

PART K
Ventilation Stacks

Part K: Ventilation Stacks

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1 Introduction

The Lane Cove tunnel was completed and opened for traffic in March 2007.

Vehicle emissions from the tunnel are vented by two stacks: one at the western end, Sirius Road (Lane Cove Council local government area) and one at the eastern end, in the Artarmon industrial area, Marden Street (City of Willoughby local government area).

Both stacks have potential impacts on land in the Willoughby local government area.

Environmental assessments at design stage considered the potential impacts on buildings close to the stacks. The ventilation system was designed to ensure air impacts were acceptable to all existing buildings.

An air quality assessment was done to determine the likely characteristics of the plume and identify its zone of influence (a 3 dimensional zone also known as buffer volume). This is detailed the Lane Cove Tunnel Buffer Zone Analysis Report No: 21/06 Consulting Air Pollution Modelling and Meteorology, March 2008.

1.1 Land affected by this part

This part of the Willoughby Development Control Plan applies to land within an 800m radius of the stacks in Sirius Road, Lane Cove and Marden Street, Artarmon as shown in Maps A and B in Attachment 1.

1.2 Aim

This part aims to ensure new development does not reduce the effectiveness of the ventilation stacks.

1.3 Objectives

a. ensure a detailed assessment is carried out by a suitably qualified person to demonstrate that any new development is not exposed to excessive air pollution from the Lane Cove Tunnel ventilation stacks

b. ensure the assessment shows that any new development or alterations and additions to existing buildings do not alter the plume and wind conditions that may reduce the effectiveness of the ventilation stacks

2 Buffer zone analysis

The air quality assessment report defines a building overlay to ensure adequate separation between the vent stacks and any future proposed buildings. The derived overlay control has two main parts:

a. ensure sufficient separation of proposed buildings from the vent stack emissions so that occupants of those buildings would not be exposed to predicted pollutant concentrations that exceed air quality objectives

b. ensure sufficient separation of proposed buildings from the vent stack so that under any wind conditions the building wake would not interact with the vent stack plume and reduce the effectiveness of the vent stack

The height control/building overlay has been defined using conservative assumptions about the plume behaviour and meteorology. The overlay is used as a trigger to determine if more detailed site-specific investigation for a proposed building is needed.

The overlay for each vent stack is presented in the form of decision trees in Attachments 2 and 3 together with worked examples.

3 Submission requirements

The proponent is to assess the proposed building development against the objectives in Section 4 using the decision trees in Attachments 2 or 3 unless the development meets any of the exemption criteria below.

4 Exemptions

Exemption criteria:

a. the proposed development is outside the 800m radius from the stack (Attachment 1)

b. the proposal is for a change of use for commercial or industrial premises

c. the proposal is for alterations or additions to existing residential, industrial and commercial premises where the building floor area and building heights are not increased or altered

d. if the property is within the 800m radius of the Sirius Road stack:

    1. the building height of proposed new work is less than or equal to 13m (AHD 42)

    2. the building is located at a distance from the Sirius Road stack greater than five times the building height (when measured from the reference elevation level of 29m Australian Height Datum (AHD)

e. if the property is within the 800m radius of the Marden Street stack:

    1. the building height of the proposed new work is less than or equal to 24m (AHD 98)

    2. the building is located at a distance from the Marden Street stack greater than five times the building height (when measured from the reference elevation level of 74m AHD)

If the building is permitted under the decision tree assessment, no further action is needed unless Willoughby City Council considers a site specific investigation is necessary. The details showing that this process has been done are to be included with the development application.

A site specific investigation may be required due to the limitations of the decision tree process which applies more to isolated buildings and replacement of existing structures. For example, two or more new adjacent buildings that are larger than the existing buildings may together change the dispersion of the plume through building wake effects and need further investigation. Buildings of unusual shape or materials may also need further investigation.

