



# Tullamarine Landfill

## Community Health and Environment Report

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## EPA Victoria

Our role is to protect, care for and improve the environment.

We do this by making companies follow rules that protect the environment. If companies break those rules, the Environment Protection Act (1970) gives us the power to fine them, take them to court or force them to make changes.

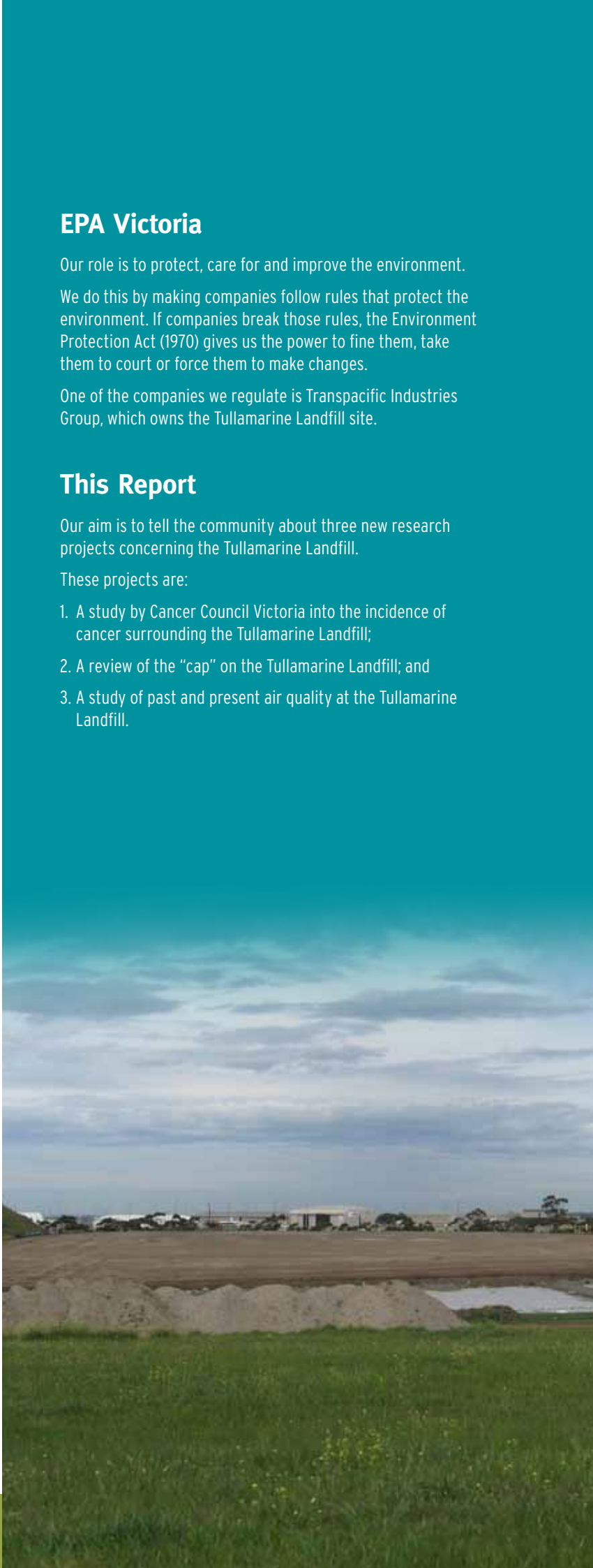
One of the companies we regulate is Transpacific Industries Group, which owns the Tullamarine Landfill site.

## This Report

Our aim is to tell the community about three new research projects concerning the Tullamarine Landfill.

These projects are:

1. A study by Cancer Council Victoria into the incidence of cancer surrounding the Tullamarine Landfill;
2. A review of the “cap” on the Tullamarine Landfill; and
3. A study of past and present air quality at the Tullamarine Landfill.



## History of the Tullamarine Landfill

The Tullamarine Landfill was built by Brambles Cleanaway and opened in 1972 on Western Avenue, Westmeadows. In 1976 a one metre layer of clay lining was added to part of the wall. However this improvement, and the general design and operation of the landfill would not meet the stringent requirements of today.

Tullamarine accepted a range of hazardous materials; notably it received more than 70% of Victoria's oil-based liquid wastes up until 1987. Around this time, the Victorian Government - motivated by concern about liquid waste contaminating groundwater - banned all liquid wastes in landfills.

