 18: Summary of xylenes annual data collected by all methods

Xylenes annual average data post 2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.001	0.001	0.000	0.005
std dev	0.001	0.000	0.000	0.016
No of individual samples at all sites	174	136	1446	599
No of Sites	4	3	32	10
No of Sites where value > MIL	0	0	0	0
Max	0.002	0.001	0.001	0.057
Min	0.000	0.000	0.000	0.000
No values > MIL	0	0	0	0
MIL	0.2	0.2	0.2	0.2
units	ppm	ppm	ppm	ppm
95th percentile	0.002	0.001	0.001	0.048
90th percentile	0.002	0.001	0.001	0.001
75th percentile	0.001	0.001	0.000	0.001
50th percentile	0.001	0.001	0.000	0.001
25th percentile	0.000	0.001	0.000	0.000

3.4.2.4 Formaldehyde

The monitoring method for formaldehyde differs from that used for benzene, toluene and xylenes. Therefore the number of sites where data have been collected is lower than that for benzene and toluene. Formaldehyde data have been collected as part of the NEPM implementation at 13 sites using NEPM methods and 12 sites using non-NEPM methods. Formaldehyde monitoring has generally been collected for sufficient periods of time to enable collection of data that would be representative over a year.

When examining the available data provided by jurisdictions formaldehyde concentrations measured at all sites by any of the methods were below the MIL. This information is summarised in Tables 19 and 20. The data from residential and industry sites tended to show the highest values.

Analysis of data collected pre- 2004 is limited. One site provided several years of monitoring in the early 2000s but the data showed no trend. The most recent data tends to exhibit lower concentrations than earlier data. However as this is from different jurisdictions and sites, care should be taken in applying this observation across jurisdictions.

Table 19: Summary of formaldehyde data collected in accordance with NEPM requirements

Formaldehyde Daily NEPM Methods post 2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.002	0.002	0.001	0.002
std dev	0.001	0.001	0.001	0.002
No of individual samples at all sites	54	62	106	378
No of Sites	1	1	3	8
No of Sites where value > MIL	0	0	0	0
Max	0.004	0.004	0.005	0.028
Min	0.000	0.000	0.000	0.000
No values > MIL	0	0	0	0
MIL	0.04	0.04	0.04	0.04
Units	ppm	ppm	ppm	ppm
95th percentile	0.004	0.003	0.003	0.003
90th percentile	0.003	0.003	0.002	0.003
75th percentile	0.003	0.002	0.002	0.002
50th percentile	0.002	0.002	0.002	0.002
25th percentile	0.002	0.001	0.001	0.001

Table 20: Summary of formaldehyde data collected by non-NEPM methods

Formaldehyde Daily Data non-NEPM Methods post 2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.005	0.003	0.008	0.005
std dev	0.003	0.001	0.007	0.005
No of individual samples at all sites	141	396	456	445
No of Sites	1	2	6	5
No of Sites where value > MIL	0	0	0	0
Max	0.019	0.005	0.031	0.024
Min	0.001	0.000	0.000	0.000
No values > MIL	0	0	0	0
MIL	0.04	0.04	0.04	0.04
units	ppm	ppm	ppm	ppm
95th percentile	0.012	0.004	0.019	0.015
90th percentile	0.010	0.004	0.017	0.013
75th percentile	0.005	0.003	0.014	0.008
50th percentile	0.004	0.003	0.009	0.003
25th percentile	0.003	0.002	0.001	0.001

As shown above the data for formaldehyde are still limited. No data are available to assess trends. This may be an important issue with the increased use of biofuels predicted to increase levels of aldehydes, including formaldehyde, in the environment. The data collected to date show no exceedance of the MIL.

3.4.2.5 Benzo (a) pyrene

Data have been collected at 18 sites as part of the implementation of the NEPM and only 1 exceedance of the MIL has been recorded. These data are summarised in Table 21. Data for BaP are still limited as only 7 sites had collected sufficient data to calculate an annual

average. The MIL for BaP is specified as an annual average so not all data collected can be compared to the MIL. All data have been collected in accordance with the NEPM requirements.

The data provided indicates that the MIL was exceeded at a residential site. However, given the limited data collected caution must be exercised when interpreting these data.

Monitoring data were provided from 5 jurisdictions for 39 sites from 1997 to 2009. The sites were a mixture of residential, industrial and wood smoke affected areas. 15 of these sites from one jurisdiction exceeded the MIL with one from a second jurisdiction exceeding the MIL. No obvious pattern was evident in the type of site where higher levels were observed as there is a mix of rural, wood smoke affected, industrial and residential.

Table 21: Summary of benzo (a) pyrene data collected in accordance with NEPM requirements

Benzo (a) pyrene NEPM Methods annual average data post 2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.11	0.15	0.11	0.11
std dev	0.13	0.11	0.03	0.08
No of individual samples at all sites	30	120	245	358
No of Sites	2	2	6	8
No of Sites where value > MIL	0	0	0	1
Max	0.20	0.30	0.13	0.30
Min	0.02	0.03	0.03	0.02
No values > MIL	0	0	0	1
MIL	0.3	0.3	0.3	0.3
Units	ng/m3	ng/m3	ng/m3	ng/m3
95th percentile	0.19	0.28	0.13	0.22
90th percentile	0.19	0.26	0.13	0.18
75th percentile	0.16	0.19	0.13	0.13
50th percentile	0.11	0.13	0.12	0.11
25th percentile	0.07	0.09	0.11	0.04

In summary the data for BaP give an indication of concentrations experienced around Australia but there is insufficient data to comment on trends or at most sites whether the MIL was actually exceeded. Observed concentrations of benzo(a)pyrene indicate that the MIL may be exceeded so it would be desirable to continue monitoring to improve the amount of data available to clarify this situation. There is still limited data for this pollutant.

3.4.3 Monitoring costs

Information supplied by jurisdictions has been useful in comparing costs of the various methods. The cost basis used is per sample. Costs do not include equipment costs and staff time. For continuous DOAS monitoring costs are on a daily basis

It should be noted that the costs of analysis differ significantly between the various methods. Standard USEPA methods for benzene, toluene and xylenes (BTX) are significantly more costly than passive samplers or DOAS. If capital costs and staff time were added this gap would widen, especially for passive samplers as the capital and staff costs would be much smaller.

Depending on the distances required to deploy and retrieve samples, staff time may be of the order of $25 to $100 per sample. It is most likely at the lower end of the scale as staff would visit multiple sites on one day.

Equipment and infrastructure costs would be of the order of hundreds of dollars for passive samplers, several thousand to $30,000 for USEPA compliant systems, or for a DOAS system on an annual basis up to $390,000 for a DOAS system. It should be noted that continuous monitors supply more data than required in the NEPM which has other advantages in examining air quality.

There are some issues apparent with the various methods, such as detection limits and sensitivity. However cost differentials suggest a full review of methods and costs should be investigated. Indicative figures provided by jurisdictions are listed in Table 22 below.

The information in the table demonstrates that Passive samplers are providing a cost effective alternative method for monitoring gaseous air toxics (BTX and formaldehyde, not PAHs).

Table 22: Methods by cost

USEPA methods		
BTX and other VOCs	Per sample	$550 - $600
Formaldehyde	Per sample	$215 - $264
PAHs	Per sample	$600 - $1000
All pollutants	Average across sample	$718
Passive samplers		
BTX and other VOCs	Per sample	$151 - $350
Formaldehyde	Per sample	$333
DOAS		
For 1 pollutant	Per day	$290

3.4.4 Summary of findings from data analyses

The examination of the data has revealed the following:

- Benzene is at or below the MIL for nearly all sites measured. The data obtained using non-NEPM methods showed that levels of benzene near heavily trafficked roads and in an area that was a mixed industrial area were close to or exceeded the MIL. The higher values found using these methods may be due to a range of factors including differences in the siting of monitoring equipment and differences in the methods used and in particular their detection limits. No clear trend over time could be observed.
- Toluene concentrations are about one tenth of the MIL with two exceptions. There is some evidence of a downward trend
- Xylene concentrations were generally well below the MIL except for one site which showed some evidence of a downward trend.
- Formaldehyde measurements were all below the MIL generally significantly but much less monitoring has been conducted than for BTX.

- Benzo (a) pyrene results were inconclusive due to the amount of monitoring conducted and more monitoring is warranted to determine the levels of this pollutant. Costs could be reduced if only benzo (a) pyrene were tested for.
- Data at many sites had low numbers of samples, especially for benzo (a) pyrene so that additional monitoring is warranted. This also means that conclusions should be treated with caution.

Investigation of the monitoring methods revealed that:

- Monitoring costs are significantly less for methods other than those recommended in the NEPM. There are some issues of detection limits that would need to be resolved to ensure comparability of data.
- Resources appear to be a limiting factor in the implementation of the NEPM.
- A nationally sponsored and funded review of monitoring methods would allow the use of appropriate alternate methods.
- Jurisdictions have made good efforts to maintain high quality. There are some areas that warrant further work to ensure comparability of data.
- Most monitoring sites were not installed specifically to NEPM requirements but many would comply. Overall the data provide general representation rather than peak site.

4 CHANGES THAT MIGHT BE REQUIRED TO THE NEPM

4.1 JURISDICTIONAL ISSUES

In accordance with the terms of reference for the mid-term review which required an examination of what changes may be required to the NEPM, jurisdictions were canvassed for opinions on the level of importance of addressing air toxics and suggestions for improvements to the NEPM to assist in implementation.

There is a shared view amongst jurisdictions that the importance of air toxics could increase in the future. This is due in part to the impact of climate change and actions taken by Government to address this issue which may include changes in fuels and industry types that may lead to increased emissions of air toxics. Predictions that ozone and particles will increase under climate change means that understanding the precursors to secondary particles and ozone, which include some air toxics, becomes more important so that actions can be taken to reduce levels of these pollutants. Bushfires and fuel reduction burning are also likely to increase in many jurisdictions and these also contribute to levels of air toxics. This was identified as a significant issue.

4.1.1 Monitoring methods

The greatest area for change was in the monitoring methods. Most jurisdictions supported a greater flexibility in monitoring methods and the introduction of continuous and passive measurement methods. There was some concern that greater flexibility would lead to inconsistencies in the data collected and that guidance would need to be provided on what methods could be used. Testing for comparability between methods was also seen to be an important issue.

Introducing flexibility to use other recognised methods for monitoring will assist in achieving the goal of the NEPM.

4.1.2 Prioritisation for monitoring

Jurisdictions also commented on the need to allow prioritisation of pollutants within their jurisdictions rather than monitoring being required for all pollutants.

This could be achieved by introducing a trigger that would screen out pollutants if they fell below a certain percentage of the MILs or by establishing a larger list of national priority pollutants and allowing jurisdictions to further prioritise this list within their jurisdiction.

4.1.3 Modelling and inventory

The increased use of modelling to support the monitoring was supported although it was noted that modelling is only indicative and monitoring would still be required. There was strong view that the emission inventories were a critical component of any modelling and would in many jurisdictions need to be further developed and resourced. The lack of inventory and modelling capacity in most jurisdictions was seen as a critical issue that would need to be addressed in modelling was to be used in a greater capacity. Modelling would need to be validated by monitoring data.

A qualitative assessment process utilising local knowledge and existing data would assist in overcoming current capacity limitations in identifying monitoring sites.

4.2 KEY FINDINGS OF THE REVIEW

Overall, there has been significant progress towards achieving the goal of the NEPM *to improve the information base regarding ambient air toxics in the Australia environment.* There is a significant increase in the information available since the NEPM was made in 2004, but further information is needed for some pollutants to enable an assessment of population.

Issues were raised around the desktop analysis procedure for identifying sites for monitoring. Jurisdictions proposed a number of improvements to the current desktop analysis procedures:

- The procedure should be revised to better account for monitoring data.
- The results of the desktop analysis should be validated with air monitoring data and modified if necessary.
- Desktop analysis threshold tables should be updated to ensure that they are airshed specific.
- The emission inventories used to support the desktop analyses need to be improved.
- The procedure should be more flexible so a representative desktop analysis can be applied either directly or extrapolated to another similar location.

Analysis of the monitoring data revealed that:

- Benzene is at or below the MIL for nearly all sites measured. The data obtained using non-NEPM methods showed that levels of benzene near heavily trafficked roads and in an area that was a mixed industrial area were close to or exceeded the MIL. The higher values found using these methods may be due to a range of factors including differences in the siting of monitoring equipment and differences in the methods used and in particular their detection limits. No clear trend over time could be observed.
- Toluene concentrations are about one tenth of the MIL with two exceptions. There is some evidence of a downward trend.
- Xylene concentrations were generally well below the MIL except for one site which showed some evidence of a downward trend.
- Formaldehyde measurements were all below the MIL generally significantly but much less monitoring has been conducted than for BTX.
- Benzo (a) pyrene results were inconclusive due to the amount of monitoring conducted and more monitoring is warranted to determine the levels of this pollutant. Monitoring costs could be reduced if only benzo (a) pyrene were tested for.
- Data at many sites had low numbers of samples, especially for benzo (a) pyrene so that additional monitoring is warranted. This also means that conclusions should be treated with caution.

Investigation of the monitoring methods revealed that:

- Monitoring costs are significantly less for methods other than those recommended in the NEPM. There are some issues of detection limits that would need to be resolved to ensure comparability of data.
- A nationally sponsored and funded review of monitoring methods would allow the use of appropriate alternate methods.

4.3 RECOMMENDATIONS FOR CHANGES TO THE NEPM

NEPM recommendations

Recommendation 1:
Amend the NEPM Schedule 2, Section 3 (vi) and Section 4 (v) that requires the 4 year repeat of the desktop analysis be undertaken using the same methodology as that used in the year 1 desktop analysis. The amendment is to also allow qualitative assessment tools to be used according to the Guidance Paper for Desktop Analysis as described in recommendation 6.

Rationale for recommendation 1
The NEPM requires the repeat desktop analysis in Year 4 to be completed using the same methodology as that used for the first analysis in Year 1. Although all jurisdictions completed the first analysis using the methods in the Guidance Paper for Desktop Analysis, circumstances have changed in most cases making it difficult for the repeat analysis to be completed using the same quantitative methods. Most jurisdictions have either not updated their emission inventories since the first analysis and/or lack the ability to conduct airshed scale modelling of air toxics, so in most cases, the repeat analysis would be based on the same data used previously. In order to respond to jurisdictions needs, provide increased flexibility and reduce costs, the NEPM would be amended by removing the following requirements:

- Schedule 2, Section 3 (iv) "In undertaking this repeat procedure, jurisdictions must reassess locations within their jurisdiction using the same methodology utilised for the initial assessment."; and
- Schedule 2, Section 4 (v) "In undertaking this repeat procedure, jurisdictions must reassess Stage 1 sites within their jurisdiction using the same methodology utilised for the initial identification of Stage 2 sites".

