19 June 2014 Project No. 1478104-116

Ashlee Farrow
Greater Wellington Regional Council
101 Wakefield Street
Wellington Central
Wellington 6011

PEER REVIEW OF: " ASSESSMENT OF AIR QUALITY EFFECTS ASSOCIATED WITH THE PROPOSED STAGE 4 EXTENSION TO THE SOUTHERN LANDFILL"

Dear Ashlee,

As requested, we have undertaken the following peer review[1] on behalf of the Greater Wellington Regional Council (GWRC), of the odour assessment submitted with the resource consents application by Wellington City Council (WCC)[2] for the Stage 4 extension of its Southern Landfill. The odour assessment[3] – herein referred to as the 'AEE' – was prepared for WCC by its consultant 'URS New Zealand Limited' (URS).

It is understood that this peer review will be used to support the section 42a Officers Report being prepared by GWRC.

GWRC defined the scope of this review to focus on whether the odour assessment method is appropriate, provides a robust assessment of effects and whether the mitigation described is likely to be effective. If any gaps or uncertainties are identified in the review of the assessment method and proposed mitigation measures, recommendations for the applicant to address these matters are to be provided.

This letter sets out a summary of the review carried out by Golder Associates (NZ) Limited (Golder). The review includes sections on: the background information, complaints data, dispersion modelling setup, modelling assessment results, the overall conclusions reached on odour effects, and the monitoring and mitigation measures. These sections are followed by Golders overall conclusions from the review and recommendations.

It should be noted that this review only relates to the discharges to air associated with the stage 4 extension of WCC landfill, and does not include existing site activities including green-waste composting or treatment of collected landfill gas, except to the extent that cumulative odour impacts may occur.

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[1] This report is provided subject to the attached report limitations.

[2] URS 2013. Resource Consent Application for the Stage 4 Extension of the Southern Landfill, Wellington – Volume 1. Application document prepared for Wellington City Council by URS New Zealand Limited. August 2013. Report number 42787470.

[3] URS 2013. Assessment of Air Quality Effects Associated with the Proposed Stage 4 Extension to the Southern Landfill. Report prepared for Wellington City Council by URS New Zealand Limited. August 2013. Report number 42775090. Volume 2a of the application document.

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Background

Overview of WCC proposal

WCC proposes an extension to its 'Southern Landfill', referred to as the 'Stage 4 extension'. The landfill is located in Cary's Gully off Landfill Road, Owhiro Bay, Wellington, and is adjacent to the residential suburbs of Happy Valley, Owhiro Bay, Kowhai Park and Mornington.

The Stage 4 extension of the landfill will give rise to discharges to air, in particular odour, but also dust and landfill gas. Consequently, an application to discharge contaminants into air has been made by WCC, and is the subject of this peer review. The AEE describes the main discharges to air of concern from the Stage 4 extension of the Southern Landfill as being odour and landfill gas (the later which is both odorous and an asphyxiant). Dust emissions can also occur, but are usually less of a concern where there is a significant separation distance to sensitive receptors which is the case for the proposed activity at this site.

The landfill is part of a wider complex of waste management activities that include a sludge dewatering facility, a composting plant, a refuse transfer station and a landfill gas treatment facility (referred to as the 'Carey's Gully Complex'). Golder understands from GWRC that the air discharges from these other activities are covered under separate air discharge permits and are therefore not the subject of this review, except to the extent that cumulative odour impacts may occur.

Historically, the Carey's Gully Complex has been a significant source of complaints relating to odour for the surrounding residential community. These complaints were largely attributed by URS to a sludge co-composting facility that ceased operating in 2008. Since that time the number of complaints has significantly reduced.

Receiving environment

The AEE describes the nearest sensitive neighbours (residential) being approximately 650 m to northeast of current landfill footprint in Mitchell Street, in the suburb of Kowhai Park. The nearest suburb is east is Kingston (1 km away) and to the south is Owhiro Bay (almost 2 km away). This description correctly describes the receiving environment.

From the information provided in the AEE it appears that the landfill footprint associated with the Stage 4 extension will generally move the active landfilling activities further from these residential suburbs (in the order of 700 m from the closest point). This increase in separation distance is expected by Golder to help mitigate potential air quality related impacts of the landfill.

Review of Applicant's Assessment Approach

The odour assessment did not follow the method described in the AEE. However, the assessment method used in practice was generally considered appropriate, whereas the description of the method given in the AEE was deficient.

By way of background, the AEE describes a method where by odour emissions from the landfill were modelled and then the odour concentrations compared against an odour modelling assessment criteria. This approach is generally not appropriate for existing or expanding activities that discharge odour.

In practice, the assessment modelled the relative change in potential odour impacts from the existing operation of the landfill to that of the Stage 4 extension, when bench-marked against community annoyance data via complaints records. The assessment goes on to describe the potential for odour effects associated with the landfill in terms of the Frequency, Intensity, Duration, Offensiveness and Location (FIDOL factors), using the information from the modelling assessment to inform the analysis of each of these factors.

Golder considers the assessment approach used in the AEE (rather than the method described in the AEE) to be appropriate and generally consistent with the Ministry for the Environment's (MfE) Good Practice Guide for Assessing Odour[4] (MfE 2003).

[4] MfE 2003. Good Practice Guide for Assessing and Managing Odour in New Zealand. MfE report 473. Ministry for the Environment.

Review of Assessment of Odour Complaint History

A key component of the AEE is the analysis of odour complaints history for the Carey's Gully complex, which is used to benchmark the odour impacts of the existing operation predicted by the dispersion modelling assessment. The following provides a discussion of the complaint history analysis made by URS, followed by an update to that analysis made by Golder using more recent complaints information from GWRC, and finally a statement about the appropriateness of the complaints history for benchmarking existing effects.

A history of odour complaints relating to Carey's Gully complex since 2003 through to the end of 2012 was provided in the AEE. This described a particularly high level of historic complaints relating to the overall complex form 2003 through to 2007 (up to 80 complaints per month - see Figure 1). After this time, complaints gradually reduced through to mid-2008 and then plateau or slightly reduces from that point through to present time, with a relatively low level complaint currently being received (typically less than 5 complaints per month, with some months receiving no complaints). The AEE describes that the reduction in complaints as relating to the closure of the sludge-co-composing facility in 2008.

The AEE describes that the majority of complaints following the closing of the sludge co-composting facility have been received from the residences located to the north-northeast of the Southern Landfill, notably the suburbs of Brooklyn and Kowhai Park. Unfortunately, no analysis of the likely on-site cause(s) of the odour complaints since 2008 was provided, although it is acknowledged that this level of detail may not readily be obtainable from the complaints records. Notwithstanding this, it is recommended that a detailed record of any future odour complaints be made and that those complaints be thoroughly investigated by the applicant to determine the likely causes of the complaint.

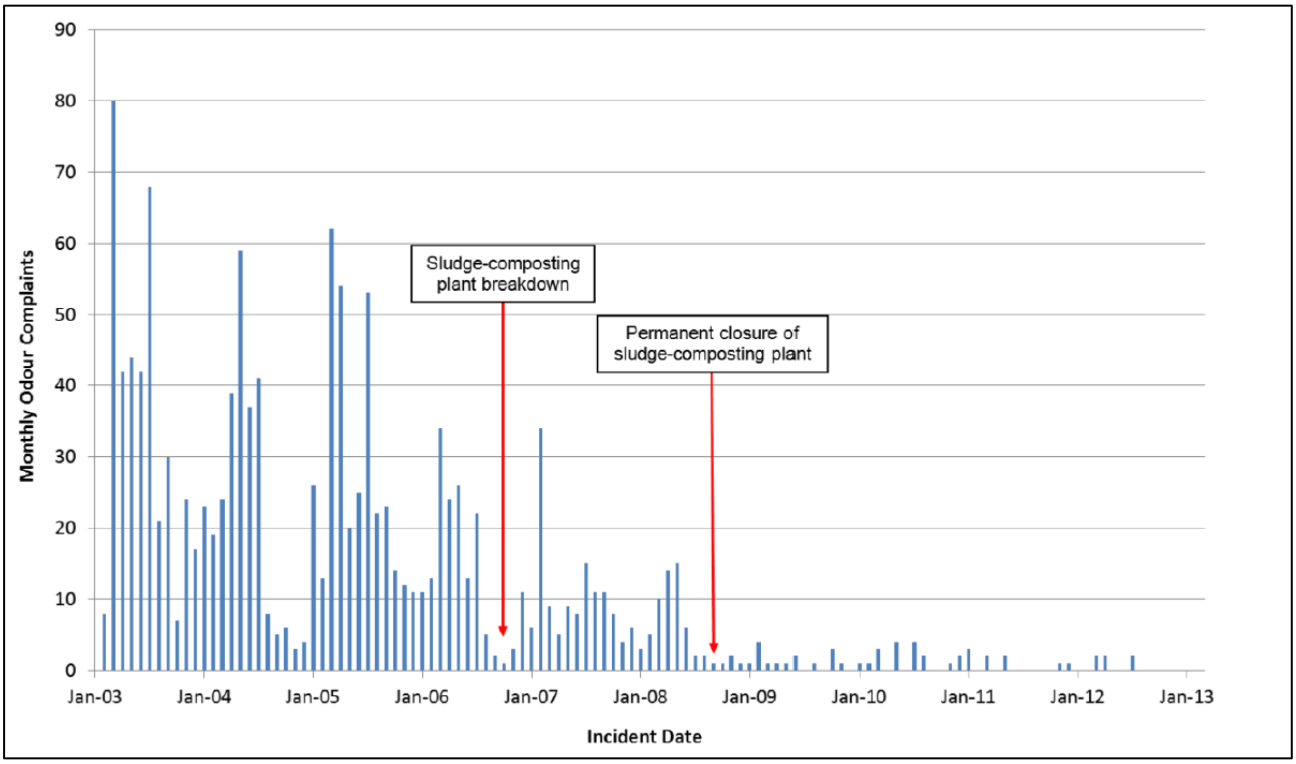

Figure 1: History of odour nuisance complaints (source: URS 2013).

The AEE goes on to describe that the:

> *"… remaining complaints [following the closure of the sludge co-composting facility] are at a level that is considered acceptable in accordance with the Good Practice Guide For Assessment and Managing Odours in New Zealand (MfE 2003)".*

Golder is not aware of any such guidance provided by MfE (2003) on what constitutes an acceptable number of complaints. MfE (2003) actually notes that:

"… complaint data alone should not be relied upon to assess the significance of adverse effects, particularly where:

a) there are low population densities;

b) there are other similar sources of odour;

c) the complaint records cannot be validated against wind conditions and site operations at the time."

At this site there is a moderate population density in the areas that have historically been affected, making the complaints data more useful. Offsetting the usefulness of the data is the fact that there are other sources of odour associated with the Carey's Gully complex, namely the remaining green-waste composting facility and sludge dewatering facility, which have a similar odour character to that expected of the landfill. Given this, it is unclear whether it is these other sources or the existing landfill operation that are the primary cause of the complaints that continue to occur. Finally, no discussion is provided in the AEE on whether the complaints have been validated or investigated, but presumably a number have been.

Golder has been provided with a record of odour complaints by GWRC relating to the Carey's Gully complex for the period of January 2011 through to March 2014 – which extends the data form that provided in Figure 1 to include all of 2013 and the first three months of 2014. A summary of the frequency of complaints by month for this period is given in Figure 2, and shows that anywhere between one and four complaints per month continue to occur, with a total number of complaints per year of between 7 and 15. While this frequency of complaint is a substantial reduction from those that occurred when the sludge co-composting facility operated, it indicates that the overall complex is still resulting in a low level of community annoyance and that there are residences that continue to be affected by odour from the site. Furthermore the updated record indicates that complaints are not reducing as might be inferred from Figure 1.

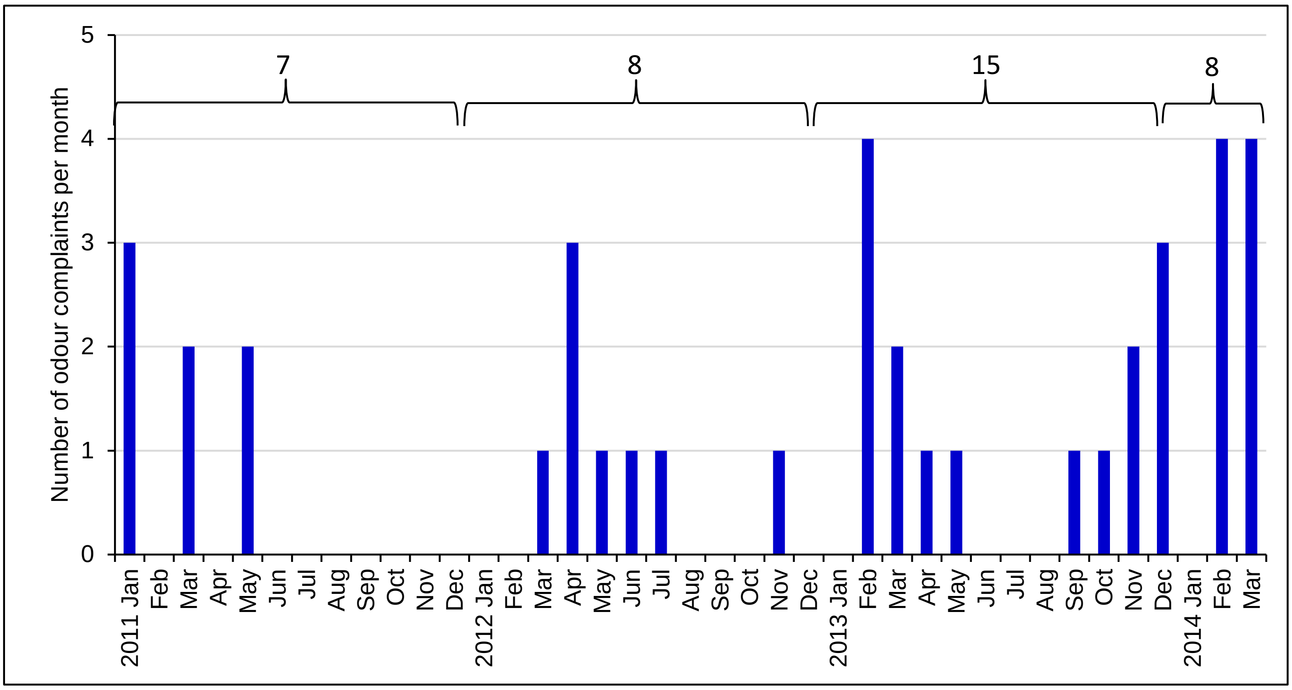

Figure 2: Odour nuisance complaints received by GWRC in relation to the Carey's Gully Complex - year 2011 to March 2014[5].

On balance, Golder considers that the record of complaints used in the AEE to benchmark existing community annoyance effects to have a moderate to high level of weighting when evaluating existing impacts and is therefore appropriate in this instance.

[5] Source information provided by GWRC in an email to Golder dated 25 March 2014.

Review of Dispersion Modelling Setup

Overview

The other key component to the assessment of potential odour effects is dispersion modelling assessment carried out by URS. The modelling assessment was carried out using the CALMET/CALPUFF system, and included two scenarios relating to the existing emissions sources at the Carey's Gully complex, and those following the Stage 4 extension of the landfill.

Emissions data

The source of the emissions data used in the modelling assessment was not reviewed in detail as this was outside the scope of this review. However, the manner in which the emissions data were used for the dispersion modelling assessment was checked, and identified that the calculated area flux emission rates used as input to the CALPUFF dispersion model were not correct. This matter was raised with URS, amongst other matters, who acknowledged the error and subsequently address it via a 'revised modelling assessment'[6] – attached to this review document. Accordingly, Golder is now satisfied with the format of the emissions data used in the dispersion modelling assessment.

Meteorological Modelling

As part of the dispersion modelling assessment, URS developed a site specific three-dimensional meteorological dataset using the CALMET model. A review the CALMET model setup by Golder was carried out and identified substantial issues relating to the use of incorrect map co-ordinates to describe the location of meteorological monitoring stations, whose data are used as input to the model. This matter was raised with URS, who confirmed this error and subsequently updated the meteorological modelling and subsequent dispersion modelling.

A windrose provided with the revised modelling assessment showed a frequency of wind directions that were similar to the original modelling – albeit with the prevailing winds tending to be more from the north-northwest for the revised dataset than from the northwest for the original dataset. The revised dataset had a noticeable change in the frequency of wind-speeds – with generally lighter winds occurring.

Given the above, Golder is now satisfied that the meteorological modelling is appropriate for the assessment or odour effects.

Dispersion Modelling

The CALPUFF dispersion model setup was reviewed by Golder, which identified a number of relatively minor inconsistencies with current good practice[7]. These were acknowledged and addressed by URS in the revised modelling assessment. Accordingly, Golder is satisfied that the updated dispersion modelling has been appropriately configured.

Review of Revised Modelling Assessment Results

The revised modelling results for the current landfill indicate odour concentrations in the order of 0.05 OU/m³ to 0.10 OU/m³ (expressed as a 99.5th percentile of 1 hour concentrations) occur over the suburbs where historic complaints have been received following the closure of the sludge co-composting facility.

The subsequent dispersion modelling of the Stage 4 extension, predicts concentrations that are generally less than 0.05 OU/m³, or in some cases remain between 0.05 OU/m³ and 0.10 OU/m³. A comparison of the modelling results between the existing landfill operation and that of the proposed stage 4 extension indicates a slight reduction in intensity and frequency of odour impacts. This is consistent with the Stage 4 landfill footprint being further removed from the residential areas to the east.

URS notes that the revised modelling assessment for the existing complex and the Stage 4 extension show similar trends to the original model outputs, albeit with very different concentrations. URS notes that this

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6 URS 2014. Section 92 Response to Southern Landfill Air Quality Modelling. Letter prepared by URS and addressed to Golder, dated 19 May 2014. Project No. 42787470.

7 In New Zealand and Australia.

similarity indicates that the influence of terrain on the transport of odours is a key component of the modelling, which Golder agrees with.

URS provided the following conclusion with the revised modelling assessment:

> *"… the potential nuisance odour effects for the suburbs to the east and northeast will become less frequent as the landfill shifts to the north-west, as the key odours source moves further from the receptors."*

Golder considers that this conclusion is robust. When the model results are put in the context of the existing low level of ongoing complaint experience with the current landfill, the modelling indicates a reduced impact that suggest a reduction in the likelihood of odour related complaints occurring.

Review of Overall Conclusions Relating to Odour Effects

The main application document[8] (URS 2013) summarises the findings of AEE[9] and states the following conclusion relating odour effects (emphasis added by Golder):

> *"The FIDOL assessment indicates that off-site odour effects at residential receptors from the proposed Stage 4 will be no worse than, and potentially better than those that currently occur, as long as appropriate measures continue to be utilised. …. Consequently, it is <u>not</u> considered that the operation of the Stage 4 extension will generate an unacceptable odour nuisance."*
>
> *… The potential for the proposed Stage 4 landfill to have a <u>more than minor adverse effect on air quality is considered to be mitigated</u> primarily through the following…*
>
> *… As such, adverse effects on air quality associated with the proposal are expected to be <u>less than minor</u>."*

Golder accepts that the proposed Stage 4 extension to the landfill is likely to have adverse air quality effects that are 'no more than minor', provided appropriate mitigation is continued. However, we note that residential neighbours continue to be affected by the ongoing operation of the landfill and may continue to be affected as a result of the Stage 4 extension (albeit to a lesser extent). Given this we are not able to reach the conclusion made by URS that the effects will be 'less than minor'. This finding may have implications regarding the decision that GWRC would need to make concerning public notification of the resource consent application.

Review of Monitoring and Mitigation Measures

Overview

The proposed mitigation measures and monitoring included in the AEE were described as those used at the existing landfill. However, no evaluation was provided comparing those mitigation measures and monitoring to current good practice. The following review comments relate to each of these components.

Refuse placement

A key mitigation measure for minimising odours from the placement of refuse is the progressive covering of wastes throughout each day of operation, with the working face completely covered at the end of each day.

The description of mitigation measures associated with refuse placement that are described in the AEE document discusses covering 'planned odorous loads' immediately with 0.1 m of compacted cover material. However, no discussion is given in that section to the progressive covering of the working face and fully covering it at the end of each day of operation. The application document does advise that daily cover material would be spread and compacted over the top surface of the advancing 'lift' of refuse to a compacted

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[8] URS 2013. Resource Consent Application for the Stage 4 Extension of the Southern Landfill, Wellington – Volume 1. Application document prepared for Wellington City Council by URS New Zealand Limited. August 2013. Report number 42787470.

[9] The conclusion made in the application document relates to the original AEE, but it is assumed that the applicant would apply it to the revised odour assessment given the conclusions of that assessment.

depth of not less than 200 mm, and not more than an average depth of 300 mm. The application states that cover material would be spread and compacted on the sloping face of the lift to a compacted depth of not less than 100 mm and not more than an average depth of 250 mm. The daily cover material is described as being a suitable inert waste stream material or suitable excavated site soils. The application document also advises that no refuse would be left uncovered for more than 10 hours.

