

## APPENDIX 5. TOXICITY CRITERIA

### Injury / Irritation:

Injury due to toxic exposure depends on the nature of the material, the concentration, the duration and mode of exposure and also on the sensitivity of the person exposed. It therefore follows that toxic criteria applicable to one chemical will not necessarily be appropriate for another chemical.

HIPAP4 injury and irritation risk criteria for toxic gas exposure are as follows:

Injury: "Toxic concentrations in residential areas should not exceed a level which would be seriously injurious to sensitive members of the community following a relatively short period of exposure at a maximum frequency of 10 in a million per year."

Irritation: "Toxic concentrations in residential areas should not cause irritation to eyes or throat, coughing or other acute physiological response in sensitive members of the community over a maximum frequency of 50 in a million per year."

Establishing criteria for a particular chemical necessitates determination of the terms "seriously injurious", "sensitive", "relatively short" and "irritation".

Emergency planning guidelines for some chemicals exist in the form of published data known as Acute Emergency Guidelines Levels (AEGL) and the Emergency Response Planning Guidelines (ERPG).

Note that OHS / workplace exposure limits are not considered applicable to use in QRA as they have been developed for different purposes, normally repeated exposures, or short term exposures at a peak frequency to workforce personnel familiar with the hazards in their workplace, not for involuntary one-off exposures to accident events.

For the base case assessment of injury and irritation risk Acute Emergency Guidelines Levels (AEGL) values will be used as these most closely match the HIPAP 4 injury and irritation risk definitions. AEGLs are based on extensive review of toxicological data, are set at 3 levels (AEGL1,2 and 3) and are also set for a range of times (from 10 mins to 8 hours).

Consequence results will also be carried out using an alternative set of endpoints, the Emergency Response Planning Guideline (ERPG) values (also set for three levels but for one exposure time of 60 minutes only).

The definitions for the AEGLs and ERPGs are summarised below. AEGL2 and AEGL1 are considered to match the injury / irritation risk definitions most closely. Note that AEGL3 corresponds to life threatening effects and is used to establish the potential for offsite fatality effects. If AEGL3 can be exceeded outside the site boundary, additional toxicity data is sourced if available in the form of probit equations, or UK HSE SLOT data.

It is also noted the existing DoP Sanford ammonia refrigeration QRA does not use the AEGL values for injury and irritation risk but the values of 300 ppm and 41 ppm respectively for injury and irritation risk. These have been extrapolated from the 60 minute ERPG2 and ERPG1 values for a 15 minute exposure duration using a  $c^2t$  relationship (where c is concentration and t is time) and are higher than the nearest ammonia AEGL2 and AEGL1 values for the shorter exposure duration (220 ppm and 30ppm respectively for 10 minute exposure).

The DoP values will be used for injury and irritation risk from the Sanford facility individually to avoid inconsistency with previously accepted results. These are judged to be acceptable as the inventories (total of 4 tonnes, with the DoP study having a maximum release inventory of 600kg for any scenario) in the ammonia system are relatively small and release durations corresponding short.

### AEGL and ERPG definitions

| Impact            | AEGL  | ERPG  |
|-------------------|---|---|
|                   | Base Case risk assessment   | Sensitivity study   |
| Onset of fatality | AEGL3 is the airborne concentration (expressed as ppm or $mg/m^3$ ) of a substance <b>above</b> which it is predicted that <b>the general population, including susceptible individuals</b> , could experience life-threatening health effects or death.  | ERPG3 is the maximum airborne concentration <b>below</b> which it is believed that <b>nearly all individuals</b> could be exposed for up to 1 hour without experiencing or developing life-threatening health effects   |
| Injury            | AEGL2 is the airborne concentration (expressed as ppm or $mg/m^3$ ) of a substance <b>above</b> which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape  | The ERPG2 is the maximum airborne concentration <b>below</b> which it is believed that nearly all individuals could be exposed for up to 1 hr without experiencing or developing irreversible or other serious health effects or symptoms which could impair an individual's ability to take protective action. |
| Irritation        | AEGL1 is the airborne concentration, expressed as parts per million or milligrams per cubic meter (ppm or $mg/m^3$ ) of a substance <b>above</b> which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic nonsensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure. | The ERPG1 is the maximum airborne concentration <b>below</b> which it is believed that nearly all individuals could be exposed for up to 1 hr without experiencing other than mild transient adverse health effects or perceiving a clearly defined, objectionable odour.                                       |

### **Definition of Emergency Planning Levels:**

This information has been summarised from the US Dept of Energy (DoE) Subcommittee on Consequence Assessment and Protective Actions (SCAPA) website.