This amendment would allow jurisdictions to use an alternative procedure for selecting sites.

Recommendation 2:
Amend the NEPM Schedule 3 Part 3 Table 1 to allow the use of any monitoring method for measuring ambient air toxics that has been endorsed by recognised national and international agencies.

Rationale for recommendation 2:
The increased amount of data jurisdictions have been able to provide on air toxics shows good progress towards gathering sufficient data to enable assessment and setting of standards. Examination of the data, however, shows there are still some areas where there is insufficient data or more is needed to enable a thorough assessment.

Information provided by jurisdictions indicates that at least as much but likely more has been gathered by methods other than those nominated in the NEPM. Without these data we would not have the understanding allowed only recently. To assist jurisdictions in their

endeavours to gather air toxics data and improve the national awareness and understanding of their significant it has been suggested by jurisdictions that the use of other than the nominated methods should be facilitated.

It is important that any data gathered be of good quality and that methods are suitable for the level of concentrations found in ambient air. If this is not the case then meaningful comparisons nationally and between sites are not possible.

Thus there is a need to both enable jurisdictions to use less resource hungry methods and at the same time ensure quality of data. It is proposed that alternate methods be allowed that are recognised by agencies that have examined methods for their applicability and quality in the measurement of air toxics in the ambient air. A list of these organisations could be included in the NEPM schedule. As over time standards have been developed for passive continuous air toxics monitoring by recognised organisations it is proposed that these should be included in the NEPM to further facilitate the gathering of air toxics data.

Recommendation 3:
Amend the NEPM Schedule 3 Part 5 Monitoring Investigation Levels, to allow cut off levels of the MILs below which further monitoring is not required.

Rationale for recommendation 3:
Data on air toxics has markedly increased since the commencement of the NEPM and even more since it was initially planned. Data made available to date shows clearly that some of the air toxics pollutants such as toluene and formaldehyde and possibly xylenes are at levels well below the MILs.

There are, however, still some areas where data are required to allow a meaningful assessment that would enable a setting of standards due to scarcity of data for benzo (a) pyrene or where concentrations might be approaching the MIL such as for benzene. This appears to be due to resource constraints as jurisdictions have tended to direct resources into the less costly forms of monitoring or those that provide both daily samples and short term data for jurisdictional management requirements.

In cases, and where concentrations are low and there are no other circumstances indicating a need for monitoring (such as for precursors to photochemical smog) then resources would be better directed to areas where they are most needed. This would allow a gathering of the required data for assessment and development of standards.

The simplest way to assist this is for jurisdictions to have clear criteria that allow monitoring for an air toxic to cease. Under the Ambient Air NEPM the Peer Review Committee that assists with implementation of the Ambient Air NEPM has developed screening criteria for just this purpose. It has worked well with the phasing out of leaded petrol where jurisdictions can now direct their lead monitoring around specific areas as needed. Thus a method consistent with Technical Paper No. 4 Revision 1 – January 2007 SCREENING PROCEDURES by the Peer review Committee for the Ambient air NEPM is seen as the best way forward.

Recommendation 4:
Amend the NEPM Schedule 4 Part 2 Section (iv) Reporting Proforma Table 2 to require a description of the methods used and their applicability to collect the data.

Rationale for recommendation 4:
The NEPM refers to various USEPA methods (i.e. reference methods) for the sampling and analysis of the five air toxics. Although some jurisdictions have adhered to these methods, many have found their expense a constraint in carrying out monitoring under the NEPM, while others have not reported data under the NEPM as they are using alternative methods. In order to address jurisdictions needs and maximise the amount of data collected, the NEPM would be amended to allow other recognised methods in addition to the existing methods (see Recommendation 2). To accompany this change, the NEPM would also be amended by adding the following requirement:

- Schedule 4, Part 2, Section (iv), Proforma Table 2: Monitoring results "Description of method and its applicability".

While the full review of monitoring methods would be completed (see Recommendation 8), this amendment would ensure there is enough information about other methods used to clearly establish they are robust, fit for purpose and the results are comparable with the reference methods.

Recommendation 5:
Amend the NEPM Schedule 4 Part 2 Section (iii) Reporting Proforma Table 1 to require reporting of data to include an accurate description of siting in accordance with AS 2922-1987.

Rationale for recommendation 5:
The NEPM provides requirements for siting of monitoring equipment. Although some jurisdictions have adhered to these requirements, some have found it difficult to establish compliant monitoring sites due to various constraints. To ensure monitoring data are comparable, the NEPM would be amended by adding the following requirement:

- Schedule 4, Part 2, Section (iv), Proforma Table 2: Monitoring results "Description of siting according to AS 2922-1987".

This amendment would ensure monitoring data can be interpreted and analysed in a consistent manner.

Non-NEPM recommendations

Recommendation 6:
Amend the Guidance Paper for Desktop Analysis by adding Section 7 Qualitative Analysis to provide guidance on an alternative qualitative desktop analysis procedure.

Rationale for recommendation 6:
The NEPM requires the repeat desktop analysis in Year 4 to be completed using the same methodology as that used for the first analysis in Year 1. Although all jurisdictions completed the first analysis using the methods in the Guidance Paper for Desktop Analysis, circumstances have changed in most cases making it difficult for the repeat analysis to be completed using the same quantitative methods. Most jurisdictions have either not updated their emission inventories since the first analysis and/or lack the ability to conduct airshed scale modelling of air toxics, so in most cases, the repeat analysis would be based on the same data used previously. To assist jurisdictions in completing the repeat analysis, the Guidance Paper for Desktop Analysis would be amended to include a qualitative method. This amendment would provide jurisdictions with an alternative and less resource intensive procedure for selecting monitoring sites.

Recommendation 7:
Amend Tables 5.2a, 5.2b, 6.2a and 6.2b in the Guidance Paper for Desktop Analysis by revising the threshold values for rank 1, 2, 3 and 4 to > 75%, 50-75%, 25-50% and 0-25% of the MIL.

Rationale for recommendation 7:
The NEPM refers to monitoring investigation levels (MILs) to evaluate the ambient concentrations of the five air toxics. To ensure there is clear guidance on when monitoring can conclude, the MILs would be accompanied by an acceptance limit (i.e. % of MIL) which is consistent with the Ambient Air Quality NEPM (see Recommendation 3). The Guidance Paper for Desktop Analysis also refers to the MILs as criteria for selecting monitoring sites. In order to address the inherent uncertainties in the desktop analysis and ensure broad consistency with the recommended adoption of an acceptance limit, the Guidance Paper for Desktop Analysis would be amended as follows:

- Tables 5.2a, 5.2b, 6.2a and 6.2b would include threshold values for rank 1, 2, 3 and 4 of >75%, 50-75%, 25-50% and 0-25% of the MIL.

This amendment would ensure monitoring sites are both selected and decommissioned in a consistent manner.

Recommendation 8:
Initiate a review of monitoring methods available for use in the Air Toxics NEPM.

Rationale for recommendation 8:
Interest internationally on the levels of air toxics in ambient air has led to the development of new methods for monitoring and analysis of these pollutants. This review has indicated that the current reference methods are resources intensive and that alternative methods have provided useful information to assist in meeting the goal of the NEPM. Many jurisdictions around the world are continuing to develop other methods. A review of these methods and

the applicability for the NEPM would ensure that any change to monitoring methods considered through the full review would take into account current international trends.

Recommendation 9:
Initiate discussions with laboratories to facilitate processes to ensure analysis detection limits are appropriate for measuring the environmental levels.

Rationale for recommendation 9:
Many jurisdictions do not have the capacity to conduct the analysis that is required for air toxics. This means that there is a reliance on commercial laboratories that may have set up their procedures for purposes other than environmental sampling. Experience in some jurisdictions is that the limit of detection for the analyses in some laboratories is too high for environmental samples, in some cases above the MIL. This leads to data being reported as non-detectable limits which may not actually be the case. This can lead to an inaccurate picture of ambient levels of these pollutants.

5 GLOSSARY AND ACRONYMS

BaP	Benzo(a)pyrene
BTEX	Benzene, toluene, ethyl benzene, xylenes
BTX	Benzene, toluene, xylenes
DOAS	Digital optical absorption spectrometer
EPHC	Environment Protection and Heritage Council
JRN	Jurisdictional Reference Network
MIL	Monitoring Investigation Level
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
Ng/m3	Nanograms of pollutant per cubic metre of air at zero degrees C and 1 standard atmosphere pressure
PAH	Polycyclic Aromatic Hydrocarbons
ppm	Parts per million (by volume)
Radiello ™	Method of absorbing air pollutants onto a specifically designed cartridge for later analysis in a laboratory. Different numbers refer to different types of absorbent.
VKT	Vehicle Kilometres Travelled
VOC	Volatile organic compounds

APPENDIX A: QUESTIONNAIRE AND DATA COLLECTION TOOLS

7.1 Air Toxics desktop analysis procedure

7.2 Questionnaire

7.3 Spreadsheet attachments

A.1 PROCEDURE
National Environment Protection (Air Toxics) Measure
Identification and Prioritisation of Stage 1 and Stage 2 Sites
"Desktop Analysis"

1. Purpose

This procedure outlines the "desktop analysis" methodology that jurisdictions have agreed to use for the Identification and Prioritisation of Stage 1 and Stage 2 Sites as part of the National Environment Protection (Air Toxics) Measure (NEPC, 2004).

2. Define area

Define the area subject to the "desktop analysis". The area subject to the "desktop analysis" should include those locations where:

- The highest concentrations of the five "air toxics" are likely to occur; and
- The largest populations are likely to be exposed to them.

An example is the Greater Metropolitan Region (GMR) of NSW, which meets these criteria. The definition of the NSW GMR is included at Appendix 1.

3. Identify data sets

Identify the data sets for the five "air toxics" to be used in the "desktop analysis". Data sets may typically include the following information for the five "air toxics":

- Air emissions inventory data;
- Air quality modelling data;
- Ambient monitoring data;
- EPA license information;
- Industrial, commercial and domestic activity surveys;
- Meteorological data;
- Population data; and
- Vehicle kilometres travelled data.

An example list of data sets is as follows:

- 2000 NSW GMR air emissions inventory data (3 km by 3 km grid cells) (EPAV, 2002);
- 2000 NSW GMR TAPM (Hurley, 2002) air quality modelling and meteorological data (3 km by 3 km grid cells) including year long simulations, for the year 2000, of 24-hour and annual average ground-level concentrations (glcs) for benzene, formaldehyde, benzo(α)pyrene, toluene & xylene (NSW DEC, 2005a);
- 1996 to 2001 NSW GMR benzene, toluene & xylene ambient monitoring data in the Sydney (i.e. 3 sites), Hunter (i.e. 3 sites) and Illawarra (i.e. 4 sites) Regions (NSW EPA, 2002);
- 1997 to 2001 NSW GMR polyaromatic hydrocarbon (PAH) and benzo(α)pyrene ambient monitoring data in the Sydney (i.e. 6 sites), Hunter (i.e. 3 sites), Illawarra (i.e. 7 sites) and Regional (i.e. 1 site) Regions (NSW EPA, 2002);
- 2005 NSW GMR EPA license information (NSW DEC, 2005b);
- 1992 NSW GMR industrial, commercial and domestic activity surveys (EPAV, 1996);
- 2000 NSW GMR population data (3 km by 3 km grid cells) (EPAV, 2002); and
- 2000 NSW GMR vehicle kilometres travelled data (EPAV, 2002).

Note: As a minimum requirement, emissions inventory and population data are necessary to complete the "desktop analysis" in accordance with the approach detailed at Section 5, while air quality modelling data are necessary for the approach detailed at Section 6. While it is desirable to use ambient air quality monitoring data to "ground-truth" the results of both approaches, it is not necessary to obtain this data for the initial identification of Stage 1 and Stage 2 Sites.

4. Identify emission sources

Identify the emission sources of the five "air toxics" to be used in the "desktop analysis". The emissions inventory, referred to in Section 3, should include all significant sources of the five "air toxics", which include aggregated and point source emissions. An example list of sources included in the emissions inventory is as follows:

- Mobile sources
  - Aircraft
  - Commercial Ships
  - Marine Pleasure Craft
  - On-Road/Off-Road Motor Vehicles
  - Rail
- Industrial sources
- Commercial/Domestic sources
  - Architectural surface coating (domestic/commercial)
  - Solvent use (domestic/commercial)
  - Cutback bitumen
  - Solid, liquid and gaseous fuel burning (domestic)
  - Lawn mowing and garden equipment (domestic)
  - Service stations (commercial)

5. Emissions inventory based stepwise approach to identifying Stage 1 and Stage 2 Sites

The emissions inventory based stepwise approach should be used if only emissions inventory, population and ambient air quality monitoring data are available, and where no air quality modelling data is available.

Step 1. Prepare a spreadsheet which includes gridded Map Grid of Australia (MGA) coordinates (or other local coordinate system), population, annual emissions and percentage contribution of motor vehicle (MV), industrial (I) and area based (A) sources data for each of the five "air toxics". An example data table is presented at Table 5.1 for benzene, using 3 km by 3 km grid cells.

Table 5.1: Step 1 data table

GRID_ID	MGA Easting (km)	MGA Northing (km)	Population	BNZ Emissions (tpa)	BNZ (% MV)	BNZ (% I)	BNZ (% A)
3206	304.5	6175.5	8,342.7	3.5039	0.00%	0.00%	100.00%
3207	304.5	6178.5	1,790.7	7.2511	89.60%	0.00%	10.40%
3208	304.5	6181.5	10,706.6	18.2168	35.99%	0.00%	64.01%
3209	304.5	6184.5	4,332.1	94.5328	14.31%	83.45%	2.23%

3210	304.5	6187.5	16,756.4	28.4003	75.19%	0.02%	24.79%
3211	304.5	6190.5	13,300.3	17.6563	68.33%	0.00%	31.67%
3212	304.5	6193.5	9,521.5	10.4383	61.65%	0.00%	38.35%

Step 2. Depending on the magnitude of annual emissions, assign an emissions rank from 1 to 4 according to the thresholds presented at Tables 5.2a and/or 5.2b. These thresholds link annual emissions with monitoring investigation levels (MILs) and can be used as a guide for determining which locations are likely to have the potential to exceed the MILs.