Between 1987 and 1990 a treatment facility, run by the Melbourne and Metropolitan Board of Works, operated at Tullamarine to make these liquid wastes safer.

Throughout the life of the landfill, the surrounding community were impacted by odour and dust; a number of homes are located within 800 metres of the landfill. Over time the site received more improvements, including a capping upgrade in 2001 and the enhanced removal of leachate (contaminated rainwater) in 2003.

In 2006, community concerns about cancer prompted the government to examine cancer rates in greater Broadmeadows. However the study found no unusual cancer occurrence, and no direct link between the landfill and cancer rates.

The owners of the landfill site since 2007, Transpacific Industries Group Ltd, closed the landfill in May 2008, following a campaign by community members. Transpacific Industries Group (TPI) are now rehabilitating the site according to EPA rules.

## Cancer Council Study

### The incidence of cancer proximal to the Tullamarine hazardous waste landfill

By Emily Karahalios, Vicky Thursfield and Graham Giles of the Cancer Epidemiology Centre, Cancer Council Victoria, 1 Rathdowne Street, Carlton, Vic 3053.

### Background

Communities living close to hazardous waste landfills, and similar sources of possibly carcinogenic substances, often worry about long-term health consequences, especially cancer. In the case of the Tullamarine Landfill, concerns were raised by local residents and the Terminate Tullamarine Toxic Dump Action Group.

The Action Group argued that the 2006 government analysis covered too broad an area, which might have masked higher cancer rates in a smaller area, closer to the landfill.

The Action Group produced reports, in May and July 2010, detailing cancers suffered by people living close to the landfill. These reports were based on feedback from members of the community, and on a small survey of residents who attended an Action Group meeting. The Action Group surveyed 154 households with a 35% response rate. However the small numbers of people surveyed, and the many possible limitations of this methodology, raised questions about the validity of the findings.

In order to deliver a more complete finding on cancer incidence, the Cancer Epidemiology Centre, from Cancer Council Victoria, began a research project using data from the Victorian Cancer Registry.

### The Victorian Cancer Registry

The Registry has held data on all new diagnoses of cancer in Victoria since 1982. The Cancer Act (1981) made it mandatory for hospitals and pathology laboratories to notify the Registry, which is housed by Cancer Council Victoria.

The Cancer Council is an independent, non-government organisation with a mission to control cancer by promoting research, prevention, screening and appropriate treatment. It also supports people living with cancer, and their families.

The Victorian Cancer Registry contributes Victorian data to the Australian Cancer Database, which is housed at the Australian Institute of Health and Welfare (AIHW). The AIHW links the Victorian data with similar information from other state and territory cancer registries to identify Victorian residents who are diagnosed interstate.

Importantly, the Australian Cancer Database is routinely linked with the National Death Index to identify deaths in persons who were Victorian residents at the time of diagnosis. Connecting cancer incidence data with death data allows accurate analysis of survival rates for people diagnosed with cancer.

The Victorian Cancer Registry only extracts, codes and computerises a minimum amount of data from the source records provided by hospitals and pathology laboratories including the postcode and local government area of the usual residential address at the time of cancer diagnosis, to protect privacy. Finally, the Registry retains copies of the original source documents in electronic image format for future reference.

## The work plan

### Geo-coding:

The small-area analysis of the region next to the Tullamarine Landfill required the geo-coding of all addresses where the Victorian Cancer Registry showed cancer was diagnosed to remove all information that might identify people. To do this, the addresses were converted into a format suitable for the geo-coding computer program. A researcher completed this task, reviewing and converting all addresses as required.

The de-identified standardised addresses were then sent to a third party contractor who converted them to codes based on Census Collectors Districts. For reliable population data, Collectors Districts are the smallest geographical unit the Census provides.

The end result was the geo-coding of the addresses of all residents diagnosed with cancer between 1982 and 2008 in the Broadmeadows Statistical Local Area (SLA) of the Hume City local government area.

### Data aggregation:

**Construction of zones:** Firstly, the Census Collectors Districts in the Broadmeadows SLA of the Hume City local government area were mapped. Then the distance between the centre of each Collectors District polygon and the Tullamarine Landfill was estimated in kilometres to one decimal place.

