Guidance for field odour surveillance

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Contents

1. Purpose, background and scope

Odour surveillance is used to evaluate the extent, source and frequency of odour emissions. This guide provides a recommended approach for conducting odour surveillance. The methods in this guide can be used by regulators of odour, applicants for Environment Protection Authority Victoria (EPA) or council permissions, planning professionals and consultants.

EPA devised these odour surveillance methods for compliance and investigation purposes. EPA has also used these methods in monitoring programs to obtain general information about odour sources.

This guide:

- incorporates odour surveillance methods, including area surveys, line (or transect) surveys and plume tracing
- provides instructions for gathering evidence when making odour observations
- allows data collected using these methods to be used as part of an overall odour risk assessment.

EPA recommends odour surveillance is used to understand odour impacts in an area and to profile odour emissions from specific sources. The evidence gathered during odour surveillance can support odour assessments for industrial odour emissions as set out in *Recommended Separation Distances for Industrial Residual Air Emissions – Guideline* (publication 1518). Evidence from odour surveillance can also be used to assess threshold distances as set out in Victorian Planning Provisions 53.10 – Uses with adverse amenity potential.

The methods in this guide do not provide guidance on how to assess the overall risk of harm posed by odour but will assist in gathering data in a consistent way using odour surveillance. This is covered in EPA's *Guidance for Assessing Odour* (publication 1883).

Throughout this guide, terms highlighted using bold text are described in the Glossary (section 6).

1.1 Legal status of this guide

While this guide provides a recommended approach to odour surveillance in the field, the methods are not mandatory requirements for those conducting field odour surveys. We encourage assessors to consider the selection of odour surveillance method(s) on a case-by-case basis.

Odour surveillance or campaigns generally follow the steps in Figure 1.

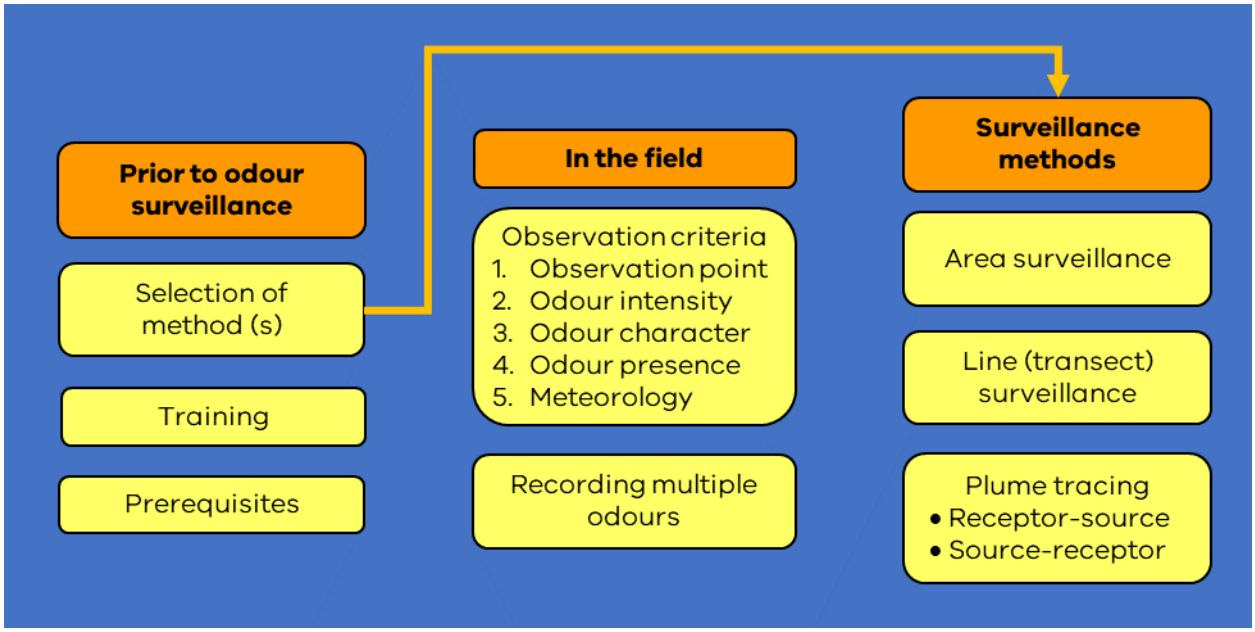

Figure 1: Steps in odour surveillance

This guide has been structured around the steps shown in Figure 1.

- Section 2 covers the work needed prior to field surveillance, including selection of method, training and pre-requisites for surveillance
- Section 3 covers field work: odour observations and record-keeping, as well as meteorology
- Sections 4.1, 4.2 and 4.3 cover area surveillance, line surveillance and plume tracing, respectively
- Section 5 covers data recording.

2. Prior to field surveillance

2.1. Selection of method

The selection of surveillance method depends on the purpose of the odour surveillance. This purpose can include:

- **investigation and compliance:** This could be in response to community reports or to monitor performance of odour controls, or to assess odour emission sources at a site
- **source identification:** Examination of a site, area or location to determine odour sources
- **assessment of separation distances or buffers:** Including variation of separation distances or determining buffer requirements for a site.

The choice of surveillance method also depends on the nature of the odour sources under investigation, including:

- single ground-level sources
- single elevated sources
- multiple sources on a single site
- multiple sites in a cluster
- multiple sites that are spread out.

The methods described in this guide (summarised here) provide three main approaches to odour surveillance:

- **area surveillance** (Section 4.1): Used when there are several odour sources and/or sources are not well understood.
- **Line (or transect) surveillance** (Section 4.2): Used where there are multiple sources of odour (on a single site or industrial zone), and there is a boundary or interface such as a street or fenceline where odour sources are on one side and sensitive uses are on the other. A set of observations is completed in a line perpendicular to the boundary or interface downwind from the sources. This becomes transect surveillance when repeated in parallel lines further from the source.
- **Plume tracing** (Section 4.3): Used to determine the length, width and area of an odour plume for a single-odour source. This can be done in two ways: working from the odour source out towards the receiving environment or working from receiving environment in towards the source.

Figure 2 provides an illustration comparing the type of study desired and the recommended odour method to use.