Note: While these thresholds have been developed by correlating gridded annual emissions with ground-level concentration (glc) predictions using TAPM for the NSW GMR, they provide a sound basis for ranking gridded emissions of the five "air toxics" in other jurisdictions.

Table 5.2a: Step 2 rank thresholds table

Rank	Concentration [C_i]	BNZ (tpa/km²)	FAD (tpa/km²)	B(α)P (tpa/km²)	TOL (tpa/km²)	XYL (tpa/km²)
1	$[C_i] > MIL$	$E_i > 10.1$	$E_i > 2.3$	$E_i > 6.5x10^{-5}$	$E_i > 43.3$	$E_i > 817.4$
2	$0.67\ MIL < [C_i] \leq MIL$	$6.7 < E_i \leq 10.1$	$1.6 < E_i \leq 2.3$	$4.4x10^{-5} < E_i \leq 6.5x10^{-5}$	$29.0 < E_i \leq 43.3$	$547.7 < E_i \leq 817.4$
3	$0.33\ MIL < [C_i] \leq 0.67\ MIL$	$3.3 < E_i \leq 6.7$	$0.8 < E_i \leq 1.6$	$2.2x10^{-5} < E_i \leq 4.4x10^{-5}$	$14.3 < E_i \leq 29.0$	$269.8 < E_i \leq 547.7$
4	$[C_i] \leq 0.33\ MIL$	$E_i \leq 3.3$	$E_i \leq 0.8$	$E_i \leq 2.2x10^{-5}$	$E_i \leq 14.3$	$E_i \leq 269.8$

[1] **[Ci] is the concentration of benzene, formaldehyde, benzo(α)pyrene, toluene and xylene**
[2] **E_i is the annual emissions of benzene, formaldehyde, benzo(α)pyrene, toluene and xylene in tpa/km²**

Table 5.2b: Step 2 rank thresholds table

Rank	Concentration [C_i]	PAH (tpa/km²)
1	$[C_i] > MIL$	$E_i > 0.47$
2	$0.67\ MIL < [C_i] \leq MIL$	$0.32 < E_i \leq 0.47$
3	$0.33\ MIL < [C_i] \leq 0.67\ MIL$	$0.16 < E_i \leq 0.32$
4	$[C_i] \leq 0.33\ MIL$	$E_i \leq 0.16$

[1] **[Ci] is the concentration of total polyaromatic hydrocarbons**
[2] **E_i is the annual emissions of total polyaromatic hydrocarbons in tpa/km²**

Step 3. Rank annual emissions, for each of the five "air toxics" in each grid cell across the entire area subject to the "desktop analysis", from highest to lowest and assign the rank thresholds from Step 2, Tables 5.2a and/or 5.2b. An example ranked emissions data table is presented at Table 5.3 for benzene, using 3 km by 3 km grid cells.

Table 5.3: Step 3 ranked emissions data table

GRID_ID	MGA Easting (km)	MGA Northing (km)	Population	BNZ Emissions (tpa)	BNZ Emissions Rank	BNZ (% MV)	BNZ (% I)	BNZ (% A)
3209	304.5	6184.5	4,332.1	94.5328	1	14.31%	83.45%	2.23%
3629	316.5	6244.5	24,753.7	89.9112	2	15.44%	79.16%	5.40%
3928	325.5	6241.5	30,630.0	72.8728	2	24.03%	67.73%	8.24%
3931	325.5	6250.5	30,135.5	66.5405	2	36.49%	54.64%	8.87%
3834	322.5	6259.5	26,557.5	64.3835	2	21.40%	70.51%	8.09%
4231	334.5	6250.5	82,697.6	64.0190	2	74.70%	0.00%	25.30%
4226	334.5	6235.5	2,228.3	61.7289	2	2.92%	70.93%	26.15%

Step 4. Identify those grid cells where ambient air quality monitoring data is available and "ground-truth" the emissions rank assigned in Step 3, Table 5.3 by comparing the measured concentrations with the rank thresholds data table values in Step 2, Tables 5.2a and/or 5.2b.

Note: Step 4 can be skipped if ambient air quality monitoring data is unavailable. An example comparison is presented at Table 5.4 for benzene.

Table 5.4: Step 4 emissions and ambient air quality monitoring data comparison table

Ambient Air Quality Monitoring Site	GRID_ID	MGA Easting (km)	MGA Northing (km)	BNZ Emissions (tpa)	BNZ Emissions Rank	BNZ Measured Annual GLC (ppm)	BNZ Measured Annual GLC Rank
St Marys	2834	293.3	6258.7	8.6595	4	0.0004	4
Albion Park	3005	297.2	6171.2	0.0634	4	0.0002	4
Kembla Grange	3009	299.5	6183.1	3.2118	4	0.0002	4
Wollongong	3211	305.7	6189.4	17.6563	4	0.0006	4
Warrawong	3308	306.3	6181.3	9.7924	4	0.0004	4
Rozelle	4131	330.1	6251.2	33.9551	3	0.0011	3
Sydney CBD	4231	334.1	6250.5	64.0190	2	0.0023	2
Beresfield	5571	374.6	6370.3	7.5018	4	0.0004	4
Wallsend	5667	375.6	6359.5	13.7009	4	0.0006	4
Newcastle	5866	383.9	6355.4	21.3792	4	0.0008	4

Step 5. Use the information from Step 3, Table 5.3 and Step 4, Table 4 (if applicable) and identify those grid cells that can be classified as Stage 1 Sites in priority order, that is, *"a site where significantly elevated concentrations of one or more air toxics are expected to occur"* (NEPC, 2004).

Note: Stage 1 Sites should consider those locations ranked 1 and 2 if Step 4 is not completed. Otherwise, Stage 1 Sites should consider those locations ranked 1.

Step 6. Multiply annual emissions by population, for each of the five "air toxics" in each grid cell across the entire area subject to the "desktop analysis". Rank annual emissions and then annual emissions multiplied by population, for each of the five "air toxics" in each grid cell

across the entire area subject to the "desktop analysis", from highest to lowest. An example ranked emissions and population exposed data table is presented at Table 5.5 for benzene, using 3 km by 3 km grid cells.

Table 5.5: Step 6 ranked emissions and population exposed data table

GRID_ID	MGA Easting (km)	MGA Northing (km)	Population	BNZ Emissions (tpa)	BNZ Emissions Rank	BNZ Emissions x Population	BNZ (% MV)	BNZ (% I)	BNZ (% A)
3209	304.5	6184.5	4,332.1	94.5328	1	409,525.72	14.31%	83.45%	2.23%
3629	316.5	6244.5	24,753.7	89.9112	2	2,225,634.38	15.44%	79.16%	5.40%
3928	325.5	6241.5	30,630.0	72.8728	2	2,232,094.78	24.03%	67.73%	8.24%
3931	325.5	6250.5	30,135.5	66.5405	2	2,005,231.54	36.49%	54.64%	8.87%
3834	322.5	6259.5	26,557.5	64.3835	2	1,709,865.86	21.40%	70.51%	8.09%
4231	334.5	6250.5	82,697.6	64.0190	2	5,294,219.31	74.70%	0.00%	25.30%
4226	334.5	6235.5	2,228.3	61.7289	2	137,550.44	2.92%	70.93%	26.15%

Step 7. Use the information from Step 6, Table 5.5 and identify those grid cells that can be classified as Stage 2 Sites in priority order, that is, "*a Stage 1 site prioritised for monitoring on the basis of it's potential for significant population exposure to one or more air toxics*" (NEPC, 2004). In selecting a Stage 2 Site in priority order, apply selection criteria in hierarchical order for each of the five "air toxics" as follows:

- **a)** Highest annual emissions;
- **b)** Highest product of annual emissions times population;
- **c)** Highest contribution of the sum of motor vehicle and area based source emissions;
- **d)** Highest density of sensitive populations and discrete locations such as schools and hospitals; and
- **e)** The feasibility of securing a suitable ambient monitoring site.

Step 8. Prepare a report in accordance with the requirements set out in the National Environment Protection (Air Toxics) Measure (NEPC, 2004).

6. Air quality modelling based stepwise approach to identifying Stage 1 and Stage 2 Sites

The air quality modelling based stepwise approach should be used if emissions inventory, population, ambient air quality monitoring and air quality modelling data are available.

Step 1. Prepare a spreadsheet which includes gridded Map Grid of Australia (MGA) coordinates (or other local coordinate system), population and percentage contribution to annual emissions of motor vehicle (MV), industrial (I) and area based (A) sources data for each of the five "air toxics". This spreadsheet should also include annual average ground-level concentration (glc) predictions for all five "air toxics, and 24-hour average glc predictions for formaldehyde, toluene and xylene. An example data table is presented at Table 6.1 for benzene, using 3 km by 3 km grid cells.

Table 6.1: Step 1 data table

GRID_ID	MGA Easting (km)	MGA Northing (km)	Population	BNZ GLC (ppm)	BNZ (% MV)	BNZ (% I)	BNZ (% A)
3206	304.5	6175.5	8,342.7	0.0002	0.00%	0.00%	100.00%
3207	304.5	6178.5	1,790.7	0.0003	89.60%	0.00%	10.40%
3208	304.5	6181.5	10,706.6	0.0006	35.99%	0.00%	64.01%
3209	304.5	6184.5	4,332.1	0.0014	14.31%	83.45%	2.23%
3210	304.5	6187.5	16,756.4	0.0005	75.19%	0.02%	24.79%
3211	304.5	6190.5	13,300.3	0.0003	68.33%	0.00%	31.67%
3212	304.5	6193.5	9,521.5	0.0002	61.65%	0.00%	38.35%

Step 2. Depending on the magnitude of glcs, assign a glc rank from 1 to 4 according to the thresholds presented at Tables 6.2a and/or 6.2b. These thresholds link glcs with monitoring investigation levels (MILs) and can be used as a guide for determining which locations are likely to have the potential to exceed the MILs.

Table 6.2a: Step 2 rank thresholds table

Rank	Concentration [C_i]	BNZ Annual (ppm)	FAD 24-hour (ppm)	B(α)P Annual (ng/m³)	TOL 24-hour (ppm)	TOL Annual (ppm)	XYL 24-hour (ppm)	XYL Annual (ppm)
1	$[C_i]$ > MIL	$[C_i]$ > 0.003	$[C_i]$ > 0.04	$[C_i]$ > 0.3	$[C_i]$ > 1	$[C_i]$ > 0.1	$[C_i]$ > 0.25	$[C_i]$ > 0.2
2	0.67 MIL < $[C_i]$ ≤ MIL	0.002 < $[C_i]$ ≤ 0.003	0.027 < $[C_i]$ ≤ 0.04	0.2 < $[C_i]$ ≤ 0.3	0.67 < $[C_i]$ ≤ 1	0.067 < $[C_i]$ ≤ 0.1	0.17 < $[C_i]$ ≤ 0.25	0.13 < $[C_i]$ ≤ 0.2
3	0.33 MIL < $[C_i]$ ≤ 0.67 MIL	0.001 < $[C_i]$ ≤ 0.002	0.013 < $[C_i]$ ≤ 0.027	0.1 < $[C_i]$ ≤ 0.2	0.33 < $[C_i]$ ≤ 0.67	0.033 < $[C_i]$ ≤ 0.067	0.083 < $[C_i]$ ≤ 0.17	0.067 < $[C_i]$ ≤ 0.13
4	$[C_i]$ ≤ 0.33 MIL	$[C_i]$ ≤ 0.001	$[C_i]$ ≤ 0.013	$[C_i]$ ≤ 0.1	$[C_i]$ ≤ 0.3	$[C_i]$ ≤ 0.033	$[C_i]$ ≤ 0.083	$[C_i]$ ≤ 0.067

[1] **[Ci] is the concentration of benzene, formaldehyde, benzo(α)pyrene, toluene and xylene**

Table 6.2b: Step 2 rank thresholds table

Rank	Concentration [C_i]	PAH Annual (ng/m³)
1	$[C_i]$ > MIL	$[C_i]$ > 2.17
2	0.67 MIL < $[C_i]$ ≤ MIL	1.45 < $[C_i]$ ≤ 2.17
3	0.33 MIL < $[C_i]$ ≤ 0.67 MIL	0.72 < $[C_i]$ ≤ 1.45
4	$[C_i]$ ≤ 0.33 MIL	$[C_i]$ ≤ 0.72

[1] **[Ci] is the concentration of total polyaromatic hydrocarbons**

Step 3. Rank glcs, for each of the five "air toxics" in each grid cell across the entire area subject to the "desktop analysis", from highest to lowest and assign the rank thresholds from Step 2, Tables 6.2 and/or 6.2b. An example ranked glcs data table is presented at Table 6.3 for benzene, using 3 km by 3 km grid cells.

Table 6.3: Step 3 ranked glcs data table

GRID_ID	MGA Easting (km)	MGA Northing (km)	Population	BNZ GLC (ppm)	BNZ GLC Rank	BNZ (% MV)	BNZ (% I)	BNZ (% A)
3629	316.5	6244.5	24,753.7	0.0020	2	15.44%	79.16%	5.40%
3928	325.5	6241.5	30,630.0	0.0017	3	24.03%	67.73%	8.24%
3931	325.5	6250.5	30,135.5	0.0016	3	36.49%	54.64%	8.87%
3733	319.5	6256.5	14,119.7	0.0015	3	23.21%	72.24%	4.55%
3209	304.5	6184.5	4,332.1	0.0014	3	14.31%	83.45%	2.23%
3729	319.5	6244.5	32,538.3	0.0013	3	78.83%	0.05%	21.11%
4129	331.5	6244.5	8,544.0	0.0012	3	47.31%	49.40%	3.29%

Step 4. Identify those grid cells where ambient air quality monitoring data is available and "ground-truth" the glcs rank assigned in Step 3, Table 6.3 by comparing the measured concentrations with the rank thresholds data table values in Step 2, Tables 6.2a and/or 6.2b.
Note: Step 4 can be skipped if ambient air quality monitoring data is unavailable. An example comparison is presented at Table 6.4 for benzene.