These measured distances allowed the grouping of Census Collectors Districts (and their respective numerators and denominators) into proximity zones, based on how close they were to the Tullamarine Landfill. The size of the zones was determined beforehand, in consultation with community representatives.

As a result, a four-kilometre zone around the Tullamarine Landfill was identified, and then modified to a segment of this circle that corresponded with what the Action Group believed to be the "vulnerability zone". The yellow shaded area on the map below indicates this zone. Other than the "vulnerability zone", the complete four-kilometre circle around the Tullamarine Landfill includes very little residential land. One exception is the area to the south-south east of the landfill, which is indicated on the map by blue shading.



### THWL zone used in analysis:

Age- and sex-specific rates for the entire Melbourne Metropolitan Area were used to calculate expected cancer incidence in the THWL zone, and in the remainder of the Hume City local government area.

**Numerator data:** (ie the number of cancer diagnoses observed in the population at risk (which is a part of the whole population of the area of interest)). After the cancer incidence data was geo-coded, a file was created to organise data annually by sex and 5-year age group for each Census Collectors District. For each of the three zones - the THWL zone, the remainder of the Hume local government area, and the Melbourne Statistical Division - the number of cancers were totalled, beginning with total cancers occurring in all age groups and both sexes combined. This produced an observed number "O". Additional analyses were completed separately for the sexes, and for particular age groups, such as 0 to 15 years. These analyses also considered subgroups of cancer types, such as blood cancers.

**Denominator data:** (the entire population of the area i.e. the total persons at risk of a cancer diagnosis, by which the numerator is divided to obtain a rate of cancer in the population)). Equivalent population (denominator) data was obtained from the 1981, 1986, 1991, 1996, 2001 and 2006 censuses for each Census Collectors District. For each zone, age and sex, specific "person years at risk" were calculated from the census denominator data.





## Reporting and further work

The project's final results all followed from the data handling, aggregation and analysis indicated above. This includes a map of the geographical zones agreed on for analysis, and tables of the Age Standardised Rates and Standardised Incidence Ratios estimates, along with their 95% confidence intervals for each zone, and for each agreed cancer and demographic grouping. Please see the Appendix for more details.

The results, all contained in the Appendix, find no excess of cancers in the THWL zone. This holds true for total cancer incidence, for the specific cancers examined, and for cancers occurring in children. In fact, most Standardised Incidence Ratios were less than the expected value of one. This is also reflected in comparisons with the THWL zone, the rest of the Hume local government area, and the Melbourne Statistical Division.

Professor Graham G. Giles  
Director, Cancer Epidemiology Centre  
Director, Victorian Cancer Registry  
Friday, 17 December, 2010  
Cancer Council of Victoria

## Cancer Council Study Summary

- **An independent study by Cancer Council of Victoria focused on residents close to the landfill**
- **Results show no evidence of an increased rate of cancer**
- **Rates of cancer no greater than would be expected in similar Australian communities.**

## Peer Review

The approach adopted by Professor Giles to determine the observed and expected cancer rates was epidemiologically sound and appropriate.

Overall the results showed no evidence of an increased incidence of cancer amongst the subjects living within the 4-km radius and those outside the area. Nor was there any difference when the comparison was made with individuals living elsewhere in the same region of Melbourne. There was no difference either in the total number of cancers or in any cancer subtype.

When compared with the rest of the Melbourne metropolitan area there were no cases in the combined male/female group where the SIR exceeded one. The pattern was similar when a comparison was made with the rest of the population of the same region of Melbourne (Hume ). In the few instances where the SIR exceeded one the increase was slight and (based on the width of the confidence intervals) likely to have been explained by chance.

Overall my conclusion would be that this data is sufficient to provide reassurance to local residents that the incidence of cancer occurring amongst individuals within the area within 4-km of the landfill is no greater than would be expected in an Australian population of the same age/sex structure. The result provides no rationale to undertake a more detailed epidemiological study.

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## Tullamarine Cap Review

### History of the Cap

The Tullamarine Landfill was partly capped in 1989, but EPA has ordered the landfill's present owners, TPI, to completely cap the site in order to improve rehabilitation and long-term management. The new cap implements a design presented by the previous owners, Brambles Cleanaway. EPA and an international, independent landfill expert approved this design in 2001. A further review re-examined the design in 2006, for the two-thirds of the site that had not been capped. The cap is now almost complete.