<http://orise.orau.gov/emi/scapa/teels.htm>

SCAPA provides technical information and recommendations for emergency preparedness to assist in safeguarding the health and safety of workers and the public.

### **Protective Action Criteria:**

Protective Action Criteria (PAC) for emergency planning of chemical release events are based on the following chemical exposure limit values:

- Acute Exposure Guideline Level (AEGL) values published by the U.S. Environmental Protection Agency (EPA)
- Emergency Response Planning Guideline (ERPG) values produced by the American Industrial Hygiene Association (AIHA)
- Temporary Emergency Exposure Limit (TEEL) values developed by SCAPA.

The PAC data set contains exposure limit values for more than 3,200 chemicals. Originally called the "TEEL data set," this was recently changed to the "PAC data set" to emphasise inclusion of AEGLs and ERPGs as well as TEELs.

AEGLs, ERPGs, and TEELs all serve the same general purpose: to assist those who are responsible for planning for and responding to chemical emergencies. For any particular chemical, PAC values are generally determined from AEGL, ERPG, and TEEL values based on the following hierarchy:

- use AEGLs (including final or interim values) if they are available
- if AEGLs are not available, use ERPGs
- if neither AEGLs or ERPGs are available (as is the case for the vast majority of chemicals in the PAC data set), use TEELs.

There are 4 PAC levels set:

- 0 - no adverse health effects
- 1 - mild, transient health effects
- 2 - irreversible or other serious health effects that could impair ability to take protective action
- 3 - life-threatening health effects

## Basic Questions Regarding Acute Exposure Guideline Levels (AEGLs) in Emergency Planning and Response

### What are AEGLS?

Acute Exposure Guidelines Levels (AEGLs) indicate the concentrations of a chemical in air above which different types of health effects could begin to occur in an unprotected civilian population. A National Advisory Committee, managed by the U.S. EPA, is currently developing AEGLs for hundreds of toxic industrial chemicals (e.g., chlorine and ammonia) as well as for chemical warfare agents. A separate committee (the National Research Council) provides a final review and then publishes the AEGLs. AEGLs include three concentration levels for specified time durations; these show the range of toxic effects caused by each chemical. Generic descriptions of the different levels are shown in Figure 1.

### Who uses AEGLs, and how?

AEGLs are to be used by federal and state agencies to aid in the development of emergency preparedness plans and to prioritize emergency response actions in the event of a chemical release from an accident or intentional terrorist attack. Used together with computerized air modeling, the different AEGL levels allow emergency personnel to determine areas of highest risk. This will assist in making the most appropriate actions to minimize the overall impacts to the public. Such actions may include public notification and instruction, sheltering-in-place, evacuation, medical response and treatment, or some combination of these approaches (See Figure 2 for an example of possible decision and actions based on AEGLs; these represent the most common application scenario, though decisions are to be tailored to site-specific conditions).

### How can I get more information?

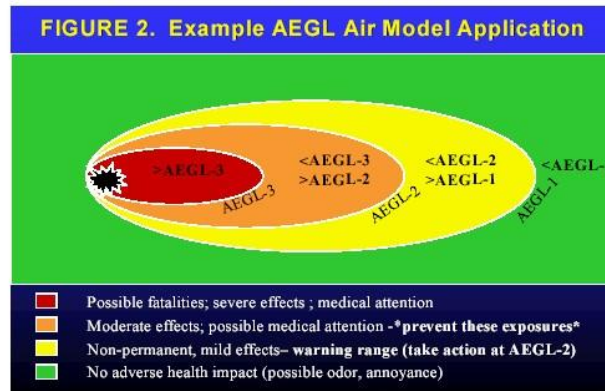
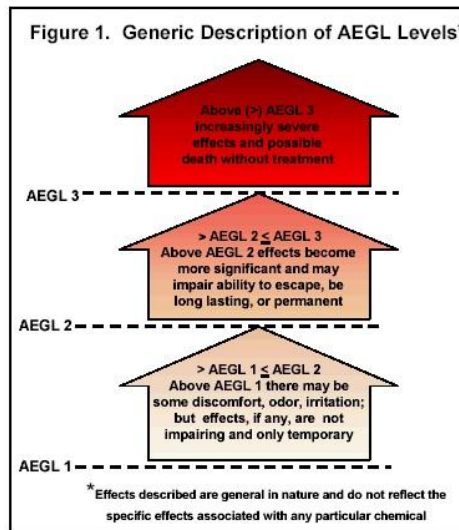
Depending on your question, there are many additional sources of information, some more technical than others. Examples include:

1. USACHPPM Fact Sheets
  - ⇒ Chemical Exposure Standards, Jan 2003
  - ⇒ Detailed Facts Regarding Health Effects Associated with AEGLs for... nerve agents, sulfur mustard, Jan 03
2. *Ready-Set-Act Fact Sheet: AEGLs and CSEPP*, Jan 03
3. *Frequently Asked Questions (FAQs) Regarding AEGLs*, *Ready-Set-Act Fact Sheet*, Jan 03
4. National Research Council (2001). *Standing Operating Procedures for Developing Acute Exposure Guideline Levels for Hazardous Chemicals*. National Academy Press, Wash, D.C. <http://www.nap.edu/index.html>

*For additional information contact USACHPPM at 410-410-5213/6096*

*The US Army Center for Health Promotion and Preventive Medicine (USACHPPM) is a support agency for the U.S. Army Surgeon General. Its mission is to provide worldwide technical support for preventive medicine, public health, and health promotion/wellness services into all aspects of America's Army and Army Community while anticipating and responding to operational needs and adapting to a changing world environment.*

USACHPPM – Basic AEGL Information, January 03



### Differences between AEGLs, ERPGs, and TEELs:

There are subtle difference in the definitions of AEGLs, ERPGs, and TEELs (hence how selection of the values and results can be interpreted in risk studies such as QRAs) and major differences in how they are developed and issued. Differences in their definitions include:

- AEGLs pertain to the “general population, including susceptible individuals,” but ERPGs and TEELs pertain to “nearly all individuals.”

- AEGLs are defined as the level “**above which**” certain health effects are expected
- ERPGs and TEELs are defined as the level “**below which**” certain health effects are *not* expected.
- ERPGs refer to exposure durations of 1 hour (with shorter periods for some chemicals), while AEGLs are developed for five time periods (i.e., 10-minutes, 30-minutes, 1-hour, 4-hours, and 8-hours), and TEELs are recommended for a peak 15-minute time Weighted Average (TWA) concentration.

AEGLs and ERPGs are developed through a rigorous review of primary sources of toxicological information, and the values eventually assigned to each chemical are individually peer reviewed.

To produce limits in a more timely fashion while maintaining high quality, TEELs are derived from secondary data sources using a peer-reviewed algorithm.

#### **AEGLs:**

The U.S. EPA's AEGL Program has developed AEGLs to describe the risk to humans resulting from once-in-a-lifetime, or rare, exposure to airborne chemicals. The National Advisory Committee and National Research Council Committee on AEGLs are developing these guidelines to help both national and local authorities, as well as private companies, deal with emergencies involving spills, or other catastrophic exposures”

#### **ERPGs**

The AIHA Emergency Response Planning Committee is tasked with developing guidelines for responding to potential releases of airborne substances for use in community emergency planning. Their goal is to publish brief summaries and estimates of tolerable-effect thresholds, not intended as exposure recommendations, to assist in the planning for accidental, episodic chemical releases.

#### **TEELs:**

Recognizing that AEGLs and ERPGs exist only for a limited number of chemicals (i.e., currently on the order of a few hundred), SCAPA developed TEELs so that facilities could conduct appropriate emergency preparedness hazard analyses (EPHA) and perform consequence assessments for the thousands of chemicals lacking AEGLs or ERPGs.