5 Site specific investigation for non-exempt development based on the decision tree assessment

If a site specific investigation is required, this should be done by an appropriately qualified consultant. The consultant should first investigate that:

a. occupants of the proposed building would not be exposed to pollutant concentrations that exceed air quality objectives

b. the building wake from the proposed building under any wind conditions would not interact with the vent stack plume and reduce the effectiveness of the vent stack

Site specific investigations should then consider:

c. the detailed geometry of the proposed building

d. any changes to ambient air quality at the location of the proposed development

e. any changes to the vent stack pollutant emission rates

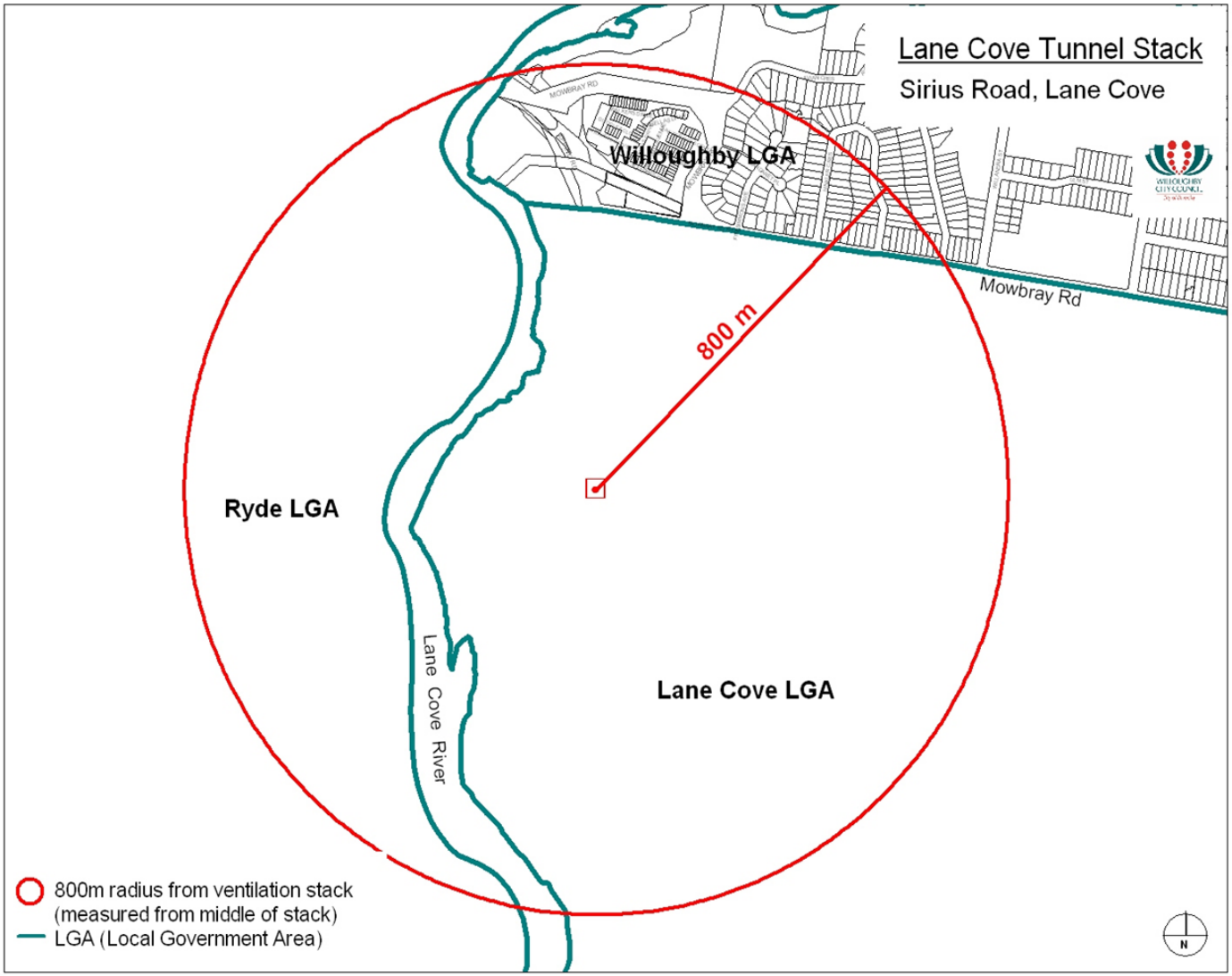
f. cumulative changes to the built form array around the ventilation stacks that may have altered the wind dispersion climate experienced by the Lane Cove Tunnel vent stacks