### What the Cap Does

The cap stops rain from entering the landfill; if rain gets in it mixes with the contents and creates contaminated water called leachate. When leachate levels are high, as happened in

the past, it escapes the landfill and enters the groundwater. Leachate levels have been significantly reduced in the landfill since cap construction commenced. The new cap is about 160 cm deep and includes a special membrane which will ensure a depth of only one third of a millimetre of rain enters the landfill each year. Along with occasional pumping, the cap will keep leachate volumes low.

The cap will also control methane, and other gases emitted by the landfill, by directing the gases to a flare that destroys them. Unlike municipal landfills, the Tullamarine Landfill contains very little green and household waste. As a result, it only generates a small - and steadily decreasing - amount of methane.

Finally, soil will be placed on top of the cap and grass will be planted, until such time as a suitable future use for the site is decided.

## Why we supported a review

Despite being confident we had chosen a high performance cap for the landfill, we responded to community concern by reviewing the design and sought independent, expert advice. The review process confirmed the cap will provide long term protection for the community and the environment.

## Who did the review?

With input from peer organisations, EPA selected two experts from the United States. Both individuals were independent of TPI and the Tullamarine Landfill.

Professor Kavazanjian, from the University of Arizona, is a recognised expert in landfills, and Richard Thiel, Director of Thiel Engineering, is a highly regarded landfill engineer. They combined their skills to examine the cap design, and the management of the landfill.

Professor Kavazanjian also visited the Tullamarine Landfill, and listened to comments and presentations from the community and from TPI.

## What were the findings?

The review concluded care was being taken to meet the following requirements:

- The cap design and construction was found good enough to meet the design intention for a hazardous waste facility in the United States (which they call an RCRA Subtitle C facility).

- The cap would keep out most rain and protect groundwater, as long as it took into account settlement, control of gas and stormwater, and slope stability.
- The cap's effectiveness would also depend on good quality construction and quality assurance, which is the case for the Tullamarine Landfill. It is being overseen by an EPA accredited auditor.

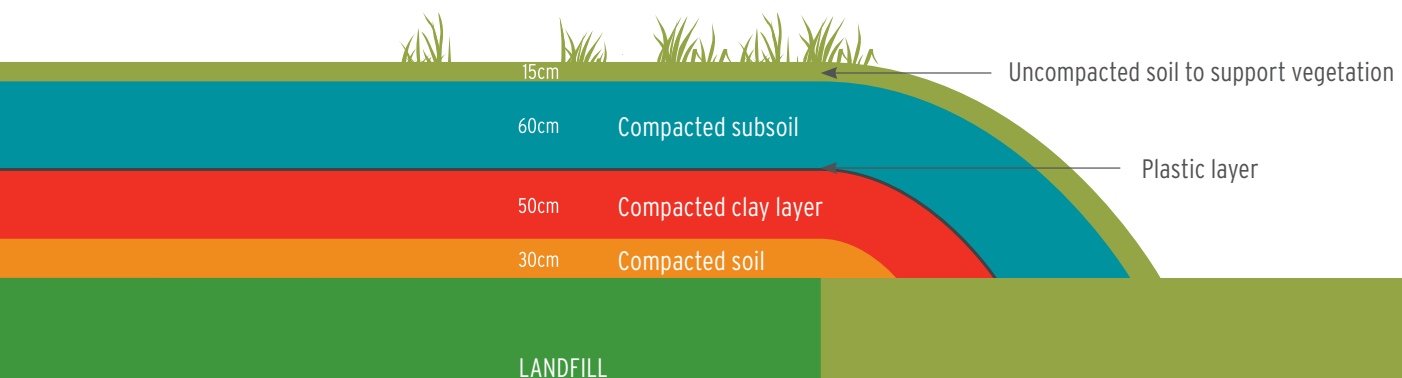
## What did the findings mean?

In summary, the design will produce a high quality cap that would protect the Tullamarine community. Design changes to make the cap thicker or more complex would not improve safety in any measurable way.

Importantly, the review provided reassurance: the cap design conformed with international best practice standards and would provide long term protection for the surrounding community and environment.

## Cap Review Summary

- **Independent review of landfill cap by international landfill experts**
- **Cap design is very resistant to rain and other infiltration**
- **Design and construction are suitable for this type of landfill**



*This diagram is a simplified representation of the rehabilitation of the landfill. It is not to scale.*

## Air quality studies at Tullamarine Landfill

During the 1970s and 80s the Tullamarine Landfill received liquid waste that contained a number of industrial chemicals. Some of these chemicals easily vaporise, which means they escape into the air.