Table 6.4: Step 4 glcs and ambient air quality monitoring data comparison table

Ambient Air Quality Monitoring *Site*	GRID_ID	MGA Easting (km)	MGA Northing (km)	BNZ Modelled Annual GLC (ppm)	BNZ Modelled Annual GLC Rank	BNZ Measured Annual GLC (ppm)	BNZ Measured Annual GLC Rank
St Marys	2834	293.3	6258.7	0.0003	4	0.0004	4
Albion Park	3005	297.2	6171.2	0.0001	4	0.0002	4
Kembla Grange	3009	299.5	6183.1	0.0001	4	0.0002	4
Wollongong	3211	305.7	6189.4	0.0003	4	0.0006	4
Warrawong	3308	306.3	6181.3	0.0003	4	0.0004	4
Rozelle	4131	330.1	6251.2	0.0011	3	0.0011	3
Sydney CBD	4231	334.1	6250.5	0.0012	3	0.0023	2
Beresfield	5571	374.6	6370.3	0.0001	4	0.0004	4
Wallsend	5667	375.6	6359.5	0.0002	4	0.0006	4
Newcastle	5866	383.9	6355.4	0.0003	4	0.0008	4

Step 5. Use the information from Step 3, Table 6.3 and Step 4, Table 6.4 (if applicable) and identify those grid cells that can be classified as Stage 1 Sites in priority order, that is, "*a site where significantly elevated concentrations of one or more air toxics are expected to occur*" (NEPC, 2004).
Note: Stage 1 Sites should consider those locations ranked 1 and 2 if Step 4 is not completed. Otherwise, Stage 1 Sites should consider those locations ranked 1.

Step 6. Multiply annual average glcs by population, for each of the five "air toxics" in each grid cell across the entire area subject to the "desktop analysis". Rank 24-hour (i.e. for formaldehyde, toluene and xylene) and annual average glcs (i.e. for benzene, benzo(α)pyrene, toluene and xylene) and then annual average glcs multiplied by population (i.e. for all five "air toxics) in each grid cell across the entire area subject to the "desktop analysis", from highest to lowest. An example ranked annual average glcs and population exposed data table is presented at Table 6.5 for benzene, using 3 km by 3 km grid cells.

Table 6.5: Step 6 ranked annual average glcs and population exposed data table

GRID_ID	MGA Easting (km)	MGA Northing (km)	Population	BNZ GLC (ppm)	BNZ GLC Rank	BNZ GLC x Population	BNZ (% MV)	BNZ (% I)	BNZ (% A)
3629	316.5	6244.5	24,753.7	0.0020	2	170800.53	15.44%	79.16%	5.40%
3928	325.5	6241.5	30,630.0	0.0017	3	180717.00	24.03%	67.73%	8.24%
3931	325.5	6250.5	30,135.5	0.0016	3	162731.70	36.49%	54.64%	8.87%
3733	319.5	6256.5	14,119.7	0.0015	3	72010.47	23.21%	72.24%	4.55%
3209	304.5	6184.5	4,332.1	0.0014	3	20794.08	14.31%	83.45%	2.23%
3729	319.5	6244.5	32,538.3	0.0013	3	143168.52	78.83%	0.05%	21.11%
4129	331.5	6244.5	8,544.0	0.0012	3	36739.20	47.31%	49.40%	3.29%

Step 7. Use the information from Step 6, Table 6.5 and identify those grid cells that can be classified as Stage 2 Sites in priority order, that is, "*a Stage 1 site prioritised for monitoring on the basis of it's potential for significant population exposure to one or more air toxics*" (NEPC, 2004). In selecting a Stage 2 Site in priority order, apply selection criteria in hierarchical order for each of the five "air toxics" as follows:

- **a)** Highest 24-hour (i.e. for formaldehyde, toluene and xylene) and annual average glcs (i.e. for benzene, benzo(α)pyrene, toluene and xylene);
- **b)** Highest product of annual average glcs times population;
- **c)** Highest contribution of the sum of motor vehicle and area based source emissions;
- **d)** Highest density of sensitive populations and discrete locations such as schools and hospitals; and
- **e)** The feasibility of securing a suitable ambient monitoring site.

Step 8. Prepare a report in accordance with the requirements set out in the National Environment Protection (Air Toxics) Measure (NEPC, 2004).

References

EPAV (1996) Metropolitan Air Quality Study Air Emissions Inventory

EPAV (2002) NSW Air Toxics Inventory Greater Metropolitan Region.

Hurley, P. (2002) The Air Pollution Model (TAPM) Version 2: User Manual. *CSIRO Atmospheric Research Technical Paper No. 25*, CSIRO Division of Atmospheric Research, Melbourne.

NEPC (2004) National Environment Protection (Air Toxics) Measure.

NSW DEC (2005a) Modelling of Volatile Organic Compounds in the NSW Greater Metropolitan Region.

NSW DEC (2005b) EPA Public Register http://www.environment.nsw.gov.au/prpoeo/searchregister.aspx

NSW EPA (2002) Ambient Air Quality Research Project (1996 – 2001) Dioxins, organics, polycyclic aromatic hydrocarbons and heavy metals.

A.2 QUESTIONNAIRE

1 INTRODUCTION

The National Environment Protection Council has initiated a mid term review of the Air Toxics NEPM to evaluate the data collected and identify any problems that jurisdictions are having in implementing the NEPM. A working group chaired by Victoria has been established to conduct the Review. The review will principally be undertaken by analysing data collected to date and surveying jurisdictions on their experiences in implementing the NEPM.

The attached questionnaire has been developed to collect information from jurisdictions that will enable the working group to conduct the review. It will greatly assist the working group if you could provide as much detail as possible in answering the questions.

2. DESKTOP ANALYSIS

1.1. Did your jurisdiction undertake a desktop analysis to identify Stage 1 and Stage 2 monitoring sites in:

- Year 1
- Year 4
- Any other year of the NEPM?

1.1.1. If you answered yes to either, please provide a copy of the detailed report you have prepared for the desktop analysis.

1.1.2. If you have not prepared a detailed report, did you submit a summary of the information outlined in the attached desktop analysis procedure to NEPC. If not please send a summary with your response.

1.2. Did your desktop analysis identify Stage 2 monitoring sites where you have not undertaken monitoring? If so, please discuss why?

1.3. Desktop analysis procedure

1.3.1. Are you familiar with the desktop analysis procedure developed by jurisdictions (Attachment 1) and did you use it to undertake your desktop analysis? If you did not use it, please discuss why?

1.3.2. Can you suggest any improvements to the desktop analysis procedure?

1.4. Please provide a breakdown of all costs associated with conducting the desktop analysis, including analysis of: modelling results, inventory data, monitoring data and report preparation?

1.5. Modelling and inventories

a. Does your jurisdiction have the capability of conducting airshed scale modelling of air toxics? If you answered yes, please provide a breakdown of all costs associated with modelling each air toxic in the NEPM for a yearly simulation?

b. Does your jurisdiction have a sufficiently detailed emissions inventory for conducting the desktop analysis and/or airshed scale modelling? If you answered yes, please list the: airshed(s), base year and air toxics included?

Please provide as much detail as possible in your response.

3. MONITORING

As part of the mid-term review of the AT NEPM a review of air monitoring data is required. Please provide the data in Excel spreadsheets as in the attached templates for NEPM Monitoring, Alternative (non-NEPM) monitoring and proposed monitoring. The data required are 24 hour averages for all pollutants for each site using the attached template as a guide. For passive sampling methods please provide as 24 hour averages if possible if not then the shortest averaging period possible is appreciated.

It is important to note that the details of a suitable contact person are important should any discussions or clarification be needed.

1.6. To inform this analysis can you please provide the following information:

- Any data collected as part of the implementation of the AT NEPM;
- Any data collected since the mid 1990's for the 5 pollutants covered by the NEPM using the monitoring methods specified in the NEPM; and

1.7. To accompany the data information on the method used and the site is essential. Requirements are detailed in the attached spreadsheet and these include:

- Source of the method
- Performance characteristics
- Comments on the method such as its appropriateness, sensitivity future use
- The analyst used and any appropriate comments on their detection limits and performance
- Cost to operate the method (see section 2.5)
- Site information is also required for location, description and size of exposed population.

1.8. In providing this data please provide the details of the sampling site to the same level as detail as required in the NEPM reporting. Please include a description of the site ie., hot-spot traffic, residential, fixed site monitoring station peak etc. This should be done using **Attachment 2a_NEPM Data Spreadsheets**.

1.9. Alternate Monitoring methods

The working group is also interested in monitoring methods other than those in the AT NEPM that you may have used and obtained data for. Similar information is needed for these methods as well as data you may have obtained. A pro-forma is provided in the attached workbook **Attachment 2b – Alternative Monitoring NEPM Site Data Spreadsheets**.

In providing this data please specify what method has been used, whether it is a continuous, grab sample or passive sampling method, averaging period of the sampling, QA/QC procedures used.

1.10. Proposed Monitoring

If the jurisdiction is planning future monitoring then information on these plans is useful in advising the working group on the direction that jurisdictions are taking. This should be done using **Attachment2c_-Proposed Site & Method Data Spreadsheets.**

1.11. Monitoring Costs

The working group also need to review the cost of operating test methods. As a guide to developing these costs jurisdictions are asked to take into account the following items:

- The pollutants measured by the method
- The number of samples that have or would be taken in a year
- Analysis costs – costs for analysis either internal or external including quality control samples
- Operating costs – consumables, electricity, repairs and maintenance, vehicle costs, site rental
- Staff costs - salaries
- Infrastructure - costs to set up, for infrastructure, and pull down at completion,
- Overhead costs office, personal equipment, computers

4. IMPLEMENTATION ISSUES

The mid-term review is evaluating the implementation of the NEPM and identifying any issues that jurisdictions have faced in this process. To inform this can you please provide the following information:

1.12. What parts of the NEPM has your jurisdiction been able to implement:

1.12.1. Desk top analysis to identify Stage 1 and 2 sites

- If yes for which pollutants?
- What did the Stage 1 analysis tell you about air toxics in your jurisdictions
  - Which were most important
  - Where were potential Stage 2 sites located?
  - Other?

1.12.2. Monitoring at any Stage 2 sites

- If yes, for which pollutants
- If not all pollutants then provide explanation why these were chosen and not others
  - What type of sites was monitored?
    - Industry
    - Traffic
    - Residential (e.g. Wood-smoke impacted)
    - How representative are these sites of other parts of your jurisdiction?

1.12.3. If you have been unable to implement the NEPM, what barriers have prevented you from doing so?

- Resources
  - Funds

- People
- Monitoring methods
  - Lack of equipment
  - Lack of analytical capability or access to that capability
  - Other
- Competing priorities within your jurisdiction
- Lack of support
- Other, please specify

1.12.4. Is your jurisdiction planning to do Air Toxics monitoring in the future?

In answering the above please provide sufficient detail to enable the project team to assess the responses received.

Expectations for the NEPM

1.13. If the NEPM were to change what would your jurisdiction want in the NEPM

1.13.1. Greater flexibility in monitoring?
- If yes please specify types of monitoring (not specific instruments but type of monitoring e.g. screening monitoring, utilisation of other instrumentation (please give examples etc)

1.13.2. Flexibility in pollutants monitored (e.g. monitoring of priority pollutants for your jurisdiction rather than agreed set at a national level)

1.13.3. Greater use of modelling to support any monitoring undertaken
- If yes then please comment on how that information would be obtained and used

1.13.4. Other, please specify.

5. EMERGING ISSUES

Are there any issues in your jurisdiction that may increase the importance of air toxics in the future?

- Climate change
- Understanding precursors to ozone and effectiveness of actions to reduce them
- Understanding precursors to secondary particles and effectiveness of actions to reduce them
- Introduction of bio-fuels
- Increase in industry
- Bushfires and fuel reduction burning
- Other, please specify

6. ATTACHMENTS

Attachment 1_Desktop Analysis procedure
Attachment 2a_NEPM Data Spreadsheets
Attachment 2b_Alternative Monitoring NEPM Site Data Spreadsheets
Attachment 2c_Proposed Site & Method Data Spreadsheets

A.3 SPREADSHEET ATTACHMENTS

PROFORMA FOR METHODS DESCRIPTION WHERE MONITORING HAS BEEN CONDUCTED

JURISDICTION NAME: Insert Jurisdiction Name

CONTACT PERSON:

Name Insert Name

Phone Number Insert Phone Number

E-Mail Insert E-Mail address

Test Method Name	Source of Method	Frequency of sampling	Minimum detection Limit	Range	Uncertainty of Measurement (Relative %) jurisdictions estimate with 2 Standard Deviation coverage	Comments	Cost to operate for one year (number of Samples)	Analyst used with comments
EXAMPLE ONLY USEPA XXX	**e.g. USEPA**	**e.g. 1 week every month or sample for calendar month**	**e.g. 0.5ppm**	**e.g.0-100ppm**	**e.g. 5**	**e.g. too much manual work, detection limit found to be too high**	**e.g. $9999pa for 50 samples**	

PROFORMA FOR SITE DESCRIPTION WHERE MONITORING HAS BEEN CONDUCTED

JURISDICTION NAME: Insert Jurisdiction Name
CONTACT PERSON:
Name Insert Name
Phone Number Insert Phone Number
E-Mail Insert E-Mail address

Site Number	Location		Air Toxics Monitored	Reason for Monitoring	Site description	Size of exposed Population	Period of monitoring	Test Method Name
	MGA Easting (km)	MGA Northing (km)						
EXAMPLE ONLY S2_FAD_WHYA_99	**Enter coordinate**	**Enter co-ordinate**	**e.g. Formaldehyde Benzene**	**e.g. Desktop study indicated a level 2 site initial screening**	**e.g. industrial area with particle board manufacture and adjoining residential**	**9789**	**1/1/2000 to 30/11/2001**	**USEPA xxx**

PROFORMA FOR DATA AT A SITE WHERE MONITORING HAS BEEN CONDUCTED
PLEASE COPY THIS SHEET FOR ADDITIONAL SITES

JURISDICTION NAME: Insert Jurisdiction Name
CONTACT PERSON:
Name Insert Name
Phone Number Insert Phone Number
E-Mail Insert E-Mail address

Site Name	Insert Site Name					
Sampling Frequency	Insert sampling frequency					
Method Name	Insert Method Name					
	Benzene	**Toluene**	**Formaldehyde**	**Xylenes (total ortho, meta, para)**	**Benzo (a) Pyrene**	**OTHER Air Toxic**
Units	**ppm**	**ppm**	**ppm**	**ppm**	**ng/m3**	**Units ppm**
Date(ending dd/mm/yyyy)						
Insert Date	Insert value	Insert value	Insert value	Insert value	Insert value	Insert value