If the investigations show that the proposal is still marginal, physical scale modelling or computational fluid dynamic (CFD) modelling may be needed. This will more accurately determine if a new building development will satisfy the purpose of the control.

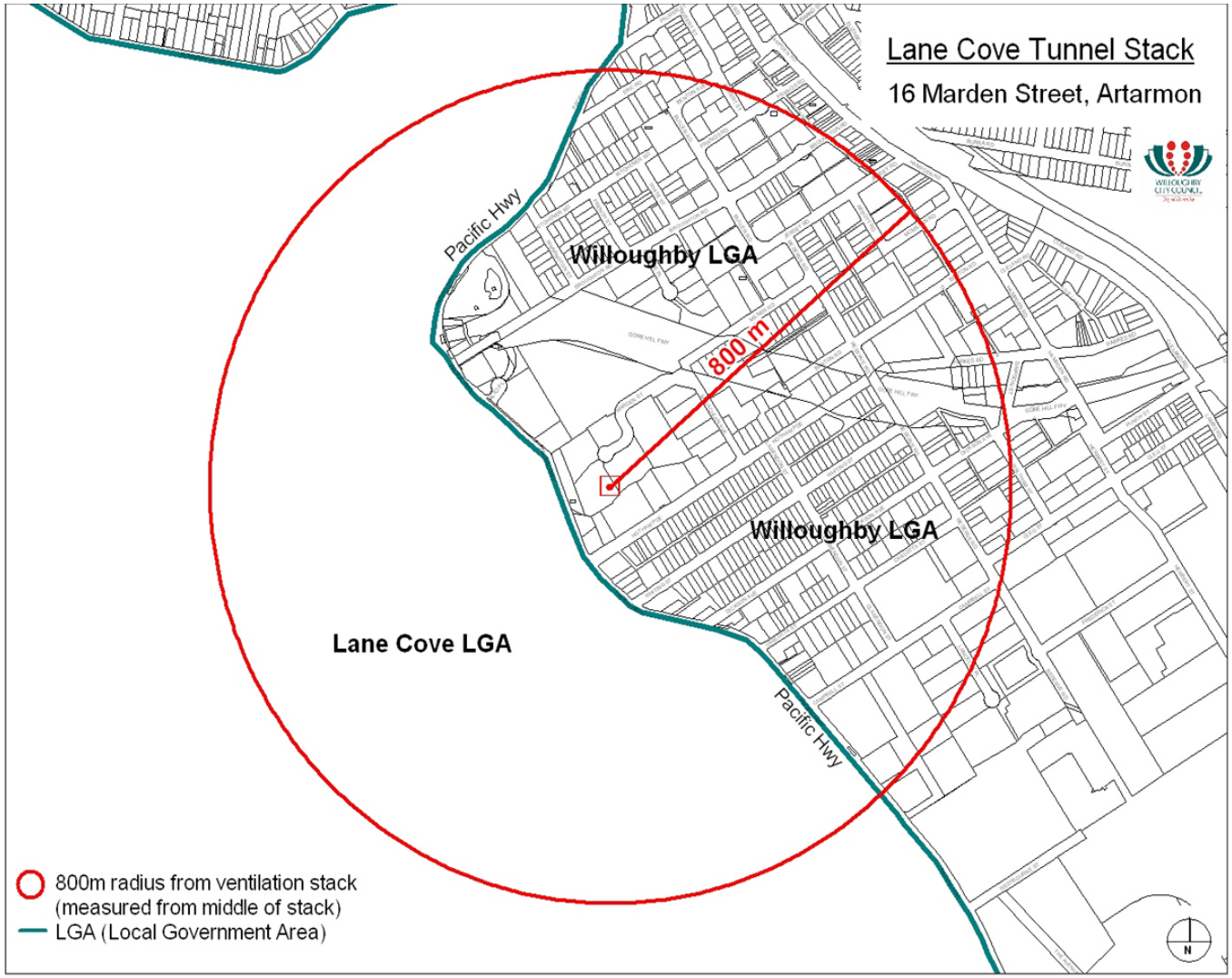
At the time of assessment the current up to date published methodologies should be used.