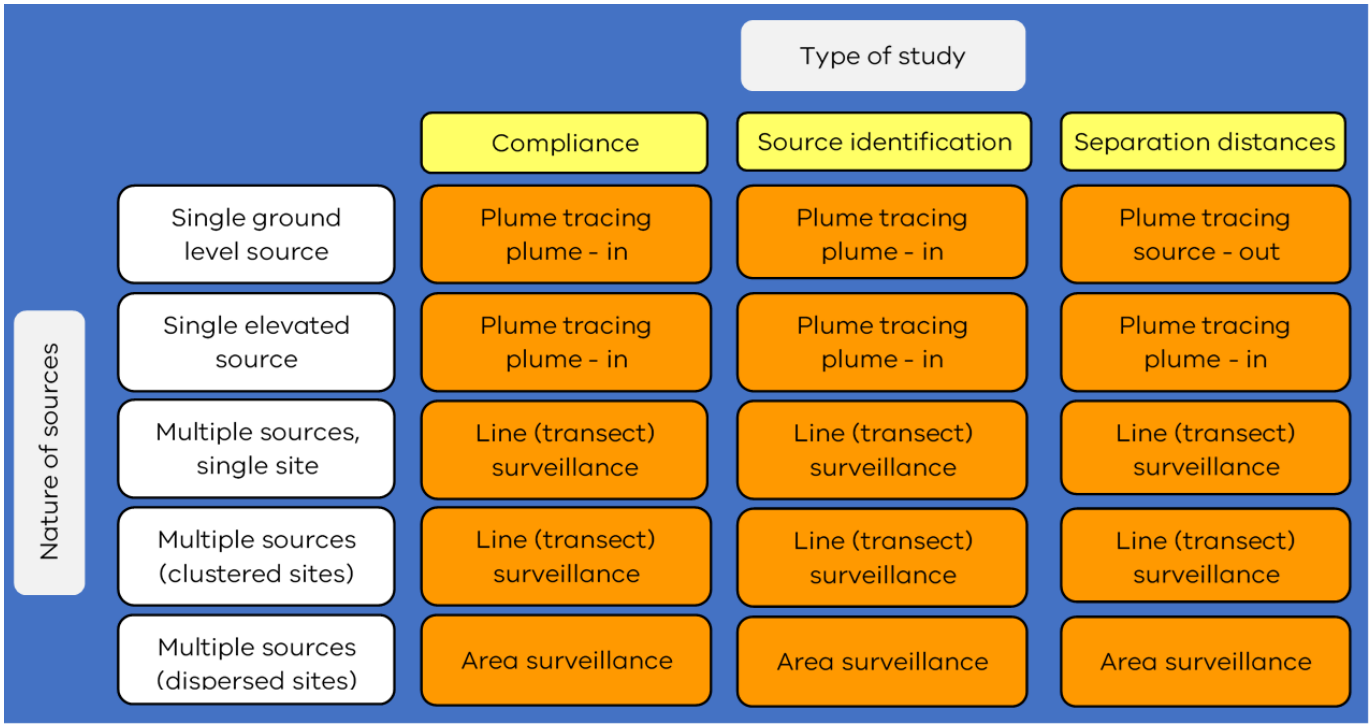

Figure 2: Decision guide of odour surveillance method

There are training, prerequisites and techniques that are common to all surveillance methods. These are detailed in the Sections 2.2, 2.3 and Section 3.

2.2. Training

Experienced staff with knowledge of the location, the sources of odour in the area, and/or activities under investigation should be used to conduct odour assessor training.

Newly trained staff should complete a first round of surveillance with an experienced staff member. This surveillance should be in the area under study, using the chosen odour surveillance method. The experienced staff member accompanying the trainee will provide instruction on local conditions or known sources prior to the trainee assessor conducting surveillance independently. In addition, before commencing field odour surveillance works, it is recommended that assessors are familiar with various industrial odour sources in the area under consideration.

2.3. Prerequisites

Prior to participating in odour surveillance, assessors should:

- be screened on an odour panel in accordance with *AS/NZS: 4323.3:2001 'Stationary source emissions – determination of odour concentration by dynamic olfactometry'*
- be rescreened periodically – at least every two years[1]
- refrain from smoking, eating, and drinking, apart from water, for at least one hour before conducting odour surveillance
- not wear strong smelling cosmetics, perfumes or other odourous substances
- not have a blocked nose or illness or other impairment, such as hay fever, that would affect the odour measurement
- avoid exposure to strong odours or work in an odorous environment before doing odour surveys.

3. In the field

Odour assessors should record odour observations for each odour investigation using the objective criteria set out below:

1. Observation point.
2. Odour intensity.
3. Odour character.
4. Odour presence (for stationary methods).
5. Meteorological conditions, including wind speed[2], wind direction[3], temperature, humidity and cloud cover.

A description of criteria 1 to 5 is provided in the sections below.

3.1. Observation point

The location of each observation point needs to be recorded. This is the location at which an odour observation is made. It will be necessary to record this differently depending on the type of surveillance, as described below.

For **area surveillance**, the observation point can be recorded by filling out a form with predetermined locations or using a GPS mapping tool on a mobile device and/or annotating a printed map. An example of a field sheet for this type of surveillance is in Appendix A

Line surveillance can involve both discrete observation points and observations of plume width depending on the type of sources under investigation. There is more about this in Sections 4.2 and 4.3. An example survey sheet that may be used for these observations is in Appendix A.

With **plume tracing** the assessor identifies the points at which the plume is encountered, again via a map, form or GPS, while moving and following the plume. The primary difference is that the assessor is only stopping briefly to make observations and record the location before moving across the plume.

3.2. Odour intensity

The odour intensity criteria described in this guide are based on how easy it is to recognise an odour. The criteria for ascribing odour intensity levels are defined in Table 1.

Table 1: Determination of odour intensity

Descriptor	Description
Obvious (O)	Odour is easily recognised, can be described and may be attributed to a source. The assessor can smell it without any effort or focus on it.
Subtle (S)	Odour can be recognised only when focusing. For example, by standing still, inhaling slowly and concentrating.
No Odour (N)	No odour, or odour is not strong enough to be recognised.

An obvious odour can generally be considered a threshold at which community is likely to complain about an odour. EPA's experience of field odour surveillance has shown that if an assessor can easily identify an odour, it will also be easy for another person to recognise the odour, and hence generate complaints.

A recognisable subtle odour is less likely to generate complaints unless it occurs very regularly, and the odour has a character that people tend to associate with risks to health or safety. For example, gassy, chemical or sewage odours.

3.3. Odour character

EPA recommends developing and using a discreet series of odour descriptors for each surveillance campaign. This helps with consistency between individual assessors when attributing character to observed odour. EPA uses the odour wheel in Figure 3 to classify odour character in the field. There are many other odour wheels[4, 5, 6] that have been produced by universities and consultants that have been published and may be suitable for different applications.

It is important to note that determination of odour character is not an assessment of the offensiveness of an odour. Rather, odour characterisation is a means to determine odour sources and describe odour in a consistent way. Assessors are actively discouraged to make judgements in the field as to whether an odour is offensive or not. Instead, assessment of odour is made according to its likelihood to cause offence, but this is a more detailed process. Refer to *Guidance for Assessing Odour* (publication 1883) for further information.