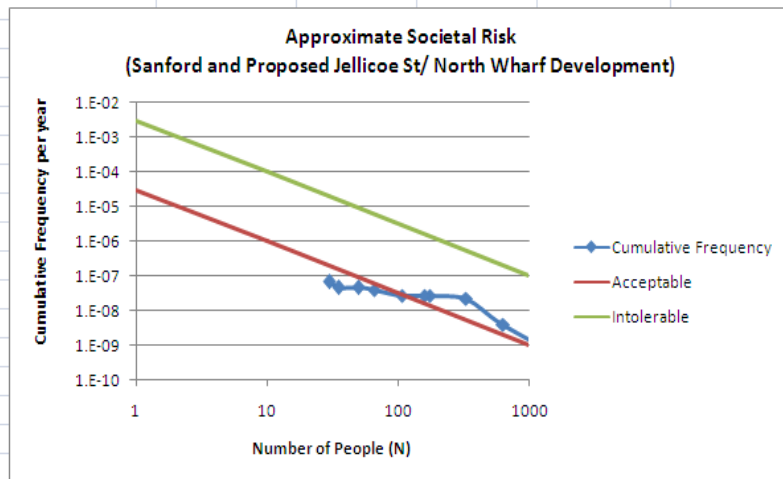
TEELs are developed using algorithms based on human exposure or animal exposure sources, either existing exposure limits designed to prevent adverse effects in humans or experimentally derived toxicity parameters. It is important to emphasize that TEELs are considered temporary; they are approximations of potential values and are subject to change whenever new or better information becomes available.

## APPENDIX 6. SOCIETAL RISK ESTIMATION

### 1. North Wharf and Jellicoe St Redevelopment

|  |  |  |  |  |  |
|--|--|--|--|--|--|
| <b>Assumptions:</b>  |  |  |  |  |  |
| 1. Restaurant - 800 seats.   |  |  |  |  |  |
| - Staff = 30, 12 hours per day, 6 days per week  |  |  |  |  |  |
| - 1 busy day per week, say 600 patrons, 6 hours at a time  |  |  |  |  |  |
| - 5 quiet days, say 40% full, approx 300 people, 6 hours at a time   |  |  |  |  |  |
| - 1 day closed   |  |  |  |  |  |
| 2. 1 special event about 5 times per year, 2000 people , 6 hours per event   |  |  |  |  |  |
| 3. Sanford numbers (population and prob of presence) have been extracted from the DoP Sanford QRA, page 31. These have not been changed / crosscheck |  |  |  |  |  |
| This assumes indoor population with Recs 1, 2 and 3 in place (best case)   |  |  |  |  |  |

| Area                                      | Av risk level (per year) | Prob of presence | N    | f        | Cumulative Frequency |
|---|--------------------------|------------------|------|----------|----------------------|
| North Wharf promenade / Jellicoe - events | 1.00E-07                 | 0.003424658      | 2000 | 3.42E-10 | 3.42E-10             |
| Jellicoe St restaurants - staff+peak      | 1.00E-07                 | 0.035616438      | 630  | 3.56E-09 | 3.90E-09             |
| Jellicoe St restaurants - staff+normal    | 1.00E-07                 | 0.178082192      | 330  | 1.78E-08 | 2.17E-08             |
| Existing Sanford commercial - 9am - 5pm   | 2.10E-08                 | 0.2381           | 175  | 5.00E-09 | 2.67E-08             |
| Existing Sanford commercial - 8am - 9am   | 2.10E-08                 | 0.0298           | 159  | 6.26E-10 | 2.73E-08             |
| Existing Sanford commercial - 7am - 8am   | 6.00E-09                 | 0.0298           | 107  | 1.79E-10 | 2.75E-08             |
| Existing Sanford commercial - 6am - 7am   | 4.11E-07                 | 0.0298           | 66   | 1.22E-08 | 3.98E-08             |
| Existing Sanford commercial - 5pm - 6pm   | 1.86E-07                 | 0.0298           | 50   | 5.54E-09 | 4.53E-08             |
| Existing Sanford commercial - 6pm- 8pm    | 3.00E-09                 | 0.0595           | 35   | 1.79E-10 | 4.55E-08             |
| Jellicoe St restaurants - staff only      | 1.00E-07                 | 0.21369863       | 30   | 2.14E-08 | 6.69E-08             |