Attachment 1 – Maps of the Lane Cove tunnel ventilation stacks

Map A Lane Cove tunnel stack, Sirius Road, Lane Cove



Map B Lane Cove tunnel stack, 16 Marden Street, Artarmon



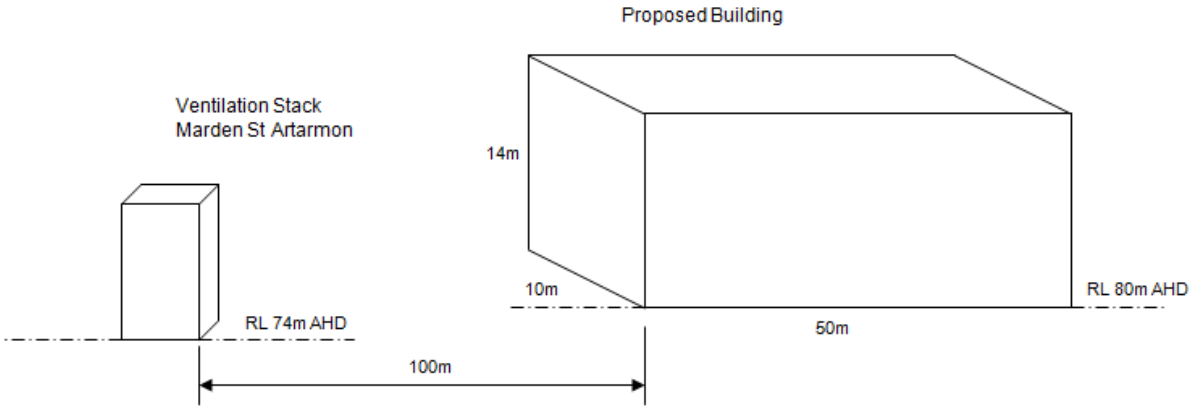
Attachment 2 – Assessment procedure for building height wake/plume interaction with Marden Street vent stack

Table 1 Procedure to assess the building height wake/plume interaction with Marden Street ventilation stack

Step	Task description	Action
Step 1	Measure the distance (Rb) from the Marden vent stack to the leading edge of the proposed building. If Rb > 800m	No height constraint
Step 1	If Rb ≤ 800m	Go to step 2
Step 2	Determine the proposed building height (Hb) measured from the ground level elevation at the base of the Marden stack (reference level of 74m AHD). If Hb ≤ 24m	Building permitted
Step 2	If Hb > 24m	Go to step 3
Step 3	On a site plan measure the projected building width (Wb) perpendicular to the line joining the building to the Marden vent stack.	Go to step 4
Step 4	Calculate the building aspect ratio A = Hb ÷ Wb Let A = 1 if Hb < Wb, that is if building width is greater than building height	Go to step 5
Step 5	Calculate the wake constraint height (Hwake) control using the trigger level curve and compare it to the proposed building height (Hb). Hwake = 0.2 × A × Rb If Hb ≤ Hwake	Go to step 6
Step 5	If Hb > Hwake	Reduce building dimensions (Wb or Hb) or go to step 7
Step 6	Calculate the plume constraint height (HT) at distance Rb from the limiting curve and compare it with the proposed building height (Hb). If Rb > 270m	Building permitted
Step 6	If Rb < 270m use plume constraint equation HT = (Rb + 90) ÷ 3 and compare Hb to HT. If Hb ≤ HT	Building permitted
Step 6	If Hb > HT	Reduce height (Hb) or go to step 7
Step 7	Detailed site-specific investigation required for the proposed building.	Contact an appropriately qualified consultant

Marden Street vent stack – example 1

Figure 1 Example 1 of proposed building interacting with Marden Street vent stack



A building that is 14m tall and 10m wide by 50m long (squat building) is proposed at a site located 100m to the east of the Marden Street stack on Hotham Parade. The reference level (RL) at the base of the proposed building is around 80m AHD.