As a result, EPA undertook a study to assess the community's past and present exposure to these chemicals, and the health risk from that exposure.

Importantly, "risk" can be described by the formula:

Risk = Hazard x Exposure.

In the case of the Tullamarine Landfill, "hazards" are pollutants in the air, from the vaporised industrial chemicals. "Exposure" is a measure of how concentrated those pollutants are in the air over the local community.

This means that if either the hazard or the exposure is removed, there is no risk to the community. Similarly, a reduction in hazard or exposure will reduce potential risk. The capping of the landfill reduces both hazard and exposure.

EPA's study on the subject used "air dispersion modelling" to estimate community exposure to a range of pollutants. The study used emissions data from 1986, 1996, and every year from 2001 to 2010. Additional data collected by EPA in 2006 was also used.

We also asked an independent organisation to sample from bores in the landfill in late 2010. This helped us understand which pollutants are currently escaping into the air and the current risk posed by those emissions.

The study identified three airborne pollutants at the Tullamarine Landfill of potential concern for detailed assessment. These chemicals were benzene, vinyl chloride and trichloroethylene. The World Health Organisation and the United States EPA have identified all three chemicals as able to cause cancer in humans.

### Results of the assessment

Cancer risk in a given area is considered acceptable as long as cancer incidence doesn't increase by more than one case per million people over their lifetimes.

In this study, none of the cancer risks modelled saw an increase of this scale. In fact, in all cases, the estimated cancer risk was very much lower. The low risk was due to low concentrations of the pollutants in residential areas, and therefore low exposure.

In practice, this means the risk to the community from pollutants in the air is too low to be detected.

In December 2010, EPA commissioned sampling at the landfill to determine current emissions. These results show the risks are lower than those measured in previous years.

These findings are also consistent with the Cancer Council study.

### Where do we go from here?

In February, 2011, we began monitoring a full range of air pollutants at several sites in the community. After twelve months of monitoring we'll conduct a review into whether more monitoring is needed.

The monitoring results will be posted to the EPA website every three months, and we'll share the data at regular community meetings.

TPI has to conduct regular monitoring of on-site air pollutants, from the bores. Their data will be reported to EPA and will be released to the public.

### Air Quality Summary

- **Historical and new data was used to understand air quality impacts from landfill**
- **Assessment shows very low risk at and beyond the landfill boundary**
- **Monitoring will continue to ensure the health and safety of residents**



## Conclusion and Future

The findings of this report confirm that:

1. The cancer incidence for people within four kilometres of the Tullamarine Landfill is no higher than expected cancer rates elsewhere, where the population has a similar age and sex structure.
2. The Tullamarine Landfill cap design will keep out most rain and help protect groundwater, as long as it takes into account settlement, control of gas and stormwater, and slope stability. The cap's effectiveness will also depend on good quality construction, quality assurance and ongoing maintenance.
3. Modelling of past and present emissions from the landfill reveals levels of benzene, vinyl chloride and trichloroethylene in the air around the landfill. The concentrations in residential areas are very low and the impact on the health of the community is too low to be detected.

The Tullamarine Landfill is now closed.

EPA will ensure that TPI maintains the site properly, so the community and environment remain protected. As part of their obligation, TPI will have to fulfil the requirements of the Post Closure Pollution Abatement Notice.

Our final rehabilitation goal is to see the land put to another purpose, but to ensure safety, we will closely examine any future land-use proposals.

Further information, source documents, historic reports and technical detail about the Tullamarine Landfill can be found at the EPA website: [www.epa.vic.gov.au](http://www.epa.vic.gov.au).

## Definitions page

### EPA

EPA Victoria's role is to protect, care for and improve the environment.

We do this by making companies follow rules that protect the environment. If companies break those rules, the Environment Protection Act (1970) gives us the power to fine them, take them to court or force them to make changes.

One of the companies we regulate is TPI, which owns the Tullamarine Landfill site.

### Transpacific Industries Group

Transpacific Industries Group Ltd (TPI) has owned the Tullamarine landfill since 2007. TPI closed the landfill ahead of schedule in May 2008. They are now rehabilitating the site according to EPA rules and regulations.