Golder considers that the described approach for covering of waste at the working face is appropriate, but notes the proposed consent conditions described in the application document do not cover these important measures to the same level of detail.

Given the above, Golder recommends that details of the minimum thickness of the daily cover material be described in the consent conditions. The other measures described in the AEE for the placement of refuse are generally considered appropriate.

Landfill gas

The AEE recommends the carrying out instantaneous surface monitoring (ISM) for landfill gas. In practice this would be carried out using a hand-held flame ionisation detector (FID) to detect methane levels at the surface of the landfill. The FID and personnel observations of odour can be used to identify locations where methane and odour may be escaping and the need for remedial works. The AEE document recommends that the ISM be carried out on a six-monthly basis over areas that have final cover and areas with intermediate cover where filling activities would not occur for a year or more. Golder considers this to be consistent with current best practice and that the monitoring should be used to check for compliance with the surface methane limit of 5,000 ppm as specified in Regulation 26 of the NES[10]. The AEE proposes a six monthly ISM frequency, which Golder considers too infrequent and instead recommends that the ISM be carried out on a three monthly basis.

In addition to the ISM, the applicant also proposes weekly site walkover inspections to check for evidence of actual or potential leaks of landfill gas. This is considered appropriate and consistent with good practice and is covered in the conditions proposed by the applicant

It is understood that additional landfill gas generated by the Stage 4 extension of the landfill will be reticulated to the existing landfill gas treatment system, where the gas is flared or used to generate electricity. Air discharges from the landfill gas treatment system are consented separately from the operation of the landfill.

In Golder's experience, the treatment of landfill gas is normally covered under the main air discharge permit for the landfill. This is because the landfill gas treatment system is an integral and crucial part of the system for mitigation odour emissions and controlling potential health effects of fugitive landfill gas emissions. When the two are separately consented, there can be a conflict between the objective of the landfill gas treatment system, whereby the gas is used to generate electricity, and the need to ensure sufficient gas extraction from the landfill itself.

Notwithstanding the above, Golder notes that there is likely to be a significant increase in the cumulative gas production of the landfill resulting from the Stage 4 extension which would need to be accommodated by the treatment system. Given this, Golder recommends that GWRC consider the consenting requirements and potential air quality effects that may arise from the treatment of the additional landfill gas.

Leachate storage

The AEE notes that the leachate from the landfill can be a source of odour. To mitigate this, it is proposed that a leachate control system would collect leachate and discharge it to the trade-waste system and conveyed offsite for treatment at the Moa Point Wastewater Treatment Plant, as is currently done for the existing landfill. Although not described in the AEE, the ability to covey the leachate off-site for treatment is considered by Golder to be a significant mitigation measure in terms of minimising odours that could otherwise occur from the on-site treatment of leachate.

Prior to discharging to trade-waste, the leachate would be temporally stored in attenuation pond(s). The duration of the temporary storage in the attenuation ponds is unclear. However, the intention that the

[10] Resource Management (National Environmental Standards for Air Quality) Regulations 2004.

storage be temporarily is considered sufficient in this instance given that this source is not expected to be a significant source of odour compared with other sources on site and given the substantial separation distance to residences.

Dust

Given the large separation distance from the Stage 4 extension of the landfill to sensitive receptors (approximately 700 m) it is unlikely that there would be any significant dust effects. This conclusion is reached by URS. Notwithstanding this, a number of good practice measures are proposed in the AEE for minimising dust emissions from the operation and those measures have been reviewed by Golder and are considered appropriate.

Conclusions and Recommendations

Conclusions

In conclusion, Golder considers that the general assessment approach used by URS to be appropriate and the findings reached from the revised assessment to be robust. Based on the revised assessment, Golder concurs that adverse effects arising from discharges to air from the Stage 4 landfill are likely to be no more than minor but does not reach URS's view that they will be 'less than minor'. This is because we are unable to conclude that there will be no affected parties.

The mitigation measures proposed in the AEE and the application document for minimising air discharges are generally considered by Golder to be consistent with current good practice and likely to be effective at this site. However, Golder recommends that these measures be described in more detail in the proposed consent conditions should the consent be granted. To this end, specific recommendations are provided below.

Recommendations

It is recommended that the following consent conditions be required in addition to those proposed by the applicant:

- Detailed records of air quality related complaints be kept and investigations be carried out to try and establish the likely cause of the complaint.
- The immediate covering of planned odorous loads with 100 mm of compacted cover material.
- Progressive covering of any putrescible waste throughout the day (not just 'planned odorous loads').
- Fully covering all refuse with cover material at the end of each day such that the cover over the top surface of the advancing lift of refuse to a compacted depth of not less than 200 mm and a compacted depth of not less 100 mm on the sloping face of the lift.
- The provision of a detailed air quality management plan describing the monitoring and mitigation measures for odour, landfill gas and dust emissions from the landfill. The air quality management plan should be provided to GWRC for certification.
- The concentration of methane at the surface of the landfill areas with intermediate or final cover to not exceed the NES limit of 5,000 ppm.
- Instantaneous surface monitoring of methane be carried out on a 3-monthly basis to check compliance against the NES limit of 5,000 ppm

Golder notes that the potential adverse effects on the environment due to air discharges from the treatment of the increase in landfill gas to be generated by the Stage 4 extension of the landfill has not been addressed by the Applicant. Accordingly, we recommend that GWRC consider the need for an air permit application (new or change of consent conditions) in relation to the landfill gas treatment facility to allow for the significant increase in landfill gas that facility will need to treat.

Closing

We trust this review meets your requirements. If you have any queries regarding it, please contact Richard Chilton on (03) 377-5696.

Yours sincerely,

GOLDER ASSOCIATES (NZ) LIMITED

Richard Chilton
Senior Air Quality Specialist

RLC/JB/as

Attachments: Golder Report Limitation Statement
URS 2014. Section 92 Response to Southern Landfill Air Quality Modelling. Letter prepared by URS and addressed to Golder, dated 19 May 2014. Project No. 42787470.

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URS

19 May 2014
Project No. 42787470

Golder Associates Limited
PO Box 2281
Christchurch 8140
New Zealand

Attention: Richard Chilton
Senior Associate Air Quality Scientist

Dear Richard

Subject: Section 92 Response to Southern Landfill Air Quality Modelling

1 Introduction

URS New Zealand Limited (URS) has been asked to respond to a Section 92 request from the peer reviewer of the report "Assessment of Air Quality Effects Associated with the Proposed Stage 4 Extension to the Southern Landfill", August 2013 ('SLF AEE').

2 Further Information Requested

Golder Associates New Zealand Limited (Golder) has identified a number of issues with the meteorological and dispersion modelling work that underpins the odour assessment of the Stage 4 extension. These issues relate to:

a) The setup on the CALMET meteorological model and the physical location given in the model for surface and upper air meteorological sites, which appeared to be incorrect

b) Emission parameters used in the CALPUFF model, which appear to have over-estimated the emission values.

3 URS Response to Meteorological and Dispersion Modelling Setup

3.1 Air Dispersion Modelling Assessment

After reviewing the queries and the modelling, URS accepts that it had made an error in the location of the meteorological stations. URS also reviewed the CALPUFF code and determined that the emission rates had been incorrectly entered and the previous model rates were overestimated.

3.1.1 CALMET

The revised locations for the meteorological stations are presented in Table 1. The various other CALMET parameters are set at their default values. A copy of the CALMET input file is attached in Appendix A.

Table 1 Meteorological Stations

Location Parameters	Location UTM 60 (km)	Monitoring Period	Distance from Site (km)
Meridian Mast 530	308.563 E 5421.209 S	8/08/2008 – 10/08/2009	2.8 to South-west
Meridian Mast 230	309.321 E 5423.998 S	1/01/2007 – 24/10/2007	1.4 to North-west
Meridian Mast 710	309.244 E 5421.738 S	7/03/2009 – 31/12/2009	1.9 to South-west
Kelburn	313.090 E 5427.195 S	1/01/2007 – 31/12/2009	4.0 to North-east
Airport	316.208 E 5423.171 S	1/01/2007 – 31/12/2009	4.7 to East
Island Bay	313.220 E 5420.872 S	TAPM Generated data for entire period	2.6 km to South-east
Kowhai Park	311.869 E 5424.114 S	TAPM Generated data for entire period	0.7 km to North-east
Southern Landfill	311.328 E 5422.887 S	TAPM Generated data for entire period	Project Site
Upper Air File	311.328 E 5422.887 S	TAPM Generated data for entire period	Project Site

3.2 Meteorological Modelling Analysis

A wind validation exercise was undertaken to compare the model outputs from the corrected CALMET modelled data with the original uncorrected CALMET generated data. These windrose's are presented in Figures 1 and 2 respectively.

As can be seen, the wind trends are very similar between the updated CALMET model and the original modelling. The plots show a very dominant north-westerly prevailing wind.

The Southern Landfill is situated within a deep valley surrounded by high ridge lines with an obvious southeast to northwest orientation. Therefore, the terrain obviously has a significant bearing on the model. Therefore, the corrected CALMET predicted windrose (Figure 1) is considered to representative of the project site.

Figure 1 Corrected CALMET Windrose – Southern Landfill Site

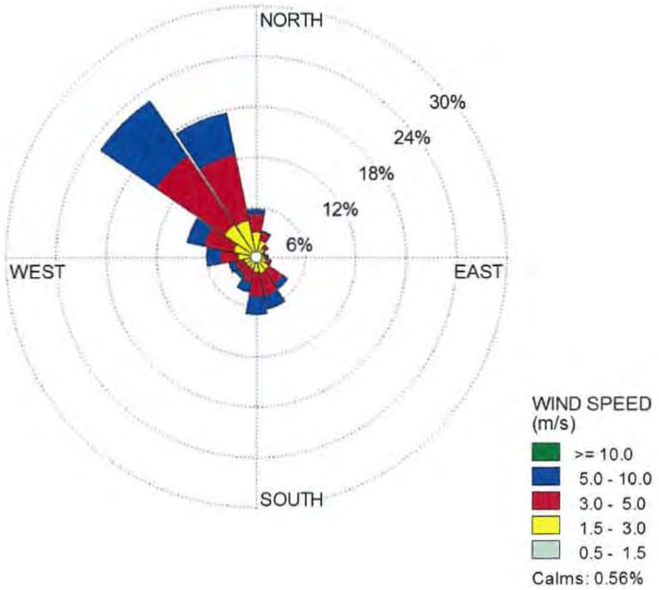
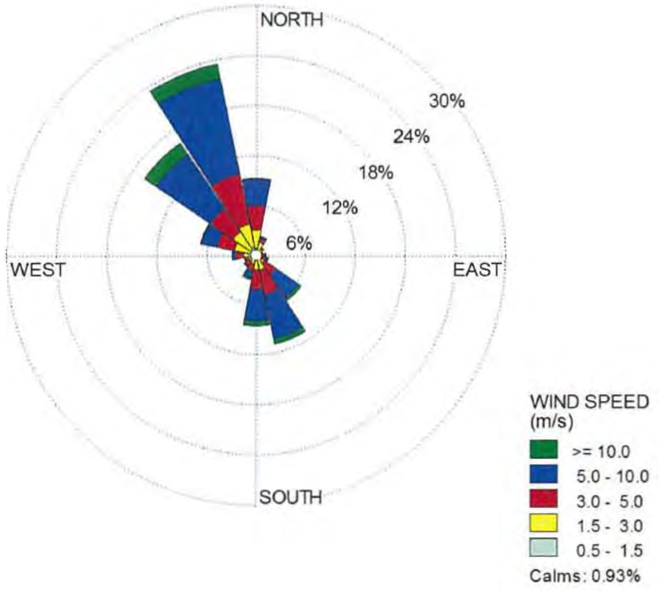


Figure 2 Original CALMET Windrose – Southern Landfill Site



3.3 Calpuff Model Inputs

URS has used the same default model inputs as those used in the SLF AEE modelling. As with the SLF AEE, the odour monitoring data that was used for this modelling was collected by Watercare Services Ltd in 2005. The odour emission data is summarised in Table 2, with the odour flux certainty and source locations used as inputs into the CALPUFF model. A copy of the CALPUFF input file is attached in Appendix A.

Table 2 Landfill Source Parameters

Source Parameters	UW Biofilter	UW Wet Well	Landfill Face	Leachate Pond	LEL Turned Compost	LEL Unturned Compost
Source Area (m)	400	1	625	2.5	400	1600
Monitored Concentration (OU/m^3)	277	350,000	9,350	6,750	2,300	523
Odour Flux Certainty ($OU/m^2/s$)	0.03	37.14	0.99	0.72	0.24	0.06
Map Reference UTM 60 (km) (Existing Stage 3)	311.273 E 5422.725 S	311.331 E 5422.624 S	311.635 E 5423.035 S	311.347 E 5423.119 S	311.317 E 5422.729 S	311.331 E 5422.749 S
Map Reference UTM 60 (km) (Proposed Stage 4)	311.273 E 5422.725 S	311.331 E 5422.624 S	310.900 E 5423.425 S	311.109 E 5423.527 S	311.317 E 5422.729 S	311.331 E 5422.749 S

4 Assessment Results

URS has re-run the dispersion models for odour associated with stage 3 and the proposed stage 4. Presented in Figure 3 is the odour modelling plots based on the existing operation and the proposed extension as a 99.9%ile.

The landfill face is likely to be the main odour source, which will be shifted to the north and west for the proposed stage 4 extension. Therefore, the distance between the landfill face and the nearest residential receptors, coincidently where the majority of the odour complaints have arisen from (the suburbs to the northeast) will increase. As expected, this shift is also evident in the modelling results, which shows the odour concentrations have approximately halved for these properties between stage 3 and stage 4.

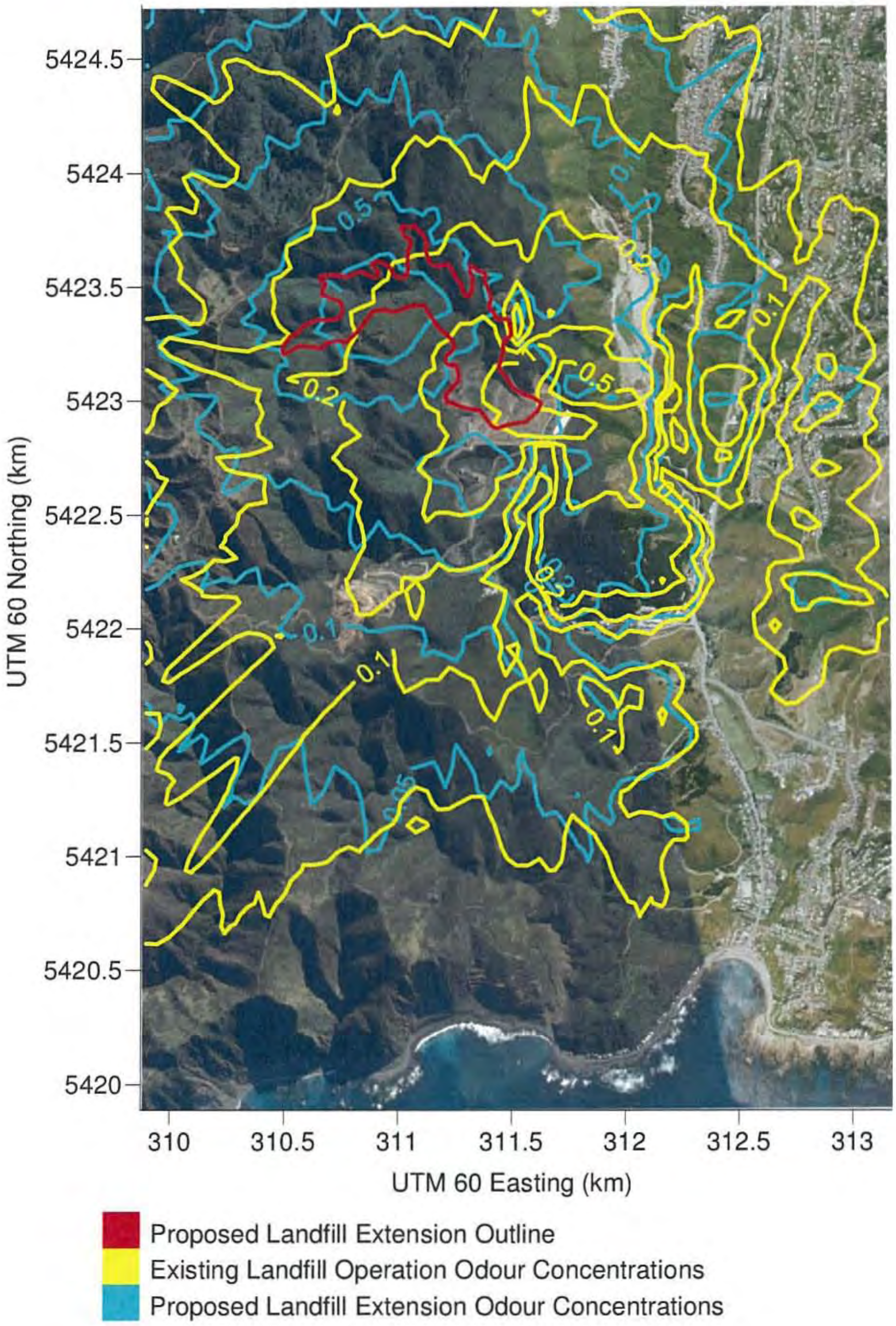
The re-modelling for both stages 3 and 4 show similar trends to the original model outputs. This clearly identifies that the terrain as a key component of the modelling.

As summarised in the SLF AEE, URS concludes that the potential nuisance odour effects for the suburbs to the east and northeast will become less frequent as the landfill shifts to the north-west, as the key odour source moves further away from the receptors.