Note:

- The RL ground elevation at the base of the Marden Street stack is 74m AHD. We need to determine RL of building at ground elevation (in this example we are using 80m AHD).

Using the table for building height wake/plume interaction with Marden Street vent stack the assessment steps are:

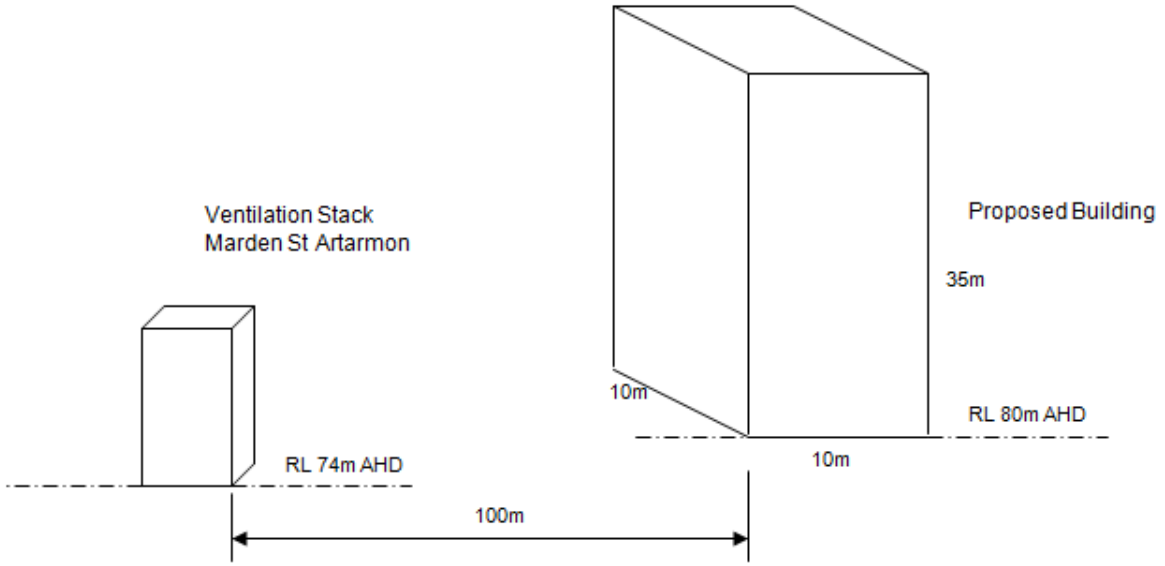
Table 2 Building height/wake plume assessment for Marden Street vent example 1

Step	Task description	Example 1	Action
Step 1	Measure the distance (Rb) from the Marden vent stack to the leading edge of the proposed building. Check if Rb ≤ 800m	Rb = 100m, therefore Rb < 800m	Go to step 2
Step 2	Determine the proposed building height (Hb) measured from the ground level elevation at the base of the Marden stack (reference level of 74m AHD)	Hb = height of building on plan - (Stack RL - Building RL) Hb = 14 – (74 - 80) Hb = 14 - (-6) Hb = 20m above elevation at stack base	As Hb ≤ 24m the building is permitted.

Therefore, in this example the building is permitted without further investigation. The building satisfies both the building wake constraint and the pollution plume constraint.

Marden Street vent stack – example 2

Figure 2 Example 2 of proposed building interacting with Marden Street vent stack



A building that is 35m tall and 10m wide by 10m long (tall building) is proposed at a site 100m to the east of the Marden Street stack on Hotham Parade. The reference level (RL) at the base of the proposed building is around 80m AHD.