PROFORMA FOR METHODS DESCRIPTION WHERE MONITORING HAS BEEN CONDUCTED with a NON-NEPM METHOD

JURISDICTION NAME: Insert Jurisdiction Name
CONTACT PERSON:
Name Insert Name
Phone Number Insert Phone Number
E-Mail Insert E-Mail address

Test Method Name	Source of Method	Frequency of sampling	Minimum detection Limit	Range	Uncertainty of Measurement (Relative %) jurisdictions estimate with 2 Standard Deviation coverage	Comments	Cost to operate for one year (number of Samples)	Analyst used with comments	QA u
EXAMPLE ONLY USEPA XXX	**e.g. USEPA**	**e.g. 1 week every month or sample for calendar month**	**e.g. 0.5ppm**	**e.g.0-100ppm**	**e.g. 5**	**e.g. too much manual work, detection limit found to be too high, passive samples**	**e.g. $9999pa for 50 samples**		

PROFORMA FOR SITE DESCRIPTION WHERE MONITORING IS PROPOSED

JURISDICTION NAME: Insert Jurisdiction Name
CONTACT PERSON:
Name Insert Name
Phone Number Insert Phone Number
E-Mail Insert E-Mail address

Site Number	Proposed Location		Air Toxics Monitored	Reason for Monitoring	Site description	Size of exposed Population	Proposed Period of monitoring	Proposed Test Method Name
	MGA Easting (km)	MGA Northing (km)						
EXAMPLE ONLY S2_FAD_WHYA_99	**Enter coordinate**	**Enter co-ordinate**	**e.g. Formaldehyde Benzene**	**e.g. Lots of complaints in this area**	**e.g. industrial area with particle board manufacture and adjoining residential**	**9789**	**1/1/2000 to 30/11/2001**	**USEPA xxx**

PROFORMA FOR METHODS DESCRIPTION WHERE MONITORING IS PROPOSED

JURISDICTION NAME: Insert Jurisdiction Name
CONTACT PERSON:
Name Insert Name
Phone Number Insert Phone Number
E-Mail Insert E-Mail address

Test Method Name	Source of Method	Frequency of sampling	Minimum detection Limit	Range	Uncertainty of Measurement (Relative %) jurisdictions estimate with 2 Standard Deviation coverage	Comments	Estimated Cost to operate for one year (number of Samples)	Proposed Analyst used with comments
EXAMPLE ONLY USEPA XXX	**e.g. USEPA**	**e.g. 1 week every month or sample for calendar month**	**e.g. 0.5ppm**	**e.g.0-100ppm**	**e.g. 5**	**e.g. good for screening**	**e.g. $9999pa for 50 samples**	

APPENDIX B: RESULTS OF SURVEY

B.1 Desktop analysis survey results

B.2 Monitoring data survey results

B1: Questionnaire results

The following sections present each question, the tabulated response for each jurisdiction, any relevant comments or observations and finally, some conclusions and recommendations.

Completion of desktop analysis

Q1.1: *Did your jurisdiction undertake a desktop analysis to identify Stage 1 and Stage 2 monitoring sites in Year 1, Year 4 or any other year of the NEPM?*

All jurisdictions completed a desktop analysis in Year 1 (i.e. 2005) of the NEPM, while one jurisdiction repeated the desktop analysis in Year 4 (i.e. 2008) of the NEPM. **Error! Reference source not found.** lists the dates when each jurisdiction completed the desktop analysis.

Table 1.1 Completion date of desktop analysis

Jurisdiction	Desktop analysis completed in Year 1	Desktop analysis completed in Year 4	Desktop analysis completed in any other year
ACT	Yes (2005)	No	No
Commonwealth[1]	Yes (2005)[2]	No[5]	No[3,4]
NSW	Yes (2005)	No	No
NT	Yes (2005)	No	No
QLD	Yes (2005)	No	No
SA	Yes (2005)	Yes (2008)	No
TAS	Yes (2005)	No	No
VIC	Yes (2005)	No	No
WA	Yes (2005)	No	No

[2] National Environment Protection Council annual report 2 0 0 5 – 2 0 0 6.
[3] National Environment Protection Council annual report 2 0 0 6 – 2 0 0 7.
[4] National Environment Protection Council annual report 2 0 0 7 – 2 0 0 8.
[5] National Environment Protection Council annual report 2 0 0 8 – 2 0 0 9.

Q1.1.1: *If you answered yes to either, please provide a copy of the detailed report you have prepared for the desktop analysis.*

All jurisdictions, with the exception of two, prepared and submitted the detailed desktop analysis reports. **Error! Reference source not found.** provides a list of whether each jurisdiction has prepared and submitted a detailed desktop analysis report.

Table 1.2 Preparation of detailed desktop analysis report

Jurisdiction	Detailed report prepared in Year 1	Detailed report prepared in Year 4	Detailed report prepared in any other year
ACT	No[1]	NA	NA
Commonwealth	Yes	NA	NA
NSW	Yes	NA	NA
NT	Yes	NA	NA
QLD	No	NA	NA
SA	Yes	Yes	NA
TAS	Yes	NA	NA
VIC	Yes	NA	NA
WA	Yes	NA	NA

[1] A detailed report is not available.
[3] NA indicates not applicable, i.e., a jurisdiction did not repeat the desktop analysis in that year.

Q1.1.2: *If you have not prepared a detailed report, did you submit a summary of the information outlined in the attached desktop analysis procedure to NEPC. If not please send a summary with your response.*

In response to this question one jurisdiction indicated that a summary report was not submitted to NEPC. **Error! Reference source not found.** lists the jurisdictions that submitted a summary of the desktop analysis findings, where relevant.

Table 1.3 Submission of desktop analysis summary findings

Jurisdiction	Summary in Year 1	Summary in Year 4	Summary in any other year
ACT	No[1]	NA	NA
Commonwealth	NA	NA	NA
NSW	NA	NA	NA
NT	NA	NA	NA
QLD	Yes	NA	NA
SA	NA	NA	NA
TAS	NA	NA	NA
VIC	NA	NA	NA
WA	NA	NA	NA

[1] National Environment Protection Council annual report 2 0 0 5 – 2 0 0 6.
[3] NA indicates not applicable, i.e., a jurisdiction has prepared and submitted a detailed desktop analysis report in that year so summary findings are not required.

Identification of stage 2 monitoring sites

Q1.2: *Did your desktop analysis identify Stage 2 monitoring sites where you have not undertaken monitoring? If so, please discuss why?*

Three of the nine jurisdictions did not identify stage 2 sites as part of the desktop analysis and subsequently have not conducted any monitoring under the NEPM. Of the remaining six jurisdictions that identified stage 2 sites as part of the desktop analysis and monitoring has been undertaken:

Substances at stage 2 sites

- four identified that formaldehyde and/or benzo(α)pyrene only are likely to exceed the MILs at the stage 2 sites identified;
- one identified that all five NEPM air toxics are likely to exceed the MILs at the stage 2 sites identified;

Monitoring at stage 2 sites

- four have conducted monitoring at either the stage 2 sites identified or representative sites;
- one has conducted monitoring at some but not all stage 2 sites identified; and
- two have not conducted monitoring at any of the stage 2 sites identified.

Of the three jurisdictions that have either conducted some or no monitoring at the stage 2 sites identified, two jurisdictions identified that resource (i.e. funds and personnel) constraints are the primary reason that monitoring has not been undertaken. **Error! Reference source not found.** summarises each jurisdiction's desktop analysis results, whether stage 2 sites where identified and monitoring was undertaken, and any other relevant comments.

Table 1.4 Identification of stage 2 monitoring sites

Jurisdiction	Stage 2 sites identified	Monitoring at stage 2 sites	Comments
ACT	No	No	No stage 2 sites identified.
Commonwealth[1]	No[2,3,4,5]	No[2,3,4,5]	No stage 2 sites identified. The Commonwealth's desktop analysis found no sites in its external Territories with emissions of air toxics high enough to result in exceedences of the Monitoring Investigation Levels. Similarly, none of the highest emitting defence facilities evaluated from each service (Air force, Navy and Army) were found to be Stage 1 sites for any of the air toxics. Of the federal-leased airports, Sydney, Melbourne and Brisbane Airports meet the criteria for a Stage 1 Site with respect to formaldehyde emissions. Given the low populations within these areas, none of these met the criteria for Stage 2 Sites. Therefore, it is not proposed that regular monitoring in accordance with the NEPM be carried out on any Commonwealth sites.[2] Stage 2 site for formaldehyde and benzo(α)pyrene identified at Sydney Airport in NSW desktop analysis. See NSW comments for further details.
NSW	Yes – 2 sites in Sydney (CBD and Earlwood).	Yes	Desktop analysis for all five NEPM air toxics concluded levels well below MILs, with the exception of formaldehyde and benzo(α)pyrene. Monitoring for all five NEPM air toxics has been completed for a full year from October 2008 to October 2009 two monitoring sites in Sydney (Turella and Rozelle).
NT	No	Yes	Desktop analysis for all five NEPM air toxics concluded levels well below MILs. Monitoring for benzene, toluene and xylenes has been completed from May 2005 to February 2006 at one monitoring site in Darwin and results are well below the NEPM MILs.
QLD	Yes - 2 sites in Brisbane (Woolloongabba and Wynnum North) [2,3,4,5].	Yes – screening monitoring undertaken in Brisbane. Monitoring also undertaken in Gladstone,	The following sites were identified as Stage 2 sites representative of locations with the most potential for significant population exposure to air toxics: Ipswich Road, Woolloongabba - representative of a medium density residential area with potential for significant population exposure to air toxics in motor vehicle emissions; Wynnum North Road, Wynnum North - representative of a low-medium density residential area with potential for significant population exposure to air toxics in industrial emissions[2].
SA	Yes – Several sites in	No	Desktop analysis for all five NEPM air toxics concluded levels well below MILs, with the

Jurisdiction	Stage 2 sites identified	Monitoring at stage 2 sites	Comments
	Adelaide		exception of benzo(α)pyrene. Stage 2 sites for benzo(α)pyrene identified in various South Australian airsheds. South Australia is developing a pilot project in Adelaide to assess the impacts of air toxics. The aim of the pilot project is to establish targets, management plans and monitoring programs over the next decade. South Australia does not propose to commit resources at this time to a formal monitoring program under the NEPM at the stage 2 sites identified.
TAS	Yes – 17 sites in Hobart and Launceston	Yes – 5 sites only	Desktop Analysis prioritised twelve stage 2 sites in Hobart and five stage 2 sites in Launceston with potential for higher levels of formaldehyde and benzo(α)pyrene, worthy of further investigation. Tasmania has adopted a staged approach to the investigation of these areas and is in the process of developing and implementing a screening monitoring program. Funding was made available for this program in 2008. Campaign monitoring was conducted at five sites during 2008/2009. The extent and duration of the program will depend on the availability of budgetary and personnel resources.
VIC	Yes – Several sites in Melbourne	Yes	Desktop Analysis identified eight benzene, eight toluene, five xylenes, seven formaldehyde and six benzo(α)pyrene stage 2 sites. Sites identified as highest ranked sites not those exceeding MILs. Monitoring has been conducted between 2003 and 2009 either at the stage 2 sites identified or locations that are representative of the stage 2 sites.
WA	Yes – 2 sites in Perth (CBD and Northern Suburbs)	Yes	Desktop Analysis identified three stage 2 sites in Perth for formaldehyde and benzo(α)pyrene.

[1] Response to survey questionnaire not submitted.
[2] National Environment Protection Council annual report 2005 – 2006.
[3] National Environment Protection Council annual report 2006 – 2007.
[4] National Environment Protection Council annual report 2007 – 2008.
[5] National Environment Protection Council annual report 2008 – 2009.

Desktop analysis procedure

Q1.3.1: *Are you familiar with the desktop analysis procedure developed by jurisdictions (Attachment 1) and did you use it to undertake your desktop analysis? If you did not use it, please discuss why?*

All jurisdictions, with the exception of one, are familiar with and used the desktop analysis procedure developed by jurisdictions. Three jurisdictions played a key role in developing the desktop analysis procedure.

Each of the detailed desktop analysis reports submitted by jurisdictions has been reviewed in some detail to establish the level of effort each jurisdiction has made in the stage 2 site selection process. All jurisdictions, with the exception of two, prepared and submitted the detailed desktop analysis reports. One jurisdiction indicated that a detailed report is not available, while the other has not provided the information requested, so the level of effort cannot be evaluated for two jurisdictions. The level of complexity in descending order for the remaining seven jurisdictions indicates that:

- three used the most complicated procedure which included model predictions, emissions inventory data, monitoring data and other data[1];
- two used a less complicated procedure without model predictions which included emissions inventory data, monitoring data and other data; and
- two used the least complicated procedure which included emissions inventory data and other data.

Table 1.5 summarises whether each jurisdiction is familiar with the desktop analysis procedure, whether they applied the procedure, the data used and level of detail contained in the desktop analysis report, and any other relevant comments.

[1] Includes either EPA license information; industrial, commercial and domestic activity surveys; meteorological data; population data; or vehicle kilometres travelled data.

Table 1.5 Desktop analysis procedure

Jurisdiction	Familiar with procedure	Used procedure	Level of effort	Data used				Comments
				Model	Inventory	Monitoring	Other[1]	
ACT[2]	Yes	Yes	Unknown[2]	Unknown[2]	Unknown[2]	Unknown[2]	Unknown[2]	Desktop analysis was undertaken in accordance with the nationally agreed desktop analysis procedure.
Commonwealth	Yes	Yes	C*		✓		✓	Desktop Analysis conducted on the five NEPM air toxics emitted by federal leased airports and military installations.
NSW	Yes	Yes	A^	✓	✓	✓	✓	Desktop Analysis conducted on the five NEPM air toxics emitted by all sources within the NSW Greater Metropolitan Region. NSW played a key role in developing the procedure.
NT	Yes	Yes	B#		✓	✓	✓	Desktop Analysis conducted on the five NEPM air toxics using a combination of monitoring data for benzene, toluene and xylenes plus NPI emissions inventory data.
QLD[3]	Yes	Yes	B#		✓			The analysis is limited to the densely populated areas of South-east Queensland.
SA	Yes	Yes	A^	✓	✓	✓	✓	Desktop Analysis conducted on the five NEPM air toxics emitted by all sources within thirteen SA airsheds. SA played a key role in developing the procedure.
TAS	Yes	Yes	C*		✓		✓	Desktop Analysis conducted on the five NEPM air toxics emitted by all sources within two TAS airsheds.
VIC	Yes	Yes	A^	✓	✓	✓	✓	Desktop Analysis conducted on the five NEPM air toxics emitted by all sources within one VIC airshed plus Victoria. VIC played a key role in developing the procedure.
WA	Yes	Yes	B#		✓	✓	✓	Desktop Analysis conducted on the five NEPM air toxics emitted by all sources within the Greater Perth Metropolitan Region.