URS

Richard Chilton
Golder Associates Limited
19 May 2014

Figure 3 Odour Comparison Between Existing and Proposed Landfill Stages



Yours sincerely
URS New Zealand Limited

Jeremy Hunt
Environmental Engineer

Andrew Curtis
Principal Air Quality Engineer

Appendix A – Modelling Inputs

```
CALMET.INP      2.1            Hour Start and End Times with Seconds
CALMET
8 surface met stations
1 upper air met
---------------- Run title (3 lines) ------------------------------------------

                    CALMET MODEL CONTROL FILE
                    --------------------------

-------------------------------------------------------------------------------

INPUT GROUP: 0 -- Input and Output File Names


Subgroup (a)
------------
Default Name  Type          File Name
------------  ----          ---------
GEO.DAT       input    ! GEODAT=C:\URS-Data\GEO4.DAT    !
SURF.DAT      input    ! SRFDAT=C:\URS-Data\wltnlf.sur    !
CLOUD.DAT     input    * CLDDAT=            *
PRECIP.DAT    input    * PRCDAT=            *
WT.DAT        input    * WTDAT=             *

CALMET.LST    output   ! METLST=C:\URS-Data\CALMET4.LST     !
CALMET.DAT    output   ! METDAT=C:\URS-Data\CALMET4.DAT    !
PACOUT.DAT    output   * PACDAT=            *

All file names will be converted to lower case if LCFILES = T
Otherwise, if LCFILES = F, file names will be converted to UPPER CASE
         T = lower case      ! LCFILES = F !
         F = UPPER CASE

NUMBER OF UPPER AIR & OVERWATER STATIONS:

    Number of upper air stations (NUSTA)  No default     ! NUSTA =  1  !
    Number of overwater met stations
                                 (NOWSTA) No default     ! NOWSTA =  0  !

NUMBER OF PROGNOSTIC and IGF-CALMET FILEs:

    Number of MM4/MM5/3D.DAT files
                                 (NM3D)  No default      ! NM3D =  0  !

    Number of IGF-CALMET.DAT files
                                 (NIGF)   No default     ! NIGF =  0  !

                       !END!
-------------------------------------------------------------------------------
Subgroup (b)
---------------------------------
Upper air files (one per station)
---------------------------------
Default Name  Type       File Name
------------  ----       ---------
UP1.DAT       input     1  ! UPDAT=C:\URS-Data\UP.DAT!    !END!
-------------------------------------------------------------------------------
Subgroup (c)
-----------------------------------------
Overwater station files (one per station)
-----------------------------------------
Default Name  Type       File Name
------------  ----       ---------
SEA1.DAT       input     1  * SEADAT=4007.DAT*    *END*
-------------------------------------------------------------------------------
Subgroup (d)
------------------------------------------------
MM4/MM5/3D.DAT files (consecutive or overlapping)
------------------------------------------------
Default Name  Type       File Name
------------  ----       ---------
MM51.DAT       input     1  * M3DDAT=MM4.DAT*    *END*
-------------------------------------------------------------------------------
Subgroup (e)
-------------------------------------------------
IGF-CALMET.DAT files (consecutive or overlapping)
-------------------------------------------------
```

```
Default Name  Type        File Name
------------  ----        ---------
IGFn.DAT       input      1  * IGFDAT=CALMET0.DAT *    *END*
--------------------------------------------------------------------------------
Subgroup (f)
----------------
Other file names
----------------

Default Name  Type        File Name
------------  ----        ---------
DIAG.DAT      input       * DIADAT=                 *
PROG.DAT      input       * PRGDAT=                 *

TEST.PRT      output      * TSTPRT=                 *
TEST.OUT      output      * TSTOUT=                 *
TEST.KIN      output      * TSTKIN=                 *
TEST.FRD      output      * TSTFRD=                 *
TEST.SLP      output      * TSTSLP=                 *
DCST.GRD      output      * DCSTGD=                 *

--------------------------------------------------------------------------------
NOTES: (1) File/path names can be up to 70 characters in length
       (2) Subgroups (a) and (f) must have ONE 'END' (surrounded by
           delimiters) at the end of the group
       (3) Subgroups (b) through (e) are included ONLY if the corresponding
           number of files (NUSTA, NOWSTA, NM3D, NIGF) is not 0, and each must have
           an 'END' (surround by delimiters) at the end of EACH LINE

                          !END!


-------------------------------------------------------------------------------

INPUT GROUP: 1 -- General run control parameters
--------------

     Starting date:    Year   (IBYR)  --    No default   ! IBYR  =  2007  !
                       Month  (IBMO)  --    No default   ! IBMO  =  1  !
                       Day    (IBDY)  --    No default   ! IBDY  =  3  !
     Starting time:    Hour   (IBHR)  --    No default   ! IBHR  =  1  !
                       Second (IBSEC) --    No default   ! IBSEC =  0  !

     Ending date:      Year   (IEYR)  --    No default   ! IEYR  =  2009  !
                       Month  (IEMO)  --    No default   ! IEMO  =  12  !
                       Day    (IEDY)  --    No default   ! IEDY  =  31  !
     Ending time:      Hour   (IEHR)  --    No default   ! IEHR  =  23  !
                       Second (IESEC) --    No default   ! IESEC =  0  !

      UTC time zone         (ABTZ) -- No default       ! ABTZ= UTC+1200 !
         (character*8)
         PST = UTC-0800, MST = UTC-0700 , GMT = UTC-0000
         CST = UTC-0600, EST = UTC-0500

     Length of modeling time-step (seconds)
     Must divide evenly into 3600 (1 hour)
     (NSECDT)                         Default:3600     ! NSECDT =  3600  !
                                      Units: seconds

     Run type            (IRTYPE) -- Default: 1       ! IRTYPE=  1  !

        0 = Computes wind fields only
        1 = Computes wind fields and micrometeorological variables
            (u*, w*, L, zi, etc.)
        (IRTYPE must be 1 to run CALPUFF or CALGRID)

     Compute special data fields required
     by CALGRID (i.e., 3-D fields of W wind
     components and temperature)
     in additional to regular            Default: T    ! LCALGRD = T !
     fields ? (LCALGRD)
     (LCALGRD must be T to run CALGRID)

      Flag to stop run after
      SETUP phase (ITEST)             Default: 2       ! ITEST=  2   !
      (Used to allow checking
      of the model inputs, files, etc.)
```

```
       ITEST = 1 - STOPS program after SETUP phase
       ITEST = 2 - Continues with execution of
                   COMPUTATIONAL phase after SETUP


     Test options specified to see if
     they conform to regulatory
     values? (MREG)                   No Default       ! MREG =    0   !

        0 = NO checks are made
        1 = Technical options must conform to USEPA guidance
                  IMIXH    -1       Maul-Carson convective mixing height
                                    over land; OCD mixing height overwater
                  ICOARE   0        OCD deltaT method for overwater fluxes
                  THRESHL  0.0      Threshold buoyancy flux over land needed
                                    to sustain convective mixing height growth
                  ISURFT   > 0      Pick one representative station, OR
                           -2       in NOOBS mode (ITPROG=2) average all
                                    surface prognostic temperatures to get
                                    a single representative surface temp.
                  IUPT     > 0      Pick one representative station, OR
                           -2       in NOOBS mode (ITPROG>0) average all surface
                                    prognostic temperatures to get a single
                                    representative surface temp.
                  IZICRLX  0        Do NOT use convective mixing height
                                    relaxation to equilibrium value

!END!

--------------------------------------------------------------------------------

INPUT GROUP: 2 -- Map Projection and Grid control parameters
--------------

     Projection for all (X,Y):
     -------------------------

     Map projection
     (PMAP)                     Default: UTM     ! PMAP = UTM  !

         UTM :  Universal Transverse Mercator
         TTM :  Tangential Transverse Mercator
         LCC :  Lambert Conformal Conic
          PS :  Polar Stereographic
          EM :  Equatorial Mercator
        LAZA :  Lambert Azimuthal Equal Area

     False Easting and Northing (km) at the projection origin
     (Used only if PMAP= TTM, LCC, or LAZA)
     (FEAST)                    Default=0.0      ! FEAST  = 0.000  !
     (FNORTH)                   Default=0.0      ! FNORTH = 0.000  !

     UTM zone (1 to 60)
     (Used only if PMAP=UTM)
     (IUTMZN)                   No Default       ! IUTMZN =  60   !

     Hemisphere for UTM projection?
     (Used only if PMAP=UTM)
     (UTMHEM)                   Default: N       ! UTMHEM = S  !
         N   :  Northern hemisphere projection
         S   :  Southern hemisphere projection

     Latitude and Longitude (decimal degrees) of projection origin
     (Used only if PMAP= TTM, LCC, PS, EM, or LAZA)
     (RLAT0)                    No Default       ! RLAT0 =  0N  !
     (RLON0)                    No Default       ! RLON0 =  0E  !

         TTM :  RLON0 identifies central (true N/S) meridian of projection
                RLAT0 selected for convenience
         LCC :  RLON0 identifies central (true N/S) meridian of projection
                RLAT0 selected for convenience
         PS  :  RLON0 identifies central (grid N/S) meridian of projection
                RLAT0 selected for convenience
         EM  :  RLON0 identifies central meridian of projection
                RLAT0 is REPLACED by 0.0N (Equator)
         LAZA:  RLON0 identifies longitude of tangent-point of mapping plane
                RLAT0 identifies latitude of tangent-point of mapping plane
```

```
     Matching parallel(s) of latitude (decimal degrees) for projection
     (Used only if PMAP= LCC or PS)
     (XLAT1)                  No Default      ! XLAT1 =  0N  !
     (XLAT2)                  No Default      ! XLAT2 =  0N  !

         LCC :  Projection cone slices through Earth's surface at XLAT1 and XLAT2
         PS  :  Projection plane slices through Earth at XLAT1
                (XLAT2 is not used)

     ----------
     Note:  Latitudes and longitudes should be positive, and include a
            letter N,S,E, or W indicating north or south latitude, and
            east or west longitude.  For example,
            35.9  N Latitude  =  35.9N
            118.7 E Longitude = 118.7E


     Datum-region
     ------------

     The Datum-Region for the coordinates is identified by a character
     string.  Many mapping products currently available use the model of the
     Earth known as the World Geodetic System 1984 (WGS-84).  Other local
     models may be in use, and their selection in CALMET will make its output
     consistent with local mapping products.  The list of Datum-Regions with
     official transformation parameters is provided by the National Imagery and
     Mapping Agency (NIMA).

     NIMA Datum - Regions(Examples)
     ------------------------------------------------------------------------------
     WGS-84    WGS-84 Reference Ellipsoid and Geoid, Global coverage (WGS84)
     NAS-C     NORTH AMERICAN 1927 Clarke 1866 Spheroid, MEAN FOR CONUS (NAD27)
     NAR-C     NORTH AMERICAN 1983 GRS 80 Spheroid, MEAN FOR CONUS (NAD83)
     NWS-84    NWS 6370KM Radius, Sphere
     ESR-S     ESRI REFERENCE 6371KM Radius, Sphere

     Datum-region for output coordinates
     (DATUM)                  Default: WGS-84    ! DATUM = WGS-84  !


     Horizontal grid definition:
     ---------------------------

     Rectangular grid defined for projection PMAP,
     with X the Easting and Y the Northing coordinate

            No. X grid cells (NX)      No default     ! NX =   66  !
            No. Y grid cells (NY)      No default     ! NY =   97  !

     Grid spacing (DGRIDKM)            No default     ! DGRIDKM = 0.05 !
                                       Units: km

     Reference grid coordinate of
     SOUTHWEST corner of grid cell (1,1)

        X coordinate (XORIGKM)         No default     ! XORIGKM = 309.871 !
        Y coordinate (YORIGKM)         No default     ! YORIGKM = 5419.887 !
                                       Units: km


     Vertical grid definition:
     -------------------------

        No. of vertical layers (NZ)    No default     ! NZ =  12  !

        Cell face heights in arbitrary
        vertical grid (ZFACE(NZ+1))    No defaults
                                       Units: m
        ! ZFACE = 0.,20.,50.,100.,200.,400.,800.,1200.,1600.,2000.,2500.,3000.,3500. !

!END!

-------------------------------------------------------------------------------

INPUT GROUP: 3 -- Output Options
```

```
--------------

    DISK OUTPUT OPTION

       Save met. fields in an unformatted
       output file ?            (LSAVE)  Default: T     ! LSAVE = T !
       (F = Do not save, T = Save)

       Type of unformatted output file:
       (IFORMO)                          Default: 1    ! IFORMO =  1  !

            1 = CALPUFF/CALGRID type file (CALMET.DAT)
            2 = MESOPUFF-II type file     (PACOUT.DAT)

    LINE PRINTER OUTPUT OPTIONS:

       Print met. fields ?  (LPRINT)      Default: F     ! LPRINT = F !
       (F = Do not print, T = Print)
       (NOTE: parameters below control which
              met. variables are printed)

       Print interval
       (IPRINF) in hours                  Default: 1     ! IPRINF =  1  !
       (Meteorological fields are printed
        every  1  hours)


       Specify which layers of U, V wind component
       to print (IUVOUT(NZ)) -- NOTE: NZ values must be entered
       (0=Do not print, 1=Print)
       (used only if LPRINT=T)        Defaults: NZ*0
       ! IUVOUT =  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0  !
       -----------------------


       Specify which levels of the W wind component to print
       (NOTE: W defined at TOP cell face --  12  values)
       (IWOUT(NZ)) -- NOTE: NZ values must be entered
       (0=Do not print, 1=Print)
       (used only if LPRINT=T & LCALGRD=T)
       -----------------------------------
                                           Defaults: NZ*0
        ! IWOUT =  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0  !


       Specify which levels of the 3-D temperature field to print
       (ITOUT(NZ)) -- NOTE: NZ values must be entered
       (0=Do not print, 1=Print)
       (used only if LPRINT=T & LCALGRD=T)
       -----------------------------------
                                           Defaults: NZ*0
        ! ITOUT =  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0  !

       Specify which meteorological fields
       to print
       (used only if LPRINT=T)             Defaults: 0 (all variables)
       -----------------------


         Variable            Print ?
                         (0 = do not print,
                          1 = print)
         --------        ------------------

     !  STABILITY  =           0           ! - PGT stability class
     !  USTAR      =           0           ! - Friction velocity
     !  MONIN      =           0           ! - Monin-Obukhov length
     !  MIXHT      =           0           ! - Mixing height
     !  WSTAR      =           0           ! - Convective velocity scale
     !  PRECIP     =           0           ! - Precipitation rate
     !  SENSHEAT   =           0           ! - Sensible heat flux
     !  CONVZI     =           0           ! - Convective mixing ht.


       Testing and debug print options for micrometeorological module
```

```
         Print input meteorological data and
         internal variables (LDB)        Default: F       ! LDB = F !
         (F = Do not print, T = print)
         (NOTE: this option produces large amounts of output)

         First time step for which debug data
         are printed (NN1)               Default: 1       ! NN1 =  1  !

         Last time step for which debug data
         are printed (NN2)               Default: 1       ! NN2 =  1  !

         Print distance to land
         internal variables (LDBCST)     Default: F       ! LDBCST = F !
         (F = Do not print, T = print)
         (Output in .GRD file DCST.GRD, defined in input group 0)

      Testing and debug print options for wind field module
      (all of the following print options control output to
       wind field module's output files: TEST.PRT, TEST.OUT,
       TEST.KIN, TEST.FRD, and TEST.SLP)

         Control variable for writing the test/debug
         wind fields to disk files (IOUTD)
         (0=Do not write, 1=write)       Default: 0       ! IOUTD =  0  !

         Number of levels, starting at the surface,
         to print (NZPRN2)               Default: 1       ! NZPRN2 =  1  !

         Print the INTERPOLATED wind components ?
         (IPR0) (0=no, 1=yes)            Default: 0       !  IPR0 =  0  !

         Print the TERRAIN ADJUSTED surface wind
         components ?
         (IPR1) (0=no, 1=yes)            Default: 0       !  IPR1 =  0  !

         Print the SMOOTHED wind components and
         the INITIAL DIVERGENCE fields ?
         (IPR2) (0=no, 1=yes)            Default: 0       !  IPR2 =  0  !

         Print the FINAL wind speed and direction
         fields ?
         (IPR3) (0=no, 1=yes)            Default: 0       !  IPR3 =  0  !

         Print the FINAL DIVERGENCE fields ?
         (IPR4) (0=no, 1=yes)            Default: 0       !  IPR4 =  0  !

         Print the winds after KINEMATIC effects
         are added ?
         (IPR5) (0=no, 1=yes)            Default: 0       !  IPR5 =  0  !

         Print the winds after the FROUDE NUMBER
         adjustment is made ?
         (IPR6) (0=no, 1=yes)            Default: 0       !  IPR6 =  0  !

         Print the winds after SLOPE FLOWS
         are added ?
         (IPR7) (0=no, 1=yes)            Default: 0       !  IPR7 =  0  !

         Print the FINAL wind field components ?
         (IPR8) (0=no, 1=yes)            Default: 0       !  IPR8 =  0  !

!END!

-------------------------------------------------------------------------------

INPUT GROUP: 4 -- Meteorological data options
--------------

    NO OBSERVATION MODE             (NOOBS)  Default: 0     ! NOOBS =  0   !
          0 = Use surface, overwater, and upper air stations
          1 = Use surface and overwater stations (no upper air observations)
              Use MM4/MM5/3D.DAT for upper air data
          2 = No surface, overwater, or upper air observations
              Use MM4/MM5/3D.DAT for surface, overwater, and upper air data
```

```
    NUMBER OF SURFACE & PRECIP. METEOROLOGICAL STATIONS

       Number of surface stations   (NSSTA)  No default     ! NSSTA =  8  !

       Number of precipitation stations
       (NPSTA=-1: flag for use of MM5/3D.DAT precip data)
                                    (NPSTA)  No default     ! NPSTA =  0  !

    CLOUD DATA OPTIONS
       Gridded cloud fields:
                                   (ICLOUD)  Default: 0     ! ICLOUD =  0  !
       ICLOUD = 0 - Gridded clouds not used
       ICLOUD = 1 - Gridded CLOUD.DAT generated as OUTPUT
       ICLOUD = 2 - Gridded CLOUD.DAT read as INPUT
       ICLOUD = 3 - Gridded cloud cover from Prognostic Rel. Humidity
                    at 850mb (Teixera)
       ICLOUD = 4 - Gridded cloud cover from Prognostic Rel. Humidity
                    at all levels (MM5toGrads algorithm)

    FILE FORMATS

       Surface meteorological data file format
                                   (IFORMS)  Default: 2     ! IFORMS =  2  !
       (1 = unformatted (e.g., SMERGE output))
       (2 = formatted   (free-formatted user input))

       Precipitation data file format
                                   (IFORMP)  Default: 2     ! IFORMP =  2  !
       (1 = unformatted (e.g., PMERGE output))
       (2 = formatted   (free-formatted user input))

       Cloud data file format
                                   (IFORMC)  Default: 2     ! IFORMC =  2  !
       (1 = unformatted - CALMET unformatted output)
       (2 = formatted   - free-formatted CALMET output or user input)

!END!


--------------------------------------------------------------------------------

INPUT GROUP: 5 -- Wind Field Options and Parameters
--------------


    WIND FIELD MODEL OPTIONS
       Model selection variable (IWFCOD)     Default: 1      ! IWFCOD =  1  !
          0 = Objective analysis only
          1 = Diagnostic wind module

       Compute Froude number adjustment
       effects ? (IFRADJ)                    Default: 1      ! IFRADJ =  1  !
       (0 = NO, 1 = YES)

       Compute kinematic effects ? (IKINE)   Default: 0      ! IKINE  =  0  !
       (0 = NO, 1 = YES)

       Use O'Brien procedure for adjustment
       of the vertical velocity ? (IOBR)     Default: 0      ! IOBR =  0  !
       (0 = NO, 1 = YES)

       Compute slope flow effects ? (ISLOPE) Default: 1      ! ISLOPE  =  1  !
       (0 = NO, 1 = YES)

       Extrapolate surface wind observations
       to upper layers ? (IEXTRP)            Default: -4     ! IEXTRP = -4  !
       (1 = no extrapolation is done,
        2 = power law extrapolation used,
        3 = user input multiplicative factors
            for layers 2 - NZ used (see FEXTRP array)
        4 = similarity theory used
       -1, -2, -3, -4 = same as above except layer 1 data
            at upper air stations are ignored

       Extrapolate surface winds even
       if calm? (ICALM)                      Default: 0      ! ICALM  =  0  !
       (0 = NO, 1 = YES)
```

```
   Layer-dependent biases modifying the weights of
   surface and upper air stations (BIAS(NZ))
     -1<=BIAS<=1
   Negative BIAS reduces the weight of upper air stations
     (e.g. BIAS=-0.1 reduces the weight of upper air stations
   by 10%; BIAS= -1, reduces their weight by 100 %)
   Positive BIAS reduces the weight of surface stations
     (e.g. BIAS= 0.2 reduces the weight of surface stations
   by 20%; BIAS=1 reduces their weight by 100%)
   Zero BIAS leaves weights unchanged (1/R**2 interpolation)
   Default: NZ*0
                          ! BIAS =  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,
                          0  !

   Minimum distance from nearest upper air station
   to surface station for which extrapolation
   of surface winds at surface station will be allowed
   (RMIN2: Set to -1 for IEXTRP = 4 or other situations
    where all surface stations should be extrapolated)
                                      Default: 4.     ! RMIN2 = 1.0 !

   Use gridded prognostic wind field model
   output fields as input to the diagnostic
   wind field model (IPROG)           Default: 0      ! IPROG =  0  !
   (0 = No, [IWFCOD = 0 or 1]
    1 = Yes, use CSUMM prog. winds as Step 1 field, [IWFCOD = 0]
    2 = Yes, use CSUMM prog. winds as initial guess field [IWFCOD = 1]
    3 = Yes, use winds from MM4.DAT file as Step 1 field [IWFCOD = 0]
    4 = Yes, use winds from MM4.DAT file as initial guess field [IWFCOD = 1]
    5 = Yes, use winds from MM4.DAT file as observations [IWFCOD = 1]
    13 = Yes, use winds from MM5/3D.DAT file as Step 1 field [IWFCOD = 0]
    14 = Yes, use winds from MM5/3D.DAT file as initial guess field [IWFCOD = 1]
    15 = Yes, use winds from MM5/3D.DAT file as observations [IWFCOD = 1]

   Timestep (seconds) of the prognostic
   model input data   (ISTEPPGS)      Default: 3600   ! ISTEPPGS =  3600   !

   Use coarse CALMET fields as initial guess fields (IGFMET)
   (overwrites IGF based on prognostic wind fields if any)
                                      Default: 0      ! IGFMET =  0  !

RADIUS OF INFLUENCE PARAMETERS

   Use varying radius of influence    Default: F      ! LVARY =  F!
   (if no stations are found within RMAX1,RMAX2,
    or RMAX3, then the closest station will be used)

   Maximum radius of influence over land
   in the surface layer (RMAX1)       No default      ! RMAX1 = 0.2 !
                                      Units: km
   Maximum radius of influence over land
   aloft (RMAX2)                      No default      ! RMAX2 = 1. !
                                      Units: km
   Maximum radius of influence over water
   (RMAX3)                            No default      ! RMAX3 = 20. !
                                      Units: km


OTHER WIND FIELD INPUT PARAMETERS

   Minimum radius of influence used in
   the wind field interpolation (RMIN)  Default: 0.1  ! RMIN = 0.05 !
                                      Units: km
   Radius of influence of terrain
   features (TERRAD)                  No default      ! TERRAD = 0.1 !

                                      Units: km
   Relative weighting of the first
   guess field and observations in the
   SURFACE layer (R1)                 No default      ! R1 = 0.2 !
   (R1 is the distance from an        Units: km
   observational station at which the
   observation and first guess field are
   equally weighted)

   Relative weighting of the first
```

```
      guess field and observations in the
      layers ALOFT (R2)                      No default      ! R2 = 1. !
      (R2 is applied in the upper layers     Units: km
      in the same manner as R1 is used in
      the surface layer).

      Relative weighting parameter of the