Note:

- The RL ground elevation at the base of the Marden Street stack is 74m AHD. We need to determine RL of building at ground elevation (in this example we are using 80m AHD).

Using the table for building height wake/plume interaction with Marden Street vent stack the assessment steps are:

Table 3 Building height/wake plume assessment for Marden Street vent example 2

Step	Task description	Example 2	Action
Step 1	Measure the distance (Rb) from the Marden vent stack to the leading edge of the proposed building. Check if Rb ≤ 800m	Rb = 100m, therefore Rb < 800m	Go to step 2
Step 2	Determine the proposed building height (Hb) measured from the ground level elevation at the base of the Marden stack (reference level of 74m AHD)	Hb = height of building on plan - (Stack RL - Building RL) Hb = 35 - (74 - 80) Hb = 35 - (-6) Hb = 41m above elevation at stack base	Go to step 3 as Hb > 24m

Step	Task description	Example 2	Action
Step 3	On a site plan measure the projected building width (Wb) perpendicular to the line joining the building to the Marden vent stack.	In this example Wb = 10m	Go to step 4
Step 4	Calculate the building aspect ratio A = Hb ÷ Wb Let A = 1 if Hb < Wb	A = Hb ÷ Wb A = 41 ÷ 10 = 4.1	Go to step 5
Step 5	Calculate the wake constraint height (Hwake) control using the trigger level curve and compare it to the proposed building height (Hb) Hwake = 0.2 × A × Rb	Hwake = 0.2 × A × Rb Hwake = 0.2 × 4.1 × 100 = 82m Hb = 41m from step 2 Therefore Hb ≤ Hwake and the building satisfies the wake constraint	Go to step 6 as Hb ≤ Hwake
Step 6	Calculate the plume constraint height (HT) at distance Rb from the limiting curve and compare it with the proposed building height (Hb):	Given distance from stack Rb < 270m use the plume constraint equation HT = (Rb + 90) ÷ 3 HT = (100 + 90) ÷ 3 = 63m Hb = 41m Therefore Hb < HT and the building satisfies the plume constraint	Building permitted

If Hb was greater than Hwake or HT in the steps 5 or 6 above the wake constraint or plume constraint would not be satisfied and the dimensions of the proposed building would need to be reduced until compliance was achieved. Otherwise, further investigations must be conducted to determine if the proposed building can be permitted.

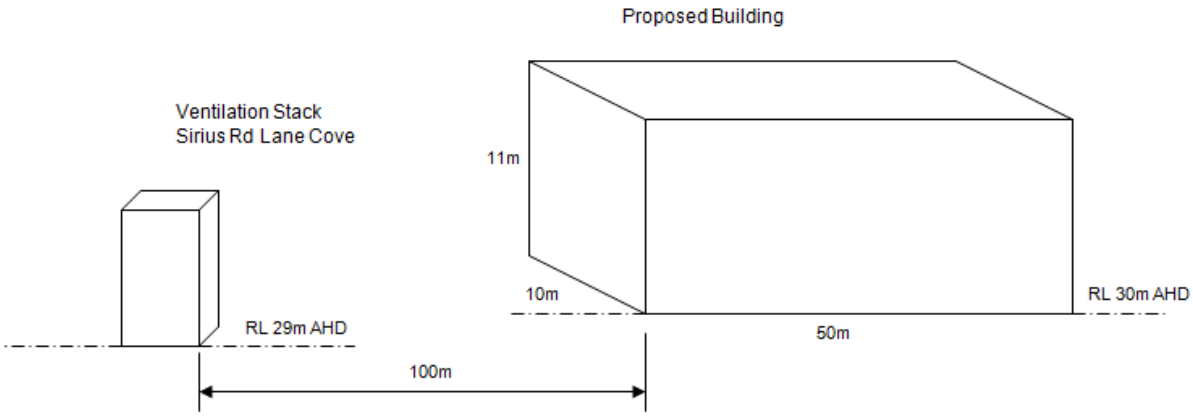
Attachment 3 – Assessment procedure for building height wake/plume interaction with Sirius Rod vent stack