[1] Includes either EPA license information; industrial, commercial and domestic activity surveys; meteorological data; population data; or vehicle kilometres travelled data.

[2] A detailed report is not available.
[3] Response to survey questionnaire not submitted.
[4] National Environment Protection Council annual report 2 0 0 5 – 2 0 0 6.
[5] National Environment Protection Council annual report 2 0 0 6 – 2 0 0 7.
[6] National Environment Protection Council annual report 2 0 0 7 – 2 0 0 8.
[7] National Environment Protection Council annual report 2 0 0 8 – 2 0 0 9.
^ A indicates the most comprehensive suite of tools and data were used to undertake the desktop analysis.
# B indicates a less comprehensive suite of tools and data were used to undertake the desktop analysis, when compared to A.
* C indicates the minimum required suite of tools and data used to undertake the desktop analysis.

Q1.3.2: *Can you suggest any improvements to the desktop analysis procedure?*

Of the nine jurisdictions surveyed, only four suggested improvements to the desktop analysis procedure, while two jurisdictions did not submit a response to the survey questionnaire so their views in relation to this question cannot be evaluated. The four suggested improvements are quite diverse and can be summarised as follows:

- The procedure should be revised to better account for monitoring data;
- Emissions threshold tables should be updated to ensure they are airshed specific;
- Air emissions inventories need improving; and
- The procedure should be more flexible so a representative desktop analysis can be applied either directly or extrapolated to another location.
- Ranking should be based on highest levels above a %of the MIL not exceeding it. Approach not accurate enough to rely on predicted exceedances. Could miss sites.

Error! Reference source not found. lists the suggestions for improving the desktop analysis procedure provided by each jurisdiction.

Table 1.5 Suggested improvements to desktop analysis procedure

Jurisdiction	Suggested improvements	Comments
ACT	Yes	The procedure should be reviewed and revised where necessary based on monitoring data.
Commonwealth[1]	Unknown[1]	Unknown[1]
NSW	Yes	Emission threshold tables should be developed for other major airsheds in order to account for differences in emissions, topography and meteorology.
NT	No	No improvements suggested in response to questionnaire.
QLD[1]	No	No improvements suggested in response to questionnaire.
SA	Yes	Air emission inventory should be improved.
TAS	No	No improvements suggested in response to questionnaire.
VIC	Yes	The procedure should provide include greater flexibility. For example, the option of using a representative desktop analysis undertaken in other Jurisdictions could be used directly or the results extrapolated. Ranking should be based on highest levels above a %of the MIL not exceeding it. Approach not accurate enough to rely on predicted exceedances. Could miss sites.
WA	No	No improvements suggested in response to questionnaire.

[1] Response to survey questionnaire not submitted.

Desktop analysis costs

Q1.4: *Please provide a breakdown of all costs associated with conducting the desktop analysis, including analysis of: modelling results, inventory data, monitoring data and report preparation?*

Of the nine jurisdictions surveyed, seven provided either time and/or cost to complete the desktop analysis, while two jurisdictions did not submit a response to the survey questionnaire so their views in relation to this question cannot be evaluated.

The time to complete the desktop analysis ranged from 2 months to 1 year, while the costs ranged from $15,000 to $50,000. The average time and cost to complete the desktop analysis are 4.6 months and $26,650, respectively.

Error! Reference source not found. lists to desktop analysis time and cost information provided by jurisdictions.

Table 1.6 Desktop analysis time and costs

Jurisdiction	Desktop analysis time and costs	Estimated time year (month)	Estimated cost $
ACT	Two staff members for 1 month.	0.17 (2)	15,250[1]
Commonwealth[2]	Unknown[2]	Unknown[2]	Unknown[2]
NSW	Airshed modelling - $10,000; Inventory data - $2,500; Monitoring data – $1,250; Desktop analysis - $5,000; Report preparation - $5,000; and Total cost - $23,750. Two staff members for 1.5 months.	0.25 (3)	23,750
NT	No time or costs provided in response to questionnaire.	No time provided in response to questionnaire.	No costs provided in response to questionnaire.
QLD[2]	Unknown[2]	Unknown[2]	Unknown[2]
SA	Total cost - $33,000.	0.36 (4.3)[1]	33,000[3]
TAS	One staff member for 3 months.	0.25 (3)	22,900[1]
VIC	Total cost - $50,000. One staff member for 12 months.	1 (12)	50,000
WA	Total cost - $15,000. One staff member for 3 months.	0.25 (3)	15,000
Average		0.38 (4.6)	26,650

[1] Assuming NSW DECCW Senior Air Quality Scientist annual salary.
[2] Response to survey questionnaire not submitted.
[3] This cost is for one desktop analysis only, SA completed the desktop analysis twice.

Modelling and inventories

Q1.5a: *Does your jurisdiction have the capability of conducting airshed scale modelling of air toxics? If you answered yes, please provide a breakdown of all costs associated with modelling each air toxic in the NEPM for a yearly simulation?*

Of the nine jurisdictions surveyed, seven provided responses about their airshed model capabilities, while two jurisdictions did not submit a response to the survey questionnaire so their views in relation to this question cannot be evaluated.

Three jurisdictions indicated they have airshed model capabilities, although only one has a sufficiently detailed and up-to-date emissions inventory suitable for air toxics modelling. Only one jurisdiction provided airshed model costs, which are estimated to be of the order of $17,500 for all five NEPM air toxics for a yearly simulation.

Error! Reference source not found. lists the airshed model capabilities and cost information provided by jurisdictions.

Table 1.8 Modelling capability

Jurisdiction	Modelling capability	Comments	Costs $
ACT	No	No comments provided in response to questionnaire.	No costs provided in questionnaire response.
Commonwealth[1]	Unknown[1]	Unknown[1]	Unknown[1]
NSW	Yes	NSW can model air toxics as inert pollutants using TAPM. The estimated cost breakdown to simulate all five NEPM air toxics using one full year of meteorology for the NSW Greater Metropolitan Region is as follows: Preparation of inventory files - $7,500; Running TAPM - $6,500; Report preparation - $3,500; and Total cost - $17,500.	17,500 for all five NEPM air toxics.
NT	No	No comments provided in response to questionnaire.	No costs provided in questionnaire response.
QLD	No	No comments provided in response to questionnaire.	Unknown[1]
SA	No	SA does not currently have the capability but is in the process of rebuilding its staff resources in this area.	No costs provided in questionnaire response.
TAS	Yes	TAS has the capability of conducting airshed modelling of air toxics, however the emissions inventory is not sufficiently detailed.	No costs provided in questionnaire response.
VIC	No	VIC does not have the capability to undertake airshed modelling of air toxics at this time.	No costs provided in questionnaire response.
WA	Yes	WA has the capability of conducting airshed modelling of air toxics, however the emissions inventory is not sufficiently detailed.	No costs provided in questionnaire response.

[1] Response to survey questionnaire not submitted.

Q1.5b: *Does your jurisdiction have a sufficiently detailed emissions inventory for conducting the desktop analysis and/or airshed scale modelling? If you answered yes, please list the: airshed(s), base year and air toxics included?*

Of the nine jurisdictions surveyed, seven provided responses about the quality of their emissions inventories, while two jurisdictions did not submit a response to the survey questionnaire so their views in relation to this question cannot be evaluated.

Two jurisdictions indicated they have emissions inventories that are sufficiently detailed, up-to-date and suitable for airshed modelling. Of the remaining six jurisdictions, all relied upon the NPI[2] emissions inventory for conducting the desktop analysis. The NPI does not vary temporally, so it is not suitable for airshed modelling.

Error! Reference source not found. lists the emission inventory information provided by jurisdictions.

[2] National Pollutant Inventory http://www.npi.gov.au/index.html

Table 1.9 Detailed inventory

Jurisdiction	Detailed inventory for modelling	Comments	Airsheds	Base year	Air toxics
ACT	No	No information provided in response to questionnaire.	No information provided in response to questionnaire.	No information provided	No information provided
Commonwealth[1]	Unknown[1]	Unknown[1]	Unknown[1]	Unknown[1]	Unknown[1]
NSW	Yes	Current emissions inventory for 2003 calendar year presently being updated for the 2008 calendar year, which includes spatially and temporally varying emissions.	NSW Greater Metropolitan Region, Sydney, Newcastle and Wollongong regions plus 66 local government areas.	2003	855 substances
NT	No	Annual NPI emissions inventory data, which only includes spatial variation.	Darwin	2001	NPI substances
QLD[1]	Yes	Needs updating	SEQ	2000	BTX
SA	No	Annual NPI emissions inventory data, which only includes spatial variation. Emissions inventory needs updating to include temporally varying emissions in order to be sufficiently reliable for airshed modelling.	Adelaide, Barmera, Berri, Loxton, Lyndoch, Millicent, Mount Gambier, Nuriootpa, Port Augusta, Port Lincoln, Port, Pirie, Renmark and Whyalla.	2002	NPI substances
TAS	No	TAS does not currently have an emissions inventory that is sufficiently detailed for airshed modelling.	No information provided in response to questionnaire.	No information provided	No information provided
VIC	Yes	Emissions inventory for 2002 calendar year, which includes spatially and temporally varying emissions.	Port Phillip Region (which includes Melbourne and Geelong) and Victoria.	2006	NPI substances
WA	No	Emissions inventory needs updating to include temporally varying emissions in order to be sufficiently reliable for airshed modelling.	No information provided in response to questionnaire.	No information provided	No information provided

[1] Response to survey questionnaire not submitted.

Appendix B.2: Data Analysis

Data were further broken down in to site type, and pre- 2004 and 2004 onwards to assist in the examination of data. Observations are summarised above but all the tables are included here for information.

Some sites had parameters measured by different methods but not necessarily at the same time.

BENZENE DATA POST 2004 ALL METHODS

Benzene annual average data post 2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.001	0.000	0.000	0.009
std dev	0.001	0.000	0.001	0.035
No of individual samples at all sites	361	91	3603	785
No of Sites	6	4	35	11
No of Sites where value > MIL	0	0	1	1
Max	0.003	0.001	0.008	0.167
Min	0.000	0.000	0.000	0.000
No values > MIL	0	0	1	2
MIL	0.003	0.003	0.003	0.003
units	ppm	ppm	ppm	ppm
95th percentile	0.003	0.001	0.001	0.043
90th percentile	0.003	0.001	0.001	0.002
75th percentile	0.002	0.000	0.001	0.001
50th percentile	0.001	0.000	0.000	0.000
25th percentile	0.001	0.000	0.000	0.000

BENZENE DATA POST 2004 NEPM METHODS

Benzene NEPM Methods annual average data post 2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.001	0.000	0.001	0.000
std dev	0.001	0.000	0.000	0.000
No of individual samples at all sites	187	33	267	316
No of Sites	4	1	11	8
No of Sites where value > MIL	0	0	0	0
Max	0.002	0.000	0.001	0.001
Min	0.000	0.000	0.000	0.000
No values > MIL	0	0	0	0
MIL	0.003	0.003	0.003	0.003
units	ppm	ppm	ppm	ppm
95th percentile	0.002	0.000	0.001	0.001
90th percentile	0.001	0.000	0.001	0.001
75th percentile	0.001	0.000	0.001	0.001
50th percentile	0.001	0.000	0.001	0.000
25th percentile	0.001	0.000	0.000	0.000

BENZENE DATA POST 2004 NON-NEPM METHODS

Benzene non-NEPM Methods annual average data post 2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.001	0.000	0.000	0.020
std dev	0.001	0.001	0.001	0.051
No of individual samples at all sites	174	58	3336	469
No of Sites	2	2	24	5
No of Sites where value > MIL	0	0	1	1
Max	0.003	0.001	0.008	0.167
Min	0.000	0.000	0.000	0.000
No values > MIL	0	0	1	2
MIL	0.003	0.003	0.003	0.003
units	ppm	ppm	ppm	ppm
95th percentile	0.003	0.001	0.001	0.108
90th percentile	0.003	0.001	0.001	0.050
75th percentile	0.003	0.001	0.000	0.002
50th percentile	0.002	0.000	0.000	0.000
25th percentile	0.000	0.000	0.000	0.000

TOLUENE DAILY DATA POST 2004 ALL METHODS

Toluene Daily data post 2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.006	0.003	0.001	0.002
std dev	0.005	0.003	0.002	0.004
No of individual samples at all sites	374	319	1618	2429
No of Sites	7	3	31	14
No of Sites where value > MIL	0	0	0	0
Max	0.020	0.016	0.015	0.045
Min	0.000	0.000	0.000	0.000
No values > MIL	0	0	0	0
MIL	1	1	1	1
Units	ppm	ppm	ppm	ppm
95th percentile	0.015	0.008	0.007	0.013
90th percentile	0.014	0.006	0.005	0.003
75th percentile	0.012	0.005	0.001	0.002
50th percentile	0.005	0.003	0.000	0.001
25th percentile	0.002	0.002	0.000	0.001

TOLUENE DAILY DATA POST 2004 NEPM METHODS

Toluene NEPM Methods daily data post 2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.002	0.001	0.003	0.001
std dev	0.003	0.001	0.003	0.001
No of individual samples at all sites	876	33	299	360
No of Sites	22	1	7	9
No of Sites where value > MIL	0	0	0	0
Max	0.015	0.004	0.015	0.007
Min	0.000	0.000	0.000	0.000
No values > MIL	0	0	0	0
MIL	1	1	1	1
Units	ppm	ppm	ppm	ppm
95th percentile	0.008	0.003	0.008	0.004
90th percentile	0.007	0.002	0.008	0.002
75th percentile	0.003	0.002	0.007	0.001
50th percentile	0.001	0.001	0.002	0.001
25th percentile	0.001	0.001	0.001	0.000