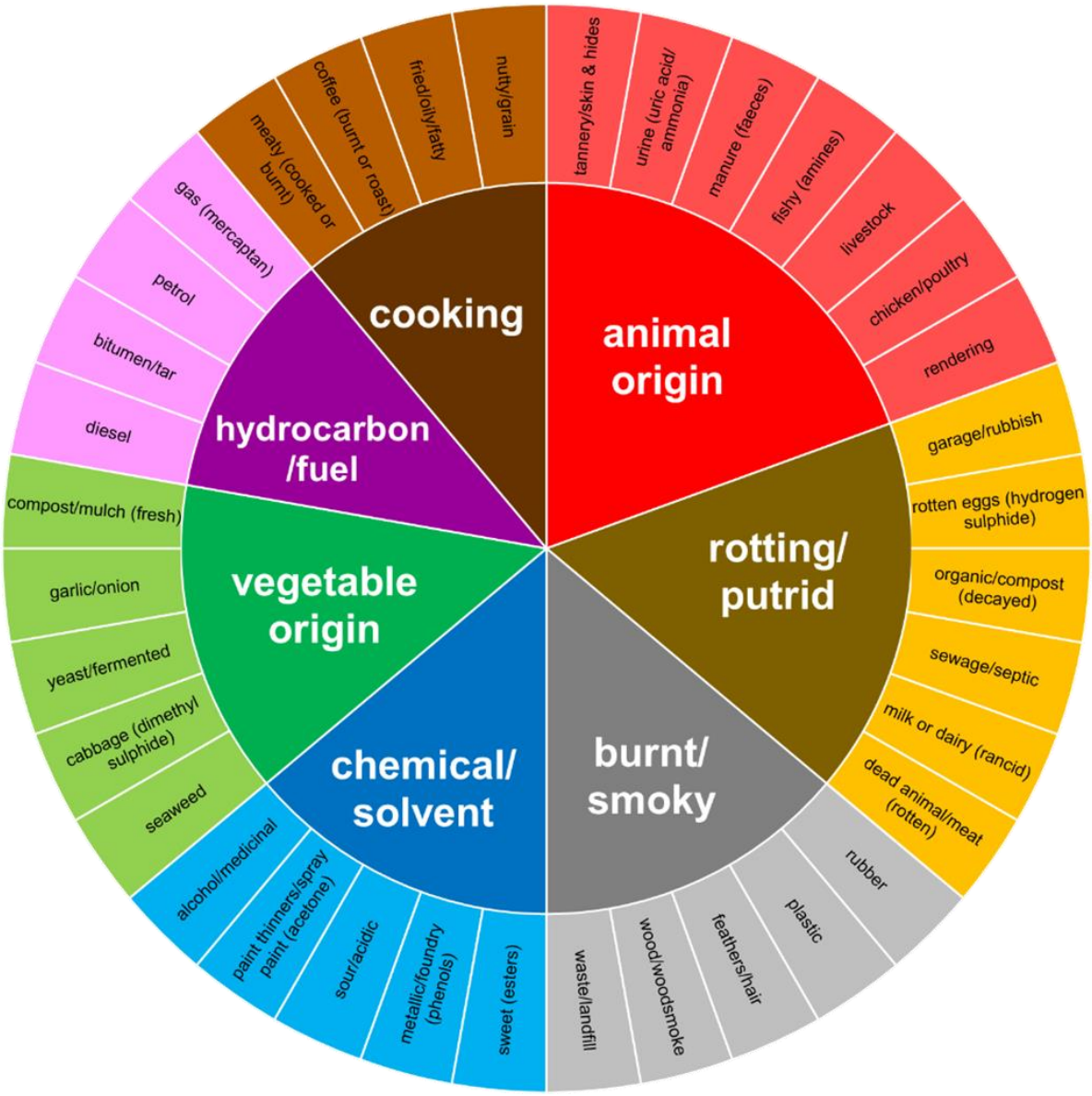

Figure 3: EPA's odour wheel with **odour character** descriptors.

3.4. Odour presence

Odour presence is an assessment of how often an odour can be smelt during an odour observation. It therefore determines the proportion of time an odour is present during a single odour observation. EPA recommends assessing odour presence during each odour observation.

Odour presence during an observation is needed to later analyse the odour data. The length of time recommended for an odour observation is a minimum of five minutes. During this observation, the assessor observes the odour continuously while taking meteorological measurements.

For example, the odour may present for short periods, coming and going with gusts of wind, or it could be present the whole observation period. Table 2 gives three categories of odour presence. The percentages represent the cumulative duration of the odour being recognised over the period of an odour observation.

Table 2: Odour presence descriptors

Descriptor	Rating.	Description of odour presence
Constant	C	Can smell it constantly or almost constantly (> 80% of the time).
Frequent/Repetitive	F	On and off extended periods with recognised odour (10–80% of the time).
Transient	T	On and off with significant periods with no odour or no recognised odour (< 10% of the time).

Odour presence is not recorded for plume tracing methods as in these cases the observer is continually moving, following the plume; in effect establishing where the odour is constant.

3.5. Meteorology

Wind speed and direction ideally should be determined at unobstructed points throughout the survey. At the very minimum, measurements should be taken:

- at the beginning of surveillance
- at the end of the surveillance
- if there are any significant wind changes during the survey.

Meteorological data obtained in the field should be cross-referenced with data obtained from other resources, such as the Bureau of Meteorology. Good meteorological data aids in the later analysis of the data and determining the sources of the odour.

It is good practice to assess wind speed with a hand-held anemometer. Where possible, assess wind speed in representative locations that are open and free of obstructions. Wind speed should be recorded as an average over the time an odour observation is made. This is to account for wind gusts and changes in wind direction.

A compass can be used to determine wind direction at an open location. Wind direction and wind speed should be recorded at the same location and same time. An analogue compass is preferable to mobile phone apps, as the latter can occasionally give inaccurate compass directions. When measuring wind direction, the following should be noted:

- structures and local topography can affect wind direction
- wind direction may behave differently to the general local weather pattern
- wind direction may change during an odour surveillance
- when using a compass, you are measuring magnetic north. True north will be different depending on your location. This is between 10 and 13 degrees in Victoria.

Use Bureau of Meteorology data (or equivalent) to verify hand-held measurements.

Wind speed and direction can be measured at locations other than observation points if it is more practicable to do so and more representative measurements can be made.

For recording temperature, use a thermometer or local meteorological data to determine the temperature at the start and end of odour surveillance. It is a good idea to also record relative humidity, cloud cover and details of mixing heights at the same time as temperature is recorded.

3.6. Recording observations of multiple odours or intensity

During a single odour observation, **odour presence**, intensity and, occasionally, odour character can vary. This section provides guidance on how **odour observations** can be recorded.

Steps:

1. Determine and record the first **odour character**. This is classified as 'odour A'.
2. Record the intensity of odour A (subtle or obvious).
3. Record the presence for odour A (constant, transient or frequent).
4. If no other odour is observed move to next **observation point.**
5. If there are other odour(s), determine and record the next odour. This is classified as 'odour B' and record the odour as per steps 2 and 3.
6. If **odour intensity** changes, record it as a separate entry in the column for Odour Character B and note the frequency (**Odour Frequency B**) at the different intensity (see entry at 12:20 in Figure 4).
7. Continue this process until all odour characters are recorded (odours C, D, etc.)

If there is more than one odour, 'odour A' must be the odour with highest (or equal) intensity, and the greatest (or equal) presence. Odour B should have the next most intensity and presence, followed by odour C, and so on. See Figure 4 for an example survey sheet.

Start time	Stop time	Observation point	Odour character			Odour intensity (O/S)			Odour presence (C/F/T)		
			A	B	C	A	B	C	A	B	C
12:10	12:15	R1, Pine St	rotten compost	rendering	manure	O	O	S	C	C	F
12:20	12:25	R2, Cone Ave	fresh compost	fresh compost	-	O	S	-	T	F	-
12:30	12:35	R3, Jones Park	manure	urine	-	O	S	-	C	F	-

Figure 4: Sample field odour survey sheet filled in (see Appendix A for a blank template)

The data gathered from this observation process may then be used to determine odour frequency and duration (see EPA publication 1883 for further details on odour assessment).

4. Surveillance methods

The different methods for field odour surveillance developed by EPA are described in this section. These include area surveillance, line (or transect) surveillance and plume tracing. The following sections describe these three methods.