Table 4 Procedure to assess the building height wake/plume interaction with Sirius Road ventilation stack

Step	Task description	Action
Step 1	Measure the distance (Rb) from the Sirius vent stack to the leading edge of the proposed building. If Rb > 800m	No height constraint
Step 1	If Rb ≤ 800m	Go to step 2
Step 2	Determine the proposed building height (Hb) measured from the ground level elevation at the base of the Sirius stack (reference level of 29m AHD). If Hb ≤ 13m	Building permitted
Step 2	If Hb > 13m	Go to step 3
Step 3	On a site plan measure the projected building width (Wb) perpendicular to the line joining the building to the Sirius vent stack.	Go to step 4
Step 4	Calculate the building aspect ratio A = Hb ÷ Wb Let A = 1 if Hb < Wb	Go to step 5
Step 5	Calculate the wake constraint height (Hwake) control using the trigger level curve and compare it to the proposed building height (Hb). Hwake = 0.2 × A × Rb If Hb ≤ Hwake	Go to step 6
Step 5	If Hb > Hwake	Reduce building dimensions (Wb or Hb) or go to step 7
Step 6	Calculate the plume constraint height (HT) at distance Rb from the limiting curve and compare it with the proposed building height (Hb). If Rb > 150m	Building permitted
Step 6	If Rb < 40m, HT = 20m If 40m ≤ Rb < 120m, HT = 0.5 × Rb If 120m ≤ Rb < 150m, HT = 2 × (Rb - 90) Compare Hb to HT. If Hb ≤ HT	Building permitted
Step 6	If Hb > HT	Reduce height (Hb) or go to step 7
Step 7	Detailed site-specific investigation required for the proposed building.	Contact an appropriately qualified consultant

Sirius Road vent stack – example 1

Figure 3 Example 1 of proposed building interacting with Sirius Road vent stack



A building that is 11m tall and 10m wide by 50m long (squat building) is proposed at a site located 100m to the east of the Sirius Road stack. The reference level (RL) at the base of the proposed building is around 30m AHD.

Note:

- The RL ground elevation at the base of the Sirius Road stack is 29m AHD. We need to determine RL of building at ground elevation (in this example we are using 30m AHD).

Using the table for building height wake/plume interaction with Sirius Road vent stack the assessment steps are:

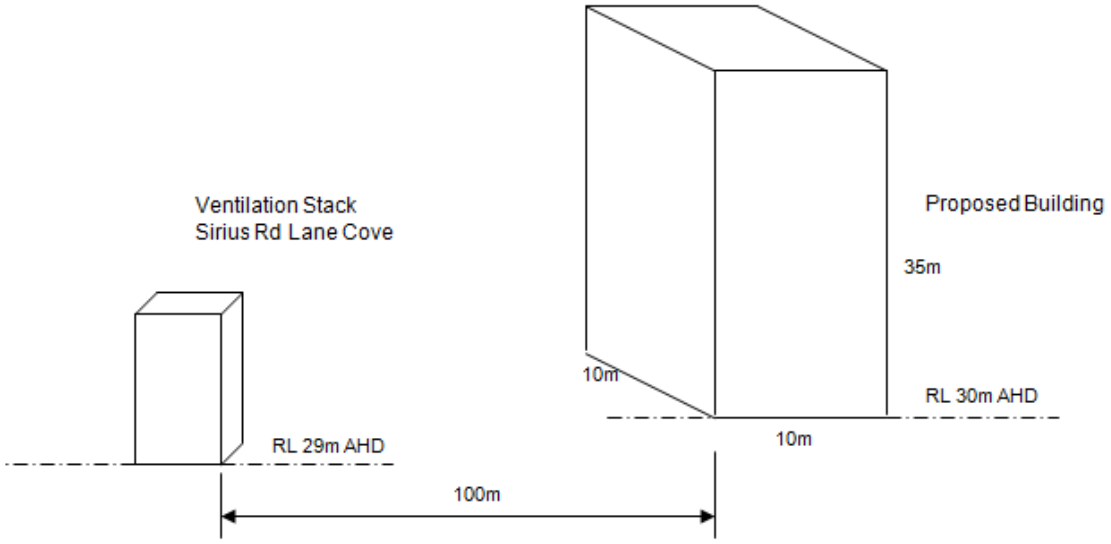
Table 5 Building height/wake plume assessment for Sirius Road vent example 1