TOLUENE DAILY DATA POST 2004 NON-NEPM METHODS

Toluene non-NEPM Methods daily data post 2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.010	0.004	0.001	0.003
std dev	0.005	0.003	0.001	0.005
No of individual samples at all sites	190	286	1319	2069
No of Sites	2	2	23	6
No of Sites where value > MIL	0	0	0	0
Max	0.020	0.016	0.007	0.045
Min	0.000	0.000	0.000	0.000
No values > MIL	0	0	0	0
MIL	1	1	1	1
units	ppm	ppm	ppm	ppm
95th percentile	0.016	0.009	0.005	0.014
90th percentile	0.015	0.007	0.003	0.003
75th percentile	0.013	0.005	0.001	0.002
50th percentile	0.012	0.003	0.000	0.001
25th percentile	0.004	0.002	0.000	0.001

TOLUENE ANNUAL DATA POST 2004 ALL METHODS

Toluene annual average data post 2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.004	0.002	0.001	0.002
std dev	0.004	0.002	0.001	0.003
No of individual samples at all sites	374	295	1446	2600
No of Sites	5	3	28	19
No of Sites where value > MIL	0	0	0	0
Max	0.013	0.004	0.006	0.016
Min	0.001	0.000	0.000	0.000
No values > MIL	0	0	0	0
MIL	0.1	0.1	0.1	0.1
units	ppm	ppm	ppm	ppm
95th percentile	0.012	0.004	0.002	0.005
90th percentile	0.012	0.004	0.001	0.003
75th percentile	0.005	0.002	0.001	0.001
50th percentile	0.002	0.001	0.000	0.001
25th percentile	0.002	0.000	0.000	0.001

TOLUENE ANNUAL DATA POST 2004 NEPM METHODS

Toluene NEPM Methods annual average data post 2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.003	0.001	0.002	0.001
std dev	0.002	0.000	0.002	0.001
No of individual samples at all sites	184	33	267	314
No of Sites	4	1	7	12
No of Sites where value > MIL	0	0	0	0
Max	0.006	0.002	0.006	0.003
Min	0.001	0.001	0.000	0.000
No values > MIL	0	0	0	0
MIL	0.1	0.1	0.1	0.1
Units	ppm	ppm	ppm	ppm
95th percentile	0.005	0.002	0.005	0.002
90th percentile	0.005	0.002	0.004	0.002
75th percentile	0.003	0.001	0.002	0.001
50th percentile	0.002	0.001	0.001	0.001
25th percentile	0.002	0.001	0.001	0.001

TOLUENE ANNUAL DATA POST 2004 NON-NEPM METHODS

Toluene non-NEPM Methods annual average data post 2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.007	0.002	0.000	0.001
std dev	0.006	0.002	0.000	0.001
No of individual samples at all sites	190	286	1179	314
No of Sites	2	2	21	12
No of Sites where value > MIL	0	0	0	0
Max	0.013	0.004	0.001	0.003
Min	0.001	0.000	0.000	0.000
No values > MIL	0	0	0	0
MIL	0.1	0.1	0.1	0.1
units	ppm	ppm	ppm	ppm
95th percentile	0.012	0.004	0.001	0.002
90th percentile	0.012	0.004	0.001	0.002
75th percentile	0.012	0.002	0.001	0.001
50th percentile	0.007	0.000	0.000	0.001
25th percentile	0.001	0.000	0.000	0.001

FORMALDEHYDE DAILY DATA POST 2004 ALL METHODS

Formaldehyde Daily Data post 2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.004	0.003	0.008	0.004
std dev	0.003	0.001	0.007	0.004
No of individual samples at all sites	195	396	456	823
No of Sites	2	2	6	13
No of Sites where value > MIL	0	0	0	0
Max	0.019	0.005	0.031	0.028
Min	0.000	0.000	0.000	0.000
No values > MIL	0	0	0	0
MIL	0.04	0.04	0.04	0.04
units	ppm	ppm	ppm	ppm
95th percentile	0.011	0.004	0.019	0.013
90th percentile	0.008	0.004	0.017	0.012
75th percentile	0.005	0.003	0.014	0.003
50th percentile	0.004	0.003	0.009	0.002
25th percentile	0.003	0.002	0.001	0.001

FORMALDEHYDE DAILY DATA POST 2004 NEPM METHODS

Formaldehyde Daily NEPM Methods post 2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.002	0.002	0.001	0.002
std dev	0.001	0.001	0.001	0.002
No of individual samples at all sites	54	62	106	378
No of Sites	1	1	3	8
No of Sites where value > MIL	0	0	0	0
Max	0.004	0.004	0.005	0.028
Min	0.000	0.000	0.000	0.000
No values > MIL	0	0	0	0
MIL	0.04	0.04	0.04	0.04
Units	ppm	ppm	ppm	ppm
95th percentile	0.004	0.003	0.003	0.003
90th percentile	0.003	0.003	0.002	0.003
75th percentile	0.003	0.002	0.002	0.002
50th percentile	0.002	0.002	0.002	0.002
25th percentile	0.002	0.001	0.001	0.001

FORMALDEHYDE DAILY DATA POST 2004 NON-NEPM METHODS

Formaldehyde Daily Data non-NEPM Methods post 2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.005	0.003	0.008	0.005
std dev	0.003	0.001	0.007	0.005
No of individual samples at all sites	141	396	456	445
No of Sites	1	2	6	5
No of Sites where value > MIL	0	0	0	0
Max	0.019	0.005	0.031	0.024
Min	0.001	0.000	0.000	0.000
No values > MIL	0	0	0	0
MIL	0.04	0.04	0.04	0.04
units	ppm	ppm	ppm	ppm
95th percentile	0.012	0.004	0.019	0.015
90th percentile	0.010	0.004	0.017	0.013
75th percentile	0.005	0.003	0.014	0.008
50th percentile	0.004	0.003	0.009	0.003
25th percentile	0.003	0.002	0.001	0.001

XYLENES DAILY DATA POST 2004 ALL METHODS

Xylenes Daily data post 2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.001	0.001	0.000	0.000
std dev	0.001	0.001	0.000	0.000
No of individual samples at all sites	174	145	1641	602
No of Sites	4	3	32	10
No of Sites where value > MIL	0	1	0	0
Max	0.005	0.003	0.007	0.005
Min	0.000	0.000	0.000	0.000
No values > MIL	0	0	0	0
MIL	0.25	0.25	0.25	0.25
Units	ppm	ppm	ppm	ppm
95th percentile	0.003	0.002	0.001	0.001
90th percentile	0.002	0.002	0.001	0.001
75th percentile	0.002	0.001	0.000	0.001
50th percentile	0.001	0.000	0.000	0.000
25th percentile	0.000	0.000	0.000	0.000

XYLENES DAILY DATA POST 2004 NEPM METHODS

Xylenes NEPM Methods daily data post 2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.001	0.001	0.000	0.001
std dev	0.001	0.001	0.000	0.001
No of individual samples at all sites	126	91	1641	318
No of Sites	3	2	32	9
No of Sites where value > MIL	0	0	0	0
Max	0.005	0.003	0.007	0.005
Min	0.000	0.000	0.000	0.000
No values > MIL	0	0	0	0
MIL	0.25	0.25	0.25	0.25
Units	ppm	ppm	ppm	ppm
95th percentile	0.003	0.002	0.001	0.002
90th percentile	0.002	0.002	0.001	0.001
75th percentile	0.002	0.001	0.000	0.001
50th percentile	0.001	0.001	0.000	0.001
25th percentile	0.000	0.000	0.000	0.000

XYLENES DAILY DATA POST 2004 NON-NEPM METHODS

Xylenes non-NEPM Methods daily data post 2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.001	0.000	0.000	0.000
std dev	0.000	0.000	0.000	0.000
No of individual samples at all sites	48	54	1177	284
No of Sites	1	1	21	4
No of Sites where value > MIL	0	0	0	0
Max	0.001	0.000	0.002	0.001
Min	0.000	0.000	0.000	0.000
No values > MIL	0	0	0	0
MIL	0.2	0.2	0.25	0.25
units	ppm	ppm	ppm	ppm
95th percentile	0.001	-	0.001	0.001
90th percentile	0.001	-	0.001	0.000
75th percentile	0.001	-	0.000	0.000
50th percentile	0.001	-	0.000	0.000
25th percentile	0.001	-	0.000	0.000

XYLENES ANNUAL DATA POST 2004 ALL METHODS

Xylenes annual average data post 2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.001	0.001	0.000	0.005
std dev	0.001	0.000	0.000	0.016
No of individual samples at all sites	174	136	1446	599
No of Sites	4	3	32	10
No of Sites where value > MIL	0	0	0	0
Max	0.002	0.001	0.001	0.057
Min	0.000	0.000	0.000	0.000
No values > MIL	0	0	0	0
MIL	0.2	0.2	0.2	0.2
units	ppm	ppm	ppm	ppm
95th percentile	0.002	0.001	0.001	0.048
90th percentile	0.002	0.001	0.001	0.001
75th percentile	0.001	0.001	0.000	0.001
50th percentile	0.001	0.001	0.000	0.001
25th percentile	0.000	0.001	0.000	0.000

XYLENES ANNUAL DATA POST 2004 NEPM METHODS

Xylenes NEPM Methods annual average data post 2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.001	0.001	0.001	0.001
std dev	0.001	0.000	0.000	0.000
No of individual samples at all sites	126	82	267	315
No of Sites	3	2	11	8
No of Sites where value > MIL	0	0	0	0
Max	0.002	0.001	0.001	0.001
Min	0.000	0.001	0.000	0.000
No values > MIL	0	0	0	0
MIL	0.2	0.2	0.2	0.2
Units	ppm	ppm	ppm	ppm
95th percentile	0.002	0.001	0.001	0.001
90th percentile	0.002	0.001	0.001	0.001
75th percentile	0.002	0.001	0.001	0.001
50th percentile	0.001	0.001	0.001	0.001
25th percentile	0.001	0.001	0.000	0.000

XYLENES ANNUAL DATA POST 2004 NON-NEPM METHODS

Xylenes non-NEPM Methods annual average data post 2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.001	0.000	0.000	0.012
std dev	0.000	0.000	0.000	0.024
No of individual samples at all sites	48	54	1179	284
No of Sites	1	1	21	4
No of Sites where value > MIL	0	0	0	0
Max	0.001	0.000	0.001	0.057
Min	0.000	0.000	0.000	0.000
No values > MIL	0	0	0	0
MIL	0.2	0.2	0.2	0.2
Units	ppm	ppm	ppm	ppm
95th percentile	0.001	-	0.000	0.054
90th percentile	0.001	-	0.000	0.051
75th percentile	0.001	-	0.000	0.001
50th percentile	0.001	-	0.000	0.000
25th percentile	0.001	-	0.000	0.000

BENZO (A) PYRENE DATA POST 2004 ALL METHODS

Benzo (a) pyrene annual average data post 2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.11	0.15	0.11	0.11
std dev	0.13	0.11	0.03	0.08
No of individual samples at all sites	30	120	245	358
No of Sites	2	2	6	8
No of Sites where value > MIL	0	0	0	1
Max	0.20	0.30	0.13	0.30
Min	0.02	0.03	0.03	0.02
No values > MIL	0	0	0	1
MIL	0.3	0.3	0.3	0.3
units	ng/m3	ng/m3	ng/m3	ng/m3
95th percentile	0.19	0.28	0.13	0.22
90th percentile	0.19	0.26	0.13	0.18
75th percentile	0.16	0.19	0.13	0.13
50th percentile	0.11	0.13	0.12	0.11
25th percentile	0.07	0.09	0.11	0.04

BENZO (A) PYRENE DATA POST 2004 NEPM METHODS

Benzo (a) pyrene NEPM Methods annual average data post 2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.11	0.15	0.11	0.11
std dev	0.13	0.11	0.03	0.08
No of individual samples at all sites	30	120	245	358
No of Sites	2	2	6	8
No of Sites where value > MIL	0	0	0	1
Max	0.20	0.30	0.13	0.30
Min	0.02	0.03	0.03	0.02
No values > MIL	0	0	0	1
MIL	0.3	0.3	0.3	0.3
Units	ng/m3	ng/m3	ng/m3	ng/m3
95th percentile	0.19	0.28	0.13	0.22
90th percentile	0.19	0.26	0.13	0.18
75th percentile	0.16	0.19	0.13	0.13
50th percentile	0.11	0.13	0.12	0.11
25th percentile	0.07	0.09	0.11	0.04

BENZO (A) PYRENE DATA POST 2004 NON-NEPM METHODS

Benzo (a) pyrene non-NEPM Methods annual average data post 2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean				
std dev				
No of individual samples at all sites				
No of Sites	0	0	0	0
No of Sites where value > MIL				
Max				
Min				
No values > MIL				
MIL				
units				
95th percentile				
90th percentile				
75th percentile				
50th percentile				
25th percentile				

BENZENE DATA PRE-2004 ALL METHODS

Benzene annual average data Pre-2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.005	0.651	0.003	0.003
std dev	0.005	1.040	0.002	0.002
No of individual samples at all sites	34	1508	1630	1326
No of Sites	2	4	9	7
No of Sites where value > MIL	1	2	6	4
Max	0.009	2.793	0.007	0.007
Min	0.001	0.001	0.001	0.001
No values > MIL	1	11	10	15
MIL	0.003	0.003	0.003	0.003
units	ppm	ppm	ppm	ppm
95th percentile	0.008	2.399	0.006	0.005
90th percentile	0.008	2.375	0.006	0.004
75th percentile	0.007	1.706	0.005	0.004
50th percentile	0.005	0.005	0.004	0.002
25th percentile	0.003	0.001	0.002	0.001

BENZENE DATA PRE-2004 NEPM METHODS

Benzene NEPM Methods annual average data Pre-2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.001	0.814	0.004	0.003
std dev	-!	1.109	0.001	0.002
No of individual samples at all sites	15	564	68	737
No of Sites	1	3	1	6
No of Sites where value > MIL	0	2	1	4
Max	0.001	2.793	0.005	0.007
Min	0.001	0.001	0.003	0.001
No values > MIL	0	11	5	15
MIL	0.003	0.003	0.003	0.003
units	ppm	ppm	ppm	ppm
95th percentile	0.001	2.482	0.004	0.006
90th percentile	0.001	2.377	0.004	0.004
75th percentile	0.001	1.799	0.004	0.004
50th percentile	0.001	0.006	0.004	0.003
25th percentile	0.001	0.001	0.004	0.001