### City of Hume

The City of Hume runs operational landfill facilities at Campbellfield and Sunbury. Its predecessor, the Shire of Bulla, was the original regulator of the Tullamarine Landfill under the Health Act (1958). From the mid 1970s EPA Victoria became the landfill's regulator.

### Cancer Council Victoria

Cancer Council Victoria is an independent non government organisation with a mission to control cancer by promoting research, prevention, screening and appropriate treatment of cancer and to support people and their families living with cancer.

CCV's Cancer Epidemiology Centre was commissioned by the EPA to provide independent research on cancer incidence in the vicinity of the Tullamarine Landfill using data from the Victorian Cancer Registry.

### Health information and contacts

If anyone is experiencing symptoms seek medical advice from your local doctor.

For further information contact the Department of Health environmental health information line 1300 761 874.

### Cancer Council of Victoria Health Study Definitions

#### Statistical analysis:

**Numerator** = the number of cancer diagnoses observed in the population at risk (which is a part of the whole population of the area of interest)

**Denominator** = the entire population of the area i.e. the total persons at risk of a cancer diagnosis, by which the numerator is divided to obtain a rate of cancer in the population.

**Crude Rates:** were calculated for males and females separately by dividing the numerators by the denominators, and multiplying by 100,000.

**Age and Sex Specific Rates:** were calculated for each 5-year age group for males and females separately by dividing each 5-year age and sex-specific numerator by the appropriate denominator, and multiplying by 100,000.

**Age Standardised Rates (with 95% confidence intervals):** were calculated by weighting the 5-year age and sex-specific rates according to those from standard population. The Australian 2001 standard population is routinely used by the Department of Health, and the Australian Bureau of Statistics.

**Standardised Incidence Ratios (with 95% confidence intervals):** were calculated for each zone by dividing the observed number of cancers "O" by the expected number of cancers "E". For example, if the observed number of cancers "O" is 10 and the expected number "E" is 5, the Standardised Incidence Ratio = 2. (Or twice that expected.)

To calculate the expected number of cancers "E" for each zone, researchers multiplied age- and sex-specific incidence rates for the Melbourne Statistical Division against the age- and sex-specific person years at risk, which were obtained by aggregating the annual counts of people living in each zone.

**Interpretation:** The statistical significance of a Standardised Incidence Ratio (SIR) depends on the numbers on which it is based. Small numbers often produce SIRs that are different to 1, but these SIRs are seldom statistically significant. If the analysis is repeated several times for different breakdowns by areas, age-groups, sexes and particular cancers, then more computations of statistical significance are needed to adjust for the problem of multiple comparisons. To reduce the risk of chance findings due to very large numbers of comparisons, the researchers decided in advance on the cancers to be included in the analysis. The cancers studied were those reported by TTTDAG as being of concern.

In addition to malignant tumours, SIRs were calculated for the cancers listed in the Action Group's report results (Table 1. Page 10.) These were melanoma and cancers of the breast, liver, bowel, stomach, bone, pancreas, prostate, kidney and brain. SIRs were also calculated for all haematological malignancies combined, and for all cancers diagnosed in children under 15 years.