4.1. Area surveillance

In the area surveillance method, assessors patrol a predetermined route and make odour observations at set observation points. Odour observations should be made for at least five minutes while breathing normally. It is recommended that observation points are chosen that:

- cover a range of distances from sources
- are in sensitive-use areas
- are inside and at the boundaries of odour generating activities
- are in areas upwind of sources at different times.

A range of location aids should be used in identifying and attributing an odour's source. This also ensures good spatial coverage of the area impacted by the odour.

It is important that the area odour assessment is performed at the same locations for every survey. This allows the assessor to determine the statistical contribution of odour from sources under investigation, or in a specific area.

Observation points should be pre-set to consider the impact zones of odour complaints, if known, and have a good spatial distribution, depending on the size of the survey area. At each point in the survey the assessor records the parameters listed in Section 3, according to the general guidance. Figure 5 provides an example of an **area odour survey** route.

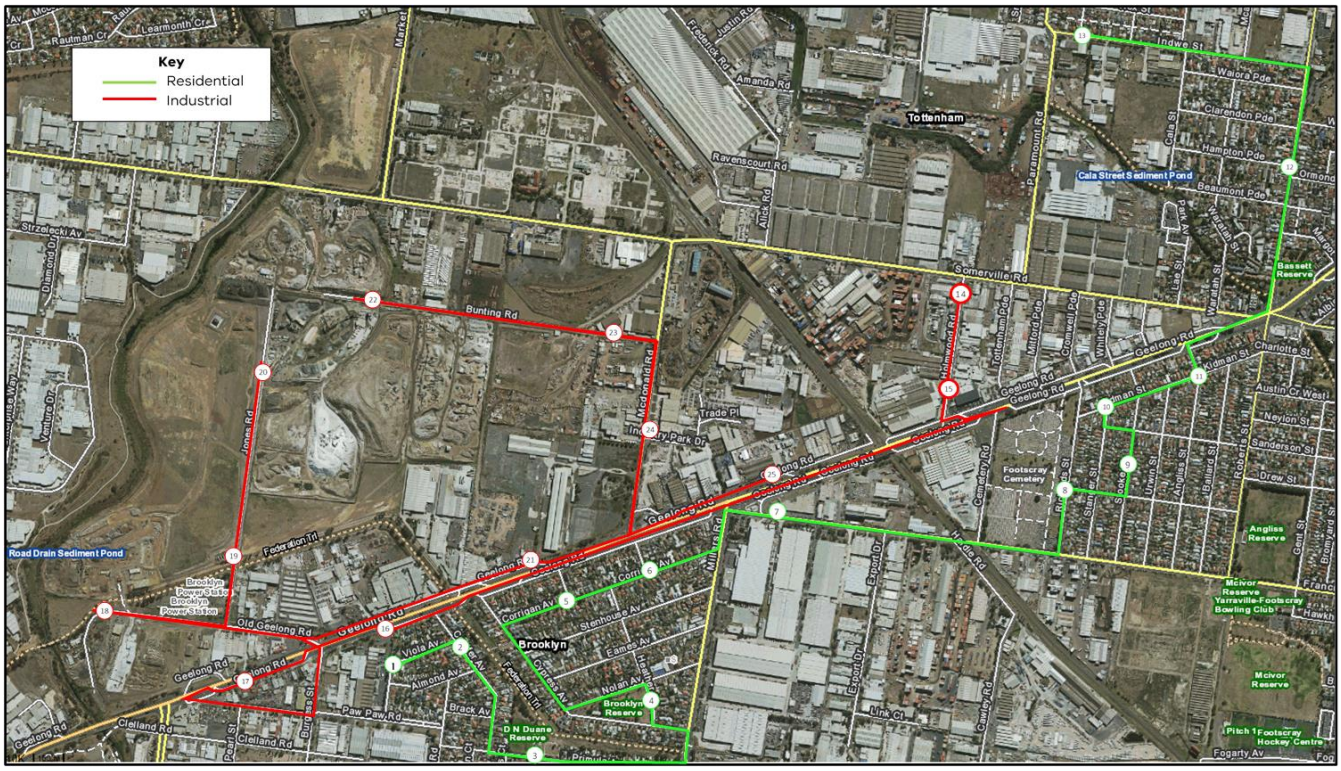

Figure 5: Example of an area odour survey route

An **area odour survey** should be repeated a minimum of 13 times over a period of at least two months. This is to allow for occurrences of the worst odour conditions, and ideally should cover the broadest possible range of weather conditions. Preferable survey durations are 26 surveys over six to 12 months.

There can sometimes be seasonal factors that mean an odour survey needs to be deferred or repeated, depending on the objectives of the campaign. The time of day also needs to be considered, depending on the purpose of the surveillance surveys and factors such as operating hours.

To obtain a good representation of the frequency of odour impacts, EPA recommends conducting surveys on a one-in-six-day or one-in-three-day schedule, so each day of the week is covered evenly. The density at which observation points are located will vary, according to the size of the area of interest, the time available to conduct surveys and accessibility to observation points.

In the example above, EPA used 24 locations in an area of 5km^2, with a greater number of observation points in nearby residential areas. In this case, EPA had 11 observation points in 0.8 km^2 as the purpose of the study was to track odour sources that were impacting the community from several sources.

Once data is collected, statistical analyses can be performed to determine the:

- characteristics and sources of odour in an area
- relative contribution of odour sources to create an odour profile of the area
- probability of exposure to odour in an area.

Completion of a larger number of surveys covers a greater variety of weather conditions, seasons and operating times. This increases the robustness of analyses performed on the data, leading to higher statistical significance. Refer to *Guidance for Assessing Odour* (publication 1883) for further instruction on how to use data gathered from surveys in a risk assessment of offensive odour.

4.2. Line (transect) surveillance

Line or transect surveillance is the recommended odour surveillance method when there is an interface between sensitive land uses and a single industrial site or sites in an estate or cluster. Line surveillance can also be applied where an odour source or sources only impacts on an area during specific wind conditions, as surveillance can be designed, with some forecasting of weather conditions, on days when the wind is favourable.

Line surveillance may be used to:

- survey the boundary of a site with multiple odour sources as part of regular site monitoring
- survey the interface between a sensitive area and a site or sites with multiple sources of odour during specific wind conditions
- conduct a series of parallel surveys, or transects, to determine relative distance each odour source is emitting to.

Line surveillance can be conducted continuously by foot, only stopping when encountering odours then making observations. It can also be designed with discrete observation points as

with area surveillance. Observation points should be chosen so that the assessor or assessors are positioned downwind from odour sources.

Upwind observations should also be made to rule out or identify other sources upwind of the area under assessment. These points should be along a perpendicular line, with observation points evenly spread apart and preferably positioned downwind from any known sources. There should be an even spread of observation points according to the size of the sources under examination.

Factors such as local topography, access to surveillance points and the type of odour source will influence the location of observation points.

A single transect near to the site boundary or interface between the industrial and residential areas should suffice if the objective is to:

- simply confirm the presence or sources of odours
- check on operational performance (site monitoring) without detailed analysis.

If access is available, these transects can be conducted within the site boundary.

It may also be desirable to conduct line surveillance along other transects for different wind directions as this will enhance source identification.

For more detailed assessments, further transects are completed at increasing distances from sources until no odour is encountered during a transect. These transects can be shorter depending on odours observed during the closer earlier **traverse**.

The following method gives an example of surveillance where it is conducted on foot with multiple transects.