      prognostic wind field data (RPROG)     No default      ! RPROG = 0. !
      (Used only if IPROG = 1)               Units: km
      ------------------------

      Maximum acceptable divergence in the
      divergence minimization procedure
      (DIVLIM)                               Default: 5.E-6  ! DIVLIM= 5.0E-06 !

      Maximum number of iterations in the
      divergence min. procedure (NITER)      Default: 50     ! NITER =  50  !

      Number of passes in the smoothing
      procedure (NSMTH(NZ))
      NOTE: NZ values must be entered
           Default: 2,(mxnz-1)*4 ! NSMTH =
 2 ,  4 ,  4 ,  4 ,  4 ,  4 ,  4 ,  4 ,  4 ,  4 ,  4 ,  4  !

      Maximum number of stations used in
      each layer for the interpolation of
      data to a grid point (NINTR2(NZ))
      NOTE: NZ values must be entered        Default: 99.    ! NINTR2 =
 5 ,  5 ,  5 ,  5 ,  5 ,  5 ,  5 ,  5 ,  5 ,  5  !

      Critical Froude number (CRITFN)        Default: 1.0    ! CRITFN = 1. !

      Empirical factor controlling the
      influence of kinematic effects
      (ALPHA)                                Default: 0.1    ! ALPHA = 0.1 !

      Multiplicative scaling factor for
      extrapolation of surface observations
      to upper layers (FEXTR2(NZ))           Default: NZ*0.0
      ! FEXTR2 = 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0. !
      (Used only if IEXTRP = 3 or -3)


   BARRIER INFORMATION

      Number of barriers to interpolation
      of the wind fields (NBAR)              Default: 0      ! NBAR =  0  !

      Level (1 to NZ) up to which barriers
      apply (KBAR)                           Default: NZ     ! KBAR =  12  !

      THE FOLLOWING 4 VARIABLES ARE INCLUDED
      ONLY IF NBAR > 0
      NOTE: NBAR values must be entered      No defaults
            for each variable                Units: km

         X coordinate of BEGINNING
         of each barrier (XBBAR(NBAR))       ! XBBAR = 0. !
         Y coordinate of BEGINNING
         of each barrier (YBBAR(NBAR))       ! YBBAR = 0. !

         X coordinate of ENDING
         of each barrier (XEBAR(NBAR))       ! XEBAR = 0. !
         Y coordinate of ENDING
         of each barrier (YEBAR(NBAR))       ! YEBAR = 0. !


   DIAGNOSTIC MODULE DATA INPUT OPTIONS

      Surface temperature (IDIOPT1)          Default: 0      ! IDIOPT1 =  0  !
         0 = Compute internally from
             hourly surface observations or prognostic fields
         1 = Read preprocessed values from
             a data file (DIAG.DAT)

         Surface met. station to use for
         the surface temperature (ISURFT)    Default: -1    ! ISURFT =  -1  !
```

```
          (Must be a value from 1 to NSSTA,
           or -1 to use 2-D spatially varying
              surface temperatures,
           or -2 to use a domain-average prognostic
              surface temperatures (only with ITPROG=2))
          (Used only if IDIOPT1 = 0)
          --------------------------

       Temperature lapse rate used in the    Default: 0     ! IDIOPT2 =  0  !
          computation of terrain-induced
          circulations (IDIOPT2)
          0 = Compute internally from (at least) twice-daily
              upper air observations or prognostic fields
          1 = Read hourly preprocessed values
              from a data file (DIAG.DAT)

          Upper air station to use for
          the domain-scale lapse rate (IUPT) Default: -1    ! IUPT   =  -1  !
          (Must be a value from 1 to NUSTA,
           or -1 to use 2-D spatially varying lapse rate,
           or -2 to use a domain-average prognostic
              lapse rate (only with ITPROG>0))
          (Used only if IDIOPT2 = 0)
          --------------------------

          Depth through which the domain-scale
          lapse rate is computed (ZUPT)      Default: 200.  ! ZUPT = 200. !
          (Used only if IDIOPT2 = 0)         Units: meters
          --------------------------

       Initial Guess Field Winds
       (IDIOPT3)                             Default: 0     ! IDIOPT3 =  0  !
          0 = Compute internally from
              observations or prognostic wind fields
          1 = Read hourly preprocessed domain-average wind values
              from a data file (DIAG.DAT)

          Upper air station to use for
          the initial guess winds (IUPWND)   Default: -1    ! IUPWND = -1  !
          (Must be a value from -1 to NUSTA, with
          -1 indicating 3-D initial guess fields,
          and IUPWND>1 domain-scaled (i.e. constant) IGF)
          (Used only if IDIOPT3 = 0 and noobs=0)
          --------------------------------------

          Bottom and top of layer through
          which the domain-scale winds
          are computed
          (ZUPWND(1), ZUPWND(2))       Defaults: 1., 1000. ! ZUPWND= 1., 1000. !
          (Used only if IDIOPT3 = 0, NOOBS>0 and IUPWND>0)    Units: meters
          --------------------------

       Observed surface wind components
       for wind field module (IDIOPT4)  Default: 0     ! IDIOPT4 =  0  !
          0 = Read WS, WD from a surface
              data file (SURF.DAT)
          1 = Read hourly preprocessed U, V from
              a data file (DIAG.DAT)

       Observed upper air wind components
       for wind field module (IDIOPT5)  Default: 0     ! IDIOPT5 =  0  !
          0 = Read WS, WD from an upper
              air data file (UP1.DAT, UP2.DAT, etc.)
          1 = Read hourly preprocessed U, V from
              a data file (DIAG.DAT)

       LAKE BREEZE INFORMATION

          Use Lake Breeze Module  (LLBREZE)
                                          Default: F      ! LLBREZE = F !

           Number of lake breeze regions (NBOX)           ! NBOX =  0  !

        X Grid line 1 defining the region of interest
                                                     ! XG1 = 0. !
        X Grid line 2 defining the region of interest
                                                     ! XG2 = 0. !
```

```
        Y Grid line 1 defining the region of interest
                                                  ! YG1 = 0. !
        Y Grid line 2 defining the region of interest
                                                  ! YG2 = 0. !

         X Point defining the coastline (Straight line)
                   (XBCST)  (KM)   Default: none    ! XBCST = 0. !

         Y Point defining the coastline (Straight line)
                   (YBCST)  (KM)   Default: none    ! YBCST = 0. !

         X Point defining the coastline (Straight line)
                   (XECST)  (KM)   Default: none    ! XECST = 0. !

         Y Point defining the coastline (Straight line)
                   (YECST)  (KM)   Default: none    ! YECST = 0. !


       Number of stations in the region     Default: none ! NLB =  0 !
       (Surface stations + upper air stations)

       Station ID's  in the region   (METBXID(NLB))
       (Surface stations first, then upper air stations)
         ! METBXID =  0 !

!END!


-------------------------------------------------------------------------------

INPUT GROUP: 6 -- Mixing Height, Temperature and Precipitation Parameters
--------------

    EMPIRICAL MIXING HEIGHT CONSTANTS

       Neutral, mechanical equation
       (CONSTB)                             Default: 1.41    ! CONSTB = 1.41 !
       Convective mixing ht. equation
       (CONSTE)                             Default: 0.15    ! CONSTE = 0.15 !
       Stable mixing ht. equation
       (CONSTN)                             Default: 2400.   ! CONSTN = 2400.!
       Overwater mixing ht. equation
       (CONSTW)                             Default: 0.16    ! CONSTW = 0.16 !
       Absolute value of Coriolis
       parameter (FCORIOL)                  Default: 1.E-4   ! FCORIOL = 1.0E-04!
                                            Units: (1/s)

    SPATIAL AVERAGING OF MIXING HEIGHTS

       Conduct spatial averaging
       (IAVEZI)  (0=no, 1=yes)              Default: 1       ! IAVEZI =  1  !

       Max. search radius in averaging
       process (MNMDAV)                     Default: 1       ! MNMDAV =  1  !
                                            Units: Grid
                                                   cells
       Half-angle of upwind looking cone
       for averaging (HAFANG)               Default: 30.     ! HAFANG = 30. !
                                            Units: deg.
       Layer of winds used in upwind
       averaging (ILEVZI)                   Default: 1       ! ILEVZI =  1  !
       (must be between 1 and NZ)


    CONVECTIVE MIXING HEIGHT OPTIONS:
       Method to compute the convective
       mixing height(IMIHXH)                Default: 1       ! IMIXH =  1  !
           1: Maul-Carson for land and water cells
          -1: Maul-Carson for land cells only -
              OCD mixing height overwater
           2: Batchvarova and Gryning for land and water cells
          -2: Batchvarova and Gryning for land cells only
              OCD mixing height overwater

       Threshold buoyancy flux required to
       sustain convective mixing height growth
       overland (THRESHL)                   Default: 0.0     ! THRESHL = 0. !
```

```
      (expressed as a heat flux           units: W/m3
       per meter of boundary layer)


      Threshold buoyancy flux required to
      sustain convective mixing height growth
      overwater (THRESHW)                 Default: 0.05    ! THRESHW = 0.05 !
      (expressed as a heat flux           units: W/m3
       per meter of boundary layer)


      Flag to allow relaxation of convective mixing height
      to equilibrium value when  0<QH<THRESHL (overland)
                              or  0<QH<THRESHW (overwater)
      (IZICRLX)                           Default: 1       ! IZICRLX =  1  !
         0 : do NOT use convective mixing height relaxation
             to equilibrium value (treatment identical to CALMET v5.8)
         1 : use convective mixing height relaxation
             to equilibrium value


      Relaxation time of convective mixing height to
      equilibrium value when  0<QH<THRESHL (overland)
                           or  0<QH<THRESHW (overwater)
      (Used only if IZICRLX = 1 and  TZICRLX must be >= 1.)
      (TZICRLX)                           Default: 800.    ! TZICRLX = 800. !
                                          Units: seconds


      Option for overwater lapse rates used
      in convective mixing height growth
      (ITWPROG)                           Default: 0       ! ITWPROG =  0  !
      0 : use SEA.DAT lapse rates and deltaT (or assume neutral
          conditions if missing)
      1 : use prognostic lapse rates (only if IPROG>2)
          and SEA.DAT deltaT (or neutral if missing)
      2 : use prognostic lapse rates and prognostic delta T
          (only if iprog>12 and 3D.DAT version# 2.0 or higher)

      Land Use category ocean in 3D.DAT datasets
      (ILUOC3D)                           Default: 16      ! ILUOC3D =  16  !
      Note: if 3D.DAT from MM5 version 3.0, iluoc3d = 16
            if MM4.DAT,           typically iluoc3d = 7


   OTHER MIXING HEIGHT VARIABLES

      Minimum potential temperature lapse
      rate in the stable layer above the
      current convective mixing ht.       Default: 0.001   ! DPTMIN = 0.001 !
      (DPTMIN)                            Units: deg. K/m
      Depth of layer above current conv.
      mixing height through which lapse   Default: 200.    ! DZZI = 200. !
      rate is computed (DZZI)             Units: meters

      Minimum overland mixing height      Default:  50.    ! ZIMIN = 50. !
      (ZIMIN)                             Units: meters
      Maximum overland mixing height      Default: 3000.   ! ZIMAX = 3000. !
      (ZIMAX)                             Units: meters
      Minimum overwater mixing height     Default:   50.   ! ZIMINW = 50. !
      (ZIMINW) -- (Not used if observed   Units: meters
      overwater mixing hts. are used)
      Maximum overwater mixing height     Default: 3000.   ! ZIMAXW = 3000. !
      (ZIMAXW) -- (Not used if observed   Units: meters
      overwater mixing hts. are used)


   OVERWATER SURFACE FLUXES METHOD and PARAMETERS
         (ICOARE)                         Default: 10      ! ICOARE =  10   !
           0: original deltaT method (OCD)
          10: COARE with no wave parameterization (jwave=0, Charnock)
          11: COARE with wave option jwave=1 (Oost et al.)
              and default wave properties
         -11: COARE with wave option jwave=1 (Oost et al.)
              and observed wave properties (must be in SEA.DAT files)
          12: COARE with wave option 2 (Taylor and Yelland)
               and default wave properties
```

```
         -12: COARE with wave option 2 (Taylor and Yelland)
              and observed wave properties (must be in SEA.DAT files)

          Note:  When ICOARE=0, similarity wind profile stability PSI functions
                 based on Van Ulden and Holtslag (1985) are substituted for
                 later formulations used with the COARE module, and temperatures
                 used for surface layer parameters are obtained from either the
                 nearest surface station temperature or prognostic model 2D
                 temperatures (if ITPROG=2).


          Coastal/Shallow water length scale (DSHELF)
          (for modified z0 in shallow water)
          ( COARE fluxes only)
                                         Default : 0.         ! DSHELF = 0. !
                                         units: km

           COARE warm layer computation (IWARM)               ! IWARM =  0    !
           1: on - 0: off (must be off if SST measured with
           IR radiometer)                Default: 0

           COARE cool skin layer computation (ICOOL)          ! ICOOL =  0    !
           1: on - 0: off (must be off if SST measured with
           IR radiometer)                Default: 0

    RELATIVE HUMIDITY PARAMETERS

       3D relative humidity from observations or
       from prognostic data? (IRHPROG)      Default:0         ! IRHPROG =  0    !

          0 = Use RH from SURF.DAT file
              (only if NOOBS = 0,1)
          1 = Use prognostic RH
              (only if NOOBS = 0,1,2)

    TEMPERATURE PARAMETERS

       3D temperature from observations or
       from prognostic data? (ITPROG)       Default:0         ! ITPROG =  0    !

          0 = Use Surface and upper air stations
              (only if NOOBS = 0)
          1 = Use Surface stations (no upper air observations)
              Use MM5/3D.DAT for upper air data
              (only if NOOBS = 0,1)
          2 = No surface or upper air observations
              Use MM5/3D.DAT for surface and upper air data
              (only if NOOBS = 0,1,2)

       Interpolation type
       (1 = 1/R ; 2 = 1/R**2)              Default:1          ! IRAD =  1  !

       Radius of influence for temperature
       interpolation (TRADKM)              Default: 500.      ! TRADKM = 20. !
                                           Units: km

       Maximum Number of stations to include
       in temperature interpolation (NUMTS) Default: 5        ! NUMTS = 5  !

       Conduct spatial averaging of temp-
       eratures (IAVET)  (0=no, 1=yes)      Default: 1        ! IAVET =  1  !
       (will use mixing ht MNMDAV,HAFANG
        so make sure they are correct)

       Default temperature gradient         Default: -.0098   ! TGDEFB = -0.0098 !
       below the mixing height over         Units: K/m
       water (TGDEFB)

       Default temperature gradient         Default: -.0045   ! TGDEFA = -0.0045 !
       above the mixing height over         Units: K/m
       water (TGDEFA)

       Beginning (JWAT1) and ending (JWAT2)
       land use categories for temperature                    ! JWAT1 =  55  !
       interpolation over water -- Make                       ! JWAT2 =  55  !
       bigger than largest land use to disable
```

```
   PRECIP INTERPOLATION PARAMETERS

       Method of interpolation (NFLAGP)      Default: 2        ! NFLAGP =  2  !
        (1=1/R,2=1/R**2,3=EXP/R**2)
       Radius of Influence  (SIGMAP)         Default: 100.0    ! SIGMAP = 100. !
        (0.0 => use half dist. btwn          Units: km
         nearest stns w & w/out
         precip when NFLAGP = 3)
       Minimum Precip. Rate Cutoff (CUTP)    Default: 0.01     ! CUTP = 0.01 !
        (values < CUTP = 0.0 mm/hr)          Units: mm/hr
!END!

-------------------------------------------------------------------------------

INPUT GROUP: 7 -- Surface meteorological station parameters
--------------

     SURFACE STATION VARIABLES
     (One record per station --  8  records in all)


             1     2
         Name   ID            X coord.   Y coord.   Time   Anem.
                               (km)       (km)      zone   Ht.(m)
       ----------------------------------------------------------
! SS1  ='530'   54321      308.563      5421.209    12     10  !
! SS2  ='230'   54322      309.321      5423.998    12     10  !
! SS3  ='710'   54323      309.244      5421.738    12     10  !
! SS4  ='KELB'  54324      313.090      5427.195    12     10  !
! SS5  ='AERO'  54325      316.208      5423.171    12     10  !
! SS6  ='ISLA'  54326      313.220      5420.872    12     10  !
! SS7  ='KOWH'  54327      311.869      5424.114    12     10  !
! SS8  ='LFIL'  54328      311.328          5422.887    12     10  !
-------------------
      1
        Four character string for station name
        (MUST START IN COLUMN 9)

      2
        Six digit integer for station ID

!END!

-------------------------------------------------------------------------------

INPUT GROUP: 8 -- Upper air meteorological station parameters
--------------

     UPPER AIR STATION VARIABLES
     (One record per station --  1  records in all)

             1     2
         Name    ID     X coord.   Y coord.  Time zone
                          (km)       (km)
         --------------------------------------------
! US1  ='LFIL'  54321   311.328      5422.887     12  !
-------------------
      1
        Four character string for station name
        (MUST START IN COLUMN 9)

      2
        Five digit integer for station ID

!END!

-------------------------------------------------------------------------------

INPUT GROUP: 9 -- Precipitation station parameters
--------------

     PRECIPITATION STATION VARIABLES
     (One record per station --  0  records in all)
     (NOT INCLUDED IF NPSTA = 0)
```

```
      1          2
    Name   Station    X coord.  Y coord.
             Code       (km)      (km)
    ------------------------------------


-------------------
      1
        Four character string for station name
        (MUST START IN COLUMN 9)

      2
        Six digit station code composed of state
        code (first 2 digits) and station ID (last
        4 digits)

!END!
```

```
CALPUFF.INP     2.0             File version record
Assessment of Odours from Southern landfill
Stage 4 Extension

---------------- Run title (3 lines) ------------------------------------------

                     CALPUFF MODEL CONTROL FILE
                     --------------------------

-------------------------------------------------------------------------------

INPUT GROUP: 0 -- Input and Output File Names

--------------
Default Name  Type          File Name
------------  ----          ---------
CALMET.DAT    input    ! METDAT =CALMET4.DAT    !
    or
ISCMET.DAT    input    * ISCDAT =               *
    or
PLMMET.DAT    input    * PLMDAT =               *
    or
PROFILE.DAT   input    * PRFDAT =               *
SURFACE.DAT   input    * SFCDAT =               *
RESTARTB.DAT  input    * RSTARTB=               *
--------------------------------------------------------------------------------
CALPUFF.LST   output   ! PUFLST =CALPUFF4.LST  !
CONC.DAT      output   ! CONDAT =CALPUFF4.CON  !
DFLX.DAT      output   * DFDAT  =               *
WFLX.DAT      output   * WFDAT  =               *

VISB.DAT      output   * VISDAT =               *
TK2D.DAT      output   * T2DDAT =               *
RHO2D.DAT     output   * RHODAT =               *
RESTARTE.DAT  output   * RSTARTE=               *
--------------------------------------------------------------------------------
Emission Files
--------------
PTEMARB.DAT   input    * PTDAT  =               *
VOLEMARB.DAT  input    * VOLDAT =               *
BAEMARB.DAT   input    * ARDAT  =               *
LNEMARB.DAT   input    * LNDAT  =               *
--------------------------------------------------------------------------------
Other Files
-----------
OZONE.DAT     input    * OZDAT  =               *
VD.DAT        input    * VDDAT  =               *
CHEM.DAT      input    * CHEMDAT=               *
AUX           input    * AUXEXT =               *
(Extension added to METDAT filename(s) for files
 with auxiliary 2D and 3D data)
H2O2.DAT      input    * H2O2DAT=               *
NH3Z.DAT      input    * NH3ZDAT=               *
HILL.DAT      input    * HILDAT=               *
HILLRCT.DAT   input    * RCTDAT=               *
COASTLN.DAT   input    * CSTDAT=               *
FLUXBDY.DAT   input    * BDYDAT=               *
BCON.DAT      input    * BCNDAT=               *
DEBUG.DAT     output   * DEBUG =               *
MASSFLX.DAT   output   * FLXDAT=               *
MASSBAL.DAT   output   * BALDAT=               *
FOG.DAT       output   * FOGDAT=               *
RISE.DAT      output   * RISDAT=               *
--------------------------------------------------------------------------------
All file names will be converted to lower case if LCFILES = T
Otherwise, if LCFILES = F, file names will be converted to UPPER CASE
         T = lower case      ! LCFILES = F !
         F = UPPER CASE
NOTE: (1) file/path names can be up to 132 characters in length


Provision for multiple input files
----------------------------------

     Number of Modeling Domains (NMETDOM)
                                Default: 1       ! NMETDOM =   1   !
```

```
     Number of CALMET.DAT files for run (NMETDAT)
                                    Default: 1       ! NMETDAT =   1   !

     Number of PTEMARB.DAT files for run (NPTDAT)
                                    Default: 0       ! NPTDAT =   0   !

     Number of BAEMARB.DAT files for run (NARDAT)
                                    Default: 0       ! NARDAT =   0   !

     Number of VOLEMARB.DAT files for run (NVOLDAT)
                                    Default: 0       ! NVOLDAT =   0   !

!END!

-------------
Subgroup (0a)
-------------

  Provide a name for each CALMET domain if NMETDOM > 1
  Enter NMETDOM lines.
                                         a,b
Default Name              Domain Name
------------              ------------
 none                   * DOMAIN1=      *    *END*
 none                   * DOMAIN2=      *    *END*
 none                   * DOMAIN3=      *    *END*


  The following CALMET.DAT filenames are processed in sequence
  if NMETDAT > 1

  Enter NMETDAT lines, 1 line for each file name.

                                          a,c,d
Default Name  Type           File Name
------------  ----           ---------
 none                   * DOMAIN1=      *    *END*


-------------
     a
      The name for each CALMET domain and each CALMET.DAT file is treated
      as a separate input subgroup and therefore must end with an input
      group terminator.
     b
      Use DOMAIN1= to assign the name for the outermost CALMET domain.
      Use DOMAIN2= to assign the name for the next inner CALMET domain.
      Use DOMAIN3= to assign the name for the next inner CALMET domain, etc.
      --------------------------------------------------------------------
       |   When inner domains with equal resolution (grid-cell size)      |
       |   overlap, the data from the FIRST such domain in the list will  |
       |   be used if all other criteria for choosing the controlling     |
       |   grid domain are inconclusive.                                  |
      --------------------------------------------------------------------
     c
      Use METDAT1= to assign the file names for the outermost CALMET domain.
      Use METDAT2= to assign the file names for the next inner CALMET domain.
      Use METDAT3= to assign the file names for the next inner CALMET domain, etc.
     d
      The filenames for each domain must be provided in sequential order

-------------
Subgroup (0b)
-------------

  The following PTEMARB.DAT filenames are processed if NPTDAT>0
  (Each file contains a subset of the sources, for the entire simulation)

Default Name  Type           File Name
------------  ----           ---------
 none         input       * PTDAT=      *    *END*


-------------
Subgroup (0c)
-------------
```

```
  The following BAEMARB.DAT filenames are processed if NARDAT>0
  (Each file contains a subset of the sources, for the entire simulation)

Default Name  Type          File Name
------------  ----          ---------
 none         input       * ARDAT=     *    *END*


-------------
Subgroup (0d)
-------------

  The following VOLEMARB.DAT filenames are processed if NVOLDAT>0
  (Each file contains a subset of the sources, for the entire simulation)

Default Name  Type          File Name
------------  ----          ---------
 none         input       * VOLDAT=     *    *END*


--------------------------------------------------------------------------------

INPUT GROUP: 1 -- General run control parameters
--------------

    Option to run all periods found
    in the met. file     (METRUN)   Default: 0       ! METRUN =   1  !