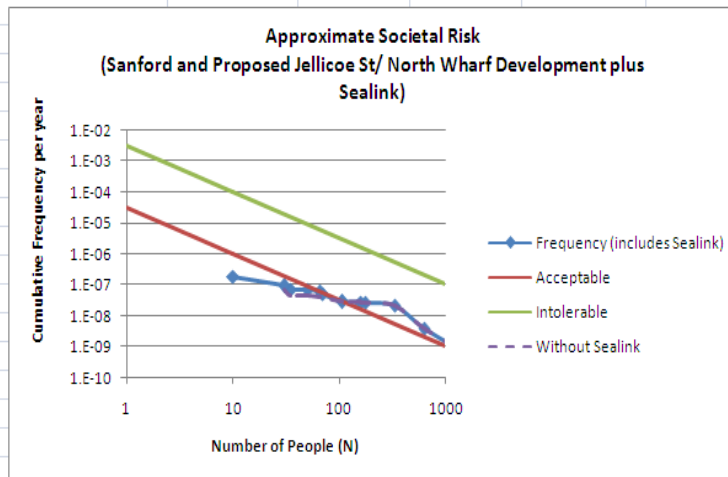


## 2. Including Sealink

**Assumptions:**

1. Restaurant - 800 seats.  
 - Staff = 30, 12 hours per day, 6 days per week  
 - 1 busy day per week, say 600 patrons, 6 hours at a time  
 - 5 quiet days, say 40% full, approx 300 people, 6 hours at a time  
 - 1 day closed
2. 1 special event about 5 times per year, 2000 people , 6 hours per event
3. Sanford numbers (population and prob of presence) have been extracted from the DoP Sanford QRA, page 31. These have not been changed / crosschecked  
 This assumes indoor population with Recs 1, 2 and 3 in place (best case)
4. Sealink assumes 10 staff, 8 hours per day 6 days per week. Sailings are people waiting with cars for ferry, say 10 sailings per week, 60 people per sailing for 1 hour

| Area                                      | Av risk level (per year) | Prob of presence | N    | f        | Cumulative Frequency |
|---|--------------------------|------------------|------|----------|----------------------|
| North Wharf promenade / Jellicoe - events | 1.00E-07                 | 0.003424658      | 2000 | 3.42E-10 | 3.42E-10             |
| Jellicoe St restaurants - staff+peak      | 1.00E-07                 | 0.035616438      | 630  | 3.56E-09 | 3.90E-09             |
| Jellicoe St restaurants - staff+normal    | 1.00E-07                 | 0.178082192      | 330  | 1.78E-08 | 2.17E-08             |
| Existing Sanford commercial - 9am - 5pm   | 2.10E-08                 | 0.2381           | 175  | 5.00E-09 | 2.67E-08             |
| Existing Sanford commercial - 8am - 9am   | 2.10E-08                 | 0.0298           | 159  | 6.26E-10 | 2.73E-08             |
| Existing Sanford commercial - 7am - 8am   | 6.00E-09                 | 0.0298           | 107  | 1.79E-10 | 2.75E-08             |
| Sealink - passengers + staff              | 4.00E-07                 | 0.059360731      | 70   | 2.37E-08 | 5.13E-08             |
| Existing Sanford commercial - 6am - 7am   | 4.11E-07                 | 0.0298           | 66   | 1.22E-08 | 6.35E-08             |
| Existing Sanford commercial - 5pm - 6pm   | 1.86E-07                 | 0.0298           | 50   | 5.54E-09 | 6.91E-08             |
| Existing Sanford commercial - 6pm- 8pm    | 3.00E-09                 | 0.0595           | 35   | 1.79E-10 | 6.92E-08             |
| Jellicoe St restaurants - staff only      | 1.00E-07                 | 0.21369863       | 30   | 2.14E-08 | 9.06E-08             |
| Sealink - staff                           | 4.00E-07                 | 0.225570776      | 10   | 9.02E-08 | 1.81E-07             |



## APPENDIX 7. REFERENCES

- 1 NSW DIPNR (April 2004) *Auckland Western Reclamation Area – Sanford Risk Assessment Final Report*
- 2 NSW Department of Planning *Hazardous Industry Planning Advisory Paper (HIPAP) No. 6 Guidelines for Hazard Analysis*
- 3 NSW Department of Planning *Hazardous Industry Planning Advisory Paper (HIPAP) No 4 Risk Criteria for Land Use Planning*
- 4 NSW Department of Planning (1997) *Multi-Level Risk Assessment*
- 5 LASTFIRE Study
- 6 A W Cox, F P Lees and M L Ang, *Classification of Hazardous Locations*, Institution of *Chemical Engineers*, 1990
- 7 TNO Purple Book, *Guidelines for Quantitative Risk Assessment, CPR 18E*, , Committee for the Prevention of Disasters, 1st edition 1999
- 8 NSW DIPNR (May 2001) *Auckland Western Reclamation Area – Transport Risk Study Report*