Example method, multiple transects, on foot

First Transect

1. Determine if there is an odour present at the beginning of the transect.
    a. Proceed along the transect until an odour is observed.
    b. Note the character and intensity of the odour. If the **odour intensity** is subtle, continue until the odour intensity becomes obvious then make a note of this in the field sheet. Continue until there is no odour and note this in the field sheet.
    c. If the odour intensity does not become obvious, continue until the odour is no longer present and note this in the field sheet.
    d. Continue the transect, noting any other odours in the same way as steps ‘a’ to ‘c’ above.
    e. If no odour is detected along the transect, and the wind has remained in the same direction there is no need to complete further transects. Otherwise continue to the next transect.

Second Transect

2. The aim now is to confirm the distances to which odours are extending away from the source.
    a. Identify where to start the second transect based on wind and **odour observations** from the first transect.
    b. Proceed to the start of the second transect on foot.
    c. Repeat steps from step ‘a’ above for the second transect.

3. If odour is only observed in a small area (i.e., less than a metre or so along a transect) treat this as a discrete **observation point** and assess the presence of the odour as well.
4. Continue along further transects until the odour is no longer present and note this in the field sheet.
5. During the survey make note of any major changes in weather conditions (i.e., major increase in wind speed or change of wind direction).
6. Only proceed to the next transect if odour was observed on the previous transect.

The odour data captured from the line surveillance method can be used with meteorological data to predict odour impacts in an area. If odour frequency and duration is the objective of the survey, EPA recommends completing a minimum of 10 surveys under a variety of wind conditions.

Line surveillance can also be used to identify the presence of odour plumes and can be combined with the plume tracing methods to identify sources.

For smaller assessments, a complete transect may be completed on foot (inhaling via the mouth between observation points). For longer transects a car is recommended to travel from point to point. An example of a line odour survey is shown in Figure 6 and an example field sheet for use in line or transect surveillance is in Appendix A.

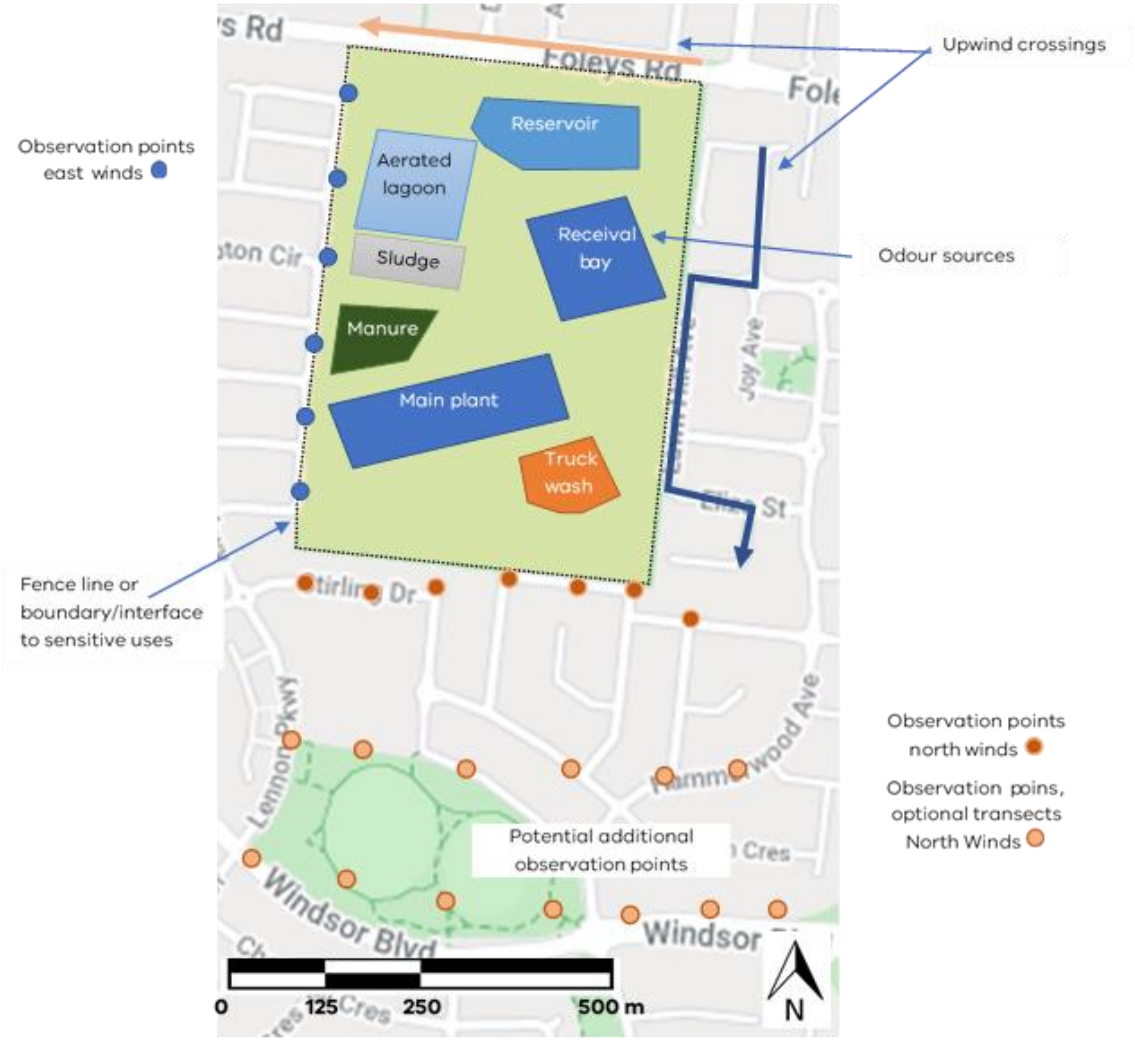

Figure 6: Example survey route: line odour survey (with example transects)

4.3. Plume tracing

Unlike the area and line methods, plume tracing does not use predetermined observation points. Plume tracing is a dynamic method where the shape of the plume is traced in the field by one or more observers crossing the plume in a zig-zag pattern.

Plume tracing presents a significant departure from the area and line methods because odour is assessed continuously as the assessor crosses the odour plume.

A surveillance round typically varies between half an hour and one hour, depending on the size of the plume and the accessibility of the terrain.

Before each round of surveillance, observations upwind of the source should be recorded to determine whether there are other odour sources further upwind. The plume direction is estimated by measuring wind direction (Section 3.5).

Plume tracing is used to assess width, length and area of odour plumes downwind from a source. Surveillance is usually performed on foot. A car[7] may be used to initially locate a plume.

For large sites where odour plumes stretch a kilometre or so, or where public access is limited, the ideal zig-zag pattern will be difficult to achieve. A car can be used to locate observation points and to make an approximate pathway, provided assessors get out of the car to confirm odour.

As it is not always possible to follow the plume, particularly in built-up environments or on private property, aim to intersect the plume wherever possible downwind of the source.

Figure 7 shows an example of a survey conducted in non-ideal locations.