         METRUN = 0 - Run period explicitly defined below
         METRUN = 1 - Run all periods in met. file

     Starting date:    Year   (IBYR)  --    No default   ! IBYR  =  2007  !
                       Month  (IBMO)  --    No default   ! IBMO  =  1  !
                       Day    (IBDY)  --    No default   ! IBDY  =  4  !
     Starting time:    Hour   (IBHR)  --    No default   ! IBHR  =  22  !
                       Minute (IBMIN) --    No default   ! IBMIN =  0  !
                       Second (IBSEC) --    No default   ! IBSEC =  0  !

     Ending date:      Year   (IEYR)  --    No default   ! IEYR  =  2007  !
                       Month  (IEMO)  --    No default   ! IEMO  =  1  !
                       Day    (IEDY)  --    No default   ! IEDY  =  5  !
     Ending time:      Hour   (IEHR)  --    No default   ! IEHR  =  23  !
                       Minute (IEMIN) --    No default   ! IEMIN =  0  !
                       Second (IESEC) --    No default   ! IESEC =  0  !

     (These are only used if METRUN = 0)

     Base time zone:          (ABTZ)  --    No default   ! ABTZ= UTC+1200 !
      (character*8)
     The modeling domain may span multiple time zones.  ABTZ defines the
     base time zone used for the entire simulation.  This must match the
     base time zone of the meteorological data.
     Examples:
         Los Angeles, USA          = UTC-0800
         New York, USA             = UTC-0500
         Santiago, Chile           = UTC-0400
         Greenwich Mean Time (GMT) = UTC+0000
         Rome, Italy               = UTC+0100
         Cape Town, S.Africa       = UTC+0200
         Sydney, Australia         = UTC+1000

     Length of modeling time-step (seconds)
     Equal to update period in the primary
     meteorological data files, or an
     integer fraction of it (1/2, 1/3 ...)
     Must be no larger than 1 hour
     (NSECDT)                        Default:3600      ! NSECDT =  3600  !
                                     Units: seconds

     Number of chemical species (NSPEC)
                                     Default: 5        ! NSPEC =  1   !

     Number of chemical species
     to be emitted  (NSE)            Default: 3        ! NSE =  1   !

     Flag to stop run after
     SETUP phase (ITEST)             Default: 2        ! ITEST =  2   !
```

```
     (Used to allow checking
     of the model inputs, files, etc.)
           ITEST = 1 - STOPS program after SETUP phase
           ITEST = 2 - Continues with execution of program
                       after SETUP

     Restart Configuration:

        Control flag (MRESTART)      Default: 0       ! MRESTART =  0   !

           0 = Do not read or write a restart file
           1 = Read a restart file at the beginning of
               the run
           2 = Write a restart file during run
           3 = Read a restart file at beginning of run
               and write a restart file during run

        Number of periods in Restart
        output cycle (NRESPD)        Default: 0       ! NRESPD =  0   !

           0 = File written only at last period
          >0 = File updated every NRESPD periods

     Meteorological Data Format (METFM)
                                     Default: 1       ! METFM =  1   !

           METFM = 1 - CALMET binary file (CALMET.MET)
           METFM = 2 - ISC ASCII file (ISCMET.MET)
           METFM = 3 - AUSPLUME ASCII file (PLMMET.MET)
           METFM = 4 - CTDM plus tower file (PROFILE.DAT) and
                       surface parameters file (SURFACE.DAT)
           METFM = 5 - AERMET tower file (PROFILE.DAT) and
                       surface parameters file (SURFACE.DAT)

     Meteorological Profile Data Format (MPRFFM)
            (used only for METFM = 1, 2, 3)
                                     Default: 1       ! MPRFFM =  1   !

           MPRFFM = 1 - CTDM plus tower file (PROFILE.DAT)
           MPRFFM = 2 - AERMET tower file (PROFILE.DAT)

     PG sigma-y is adjusted by the factor (AVET/PGTIME)**0.2
     Averaging Time (minutes) (AVET)
                                     Default: 60.0    ! AVET = 60. !
     PG Averaging Time (minutes) (PGTIME)
                                     Default: 60.0    ! PGTIME = 60. !


     Output units for binary concentration and flux files
     written in Dataset v2.2 or later formats
     (IOUTU)                         Default: 1       ! IOUTU =  2   !
         1 = mass       -  g/m3 (conc) or g/m2/s (dep)
         2 = odour      -  odour_units (conc)
         3 = radiation  -  Bq/m3 (conc) or Bq/m2/s (dep)


     Output Dataset format for binary concentration
     and flux files (e.g., CONC.DAT)
     (IOVERS)                        Default: 2       ! IOVERS =  2   !
         1 = Dataset Version 2.1
         2 = Dataset Version 2.2


!END!


-------------------------------------------------------------------------------

INPUT GROUP: 2 -- Technical options
--------------


     Vertical distribution used in the
     near field (MGAUSS)                   Default: 1     ! MGAUSS =  1   !
        0 = uniform
        1 = Gaussian
```

```
Terrain adjustment method
(MCTADJ)                            Default: 3     ! MCTADJ =  3   !
   0 = no adjustment
   1 = ISC-type of terrain adjustment
   2 = simple, CALPUFF-type of terrain
       adjustment
   3 = partial plume path adjustment

Subgrid-scale complex terrain
flag (MCTSG)                        Default: 0     ! MCTSG =  0   !
   0 = not modeled
   1 = modeled

Near-field puffs modeled as
elongated slugs? (MSLUG)            Default: 0     ! MSLUG =  0   !
   0 = no
   1 = yes (slug model used)

Transitional plume rise modeled?
(MTRANS)                            Default: 1     ! MTRANS =  1   !
   0 = no  (i.e., final rise only)
   1 = yes (i.e., transitional rise computed)

Stack tip downwash? (MTIP)          Default: 1     ! MTIP =  0  !
   0 = no  (i.e., no stack tip downwash)
   1 = yes (i.e., use stack tip downwash)

Method used to compute plume rise for
point sources not subject to building
downwash? (MRISE)                   Default: 1     ! MRISE =  1  !
   1 = Briggs plume rise
   2 = Numerical plume rise

Method used to simulate building
downwash? (MBDW)                    Default: 1     ! MBDW =  1  !
   1 = ISC method
   2 = PRIME method

Vertical wind shear modeled above
stack top (modified Briggs plume rise)?
(MSHEAR)                            Default: 0     ! MSHEAR =  0  !
   0 = no  (i.e., vertical wind shear not modeled)
   1 = yes (i.e., vertical wind shear modeled)

Puff splitting allowed? (MSPLIT)    Default: 0     ! MSPLIT =  0  !
   0 = no (i.e., puffs not split)
   1 = yes (i.e., puffs are split)

Chemical mechanism flag (MCHEM)     Default: 1     ! MCHEM =  0   !
   0 = chemical transformation not
       modeled
   1 = transformation rates computed
       internally (MESOPUFF II scheme)
   2 = user-specified transformation
       rates used
   3 = transformation rates computed
       internally (RIVAD/ARM3 scheme)
   4 = secondary organic aerosol formation
       computed (MESOPUFF II scheme for OH)
   5 = user-specified half-life with or
       without transfer to child species
   6 = transformation rates computed
       internally (Updated RIVAD scheme with
       ISORROPIA equilibrium)
   7 = transformation rates computed
       internally (Updated RIVAD scheme with
       ISORROPIA equilibrium and CalTech SOA)

Aqueous phase transformation flag (MAQCHEM)
(Used only if MCHEM = 6, or 7)      Default: 0     ! MAQCHEM =  0   !
   0 = aqueous phase transformation
       not modeled
   1 = transformation rates and wet
       scavenging coefficients adjusted
       for in-cloud aqueous phase reactions
       (adapted from RADM cloud model
        implementation in CMAQ/SCICHEM)
```

```
Liquid Water Content flag (MLWC)
(Used only if MAQCHEM = 1)           Default: 1     ! MLWC =  1   !
   0 = water content estimated from cloud cover
       and presence of precipitation
   1 = gridded cloud water data read from CALMET
       water content output files (filenames are
       the CALMET.DAT names PLUS the extension
       AUXEXT provided in Input Group 0)

Wet removal modeled ? (MWET)         Default: 1     ! MWET =  0   !
   0 = no
   1 = yes

Dry deposition modeled ? (MDRY)      Default: 1     ! MDRY =  0   !
   0 = no
   1 = yes
   (dry deposition method specified
    for each species in Input Group 3)


Gravitational settling (plume tilt)
modeled ? (MTILT)                    Default: 0     ! MTILT =  0   !
   0 = no
   1 = yes
   (puff center falls at the gravitational
    settling velocity for 1 particle species)

Restrictions:
    - MDRY  = 1
    - NSPEC = 1  (must be particle species as well)
    - sg    = 0  GEOMETRIC STANDARD DEVIATION in Group 8 is
                 set to zero for a single particle diameter

Method used to compute dispersion
coefficients (MDISP)                 Default: 3     ! MDISP =  3   !

   1 = dispersion coefficients computed from measured values
       of turbulence, sigma v, sigma w
   2 = dispersion coefficients from internally calculated
       sigma v, sigma w using micrometeorological variables
       (u*, w*, L, etc.)
   3 = PG dispersion coefficients for RURAL areas (computed using
       the ISCST multi-segment approximation) and MP coefficients in
       urban areas
   4 = same as 3 except PG coefficients computed using
       the MESOPUFF II eqns.
   5 = CTDM sigmas used for stable and neutral conditions.
       For unstable conditions, sigmas are computed as in
       MDISP = 3, described above.  MDISP = 5 assumes that
       measured values are read

Sigma-v/sigma-theta, sigma-w measurements used? (MTURBVW)
(Used only if MDISP = 1 or 5)        Default: 3     ! MTURBVW =  3  !
   1 = use sigma-v or sigma-theta measurements
       from PROFILE.DAT to compute sigma-y
       (valid for METFM = 1, 2, 3, 4, 5)
   2 = use sigma-w measurements
       from PROFILE.DAT to compute sigma-z
       (valid for METFM = 1, 2, 3, 4, 5)
   3 = use both sigma-(v/theta) and sigma-w
       from PROFILE.DAT to compute sigma-y and sigma-z
       (valid for METFM = 1, 2, 3, 4, 5)
   4 = use sigma-theta measurements
       from PLMMET.DAT to compute sigma-y
       (valid only if METFM = 3)

Back-up method used to compute dispersion
when measured turbulence data are
missing (MDISP2)                     Default: 3     ! MDISP2 =  3  !
(used only if MDISP = 1 or 5)
   2 = dispersion coefficients from internally calculated
       sigma v, sigma w using micrometeorological variables
       (u*, w*, L, etc.)
   3 = PG dispersion coefficients for RURAL areas (computed using
       the ISCST multi-segment approximation) and MP coefficients in
       urban areas
```

```
        4 = same as 3 except PG coefficients computed using
            the MESOPUFF II eqns.

     [DIAGNOSTIC FEATURE]
     Method used for Lagrangian timescale for Sigma-y
     (used only if MDISP=1,2 or MDISP2=1,2)
     (MTAULY)                        Default: 0     ! MTAULY =  0  !
        0 = Draxler default 617.284 (s)
        1 = Computed as Lag. Length / (.75 q) -- after SCIPUFF
       10 < Direct user input (s)             -- e.g., 306.9


     [DIAGNOSTIC FEATURE]
     Method used for Advective-Decay timescale for Turbulence
     (used only if MDISP=2 or MDISP2=2)
     (MTAUADV)                       Default: 0     ! MTAUADV =  0  !
        0 = No turbulence advection
        1 = Computed (OPTION NOT IMPLEMENTED)
       10 < Direct user input (s)   -- e.g., 800


     Method used to compute turbulence sigma-v &
     sigma-w using micrometeorological variables
     (Used only if MDISP = 2 or MDISP2 = 2)
     (MCTURB)                        Default: 1     ! MCTURB =  1  !
        1 = Standard CALPUFF subroutines
        2 = AERMOD subroutines

     PG sigma-y,z adj. for roughness?     Default: 0     ! MROUGH =  0  !
     (MROUGH)
        0 = no
        1 = yes

     Partial plume penetration of         Default: 1     ! MPARTL =  1  !
     elevated inversion modeled for
     point sources?
     (MPARTL)
        0 = no
        1 = yes

     Partial plume penetration of         Default: 1     ! MPARTLBA =  1  !
     elevated inversion modeled for
     buoyant area sources?
     (MPARTLBA)
        0 = no
        1 = yes

     Strength of temperature inversion    Default: 0     ! MTINV =  0  !
     provided in PROFILE.DAT extended records?
     (MTINV)
        0 = no (computed from measured/default gradients)
        1 = yes

     PDF used for dispersion under convective conditions?
                                      Default: 0     ! MPDF =  0  !
     (MPDF)
        0 = no
        1 = yes

     Sub-Grid TIBL module used for shore line?
                                      Default: 0     ! MSGTIBL = 0  !
     (MSGTIBL)
        0 = no
        1 = yes

     Boundary conditions (concentration) modeled?
                                      Default: 0     ! MBCON = 0  !
     (MBCON)
        0 = no
        1 = yes, using formatted BCON.DAT file
        2 = yes, using unformatted CONC.DAT file

     Note:  MBCON > 0 requires that the last species modeled
            be 'BCON'.  Mass is placed in species BCON when
            generating boundary condition puffs so that clean
            air entering the modeling domain can be simulated
            in the same way as polluted air.  Specify zero
```

```
            emission of species BCON for all regular sources.

     Individual source contributions saved?
                                          Default: 0     ! MSOURCE = 0  !
     (MSOURCE)
        0 = no
        1 = yes


     Analyses of fogging and icing impacts due to emissions from
     arrays of mechanically-forced cooling towers can be performed
     using CALPUFF in conjunction with a cooling tower emissions
     processor (CTEMISS) and its associated postprocessors.  Hourly
     emissions of water vapor and temperature from each cooling tower
     cell are computed for the current cell configuration and ambient
     conditions by CTEMISS. CALPUFF models the dispersion of these
     emissions and provides cloud information in a specialized format
     for further analysis. Output to FOG.DAT is provided in either
     'plume mode' or 'receptor mode' format.

     Configure for FOG Model output?
                                          Default: 0     ! MFOG =  0   !
     (MFOG)
        0 = no
        1 = yes  - report results in PLUME Mode format
        2 = yes  - report results in RECEPTOR Mode format


     Test options specified to see if
     they conform to regulatory
     values? (MREG)                       Default: 1     ! MREG =  0   !

        0 = NO checks are made
        1 = Technical options must conform to USEPA
            Long Range Transport (LRT) guidance
                       METFM    1 or 2
                       AVET     60. (min)
                       PGTIME   60. (min)
                       MGAUSS   1
                       MCTADJ   3
                       MTRANS   1
                       MTIP     1
                       MRISE    1
                       MCHEM    1 or 3 (if modeling SOx, NOx)
                       MWET     1
                       MDRY     1
                       MDISP    2 or 3
                       MPDF     0 if MDISP=3
                                1 if MDISP=2
                       MROUGH   0
                       MPARTL   1
                       MPARTLBA 0
                       SYTDEP   550. (m)
                       MHFTSZ   0
                       SVMIN    0.5 (m/s)


!END!


-------------------------------------------------------------------------------

INPUT GROUP: 3a, 3b -- Species list
-------------------

------------
Subgroup (3a)
------------

  The following species are modeled:

! CSPEC =          ODOR !          !END!

                                                        Dry                  OUTPUT GROUP
    SPECIES          MODELED           EMITTED        DEPOSITED                 NUMBER
     NAME        (0=NO, 1=YES)     (0=NO, 1=YES)     (0=NO,                   (0=NONE,
   (Limit: 12                                          1=COMPUTED-GAS          1=1st CGRUP,
```

```
    Characters                                              2=COMPUTED-PARTICLE    2=2nd CGRUP,
    in length)                                              3=USER-SPECIFIED)      3= etc.)

!         ODOR  =         1,              1,            0,                 0   !

!END!

  Note:  The last species in (3a) must be 'BCON' when using the
         boundary condition option (MBCON > 0).  Species BCON should
         typically be modeled as inert (no chem transformation or
         removal).


-------------
Subgroup (3b)
-------------
  The following names are used for Species-Groups in which results
  for certain species are combined (added) prior to output.  The
  CGRUP name will be used as the species name in output files.
  Use this feature to model specific particle-size distributions
  by treating each size-range as a separate species.
  Order must be consistent with 3(a) above.



-------------------------------------------------------------------------------


INPUT GROUP: 4 -- Map Projection and Grid control parameters
--------------

     Projection for all (X,Y):
     -------------------------

     Map projection
     (PMAP)                      Default: UTM     ! PMAP = UTM  !

         UTM :  Universal Transverse Mercator
         TTM :  Tangential Transverse Mercator
         LCC :  Lambert Conformal Conic
          PS :  Polar Stereographic
          EM :  Equatorial Mercator
        LAZA :  Lambert Azimuthal Equal Area

     False Easting and Northing (km) at the projection origin
     (Used only if PMAP= TTM, LCC, or LAZA)
     (FEAST)                     Default=0.0      ! FEAST  = 0.000  !
     (FNORTH)                    Default=0.0      ! FNORTH = 0.000  !

     UTM zone (1 to 60)
     (Used only if PMAP=UTM)
     (IUTMZN)                    No Default       ! IUTMZN =  60   !

     Hemisphere for UTM projection?
     (Used only if PMAP=UTM)
     (UTMHEM)                    Default: N       ! UTMHEM = S  !
         N   :  Northern hemisphere projection
         S   :  Southern hemisphere projection

     Latitude and Longitude (decimal degrees) of projection origin
     (Used only if PMAP= TTM, LCC, PS, EM, or LAZA)
     (RLAT0)                     No Default       ! RLAT0 = 0N  !
     (RLON0)                     No Default       ! RLON0 = 0E  !

         TTM :  RLON0 identifies central (true N/S) meridian of projection
                RLAT0 selected for convenience
         LCC :  RLON0 identifies central (true N/S) meridian of projection
                RLAT0 selected for convenience
         PS  :  RLON0 identifies central (grid N/S) meridian of projection
                RLAT0 selected for convenience
         EM  :  RLON0 identifies central meridian of projection
                RLAT0 is REPLACED by 0.0N (Equator)
         LAZA:  RLON0 identifies longitude of tangent-point of mapping plane
                RLAT0 identifies latitude of tangent-point of mapping plane

     Matching parallel(s) of latitude (decimal degrees) for projection
     (Used only if PMAP= LCC or PS)
```

```
     (XLAT1)                     No Default      ! XLAT1 = 0N  !
     (XLAT2)                     No Default      ! XLAT2 = 0N  !

         LCC :  Projection cone slices through Earth's surface at XLAT1 and XLAT2
         PS  :  Projection plane slices through Earth at XLAT1
                (XLAT2 is not used)

     ----------
     Note:  Latitudes and longitudes should be positive, and include a
            letter N,S,E, or W indicating north or south latitude, and
            east or west longitude.  For example,
            35.9  N Latitude  =  35.9N
            118.7 E Longitude = 118.7E


     Datum-region
     ------------

     The Datum-Region for the coordinates is identified by a character
     string.  Many mapping products currently available use the model of the
     Earth known as the World Geodetic System 1984 (WGS-84).  Other local
     models may be in use, and their selection in CALMET will make its output
     consistent with local mapping products.  The list of Datum-Regions with
     official transformation parameters is provided by the National Imagery and
     Mapping Agency (NIMA).

     NIMA Datum - Regions(Examples)
     ------------------------------------------------------------------------------
     WGS-84    WGS-84 Reference Ellipsoid and Geoid, Global coverage (WGS84)
     NAS-C     NORTH AMERICAN 1927 Clarke 1866 Spheroid, MEAN FOR CONUS (NAD27)
     NAR-C     NORTH AMERICAN 1983 GRS 80 Spheroid, MEAN FOR CONUS (NAD83)
     NWS-84    NWS 6370KM Radius, Sphere
     ESR-S     ESRI REFERENCE 6371KM Radius, Sphere

     Datum-region for output coordinates
     (DATUM)                     Default: WGS-84    ! DATUM = WGS-84  !


METEOROLOGICAL Grid:

     Rectangular grid defined for projection PMAP,
     with X the Easting and Y the Northing coordinate

            No. X grid cells (NX)      No default     ! NX =  66   !
            No. Y grid cells (NY)      No default     ! NY =  97   !
         No. vertical layers (NZ)      No default     ! NZ =  12   !

           Grid spacing (DGRIDKM)      No default     ! DGRIDKM = .05 !
                                       Units: km

                Cell face heights
                    (ZFACE(nz+1))      No defaults
                                       Units: m
   ! ZFACE = .0, 20.0, 50.0, 100.0, 200.0, 400.0, 800.0, 1200.0, 1600.0, 2000.0,
             2500.0, 3000.0, 3500.0 !

            Reference Coordinates
           of SOUTHWEST corner of
                 grid cell(1, 1):

            X coordinate (XORIGKM)     No default     ! XORIGKM = 309.871 !
            Y coordinate (YORIGKM)     No default     ! YORIGKM = 5419.887 !
                                     Units: km


COMPUTATIONAL Grid:

     The computational grid is identical to or a subset of the MET. grid.
     The lower left (LL) corner of the computational grid is at grid point
     (IBCOMP, JBCOMP) of the MET. grid.  The upper right (UR) corner of the
     computational grid is at grid point (IECOMP, JECOMP) of the MET. grid.
     The grid spacing of the computational grid is the same as the MET. grid.

        X index of LL corner (IBCOMP)      No default     ! IBCOMP =  1   !
                  (1 <= IBCOMP <= NX)

        Y index of LL corner (JBCOMP)      No default     ! JBCOMP =  1   !
```

```
                  (1 <= JBCOMP <= NY)


        X index of UR corner (IECOMP)      No default     ! IECOMP =  66   !
                  (1 <= IECOMP <= NX)

        Y index of UR corner (JECOMP)      No default     ! JECOMP =  97   !
                  (1 <= JECOMP <= NY)


SAMPLING Grid (GRIDDED RECEPTORS):

     The lower left (LL) corner of the sampling grid is at grid point
     (IBSAMP, JBSAMP) of the MET. grid.  The upper right (UR) corner of the
     sampling grid is at grid point (IESAMP, JESAMP) of the MET. grid.
     The sampling grid must be identical to or a subset of the computational
     grid.  It may be a nested grid inside the computational grid.
     The grid spacing of the sampling grid is DGRIDKM/MESHDN.

        Logical flag indicating if gridded
        receptors are used (LSAMP)         Default: T     ! LSAMP = T !
        (T=yes, F=no)

        X index of LL corner (IBSAMP)      No default     ! IBSAMP =  1   !
         (IBCOMP <= IBSAMP <= IECOMP)

        Y index of LL corner (JBSAMP)      No default     ! JBSAMP =  1   !
         (JBCOMP <= JBSAMP <= JECOMP)


        X index of UR corner (IESAMP)      No default     ! IESAMP =  66   !
         (IBCOMP <= IESAMP <= IECOMP)

        Y index of UR corner (JESAMP)      No default     ! JESAMP =  97   !
         (JBCOMP <= JESAMP <= JECOMP)


       Nesting factor of the sampling
        grid (MESHDN)                      Default: 1     ! MESHDN =  1  !
        (MESHDN is an integer >= 1)

!END!


-------------------------------------------------------------------------------


INPUT GROUP: 5 -- Output Options
--------------
                                             *                          *
     FILE                     DEFAULT VALUE             VALUE THIS RUN
     ----                     -------------             --------------

   Concentrations (ICON)           1                    !  ICON =  1   !
   Dry Fluxes (IDRY)               1                    !  IDRY =  0   !
   Wet Fluxes (IWET)               1                    !  IWET =  0   !
   2D Temperature (IT2D)           0                    !  IT2D =  0   !
   2D Density (IRHO)               0                    !  IRHO =  0   !
   Relative Humidity (IVIS)        1                    !  IVIS =  0   !
    (relative humidity file is
     required for visibility
     analysis)
   Use data compression option in output file?
   (LCOMPRS)                           Default: T       ! LCOMPRS = T !

   *
    0 = Do not create file, 1 = create file


    QA PLOT FILE OUTPUT OPTION:

       Create a standard series of output files (e.g.
       locations of sources, receptors, grids ...)
       suitable for plotting?
       (IQAPLOT)                       Default: 1       !  IQAPLOT =  1   !
         0 = no
```

```
        1 = yes

    DIAGNOSTIC PUFF-TRACKING OUTPUT OPTION:

       Puff locations and properties reported to
       PFTRAK.DAT file for postprocessing?
       (IPFTRAK)                      Default: 0        ! IPFTRAK =  0   !
         0 = no