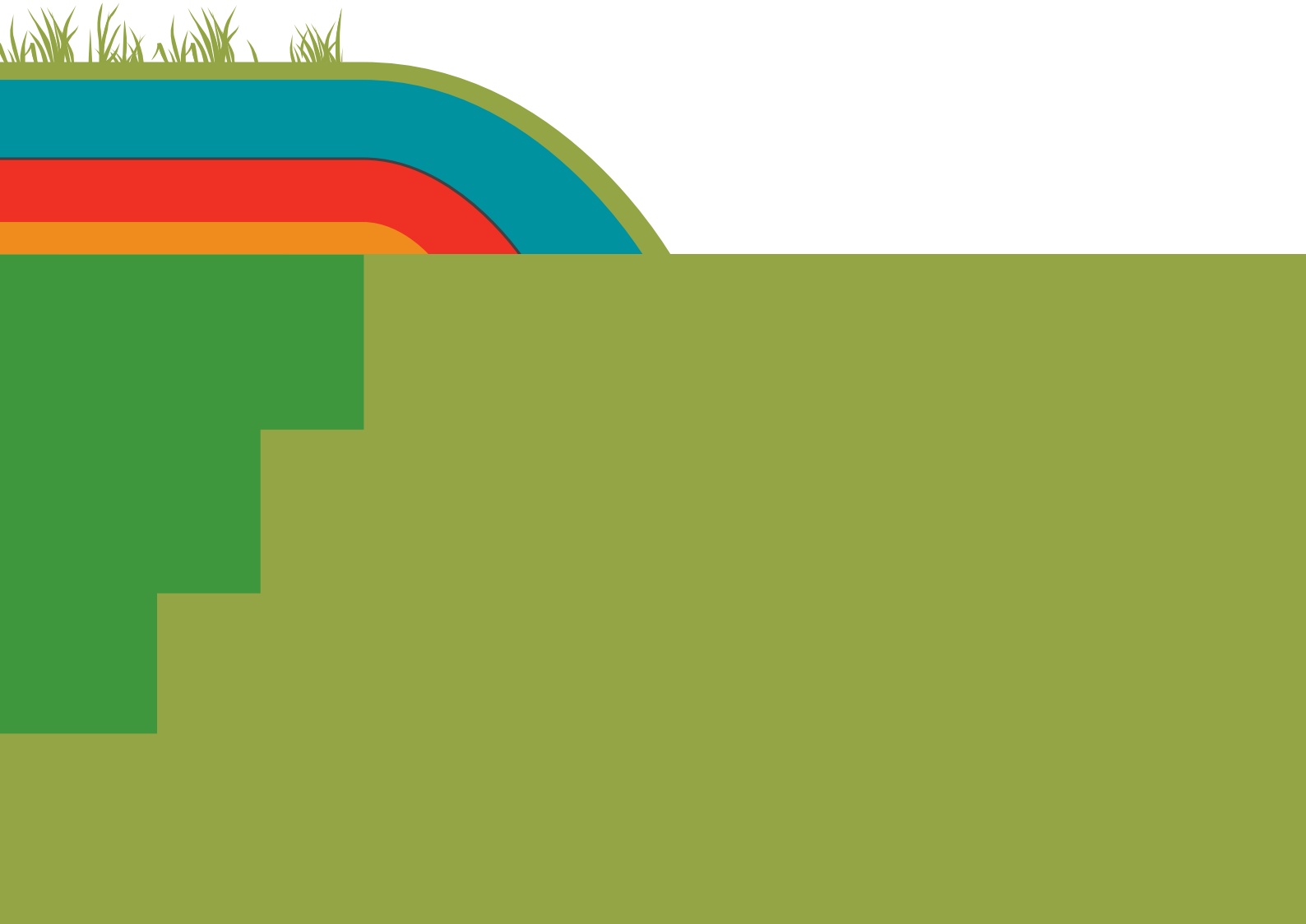
### Technical definitions

**Leachate** - A liquid material that drains from land or stockpiled material and is contaminated.

**Benzene** is a colorless liquid with a sweet odour. It is widely used in industrial processes to make plastics, resins, and nylon and synthetic fibers. Benzene is also used to make some types of rubbers, lubricants, dyes, detergents, drugs, and pesticides. Natural sources of benzene include volcanoes and forest fires. Benzene is also present in crude oil, petrol, and cigarette smoke. It evaporates into the air very quickly and dissolves slightly in water. It is highly flammable and is formed from both natural processes and human activities. Benzene is known to cause cancer in humans.

**Trichloroethylene (TCE)** is a nonflammable, colorless liquid with a somewhat sweet odor and a sweet, burning taste. It is used mainly as a solvent to remove grease from metal parts, but it is also an ingredient in adhesives, paint removers, typewriter correction fluids, and spot removers. Trichloroethylene is not thought to occur naturally in the environment. However, it has been found in underground water sources and many surface waters as a result of the manufacture, use, and disposal of the chemical. TCE is known to cause cancer in humans.

**Vinyl chloride** is a colorless gas. It burns easily and it is not stable at high temperatures. It has a mild, sweet odor. It is a manufactured substance that does not occur naturally. It can be formed when other substances such as trichloroethane, trichloroethylene, and tetrachloroethylene are broken down. Vinyl chloride is used to make polyvinyl chloride (PVC). PVC is used to make a variety of plastic products, including pipes, wire and cable coatings, and packaging materials. Vinyl chloride is known to cause cancer in humans.



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