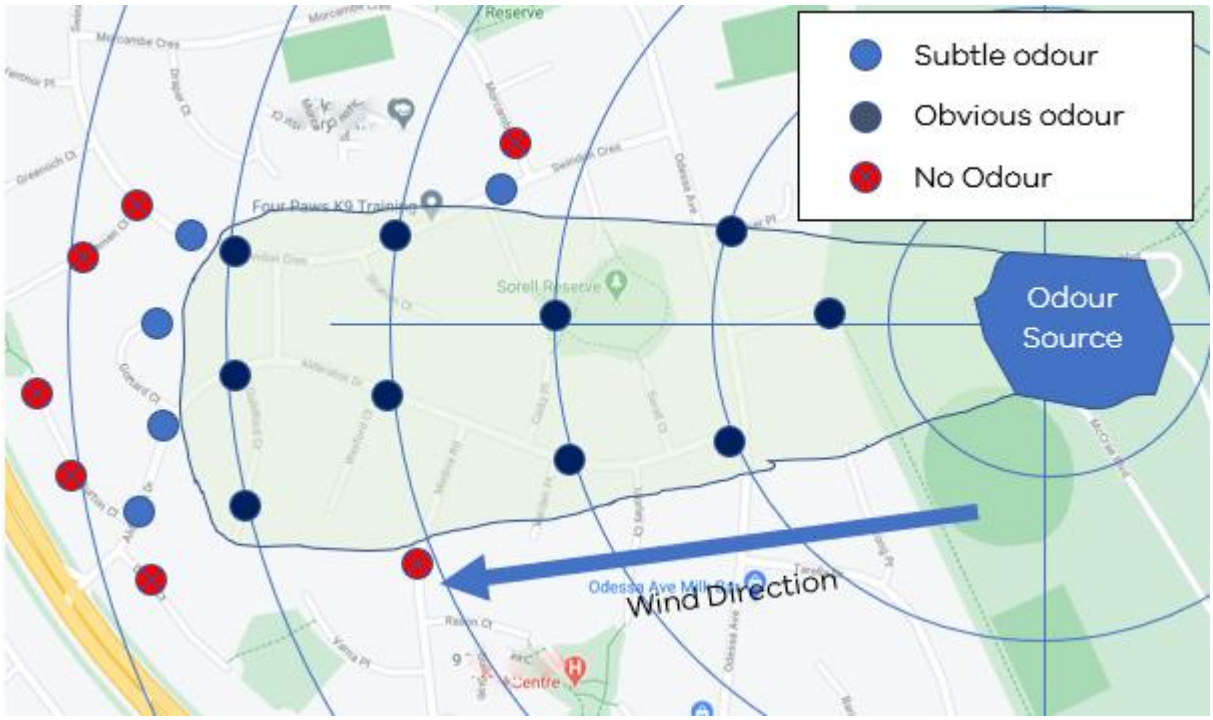

Figure 7: Example of a plume odour trace where car was used to locate the plume and more detailed odour observations made on foot.

4.4. Plume crossing method

There are two plume crossing techniques described in this section:

- **Source to receptor plume tracing**

  Conducted to trace the plume from a known ground level source starting from the source or site boundary and working outwards to the end of the plume.

- **Receptor to source plume tracing**

  Conducted to either:

  a) determine the source of an odour from a community report(s) where the source is unknown, or
  b) trace a plume from the end of the plume back towards the source. This is advised where the odour source is at a height of 10 metres or greater.

The following plume crossing methodology can be used for both source-receptor and receptor-source plume traces:

1. Go to a location upwind of the source prior to monitoring to verify there are no other sources of odour.
2. Begin **crosswind** from the odour source (outside the predicted plume).
3. Record an **odour observation** outside the plume.
4. Proceed in a line parallel to the direction of wind from the source.
5. Record an odour observation when you first encounter a recognised **(subtle) odour intensity**.
6. Continue **crossing** the plume until the odour becomes easily recognised (**obvious) odour intensity** and record another odour observation.
7. Keep observations short (no longer than a few minutes) to minimise your exposure to the odour to avoid desensitisation.
8. Continue crossing the plume sniffing at regular intervals (10 seconds) until odour is no longer observed.
9. Pause to refresh sense of smell.
10. Proceed in the next crossing in a diagonal line (either towards or away from the source depending on the method being used), making observations as before.

4.5. Receptor-source plume trace

This method is used where the source of the odour is at an elevation of around 10 metres or more (at roof level or higher). The receptor-source plume method is also useful when the source is unknown, such as when investigating pollution complaints from the community.

Preparation prior to assessment

Before going into the field for a receptor-source plume trace, it's important to plan your assessment. The method below provides guidance on what preparation is necessary. Figure 8 gives a graphic depiction of a receptor-source plume trace.

1. Prior to starting a plume trace, perform reconnaissance in person or use up-to-date aerial mapping resources. Make visual observations of all safety risks and note features of the environment that need to be investigated.

2. Create a map of the area of investigation with a series of concentric circles centred around the middle of the odour source being assessed. Leave enough space to plot the surveillance route in the field.
3. The spacing of the circles will depend on the size of the source. This be based on the information you gather during reconnaissance (step 1).
4. For a large source (such as landfills, sale yards, etc.) it is recommended to use spacing circles, increasing the radius of the circle by 250 metres each time. For smaller sites, such as small wastewater plants and transfer stations, radial increases of 50 metres should suffice.
5. Divide the circles on the map into segments corresponding to compass wind directions (N, NNE, NE, ENE, etc., Figure 8).
6. Assess local wind directions. For example, by using the Bureau of Meteorology website www.bom.gov.au or other method.
7. Use forecast wind conditions to choose the most appropriate sector where the plume trace will commence.
8. If it is not possible to access sectors for some wind directions, it may be preferable to postpone the assessment until forecast winds are favourable.
9. Based on the wind conditions and predicted **plume length**, decide on how far out to begin the trace. Plume length may be estimated by:
    a. odour complaints (where available)
    b. case studies (prior experience of similar source types)
    c. reconnaissance performed in step 1.

In the field

10. For every survey, assess the wind direction at an unobstructed location.
11. If the wind has shifted, relocate to a downwind position. It may be of assistance to locate a starting point using a car with the ventilation turned off and all windows down.
12. Start parallel to the edge of the plume and begin making crossings of the plume. Begin with a crossing perpendicular to the source (Section 0) before repeating crossings in a zig-zag fashion.
13. If a recognisable odour is detected on the first crossing, move further away and start again.
14. If an odour is not detected on the first crossing**,** continue to zig-zag across the plume towards the source, making odour observations as per Section 4.2. Continue this until you are as close to the source or site boundary as is reasonably practicable.
15. Record odour observations and the route followed on a map, either manually or using a mobile device.