         1 = yes, update puff output at end of each timestep
         2 = yes, update puff output at end of each sampling step

    DIAGNOSTIC MASS FLUX OUTPUT OPTIONS:

       Mass flux across specified boundaries
       for selected species reported?
       (IMFLX)                        Default: 0        ! IMFLX =  0  !
         0 = no
         1 = yes (FLUXBDY.DAT and MASSFLX.DAT filenames
                  are specified in Input Group 0)

       Mass balance for each species
       reported?
       (IMBAL)                        Default: 0        ! IMBAL =  0  !
         0 = no
         1 = yes (MASSBAL.DAT filename is
              specified in Input Group 0)


    NUMERICAL RISE OUTPUT OPTION:

       Create a file with plume properties for each rise
       increment, for each model timestep?
       This applies to sources modeled with numerical rise
       and is limited to ONE source in the run.
       (INRISE)                       Default: 0        ! INRISE =  0  !
         0 = no
         1 = yes (RISE.DAT filename is
                  specified in Input Group 0)


    LINE PRINTER OUTPUT OPTIONS:

       Print concentrations (ICPRT)   Default: 0        ! ICPRT =  0   !
       Print dry fluxes (IDPRT)       Default: 0        ! IDPRT =  0   !
       Print wet fluxes (IWPRT)       Default: 0        ! IWPRT =  0   !
       (0 = Do not print, 1 = Print)

       Concentration print interval
       (ICFRQ) in timesteps           Default: 1        ! ICFRQ =  1   !
       Dry flux print interval
       (IDFRQ) in timesteps           Default: 1        ! IDFRQ =  1   !
       Wet flux print interval
       (IWFRQ) in timesteps           Default: 1        ! IWFRQ =  1   !

       Units for Line Printer Output
       (IPRTU)                        Default: 1        ! IPRTU =  5   !
                       for              for
                  Concentration     Deposition
           1 =        g/m**3         g/m**2/s
           2 =       mg/m**3        mg/m**2/s
           3 =       ug/m**3        ug/m**2/s
           4 =       ng/m**3        ng/m**2/s
           5 =      Odour Units

       Messages tracking progress of run
       written to the screen ?
       (IMESG)                        Default: 2        ! IMESG =  2   !
         0 = no
         1 = yes (advection step, puff ID)
         2 = yes (YYYYJJJHH, # old puffs, # emitted puffs)


     SPECIES (or GROUP for combined species) LIST FOR OUTPUT OPTIONS

                ---- CONCENTRATIONS ----   ------ DRY FLUXES ------   ------ WET FLUXES ------
                -- MASS FLUX --
  SPECIES
```

```
   /GROUP        PRINTED?  SAVED ON DISK?   PRINTED?  SAVED ON DISK?   PRINTED?  SAVED ON DISK?
   SAVED ON DISK?
   -------    ------------------------   ------------------------   ------------------------
   ---------------
!          ODOR =     0,           1,            0,          0,            0,            0,
0    !


  Note:  Species BCON (for MBCON > 0) does not need to be saved on disk.


     OPTIONS FOR PRINTING "DEBUG" QUANTITIES (much output)

       Logical for debug output
       (LDEBUG)                                 Default: F      ! LDEBUG = F !

       First puff to track
       (IPFDEB)                                 Default: 1      ! IPFDEB =  1  !

       Number of puffs to track
       (NPFDEB)                                 Default: 1      ! NPFDEB =  1  !

       Met. period to start output
       (NN1)                                    Default: 1      ! NN1 =  1   !

       Met. period to end output
       (NN2)                                    Default: 10     ! NN2 =  10  !

!END!


-------------------------------------------------------------------------------


INPUT GROUP: 6a, 6b, & 6c -- Subgrid scale complex terrain inputs
-------------------------


---------------
Subgroup (6a)
---------------
       Number of terrain features (NHILL)       Default: 0      ! NHILL =  0   !

       Number of special complex terrain
       receptors  (NCTREC)                      Default: 0      ! NCTREC =  0   !

       Terrain and CTSG Receptor data for
       CTSG hills input in CTDM format ?
       (MHILL)                                  No Default      ! MHILL =  2   !
       1 = Hill and Receptor data created
           by CTDM processors & read from
           HILL.DAT and HILLRCT.DAT files
       2 = Hill data created by OPTHILL &
           input below in Subgroup (6b);
           Receptor data in Subgroup (6c)

       Factor to convert horizontal dimensions  Default: 1.0    ! XHILL2M = 1.0 !
       to meters (MHILL=1)

       Factor to convert vertical dimensions    Default: 1.0    ! ZHILL2M = 1.0 !
       to meters (MHILL=1)

       X-origin of CTDM system relative to      No Default      ! XCTDMKM = 0 !
       CALPUFF coordinate system, in Kilometers (MHILL=1)

       Y-origin of CTDM system relative to      No Default      ! YCTDMKM = 0 !
       CALPUFF coordinate system, in Kilometers (MHILL=1)

! END !

---------------
Subgroup (6b)
---------------

                      1 **
     HILL information
```

```
HILL        XC         YC       THETAH  ZGRID  RELIEF    EXPO 1     EXPO 2   SCALE 1    SCALE 2
AMAX1     AMAX2
 NO.       (km)       (km)      (deg.)   (m)     (m)       (m)        (m)       (m)        (m)
 (m)       (m)
----       ----       ----      ------  -----  ------    ------     ------   -------    -------
-----     -----

---------------
Subgroup (6c)
---------------

    COMPLEX TERRAIN RECEPTOR INFORMATION

                        XRCT         YRCT        ZRCT          XHH
                        (km)         (km)         (m)
                       ------        -----      ------         ----


-------------------
1
     Description of Complex Terrain Variables:
          XC, YC  = Coordinates of center of hill
          THETAH  = Orientation of major axis of hill (clockwise from
                    North)
          ZGRID   = Height of the  0  of the grid above mean sea
                    level
          RELIEF  = Height of the crest of the hill above the grid elevation
          EXPO 1  = Hill-shape exponent for the major axis
          EXPO 2  = Hill-shape exponent for the major axis
          SCALE 1 = Horizontal length scale along the major axis
          SCALE 2 = Horizontal length scale along the minor axis
          AMAX    = Maximum allowed axis length for the major axis
          BMAX    = Maximum allowed axis length for the major axis

          XRCT, YRCT = Coordinates of the complex terrain receptors
          ZRCT    = Height of the ground (MSL) at the complex terrain
                    Receptor
          XHH     = Hill number associated with each complex terrain receptor
                    (NOTE: MUST BE ENTERED AS A REAL NUMBER)

   **
     NOTE: DATA for each hill and CTSG receptor are treated as a separate
           input subgroup and therefore must end with an input group terminator.

-------------------------------------------------------------------------------


INPUT GROUP: 7 -- Chemical parameters for dry deposition of gases
--------------

      SPECIES     DIFFUSIVITY      ALPHA STAR      REACTIVITY    MESOPHYLL RESISTANCE
      HENRY'S LAW COEFFICIENT
       NAME         (cm**2/s)                                             (s/cm)
       (dimensionless)
      -------     -----------      ----------      ----------    --------------------
      -----------------------


!END!


-------------------------------------------------------------------------------


INPUT GROUP: 8 -- Size parameters for dry deposition of particles
--------------

     For SINGLE SPECIES, the mean and standard deviation are used to
     compute a deposition velocity for NINT (see group 9) size-ranges,
     and these are then averaged to obtain a mean deposition velocity.

     For GROUPED SPECIES, the size distribution should be explicitly
     specified (by the 'species' in the group), and the standard deviation
     for each should be entered as 0.  The model will then use the
     deposition velocity for the stated mean diameter.

      SPECIES      GEOMETRIC MASS MEAN        GEOMETRIC STANDARD
```

```
       NAME              DIAMETER                  DEVIATION
                         (microns)                 (microns)
      -------        -------------------      ------------------

!END!


-------------------------------------------------------------------------------


INPUT GROUP: 9 -- Miscellaneous dry deposition parameters
--------------

     Reference cuticle resistance (s/cm)
     (RCUTR)                           Default: 30    !  RCUTR = 30.0 !
     Reference ground resistance  (s/cm)
     (RGR)                             Default: 10    !    RGR = 10.0 !
     Reference pollutant reactivity
     (REACTR)                          Default: 8     ! REACTR = 8.0 !

     Number of particle-size intervals used to
     evaluate effective particle deposition velocity
     (NINT)                            Default: 9     !   NINT =  9   !

     Vegetation state in unirrigated areas
     (IVEG)                            Default: 1     !   IVEG =  1    !
        IVEG=1 for active and unstressed vegetation
        IVEG=2 for active and stressed vegetation
        IVEG=3 for inactive vegetation

!END!


-------------------------------------------------------------------------------


INPUT GROUP: 10 -- Wet Deposition Parameters
---------------


                      Scavenging Coefficient -- Units: (sec)**(-1)

       Pollutant      Liquid Precip.       Frozen Precip.
       ---------      --------------       --------------

!END!


-------------------------------------------------------------------------------


INPUT GROUP: 11a, 11b -- Chemistry Parameters
---------------------

---------------
Subgroup (11a)
---------------

     Several parameters are needed for one or more of the chemical transformation
     mechanisms.  Those used for each mechanism are:
                                       M                 B
                                       A  B  R  R  R     C  B        N
                                 B     V  C  N  N  N  M  K  C  O     D
                                 C  M  G  K  I  I  I  H  H  K  F  V  E
                              M  K  N  N  N  T  T  T  2  2  P  R  C  C
                              O  O  H  H  H  E  E  E  O  O  M  A  N  A
     Mechanism (MCHEM)        Z  3  3  3  3  1  2  3  2  2  F  C  X  Y
     --------------------   -------------------------------------------
     0 None                   .  .  .  .  .  .  .  .  .  .  .  .  .  .
     1 MESOPUFF II            X  X  .  .  X  X  X  X  .  .  .  .  .  .
     2 User Rates             .  .  .  .  .  .  .  .  .  .  .  .  .  .
     3 RIVAD                  X  X  .  .  X  .  .  .  .  .  .  .  .  .
     4 SOA                    X  X  .  .  .  .  .  .  .  .  X  X  X  .
     5 Radioactive Decay      .  .  .  .  .  .  .  .  .  .  .  .  .  X
     6 RIVAD/ISORRPIA         X  X  X  X  X  X  .  .  X  X  .  .  .  .
     7 RIVAD/ISORRPIA/SOA     X  X  X  X  X  X  .  .  X  X  X  X  .  .
```

```
Ozone data input option (MOZ)     Default: 1            ! MOZ =  0   !
(Used only if MCHEM = 1, 3, 4, 6, or 7)
   0 = use a monthly background ozone value
   1 = read hourly ozone concentrations from
       the OZONE.DAT data file

Monthly ozone concentrations in ppb (BCKO3)
(Used only if MCHEM = 1,3,4,6, or 7 and either
   MOZ = 0, or
   MOZ = 1 and all hourly O3 data missing)
                                  Default: 12*80.
!  BCKO3 = 40.00, 40.00, 40.00, 40.00, 40.00, 40.00, 40.00, 40.00, 40.00, 40.00, 40.00,
40.00 !

Ammonia data option (MNH3)        Default: 0            ! MNH3 =  0   !
(Used only if MCHEM = 6 or 7)
   0 = use monthly background ammonia values (BCKNH3) - no vertical variation
   1 = read monthly background ammonia values for each layer from
       the NH3Z.DAT data file

Ammonia vertical averaging option (MAVGNH3)
(Used only if MCHEM = 6 or 7, and MNH3 = 1)
   0 = use NH3 at puff center height (no averaging is done)
   1 = average NH3 values over vertical extent of puff
                                  Default: 1            ! MAVGNH3 =  1   !

Monthly ammonia concentrations in ppb (BCKNH3)
(Used only if MCHEM = 1 or 3, or
          if MCHEM = 6 or 7, and MNH3 = 0)
                                  Default: 12*10.
!  BCKNH3 = 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00,
10.00 !

Nighttime SO2 loss rate in %/hour (RNITE1)
(Used only if MCHEM = 1, 6 or 7)
This rate is used only at night for MCHEM=1
and is added to the computed rate both day
and night for MCHEM=6,7 (heterogeneous reactions)
                                  Default: 0.2          ! RNITE1 = .2 !

Nighttime NOx loss rate in %/hour (RNITE2)
(Used only if MCHEM = 1)
                                  Default: 2.0          ! RNITE2 = 2.0 !

Nighttime HNO3 formation rate in %/hour (RNITE3)
(Used only if MCHEM = 1)
                                  Default: 2.0          ! RNITE3 = 2.0 !

H2O2 data input option (MH2O2)    Default: 1            ! MH2O2 =  1   !
(Used only if MCHEM = 6 or 7, and MAQCHEM = 1)
   0 = use a monthly background H2O2 value
   1 = read hourly H2O2 concentrations from
       the H2O2.DAT data file

Monthly H2O2 concentrations in ppb (BCKH2O2)
(Used only if MQACHEM = 1 and either
   MH2O2 = 0 or
   MH2O2 = 1 and all hourly H2O2 data missing)
                                  Default: 12*1.
!  BCKH2O2 = 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00 !


--- Data for SECONDARY ORGANIC AEROSOL (SOA) Options
    (used only if MCHEM = 4 or 7)

    The MCHEM = 4 SOA module uses monthly values of:
         Fine particulate concentration in ug/m^3 (BCKPMF)
         Organic fraction of fine particulate     (OFRAC)
         VOC / NOX ratio (after reaction)         (VCNX)

    The MCHEM = 7 SOA module uses monthly values of:
         Fine particulate concentration in ug/m^3 (BCKPMF)
         Organic fraction of fine particulate     (OFRAC)

    These characterize the air mass when computing
    the formation of SOA from VOC emissions.
```

```
     Typical values for several distinct air mass types are:

        Month    1     2     3     4     5     6     7     8     9    10    11    12
                Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec

     Clean Continental
        BCKPMF   1.    1.    1.    1.    1.    1.    1.    1.    1.    1.    1.    1.
        OFRAC  .15   .15   .20   .20   .20   .20   .20   .20   .20   .20   .20   .15
        VCNX    50.   50.   50.   50.   50.   50.   50.   50.   50.   50.   50.   50.

     Clean Marine (surface)
        BCKPMF  .5    .5    .5    .5    .5    .5    .5    .5    .5    .5    .5    .5
        OFRAC  .25   .25   .30   .30   .30   .30   .30   .30   .30   .30   .30   .25
        VCNX    50.   50.   50.   50.   50.   50.   50.   50.   50.   50.   50.   50.

     Urban - low biogenic (controls present)
        BCKPMF  30.   30.   30.   30.   30.   30.   30.   30.   30.   30.   30.   30.
        OFRAC  .20   .20   .25   .25   .25   .25   .25   .25   .20   .20   .20   .20
        VCNX     4.    4.    4.    4.    4.    4.    4.    4.    4.    4.    4.    4.

     Urban - high biogenic (controls present)
        BCKPMF  60.   60.   60.   60.   60.   60.   60.   60.   60.   60.   60.   60.
        OFRAC  .25   .25   .30   .30   .30   .55   .55   .55   .35   .35   .35   .25
        VCNX    15.   15.   15.   15.   15.   15.   15.   15.   15.   15.   15.   15.

     Regional Plume
        BCKPMF  20.   20.   20.   20.   20.   20.   20.   20.   20.   20.   20.   20.
        OFRAC  .20   .20   .25   .35   .25   .40   .40   .40   .30   .30   .30   .20
        VCNX    15.   15.   15.   15.   15.   15.   15.   15.   15.   15.   15.   15.

     Urban - no controls present
        BCKPMF 100.  100.  100.  100.  100.  100.  100.  100.  100.  100.  100.  100.
        OFRAC  .30   .30   .35   .35   .35   .55   .55   .55   .35   .35   .35   .30
        VCNX     2.    2.    2.    2.    2.    2.    2.    2.    2.    2.    2.    2.

     Default: Clean Continental
     ! BCKPMF = 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00 !
     ! OFRAC  = 0.15, 0.15, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.15 !
     ! VCNX   = 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00,
     50.00 !

 --- End Data for SECONDARY ORGANIC AEROSOL (SOA) Option


     Number of half-life decay specification blocks provided in Subgroup 11b
     (Used only if MCHEM = 5)
     (NDECAY)                                  Default: 0      ! NDECAY =  0   !

!END!


--------------
Subgroup (11b)
--------------

     Each species modeled may be assigned a decay half-life (sec), and the associated
     mass lost may be assigned to one or more other modeled species using a mass yield
     factor. This information is used only for MCHEM=5.

     Provide NDECAY blocks assigning the half-life for a parent species and mass yield
     factors for each child species (if any) produced by the decay.
     Set HALF_LIFE=0.0 for NO decay (infinite half-life).


                                     a            b
        SPECIES        Half-Life    Mass Yield
         NAME            (sec)        Factor
        -------        ---------    ----------

     *   SPEC1   =     3600.,         -1.0    *     (Parent)
     *   SPEC2   =      -1.0,          0.0    *     (Child)
   *END*

--------
    a
     Specify a half life that is greater than or equal to zero for 1 parent species
     in each block, and set the yield factor for this species to -1
```

```
    b
     Specify a yield factor that is greater than or equal to zero for 1 or more child
     species in each block, and set the half-life for each of these species to -1

     NOTE: Assignments in each block are treated as a separate input
           subgroup and therefore must end with an input group terminator.
           If NDECAY=0, no assignments and input group terminators should appear.

--------------------------------------------------------------------------------


INPUT GROUP: 12 -- Misc. Dispersion and Computational Parameters
---------------

     Horizontal size of puff (m) beyond which
     time-dependent dispersion equations (Heffter)
     are used to determine sigma-y and
     sigma-z (SYTDEP)                           Default: 550.   ! SYTDEP = 5.5E02 !

     Switch for using Heffter equation for sigma z
     as above (0 = Not use Heffter; 1 = use Heffter
     (MHFTSZ)                                   Default: 0      ! MHFTSZ =  0   !

     Stability class used to determine plume
     growth rates for puffs above the boundary
     layer (JSUP)                               Default: 5      ! JSUP =  5   !

     Vertical dispersion constant for stable
     conditions (k1 in Eqn. 2.7-3)  (CONK1)     Default: 0.01   ! CONK1 = .01 !

     Vertical dispersion constant for neutral/
     unstable conditions (k2 in Eqn. 2.7-4)
     (CONK2)                                    Default: 0.1    ! CONK2 = .1 !

     Factor for determining Transition-point from
     Schulman-Scire to Huber-Snyder Building Downwash
     scheme (SS used for Hs < Hb + TBD * HL)
     (TBD)                                      Default: 0.5    ! TBD = .5 !
        TBD < 0   ==> always use Huber-Snyder
        TBD = 1.5 ==> always use Schulman-Scire
        TBD = 0.5 ==> ISC Transition-point

     Range of land use categories for which
     urban dispersion is assumed
     (IURB1, IURB2)                             Default: 10     ! IURB1 =  10  !
                                                         19     ! IURB2 =  19  !

     Site characterization parameters for single-point Met data files ---------
     (needed for METFM = 2,3,4,5)

        Land use category for modeling domain
        (ILANDUIN)                              Default: 20     ! ILANDUIN =  20  !

        Roughness length (m) for modeling domain
        (Z0IN)                                  Default: 0.25   ! Z0IN = .25 !

        Leaf area index for modeling domain
        (XLAIIN)                                Default: 3.0    ! XLAIIN = 3.0 !

        Elevation above sea level (m)
        (ELEVIN)                                Default: 0.0    ! ELEVIN = .0 !

        Latitude (degrees) for met location
        (XLATIN)                                Default: -999.  ! XLATIN = -999.0 !

        Longitude (degrees) for met location
        (XLONIN)                                Default: -999.  ! XLONIN = -999.0 !

     Specialized information for interpreting single-point Met data files -----

        Anemometer height (m) (Used only if METFM = 2,3)
        (ANEMHT)                                Default: 10.    ! ANEMHT = 10.0 !

        Form of lateral turbulance data in PROFILE.DAT file
        (Used only if METFM = 4,5 or MTURBVW = 1 or 3)
        (ISIGMAV)                               Default: 1      ! ISIGMAV =  1  !
            0 = read sigma-theta
```

```
          1 = read sigma-v

       Choice of mixing heights (Used only if METFM = 4)
       (IMIXCTDM)                             Default: 0       ! IMIXCTDM =  0  !
          0 = read PREDICTED mixing heights
          1 = read OBSERVED mixing heights

    Maximum length of a slug (met. grid units)
    (XMXLEN)                                  Default: 1.0     ! XMXLEN = 1.0 !

    Maximum travel distance of a puff/slug (in
    grid units) during one sampling step
    (XSAMLEN)                                 Default: 1.0     ! XSAMLEN = 1.0 !

    Maximum Number of slugs/puffs release from
    one source during one time step
    (MXNEW)                                   Default: 99      ! MXNEW =  99   !

    Maximum Number of sampling steps for
    one puff/slug during one time step
    (MXSAM)                                   Default: 99      ! MXSAM =  99   !

    Number of iterations used when computing
    the transport wind for a sampling step
    that includes gradual rise (for CALMET
    and PROFILE winds)
    (NCOUNT)                                  Default: 2       ! NCOUNT =  2   !

    Minimum sigma y for a new puff/slug (m)
    (SYMIN)                                   Default: 1.0     ! SYMIN = 1.0  !

    Minimum sigma z for a new puff/slug (m)
    (SZMIN)                                   Default: 1.0     ! SZMIN = 1.0  !

    Maximum sigma z (m) allowed to avoid
    numerical problem in calculating virtual
    time or distance.  Cap should be large
    enough to have no influence on normal events.
    Enter a negative cap to disable.
    (SZCAP_M)                                 Default: 5.0e06 ! SZCAP_M = 5.0E06 !

    Default minimum turbulence velocities sigma-v and sigma-w
    for each stability class over land and over water (m/s)
    (SVMIN(12) and SWMIN(12))

                    ---------- LAND ----------       --------- WATER ----------
       Stab Class : A    B    C    D    E    F        A    B    C    D    E    F
                    ---  ---  ---  ---  ---  ---      ---  ---  ---  ---  ---  ---
    Default SVMIN : .50, .50, .50, .50, .50, .50,     .37, .37, .37, .37, .37, .37
    Default SWMIN : .20, .12, .08, .06, .03, .016,    .20, .12, .08, .06, .03, .016

          ! SVMIN = 0.500, 0.500, 0.500, 0.500, 0.500, 0.500, 0.370, 0.370, 0.370, 0.370,
          0.370, 0.370!
          ! SWMIN = 0.200, 0.120, 0.080, 0.060, 0.030, 0.016, 0.200, 0.120, 0.080, 0.060,
          0.030, 0.016!

    Divergence criterion for dw/dz across puff
    used to initiate adjustment for horizontal
    convergence (1/s)
    Partial adjustment starts at CDIV(1), and
    full adjustment is reached at CDIV(2)
    (CDIV(2))                                 Default: 0.0,0.0  ! CDIV = .0, .0 !

    Search radius (number of cells) for nearest
    land and water cells used in the subgrid
    TIBL module
    (NLUTIBL)                                 Default: 4       ! NLUTIBL =  4  !

    Minimum wind speed (m/s) allowed for
    non-calm conditions. Also used as minimum
    speed returned when using power-law
    extrapolation toward surface
    (WSCALM)                                  Default: 0.5     ! WSCALM = .5 !

    Maximum mixing height (m)
    (XMAXZI)                                  Default: 3000.   ! XMAXZI = 3000.0 !
```

```
Minimum mixing height (m)
(XMINZI)                              Default: 50.     ! XMINZI = 50.0 !

Default wind speed classes --
5 upper bounds (m/s) are entered;
the 6th class has no upper limit
(WSCAT(5))                 Default   :
                           ISC RURAL : 1.54, 3.09, 5.14, 8.23, 10.8 (10.8+)

                    Wind Speed Class :  1     2     3     4     5
                                       ---   ---   ---   ---   ---
                             ! WSCAT = 1.54, 3.09, 5.14, 8.23, 10.80 !

Default wind speed profile power-law
exponents for stabilities 1-6
(PLX0(6))                  Default   : ISC RURAL values
                           ISC RURAL : .07, .07, .10, .15, .35, .55
                           ISC URBAN : .15, .15, .20, .25, .30, .30

                     Stability Class :  A     B     C     D     E     F
                                       ---   ---   ---   ---   ---   ---
                              ! PLX0 = 0.07, 0.07, 0.10, 0.15, 0.35, 0.55 !

Default potential temperature gradient
for stable classes E, F (degK/m)
(PTG0(2))                  Default: 0.020, 0.035
                              ! PTG0 = 0.020,  0.035 !

Default plume path coefficients for
each stability class (used when option
for partial plume height terrain adjustment
is selected -- MCTADJ=3)