Step	Task description	Example 1	Action or result
Step 1	Measure the distance (Rb) from the Sirius vent stack to the leading edge of the proposed building. Check if Rb ≤ 800m	Rb = 100m, therefore Rb < 800m	Go to step 2
Step 2	Determine the proposed building height (Hb) measured from the ground level elevation at the base of the Sirius stack (reference level of 29m AHD)	Hb = height of building on plan - (Stack RL - Building RL) Hb = 11 - (29 - 30) Hb = 11 - (-1) Hb = 12m above elevation at stack base	As Hb ≤ 13m the building is permitted.

In this example the building is permitted without further investigation. The building satisfies both the building wake constraint and the pollution plume constraint.

Sirius Road vent stack – example 2

Figure 4 Example 2 of proposed building interacting with Sirius Road vent stack



A building that is 35m tall and 10m wide by 10m long (tall building) is proposed at a site located 100m to the east of the Sirius Road stack. The reference level (RL) at the base of the proposed building is around 30m AHD.

Note:

- The RL ground elevation at the base of the Sirius Road stack is 29m AHD. We need to determine RL of building at ground elevation (in this example we are using 30m AHD).

Using the table for building height wake/plume interaction with Sirius Road vent stack the assessment steps are:

Table 6 Building height/wake plume assessment for Sirius Road vent example 2

Step	Task description	Example 2	Action or result
Step 1	Measure the distance (Rb) from the Sirius vent stack to the leading edge of the proposed building. Check if Rb ≤ 800m	Rb = 100m, therefore Rb < 800m	Go to step 2
Step 2	Determine the proposed building height (Hb) measured from the ground level elevation at the base of the Sirius stack (reference level of 29m AHD)	Hb = height of building on plan - (Stack RL - Building RL) Hb = 35 - (29 - 30) Hb = 35 - (-1) Hb = 36m above elevation at stack base	Go to step 3 as Hb > 13m

Step	Task description	Example 2	Action or result
Step 3	On a site plan, measure the projected building width (Wb) perpendicular to the line joining the building to the Sirius vent stack.	Measure the projected building width (Wb). In this example Wb = 10m	Go to step 4
Step 4	Calculate the building aspect ratio A = Hb ÷ Wb Let A = 1 if Hb < Wb	A = Hb ÷ Wb A = 36 ÷ 10 = 3.6	Go to step 5
Step 5	Calculate the wake constraint height (Hwake) control using the trigger level curve and compare it to the proposed building height (Hb) Hwake = 0.2 × A × Rb	Hwake = 0.2 × A × Rb Hwake = 0.2 × 3.6 × 100 = 72m Hb = 36m from step 2 Therefore Hb ≤ Hwake and the building satisfies the wake constraint	Go to step 6 as Hb ≤ Hwake
Step 6	Calculate the plume constraint height (HT) at distance Rb from the limiting curve and compare it with the proposed building height (Hb)	Given distance from stack Rb < 120m we need to use the plume constraint equation HT = 0.5 × Rb HT = 0.5 × 100 = 50m Hb = 36m Therefore Hb < HT and the building satisfies the plume constraint	Building permitted

If Hb was greater than Hwake or HT in the steps 5 or 6 above the wake constraint or plume constraint would not be satisfied and the dimensions of the proposed building would need to be reduced until compliance was achieved. Otherwise, further investigations need to be done to determine if the proposed building can be permitted.