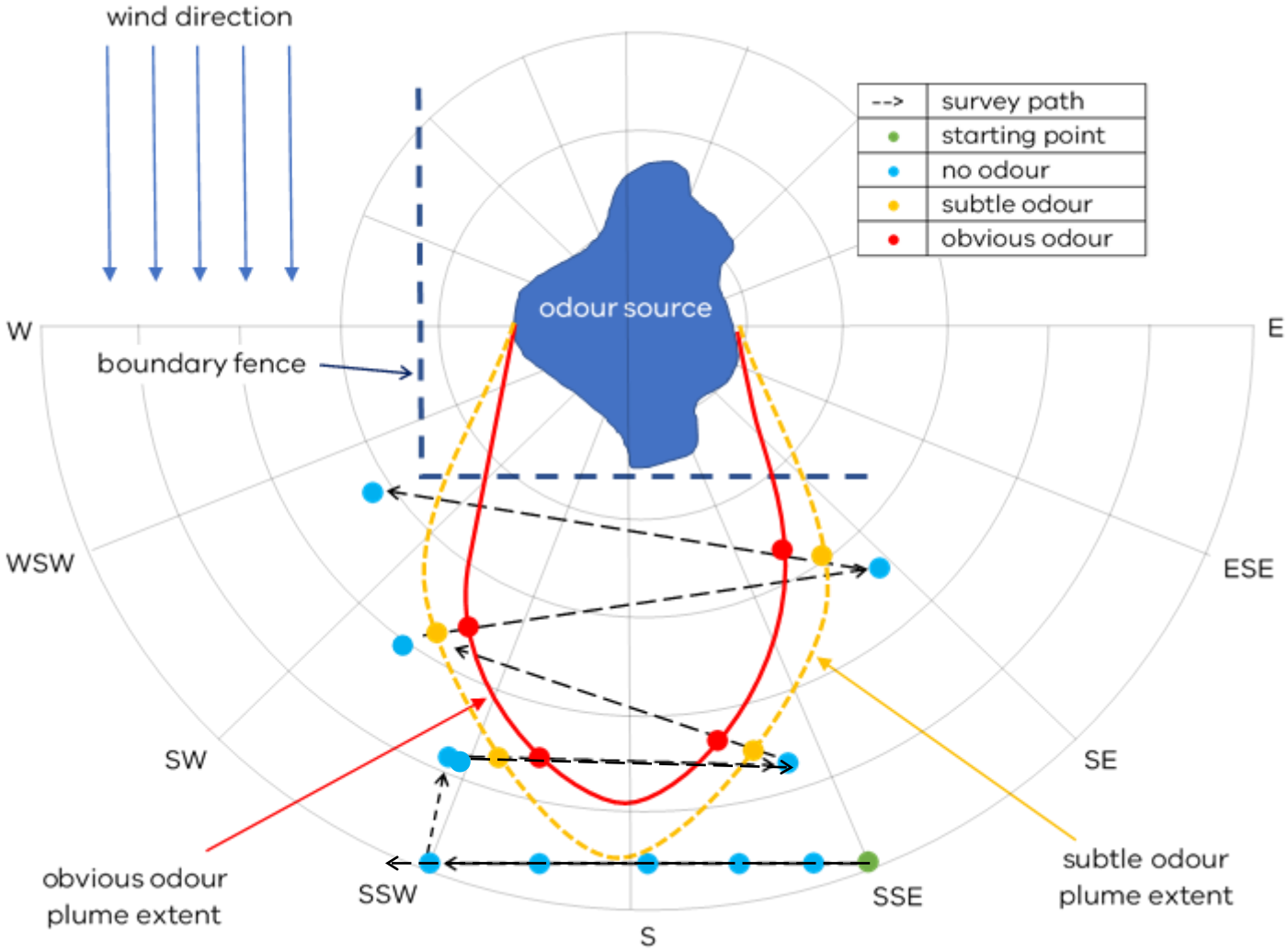

Figure 8: Receptor-source plume trace

4.6. Source-receptor plume trace

The source-receptor plume trace method is used for ground-based odour sources, at elevations of up to 10 metres. This method can be used for landfills, agricultural activities and agricultural waste processing, composting facilities and animal housing activities, including broiler sheds.

It is important to start a source-receptor plume trace as close to the source or site boundary as practicable. Below is a recommended method for conducting a source-receptor plume trace. Figure 9 shows a graphic depiction of a source-receptor plume trace.

Preparation prior to assessment

1. Prior to starting a plume trace, perform reconnaissance in person or use up-to-date aerial mapping resources. Make visual observations of all safety risks and note features of the environment that need to be investigated.
2. Create a map of the investigation area, leaving enough space to plot the surveillance route in the field.
3. Assess local wind conditions. For example, by using the Bureau of Meteorology website www.bom.gov.au or other method.

4. Use the forecast wind conditions to choose the most appropriate side of the source to begin the plume trace.
5. If it is not possible to access **observation points** for some wind directions, postpone the plume trace until wind conditions are more favourable.

In the field

6. For every survey, assess the wind direction at an unobstructed location away from the plume.
7. If the wind has shifted, relocate to a downwind position. It may be of assistance to locate a starting point using a car with the ventilation turned off and all windows down.
8. Go to a location upwind of the source to verify there are no other sources of odour.
9. Start by locating the starting point parallel to the edge of the plume. Then cross the plume (as per section 4.2) perpendicular to the wind from a location **crosswind** from the source. This should be as close to the source as practicable before proceeding away from the source in a zig-zag fashion.
10. Record **odour observations** and the route followed on a map either manually or using a mobile device.
11. Continue zig-zag route downwind from the source until there is no recognisable odour during a **crossing**.
12. To verify plume distance, walk from the centre of the final crossing outside of the plume back towards the 'tip' of the plume, noting subtle then obvious odour as before.