(PPC(6))             Stability Class :  A     B     C     D     E     F
                        Default  PPC : .50,  .50,  .50,  .50,  .35,  .35
                                       ---   ---   ---   ---   ---   ---
                              !  PPC = 0.50, 0.50, 0.50, 0.50, 0.35, 0.35 !

Slug-to-puff transition criterion factor
equal to sigma-y/length of slug
(SL2PF)                          Default: 10.        ! SL2PF = 10.0 !

Puff-splitting control variables ------------------------

  VERTICAL SPLIT
  --------------

  Number of puffs that result every time a puff
  is split - nsplit=2 means that 1 puff splits
  into 2
  (NSPLIT)                       Default:   3        ! NSPLIT =  3  !

  Time(s) of a day when split puffs are eligible to
  be split once again; this is typically set once
  per day, around sunset before nocturnal shear develops.
  24 values: 0 is midnight (00:00) and 23 is 11 PM (23:00)
  0=do not re-split    1=eligible for re-split
  (IRESPLIT(24))                 Default:  Hour 17 = 1
  !  IRESPLIT = 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0 !

  Split is allowed only if last hour's mixing
  height (m) exceeds a minimum value
  (ZISPLIT)                      Default: 100.       ! ZISPLIT = 100.0 !

  Split is allowed only if ratio of last hour's
  mixing ht to the maximum mixing ht experienced
  by the puff is less than a maximum value (this
  postpones a split until a nocturnal layer develops)
  (ROLDMAX)                      Default: 0.25       ! ROLDMAX = 0.25 !


  HORIZONTAL SPLIT
  ----------------

  Number of puffs that result every time a puff
  is split - nsplith=5 means that 1 puff splits
  into 5
  (NSPLITH)                      Default:   5        ! NSPLITH =  5  !
```

```
        Minimum sigma-y (Grid Cells Units) of puff
        before it may be split
        (SYSPLITH)                    Default: 1.0       ! SYSPLITH = 1.0 !

        Minimum puff elongation rate (SYSPLITH/hr) due to
        wind shear, before it may be split
        (SHSPLITH)                    Default: 2.        ! SHSPLITH = 2.0 !

        Minimum concentration (g/m^3) of each
        species in puff before it may be split
        Enter array of NSPEC values; if a single value is
        entered, it will be used for ALL species
        (CNSPLITH)                    Default: 1.0E-07   ! CNSPLITH = 1.0E-07 !

      Integration control variables ------------------------

        Fractional convergence criterion for numerical SLUG
        sampling integration
        (EPSSLUG)                     Default:  1.0e-04  ! EPSSLUG = 1.0E-04 !

        Fractional convergence criterion for numerical AREA
        source integration
        (EPSAREA)                     Default:  1.0e-06  ! EPSAREA = 1.0E-06 !

        Trajectory step-length (m) used for numerical rise
        integration
        (DSRISE)                      Default:  1.0      ! DSRISE = 1.0 !

        Boundary Condition (BC) Puff control variables ------------------------

        Minimum height (m) to which BC puffs are mixed as they are emitted
        (MBCON=2 ONLY).  Actual height is reset to the current mixing height
        at the release point if greater than this minimum.
        (HTMINBC)                     Default:  500.     ! HTMINBC = 500.0 !

        Search radius (km) about a receptor for sampling nearest BC puff.
        BC puffs are typically emitted with a spacing of one grid cell
        length, so the search radius should be greater than DGRIDKM.
        (RSAMPBC)                     Default:  10.      ! RSAMPBC = 10.0 !

        Near-Surface depletion adjustment to concentration profile used when
        sampling BC puffs?
        (MDEPBC)                      Default:  1        ! MDEPBC =  1  !
           0 = Concentration is NOT adjusted for depletion
           1 = Adjust Concentration for depletion

!END!


--------------------------------------------------------------------------------


INPUT GROUPS: 13a, 13b, 13c, 13d -- Point source parameters
--------------------------------

---------------
Subgroup (13a)
---------------

     Number of point sources with
     parameters provided below      (NPT1)  No default  !  NPT1 =  0  !

     Units used for point source
     emissions below                (IPTU)  Default: 1  !  IPTU =   1  !
           1 =        g/s
           2 =       kg/hr
           3 =       lb/hr
           4 =     tons/yr
           5 =     Odour Unit * m**3/s  (vol. flux of odour compound)
           6 =     Odour Unit * m**3/min
           7 =     metric tons/yr
           8 =     Bq/s  (Bq = becquerel = disintegrations/s)
           9 =     GBq/yr

     Number of source-species
     combinations with variable
```

```
     emissions scaling factors
     provided below in (13d)        (NSPT1) Default: 0  !  NSPT1 =  0  !

     Number of point sources with
     variable emission parameters
     provided in external file      (NPT2)  No default  !  NPT2 =  0  !

     (If NPT2 > 0, these point
     source emissions are read from
     the file: PTEMARB.DAT)

!END!

---------------
Subgroup (13b)
---------------
                                              a
          POINT SOURCE: CONSTANT DATA
          -----------------------------
                                                                                 b         c
  Source       X           Y       Stack    Base     Stack    Exit  Exit    Bldg.  Emission
   No.     Coordinate Coordinate  Height Elevation Diameter  Vel.  Temp.   Dwash    Rates
              (km)       (km)       (m)      (m)       (m)   (m/s) (deg. K)
  ------   ---------- ---------- ------  ------   -------- ----- -------- ----- --------

--------

    a
     Data for each source are treated as a separate input subgroup
     and therefore must end with an input group terminator.

     SRCNAM  is a 12-character name for a source
             (No default)
     X       is an array holding the source data listed by the column headings
             (No default)
     SIGYZI  is an array holding the initial sigma-y and sigma-z (m)
             (Default: 0.,0.)
     FMFAC   is a vertical momentum flux factor (0. or 1.0) used to represent
             the effect of rain-caps or other physical configurations that
             reduce momentum rise associated with the actual exit velocity.
             (Default: 1.0  -- full momentum used)
     ZPLTFM  is the platform height (m) for sources influenced by an isolated
             structure that has a significant open area between the surface
             and the bulk of the structure, such as an offshore oil platform.
             The Base Elevation is that of the surface (ground or ocean),
             and the Stack Height is the release height above the Base (not
             above the platform).  Building heights entered in Subgroup 13c
             must be those of the buildings on the platform, measured from
             the platform deck.  ZPLTFM is used only with MBDW=1 (ISC
             downwash method) for sources with building downwash.
             (Default: 0.0)

    b
     0. = No building downwash modeled
     1. = Downwash modeled for buildings resting on the surface
     2. = Downwash modeled for buildings raised above the surface (ZPLTFM > 0.)
     NOTE: must be entered as a REAL number (i.e., with decimal point)

    c
     An emission rate must be entered for every pollutant modeled.
     Enter emission rate of zero for secondary pollutants that are
     modeled, but not emitted.  Units are specified by IPTU
     (e.g. 1 for g/s).

---------------
Subgroup (13c)
---------------

          BUILDING DIMENSION DATA FOR SOURCES SUBJECT TO DOWNWASH
          -------------------------------------------------------
Source                                                                    a
 No.      Effective building height, width, length and X/Y offset (in meters)
          every 10 degrees.  LENGTH, XBADJ, and YBADJ are only needed for
          MBDW=2 (PRIME downwash option)
------    --------------------------------------------------------------------
```

```
--------
    a
     Building height, width, length, and X/Y offset from the source are treated
     as a separate input subgroup for each source and therefore must end with
     an input group terminator.  The X/Y offset is the position, relative to the
     stack, of the center of the upwind face of the projected building, with the
     x-axis pointing along the flow direction.

---------------
Subgroup (13d)
---------------
                                                 a
          POINT SOURCE: VARIABLE EMISSIONS DATA
          ---------------------------------------

     Use this subgroup to describe temporal variations in the emission
     rates given in 13b.  Factors entered multiply the rates in 13b.
     Skip sources here that have constant emissions.  For more elaborate
     variation in source parameters, use PTEMARB.DAT and NPT2 > 0.

     IVARY determines the type of variation, and is source-specific:
     (IVARY)                               Default: 0
           0 =       Constant
           1 =       Diurnal cycle (24 scaling factors: hours 1-24)
           2 =       Monthly cycle (12 scaling factors: months 1-12)
           3 =       Hour & Season (4 groups of 24 hourly scaling factors,
                                    where first group is DEC-JAN-FEB)
           4 =       Speed & Stab. (6 groups of 6 scaling factors, where
                                    first group is Stability Class A,
                                    and the speed classes have upper
                                    bounds (m/s) defined in Group 12
           5 =       Temperature   (12 scaling factors, where temperature
                                    classes have upper bounds (C) of:
                                    0, 5, 10, 15, 20, 25, 30, 35, 40,
                                    45, 50, 50+)


--------
    a
     Data for each species are treated as a separate input subgroup
     and therefore must end with an input group terminator.


-------------------------------------------------------------------------------


INPUT GROUPS: 14a, 14b, 14c, 14d -- Area source parameters
--------------------------------

---------------
Subgroup (14a)
---------------

     Number of polygon area sources with
     parameters specified below (NAR1)       No default  !  NAR1 =  6   !

     Units used for area source
     emissions below            (IARU)       Default: 1  !  IARU =   5  !
           1 =        g/m**2/s
           2 =       kg/m**2/hr
           3 =       lb/m**2/hr
           4 =     tons/m**2/yr
           5 =     Odour Unit * m/s  (vol. flux/m**2 of odour compound)
           6 =     Odour Unit * m/min
           7 =     metric tons/m**2/yr
           8 =     Bq/m**2/s  (Bq = becquerel = disintegrations/s)
           9 =     GBq/m**2/yr

     Number of source-species
     combinations with variable
     emissions scaling factors
     provided below in (14d)        (NSAR1) Default: 0  !  NSAR1 =  0  !

     Number of buoyant polygon area sources
     with variable location and emission
```

```
     parameters (NAR2)                      No default  !  NAR2 =  0   !
     (If NAR2 > 0, ALL parameter data for
     these sources are read from the file: BAEMARB.DAT)

!END!

---------------
Subgroup (14b)
---------------
                                                a
          AREA SOURCE: CONSTANT DATA
          ----------------------------
                                                                b
Source           Effect.    Base      Initial    Emission
 No.             Height   Elevation   Sigma z     Rates
                   (m)       (m)        (m)
-------          ------    ------     --------   ---------

   1! SRCNAM = UWBIO !
   1! X =          .0,   150.0,        10.0,   0.029E00 ! !END!
   2! SRCNAM = UWWW !
   2! X =          .0,   125.0,        10.0,   3.714E01 ! !END!
   3! SRCNAM = LEACH !
   3! X =          .0,   175.0,        10.0,   0.992E00 ! !END!
   4! SRCNAM = LFF !
   4! X =          .0,   150.0,        10.0,   0.716E00 ! !END!
   5! SRCNAM = TCOMP !
   5! X =          .0,   135.0,        10.0,   0.244E00 ! !END!
   6! SRCNAM = UNCOMP !
   6! X =          .0,   135.0,        10.0,   0.056E00 ! !END!

--------
    a
     Data for each source are treated as a separate input subgroup
     and therefore must end with an input group terminator.
    b
     An emission rate must be entered for every pollutant modeled.
     Enter emission rate of zero for secondary pollutants that are
     modeled, but not emitted.  Units are specified by IARU
     (e.g. 1 for g/m**2/s).

---------------
Subgroup (14c)
---------------

           COORDINATES (km) FOR EACH VERTEX(4) OF EACH POLYGON
           --------------------------------------------------------
Source                                                          a
 No.       Ordered list of X followed by list of Y, grouped by source
------     ------------------------------------------------------------

 1    ! SRCNAM  =   UWBIO !
 1      !  XVERT = 311.2725,     311.2925,     311.2925,     311.2725!
 1      !  YVERT = 5422.7245,     5422.7245,     5422.7045,     5422.7045!
!END!
 2    ! SRCNAM  =   UWWW !
 2      !  XVERT = 311.3306,     311.3316,     311.3316,     311.3306!
 2      !  YVERT = 5422.6237,     5422.6237,     5422.6227,     5422.6227!
!END!
 3    ! SRCNAM  =   LEACH !
 3      !  XVERT = 311.1093,     311.1103,     311.1103,     311.1093!
 3      !  YVERT = 5423.5268,     5423.5268,     5423.5243,     5423.5243!
!END!
 4    ! SRCNAM  =   LFF !
 4      !  XVERT = 310.9,     310.925,     310.925,     310.9!
 4      !  YVERT = 5423.425,     5423.425,     5423.4,     5423.4!
!END!
 5    ! SRCNAM  =   TCOMP !
 5      !  XVERT = 311.3166,     311.3366,     311.3366,     311.3166!
 5      !  YVERT = 5422.7287,     5422.7287,     5422.7087,     5422.7087!
!END!
 6    ! SRCNAM  =   UNCOMP !
 6      !  XVERT = 311.3306,     311.3706,     311.3706,     311.3306!
 6      !  YVERT = 5422.7491,     5422.7491,     5422.7091,     5422.7091!
!END!

--------
```

```
    a
     Data for each source are treated as a separate input subgroup
     and therefore must end with an input group terminator.


---------------
Subgroup (14d)
---------------
                                                     a
          AREA SOURCE: VARIABLE EMISSIONS DATA
          ---------------------------------------

     Use this subgroup to describe temporal variations in the emission
     rates given in 14b.  Factors entered multiply the rates in 14b.
     Skip sources here that have constant emissions.  For more elaborate
     variation in source parameters, use BAEMARB.DAT and NAR2 > 0.

     IVARY determines the type of variation, and is source-specific:
     (IVARY)                              Default: 0
           0 =       Constant
           1 =       Diurnal cycle (24 scaling factors: hours 1-24)
           2 =       Monthly cycle (12 scaling factors: months 1-12)
           3 =       Hour & Season (4 groups of 24 hourly scaling factors,
                                    where first group is DEC-JAN-FEB)
           4 =       Speed & Stab. (6 groups of 6 scaling factors, where
                                    first group is Stability Class A,
                                    and the speed classes have upper
                                    bounds (m/s) defined in Group 12
           5 =       Temperature   (12 scaling factors, where temperature
                                    classes have upper bounds (C) of:
                                    0, 5, 10, 15, 20, 25, 30, 35, 40,
                                    45, 50, 50+)



--------
    a
     Data for each species are treated as a separate input subgroup
     and therefore must end with an input group terminator.


--------------------------------------------------------------------------------

INPUT GROUPS: 15a, 15b, 15c -- Line source parameters
---------------------------


---------------
Subgroup (15a)
---------------

     Number of buoyant line sources
     with variable location and emission
     parameters (NLN2)                            No default  !  NLN2 =  0   !

     (If NLN2 > 0, ALL parameter data for
      these sources are read from the file: LNEMARB.DAT)

     Number of buoyant line sources (NLINES)      No default   ! NLINES =  0  !

     Units used for line source
     emissions below               (ILNU)         Default: 1  !  ILNU =   1  !
           1 =        g/s
           2 =       kg/hr
           3 =        lb/hr
           4 =     tons/yr
           5 =     Odour Unit * m**3/s  (vol. flux of odour compound)
           6 =     Odour Unit * m**3/min
           7 =     metric tons/yr
           8 =     Bq/s  (Bq = becquerel = disintegrations/s)
           9 =     GBq/yr

     Number of source-species
     combinations with variable
     emissions scaling factors
     provided below in (15c)        (NSLN1) Default: 0  !  NSLN1 =  0  !

     Maximum number of segments used to model
```

```
     each line (MXNSEG)                            Default: 7   ! MXNSEG =  7  !

     The following variables are required only if NLINES > 0.  They are
     used in the buoyant line source plume rise calculations.

        Number of distances at which               Default: 6   ! NLRISE =  6  !
        transitional rise is computed

        Average building length (XL)               No default   ! XL = .0 !
                                                   (in meters)

        Average building height (HBL)              No default   ! HBL = .0 !
                                                   (in meters)

        Average building width (WBL)               No default   ! WBL = .0 !
                                                   (in meters)

        Average line source width (WML)            No default   ! WML = .0 !
                                                   (in meters)

        Average separation between buildings (DXL) No default   ! DXL = .0 !
                                                   (in meters)

        Average buoyancy parameter (FPRIMEL)       No default   ! FPRIMEL = .0 !
                                                   (in m**4/s**3)

!END!

---------------
Subgroup (15b)
---------------

          BUOYANT LINE SOURCE: CONSTANT DATA
          ----------------------------------
                                                                                            a
Source     Beg. X      Beg. Y      End. X     End. Y     Release    Base        Emission
 No.     Coordinate  Coordinate  Coordinate Coordinate   Height   Elevation      Rates
            (km)        (km)        (km)       (km)        (m)       (m)
------   ----------  ----------  ---------  ----------  -------   ---------    ---------

--------

    a
     Data for each source are treated as a separate input subgroup
     and therefore must end with an input group terminator.

    b
     An emission rate must be entered for every pollutant modeled.
     Enter emission rate of zero for secondary pollutants that are
     modeled, but not emitted.  Units are specified by ILNTU
     (e.g. 1 for g/s).

---------------
Subgroup (15c)
---------------
                                                     a
          BUOYANT LINE SOURCE: VARIABLE EMISSIONS DATA
          --------------------------------------------

     Use this subgroup to describe temporal variations in the emission
     rates given in 15b.  Factors entered multiply the rates in 15b.
     Skip sources here that have constant emissions.

     IVARY determines the type of variation, and is source-specific:
     (IVARY)                            Default: 0
           0 =       Constant
           1 =       Diurnal cycle (24 scaling factors: hours 1-24)
           2 =       Monthly cycle (12 scaling factors: months 1-12)
           3 =       Hour & Season (4 groups of 24 hourly scaling factors,
                                    where first group is DEC-JAN-FEB)
           4 =       Speed & Stab. (6 groups of 6 scaling factors, where
                                    first group is Stability Class A,
                                    and the speed classes have upper
                                    bounds (m/s) defined in Group 12
           5 =       Temperature   (12 scaling factors, where temperature
                                    classes have upper bounds (C) of:
                                    0, 5, 10, 15, 20, 25, 30, 35, 40,
```

```
                                             45, 50, 50+)


--------
    a
     Data for each species are treated as a separate input subgroup
     and therefore must end with an input group terminator.


-------------------------------------------------------------------------------


INPUT GROUPS: 16a, 16b, 16c -- Volume source parameters
---------------------------

---------------
Subgroup (16a)
---------------

     Number of volume sources with
     parameters provided in 16b,c (NVL1)     No default  !  NVL1 =  0   !

     Units used for volume source
     emissions below in 16b       (IVLU)     Default: 1  !  IVLU =   1  !
           1 =        g/s
           2 =       kg/hr
           3 =       lb/hr
           4 =      tons/yr
           5 =      Odour Unit * m**3/s  (vol. flux of odour compound)
           6 =      Odour Unit * m**3/min
           7 =      metric tons/yr
           8 =      Bq/s  (Bq = becquerel = disintegrations/s)
           9 =      GBq/yr

     Number of source-species
     combinations with variable
     emissions scaling factors
     provided below in (16c)      (NSVL1)    Default: 0  !  NSVL1 =  0  !

     Number of volume sources with
     variable location and emission
     parameters                   (NVL2)     No default  !  NVL2 =   0   !

     (If NVL2 > 0, ALL parameter data for
      these sources are read from the VOLEMARB.DAT file(s) )

!END!

---------------
Subgroup (16b)
---------------
                                             a
           VOLUME SOURCE: CONSTANT DATA
           ------------------------------
                                                                                   b
         X           Y        Effect.    Base     Initial    Initial    Emission
     Coordinate  Coordinate   Height   Elevation  Sigma y    Sigma z     Rates
        (km)        (km)        (m)       (m)       (m)        (m)
     ----------  ----------   ------    ------   --------   --------   --------


--------
    a
     Data for each source are treated as a separate input subgroup
     and therefore must end with an input group terminator.

    b
     An emission rate must be entered for every pollutant modeled.
     Enter emission rate of zero for secondary pollutants that are
     modeled, but not emitted.  Units are specified by IVLU
     (e.g. 1 for g/s).

---------------
Subgroup (16c)
---------------
                                                          a
```

```
          VOLUME SOURCE: VARIABLE EMISSIONS DATA
          ---------------------------------------

     Use this subgroup to describe temporal variations in the emission
     rates given in 16b.  Factors entered multiply the rates in 16b.
     Skip sources here that have constant emissions.  For more elaborate
     variation in source parameters, use VOLEMARB.DAT and NVL2 > 0.

     IVARY determines the type of variation, and is source-specific:
     (IVARY)                               Default: 0
           0 =       Constant
           1 =       Diurnal cycle (24 scaling factors: hours 1-24)
           2 =       Monthly cycle (12 scaling factors: months 1-12)
           3 =       Hour & Season (4 groups of 24 hourly scaling factors,
                                   where first group is DEC-JAN-FEB)
           4 =       Speed & Stab. (6 groups of 6 scaling factors, where
                                   first group is Stability Class A,
                                   and the speed classes have upper
                                   bounds (m/s) defined in Group 12
           5 =       Temperature   (12 scaling factors, where temperature
                                   classes have upper bounds (C) of:
                                   0, 5, 10, 15, 20, 25, 30, 35, 40,
                                   45, 50, 50+)


--------
    a
     Data for each species are treated as a separate input subgroup
     and therefore must end with an input group terminator.

--------------------------------------------------------------------------------

INPUT GROUPS: 17a & 17b -- Non-gridded (discrete) receptor information
-----------------------

---------------
Subgroup (17a)
---------------

     Number of non-gridded receptors (NREC)  No default  !  NREC =  0   !

!END!

---------------
Subgroup (17b)
---------------
                                                  a
           NON-GRIDDED (DISCRETE) RECEPTOR DATA
           ------------------------------------

                     X            Y          Ground        Height   b
Receptor        Coordinate   Coordinate    Elevation    Above Ground
  No.              (km)         (km)          (m)           (m)
--------        ----------   ----------    ---------    ------------


-------------
    a
     Data for each receptor are treated as a separate input subgroup
     and therefore must end with an input group terminator.

    b
     Receptor height above ground is optional.  If no value is entered,
     the receptor is placed on the ground.
```