BENZENE DATA PRE-2004 NON-NEPM METHODS

Benzene non-NEPM Methods annual average data Pre-2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.009	0.001	0.003	0.001
std dev	-	0.000	0.002	0.000
No of individual samples at all sites	19	944	1562	589
No of Sites	1	1	8	1
No of Sites where value > MIL	1	0	5	0
Max	0.009	0.001	0.007	0.001
Min	0.009	0.001	0.001	0.001
No values > MIL	1	0	5	0
MIL	0.003	0.003	0.003	0.003
units	ppm	ppm	ppm	ppm
95th percentile	0.009	0.001	0.007	0.001
90th percentile	0.009	0.001	0.006	0.001
75th percentile	0.009	0.001	0.005	0.001
50th percentile	0.009	0.001	0.002	0.001
25th percentile	0.009	0.001	0.001	0.001

TOLUENE DAILY DATA PRE-2004 ALL METHODS

Toluene Daily data Pre-2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.004	0.474	0.008	0.004
std dev	0.002	1.456	0.006	0.003
No of individual samples at all sites	34	1804	177	2844
No of Sites	2	4	4	10
No of Sites where value > MIL	0	1	0	0
Max	0.008	10.000	0.045	0.047
Min	0.001	0.000	0.002	0.000
No values > MIL	0	198	0	0
MIL	1	1	1	1
Units	ppm	ppm	ppm	ppm
95th percentile	0.007	4.300	0.020	0.010
90th percentile	0.006	2.000	0.013	0.007
75th percentile	0.005	0.007	0.010	0.004
50th percentile	0.004	0.004	0.007	0.003
25th percentile	0.002	0.003	0.005	0.002

TOLUENE DAILY DATA PRE-2004 NEPM METHODS

Toluene NEPM Methods daily data Pre-2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.003	1.507	0.011	0.005
std dev	0.002	2.287	0.009	0.005
No of individual samples at all sites	15	564	68	764
No of Sites	1	3	1	6
No of Sites where value > MIL	0	1	0	0
Max	0.007	10.000	0.045	0.047
Min	0.001	0.000	0.002	0.000
No values > MIL	0	198	0	0
MIL	1	1	1	1
Units	ppm	ppm	ppm	ppm
95th percentile	0.005	5.900	0.028	0.016
90th percentile	0.004	5.100	0.023	0.011
75th percentile	0.003	3.200	0.013	0.007
50th percentile	0.002	0.008	0.008	0.004
25th percentile	0.001	0.001	0.006	0.001

TOLUENE DAILY DATA PRE-2004 NON-NEPM METHODS

Toluene non-NEPM Methods daily data Pre-2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.005	0.004	0.007	0.003
std dev	0.002	0.003	0.003	0.002
No of individual samples at all sites	19	1240	109	2080
No of Sites	1	1	3	4
No of Sites where value > MIL	0	0	0	0
Max	0.008	0.035	0.015	0.026
Min	0.002	0.001	0.002	0.000
No values > MIL	0	0	0	0
MIL	1	1	1	1
units	ppm	ppm	ppm	ppm
95th percentile	0.007	0.010	0.011	0.006
90th percentile	0.006	0.008	0.010	0.005
75th percentile	0.005	0.005	0.009	0.004
50th percentile	0.004	0.004	0.007	0.003
25th percentile	0.004	0.003	0.004	0.002

TOLUENE ANNUAL DATA PRE-2004 ALL METHODS

Toluene annual average data Pre-2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.004	1.166	0.008	0.005
std dev	0.002	1.885	0.002	0.003
No of individual samples at all sites	34	1802	50	2849
No of Sites	2	4	2	11
No of Sites where value > MIL	0	1	0	0
Max	0.006	5.000	0.009	0.016
Min	0.003	0.001	0.006	0.001
No values > MIL	0	6	0	0
MIL	0.1	0.1	0.1	0.1
Units	ppm	ppm	ppm	ppm
95th percentile	0.006	4.758	0.009	0.012
90th percentile	0.006	4.401	0.009	0.009
75th percentile	0.005	2.736	0.008	0.007
50th percentile	0.004	0.009	0.008	0.004
25th percentile	0.003	0.003	0.007	0.003

TOLUENE ANNUAL DATA PRE-2004 NEPM METHODS

Toluene NEPM Methods annual average data Pre-2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.003	1.456		0.006
std dev	-	2.013		0.003
No of individual samples at all sites	15	564		806
No of Sites	1	3	0	7
No of Sites where value > MIL	0	1		0
Max	0.003	5.000		0.013
Min	0.003	0.001		0.001
No values > MIL	0	6		0
MIL	0.1	0.1		0.1
Units	ppm	ppm		ppm
95th percentile	0.003	4.809		0.011
90th percentile	0.003	4.554		0.009
75th percentile	0.003	3.161		0.007
50th percentile	0.003	0.010		0.006
25th percentile	0.003	0.001		0.003

TOLUENE ANNUAL DATA PRE-2004 NON-NEPM METHODS

Toluene non-NEPM Methods annual average data Pre-2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.006	0.005	0.008	0.003
std dev	-	0.001	0.002	0.001
No of individual samples at all sites	19	1238	50	1861
No of Sites	1	1	2	2
No of Sites where value > MIL	0	0	0	0
Max	0.006	0.006	0.009	0.004
Min	0.006	0.004	0.006	0.002
No values > MIL	0	0	0	0
MIL	0.1	0.1	0.1	0.1
units	ppm	ppm	ppm	ppm
95th percentile	0.006	0.006	0.009	0.004
90th percentile	0.006	0.005	0.009	0.004
75th percentile	0.006	0.005	0.008	0.004
50th percentile	0.006	0.004	0.008	0.003
25th percentile	0.006	0.004	0.007	0.003

FORMALDEHYDE DAILY DATA PRE-2004 ALL METHODS

Formaldehyde Daily Data Pre-2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.012	0.003	0.019	0.007
std dev	0.002	0.001	0.004	0.004
No of individual samples at all sites	19	1245	120	919
No of Sites	1	1	4	2
No of Sites where value > MIL	0	0	0	0
Max	0.014	0.008	0.035	0.028
Min	0.008	0.001	0.009	0.000
No values > MIL	0	0	0	0
MIL	0.04	0.04	0.04	0.04
units	ppm	ppm	ppm	ppm
95th percentile	0.014	0.005	0.024	0.015
90th percentile	0.014	0.005	0.022	0.012
75th percentile	0.013	0.004	0.021	0.008
50th percentile	0.012	0.003	0.020	0.006
25th percentile	0.011	0.002	0.017	0.005

FORMALDEHYDE DAILY DATA PRE-2004 NEPM METHODS

Formaldehyde Daily NEPM Methods Pre-2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean				
std dev				
No of individual samples at all sites				
No of Sites	0	0	0	0
No of Sites where value > MIL				
Max				
Min				
No values > MIL				
MIL				
Units				
95th percentile				
90th percentile				
75th percentile				
50th percentile				
25th percentile				

FORMALDEHYDE DAILY DATA PRE-2004 NON-NEPM METHODS

Formaldehyde Daily Data non-NEPM Methods Pre-2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.012	0.003	0.019	0.007
std dev	0.002	0.001	0.004	0.004
No of individual samples at all sites	19	1245	120	919
No of Sites	1	1	4	2
No of Sites where value > MIL	0	0	0	0
Max	0.014	0.008	0.035	0.028
Min	0.008	0.001	0.009	0.000
No values > MIL	0	0	0	0
MIL	0.04	0.04	0.04	0.04
units	ppm	ppm	ppm	ppm
95th percentile	0.014	0.005	0.024	0.015
90th percentile	0.014	0.005	0.022	0.012
75th percentile	0.013	0.004	0.021	0.008
50th percentile	0.012	0.003	0.020	0.006
25th percentile	0.011	0.002	0.017	0.005

XYLENES DAILY DATA PRE-2004 ALL METHODS

Xylenes Daily data Pre-2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.006	1.084	0.007	0.004
std dev	0.004	1.688	0.004	0.004
No of individual samples at all sites	34	564	115	764
No of Sites	2	3	3	6
No of Sites where value > MIL	0	1	0	0
Max	0.010	8.500	0.017	0.040
Min	0.000	0.000	0.002	0.000
No values > MIL	0	200	0	0
MIL	0.25	0.25	0.25	0.25
Units	ppm	ppm	ppm	ppm
95th percentile	0.010	4.400	0.012	0.011
90th percentile	0.010	3.800	0.011	0.008
75th percentile	0.010	2.125	0.010	0.005
50th percentile	0.009	0.006	0.006	0.002
25th percentile	0.001	0.001	0.003	0.001

XYLENES DAILY DATA PRE-2004 NEPM METHODS

Xylenes NEPM Methods daily data Pre-2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.001	1.084	0.005	0.004
std dev	0.001	1.688	0.003	0.004
No of individual samples at all sites	15	564	68	764
No of Sites	1	3	1	6
No of Sites where value > MIL	0	1	0	0
Max	0.005	8.500	0.017	0.040
Min	0.000	0.000	0.002	0.000
No values > MIL	0	200	0	0
MIL	0.25	0.25	0.25	0.25
Units	ppm	ppm	ppm	ppm
95th percentile	0.003	4.400	0.011	0.011
90th percentile	0.002	3.800	0.008	0.008
75th percentile	0.002	2.125	0.006	0.005
50th percentile	0.001	0.006	0.004	0.002
25th percentile	0.001	0.001	0.002	0.001

XYLENES DAILY DATA PRE-2004 NON-NEPM METHODS

Xylenes non-NEPM Methods daily data Pre-2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.010		0.010	
std dev	0.000		0.002	
No of individual samples at all sites	19		47	
No of Sites	1	0	2	0
No of Sites where value > MIL	0		0	
Max	0.010		0.012	
Min	0.009		0.003	
No values > MIL	0		0	
MIL	0.25		0.25	
units	ppm		ppm	
95th percentile	0.010		0.012	
90th percentile	0.010		0.011	
75th percentile	0.010		0.011	
50th percentile	0.010		0.010	
25th percentile	0.010		0.009	

XYLENES ANNUAL DATA PRE-2004 ALL METHODS

Xylenes annual average data Pre-2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.006	1.025	0.005	0.004
std dev	0.006	1.440	0.003	0.002
No of individual samples at all sites	34	544	115	738
No of Sites	2	3	3	6
No of Sites where value > MIL	0	1	0	0
Max	0.010	3.898	0.011	0.007
Min	0.001	0.001	0.003	0.001
No values > MIL	0	6	0	0
MIL	0.2	0.2	0.2	0.2
Units	ppm	ppm	ppm	ppm
95th percentile	0.009	3.420	0.009	0.007
90th percentile	0.009	3.141	0.007	0.006
75th percentile	0.008	2.274	0.005	0.005
50th percentile	0.006	0.008	0.004	0.004
25th percentile	0.003	0.003	0.003	0.002

XYLENES ANNUAL DATA PRE-2004 NEPM METHODS

Xylenes NEPM Methods annual average data Pre-2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.001	1.025	1385	0.004
std dev	-	1.440	11	0.002
No of individual samples at all sites	15	544	1	738
No of Sites	1	3	3.898	6
No of Sites where value > MIL	0	1	0.001	0
Max	0.001	3.898	6	0.007
Min	0.001	0.001	0.2	0.001
No values > MIL	0	6	ppm	0
MIL	0.2	0.2	2.703	0.2
Units	ppm	ppm	1.508	ppm
95th percentile	0.001	3.420	0.006	0.007
90th percentile	0.001	3.141	0.004	0.006
75th percentile	0.001	2.274	0.002	0.005
50th percentile	0.001	0.008	1385	0.004
25th percentile	0.001	0.003	11	0.002

XYLENES ANNUAL DATA PRE-2004 NON-NEPM METHODS

Xylenes non-NEPM Methods annual average data Pre-2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.010		0.007	
std dev	-		0.006	
No of individual samples at all sites	19		47	
No of Sites	1	0	2	0
No of Sites where value > MIL	0		0	
Max	0.010		0.011	
Min	0.010		0.003	
No values > MIL	0		0	
MIL	0.2		0.2	
units	ppm		ppm	
95th percentile	0.010		0.010	
90th percentile	0.010		0.010	
75th percentile	0.010		0.009	
50th percentile	0.010		0.007	
25th percentile	0.010		0.005	

BENZO (A) PYRENE DATA PRE-2004 ALL METHODS

Benzo (a) pyrene annual average data Pre-2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.15	0.19	0.14	0.37
std dev	-	0.20	0.11	0.72
No of individual samples at all sites	14	153	271	566
No of Sites	1	5	9	23
No of Sites where value > MIL	0	2	2	12
Max	0.15	0.77	0.45	3.75
Min	0.15	0.02	0.02	0.02
No values > MIL	0	2	2	16
MIL	0.3	0.3	0.3	0.3
units	ng/m3	ng/m3	ng/m3	ng/m3
95th percentile	0.15	0.50	0.34	1.32
90th percentile	0.15	0.32	0.25	0.87
75th percentile	0.15	0.26	0.13	0.38
50th percentile	0.15	0.14	0.12	0.11
25th percentile	0.15	0.04	0.08	0.04

BENZO (A) PYRENE DATA PRE-2004 NEPM METHODS

Benzo (a) pyrene NEPM Methods annual average data Pre-2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean				
std dev				
No of individual samples at all sites				
No of Sites	0	0	0	0
No of Sites where value > MIL				
Max				
Min				
No values > MIL				
MIL				
Units				
95th percentile				
90th percentile				
75th percentile				
50th percentile				
25th percentile				

BENZO (A) PYRENE DATA PRE-2004 NON-NEPM METHODS

Benzo (a) pyrene non-NEPM Methods annual average data Pre-2004				
	ROADSIDE	CBD	INDUSTRIAL	RESIDENTIAL
Mean	0.15	0.19	0.14	0.37
std dev	-	0.20	0.11	0.72
No of individual samples at all sites	14	153	271	566
No of Sites	1	5	9	23
No of Sites where value > MIL	0	2	2	12
Max	0.15	0.77	0.45	3.75
Min	0.15	0.02	0.02	0.02
No values > MIL	0	2	2	16
MIL	0.3	0.3	0.3	0.3
units	ng/m3	ng/m3	ng/m3	ng/m3
95th percentile	0.15	0.50	0.34	1.32
90th percentile	0.15	0.32	0.25	0.87
75th percentile	0.15	0.26	0.13	0.38
50th percentile	0.15	0.14	0.12	0.11
25th percentile	0.15	0.04	0.08	0.04