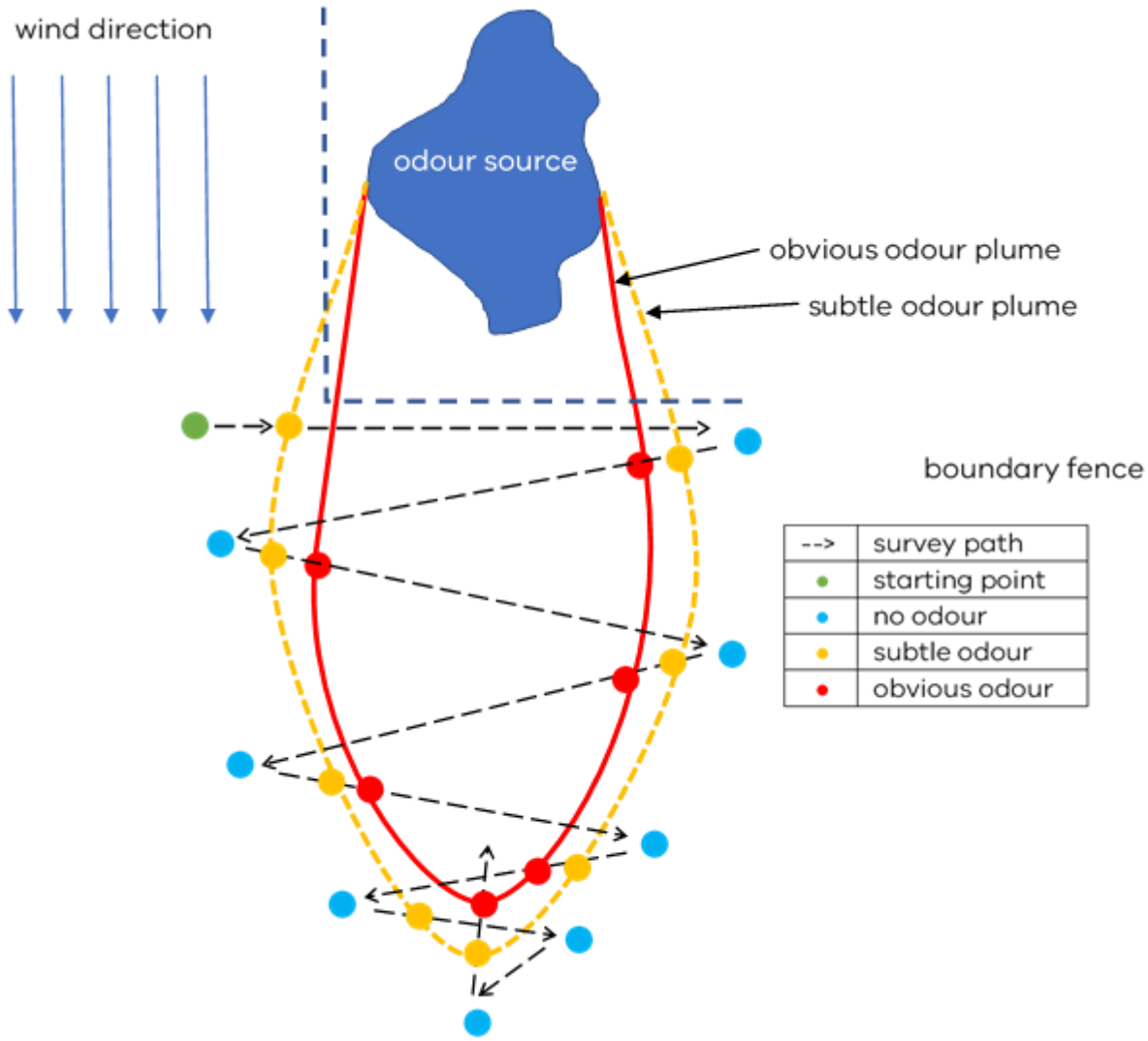

Figure 9: Source-receptor plume trace

5. Data recording

5.1. Area and line surveillance

When recording data from area surveillance or line surveillance, odour survey field sheets should be developed so that each assessor captures the data in the same way. Examples of field sheets are in appendices A and B. When designing a field sheet, the following information should be captured:

- name of the **assessor**
- status of assessor's odour screening results
- date of the surveillance
- address or location where each odour observation is made (**observation point**)
- start and stop time for each odour observation
- wind speed and direction at unobstructed points throughout the survey
- **odour intensity**, presence and character
- temperature at the start and end of surveillance.

Where applicable, EPA recommends that assessors record how they have identified the odour source on the surveillance sheet. For example, this could be due to their experience of classifying odours, their knowledge of the types of industry nearby, or from observations made on the day. This information can assist in assigning odours to sources during analyses. Weather conditions such as cloud cover and relative humidity can also be included in the surveillance sheet, depending on the purpose of the assessment.

Although there are times when the odour source is obvious, it is important to take care when assigning sources to observations without a full assessment. This should include upwind observations, boundary observations and on-site inspection, in addition to observation point, intensity, presence, character, wind speed and direction.

Odour frequency/duration can be estimated by dividing the number of odours observed of each odour character type by the number of odour observations**.** This can be for individual observation locations or aggregated over whole areas with multiple observation locations, with subsets of data based on odour intensity or presence. For line surveillance**,** wind direction should be accounted for, to determine odour frequency.

5.2. Plume tracing

Data from a single plume trace will establish the width, length and area of a plume downwind from the source. This process can be repeated to establish the frequency by which odour persists downwind from a source, where the average width, length and area of a plume can be calculated.

Combining plume tracing with modelling or a meteorological analysis can enable the prediction of odour frequency and duration for areas within reach of the odour plume.

It is recommended at least 10 plume traces are completed when determining average plume frequencies.

6. Glossary of terms

Area odour survey	Assessment of the presence of recognised odour for a series of **observation points** in predetermined locations. Locations of **observation points** are the same for each survey.
Assessor	Somebody tested and trained who participates in odour surveillance.
Crossing	Used in plume tracing, an assessor starting parallel to the plume and moving across the plume at a right angle to the wind.
Crosswind	Location outside odour plume parallel to the wind direction from the source to begin the plume crossing method.
Line survey	Static assessment of the presence of recognised odour at a series of **observation points** perpendicular and downwind of multiple odour sources.
Observation point	Single location where an **odour observation** is made.
Odour character	Attributes or description of a recognised odour – i.e., what it smells like. This can be used to determine the source of the odour.
Odour frequency	How often an odour is recognised in an odour observation divided by the total number odour observations. There can be subtle and obvious odour frequencies.
Odour intensity	Strength of the recognised odour – i.e., how easy it is to smell the odour defined as **subtle** or **obvious**.
Odour observation	An individual assessment of an odour at a single time and location during odour surveillance.
Odour presence	During a single observation, what proportion of the time the odour is present.
Odour recognition	An odour of sufficient intensity that it can be recognised if smelled again and attributed to a source if the source is known.
Odour study/campaign	A series of odour surveys conducted as part of an overall campaign for a site, industry type or industrial area.
Odour surveillance	General term used to describe odour investigation methods described in this guide.
Odour survey	One complete round or set of **odour observation(s)** – i.e., one complete area odour survey, one full line survey, or one complete plume trace.
Plume length	Distance downwind from a source where odour can be recognised.
Plume tracing	Mapping assessment of extent of presence of recognised odour at some **observation points** at the edge of the odour plume by zig-zagging a plume downwind of an odour source.
Receptor-source plume trace	Plume tracing method beginning at the end of a plume working back towards the source.

Source-receptor plume trace	Plume tracing method beginning near the source and working toward the end of the plume.
Traverse	A series of **odour observations** made perpendicular to the wind in a single line across multiple odour sources.

Endnotes

[1] Other screening techniques may also be used provided the methods used and sensitivity of assessors can be related back to the Australian Standard (sensitivity to the n-butanol standard).
[2] This should be done when odour is observed, provided the observation point is free from obstruction that would influence wind speed.
[3] Measure wind direction at unobstructed observation points where wind is unimpeded by structures, topography etc.
[4] Ruth Fisher, Juan Pablo Alvarez Gaitan, James Hayes1, Dammika Vitanage, Richard Stuetz. Can odour wheels be used as an odour emission management aid? CASANZ2017 Conference, Brisbane, 15-18 October 2017
[5] https://www.biocycle.net/the-compost-odor-wheel/
[6] H. (Mel) Suffet*, G.A. Burlingame**, P.E. Rosenfeld * and A. Bruchet*, The value of an odor-quality-wheel classification scheme for wastewater plants February 2004, Water Science & Technology 50(4):25-32
[7] When using a car to locate a plume have windows open and air conditioner and heater off. Once odour is detected, stop the car, turn off the ignition and get out to make odour observations.

Appendix A: Sample odour surveillance form (area surveillance)

Date:		**Weather prior to survey**	**Weather at end of survey**
Day:			
Assessor:			
Locality/Project:			

Start time	Stop time	Observation point	Odour character			Odour intensity (O/S)			Odour presence (C/F/T)			Wind speed (m/s)	Wind direction	Comments
			A	B	C	A	B	C	A	B	C			

Appendix A: Sample Odour Surveillance Form (line [transect] surveillance or plume tracing)

Date:		**Weather prior to survey**	**Weather at end of survey**
Day:			
Assessor:			
Locality/Project:			

Note: for single odour observations (i.e., where plume is confined to a small area (4 m^2), make note of, character and location in subtle or obvious column and note frequency

Start time	Wind		Start of plume (subtle)		Start of plume (obvious)		Plume exit		Frequency (single observations (C, F, T)	Comments
	Speed	Direction	Location	Character	Location	Character	Location	Time		