URS

22 May 2014
Project No. 42787470

Golder Associates Limited
PO Box 2281
Christchurch 8140
New Zealand

Attention: Richard Chilton
Senior Associate Air Quality Scientist

Dear Richard

Subject: Section 92 Additional Modelling Plots

Golder Associates has requested the modelling plots be presented for easier analysis as two separate figures. Please find attached Figures 1 and 2, presenting the odour modelling plots for the existing operation and proposed extension respectively.

URS New Zealand Limited
URS Centre, 13-15 College Hill
Auckland 1011
PO Box 821, Auckland 1140
New Zealand
T: 64 9 355 1300
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Richard Chilton
Golder Associates Limited
22 May 2014

Figure 1 Stage 3 Existing Operation

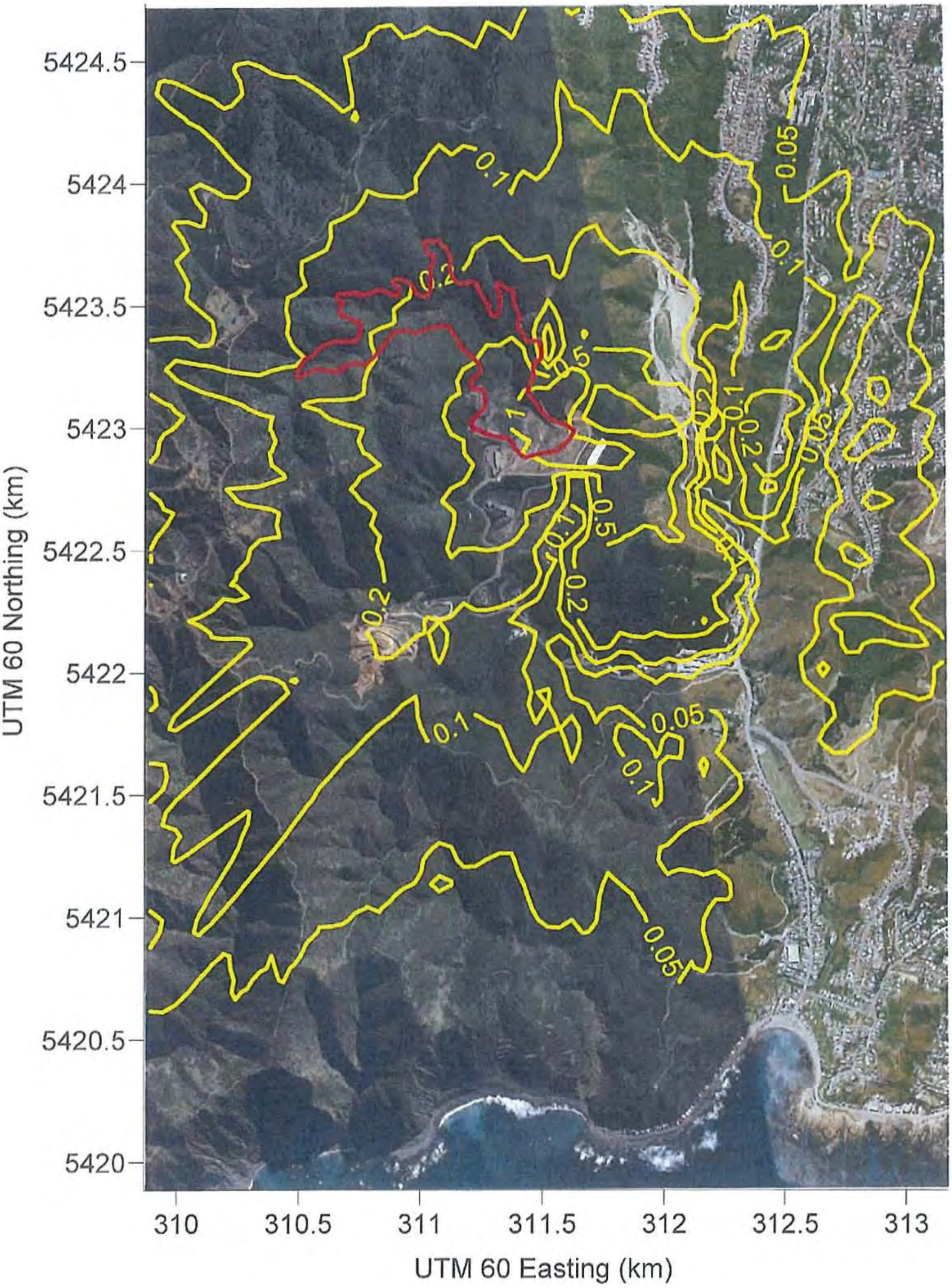
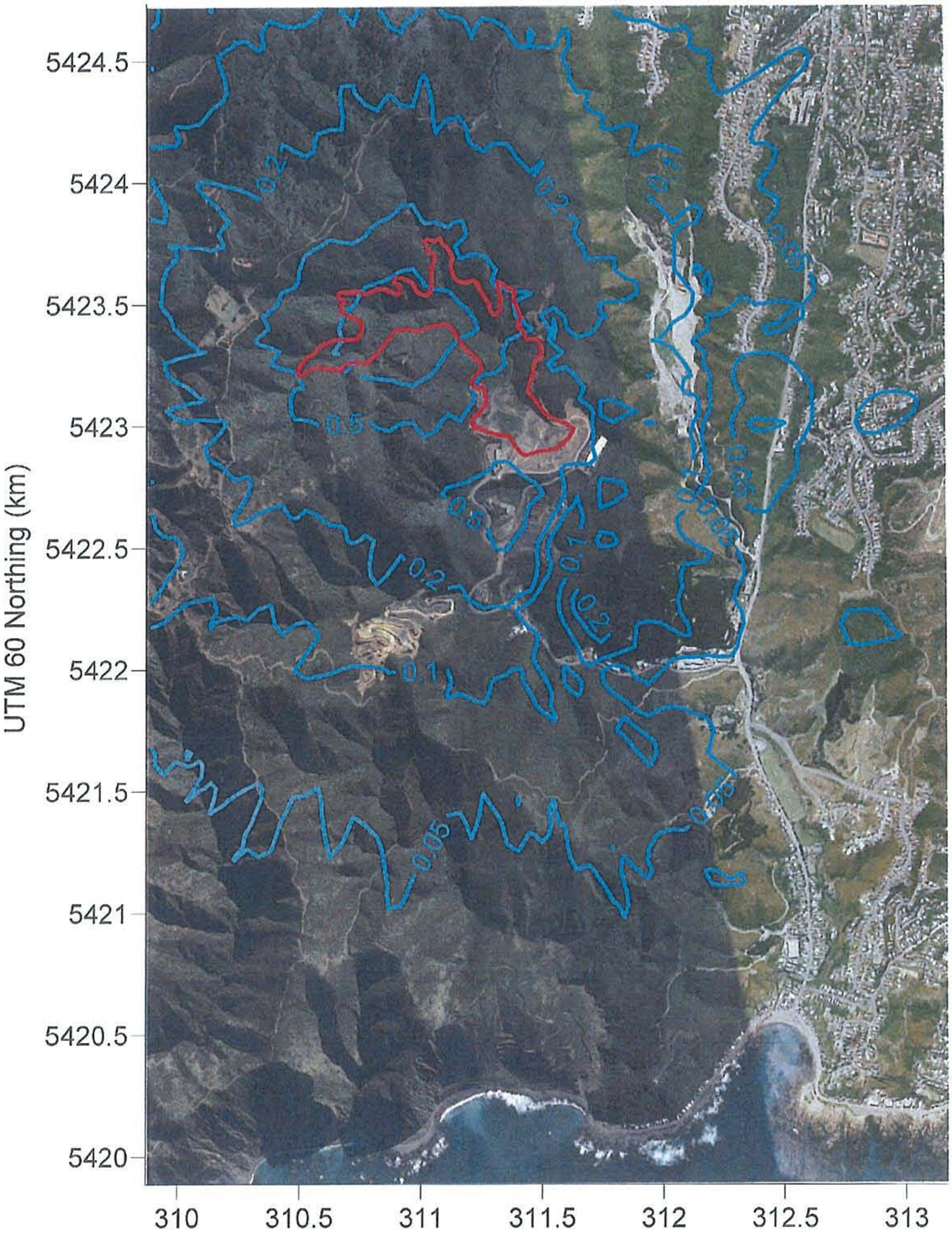


Figure 2 Stage 4 Proposed Extension



Yours sincerely
URS New Zealand Limited

Jeremy Hunt
Environmental Engineer