

National assessment of chemicals associated with coal seam gas extraction in Australia

Technical report number 11

Chemicals of low concern for human health based on an initial assessment of hazards

This report was prepared by the National Industrial Chemicals Notification and Assessment Scheme (NICNAS)



Australian Government

Department of the Environment and Energy
Department of Health
National Industrial Chemicals
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Reports in this series

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Technical report number	Title	Authoring agency
<i>Reviewing existing literature</i>		
1	Literature review: Summary report	NICNAS
2	Literature review: Human health implications	NICNAS
3	Literature review: Environmental risks posed by chemicals used coal seam gas operations	Department of the Environment and Energy
4	Literature review: Hydraulic fracture growth and well integrity	CSIRO
5	Literature review: Geogenic contaminants associated with coal seam gas operations	CSIRO
6	Literature review: Identification of potential pathways to shallow groundwater of fluids associated with hydraulic fracturing	CSIRO
<i>Identifying chemicals used in coal seam gas extraction</i>		
7	Identification of chemicals associated with coal seam gas extraction in Australia	NICNAS
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8	Human and environmental exposure conceptualisation: Soil to shallow groundwater pathways	CSIRO
9	Environmental exposure conceptualisation: Surface to surface water pathways	Department of the Environment and Energy
10	Human and environmental exposure assessment: Soil to shallow groundwater pathways – A study of predicted environmental concentrations	CSIRO
<i>Assessing risks to workers and the public</i>		
11	Chemicals of low concern for human health based on an initial assessment of hazards	NICNAS

Technical report number	Title	Authoring agency
12	Human health hazards of chemicals associated with coal seam gas extraction in Australia	NICNAS
13	Human health risks associated with surface handling of chemicals used in coal seam gas extraction in Australia	NICNAS
<i>Assessing risks to the environment</i>		
14	Environmental risks associated with surface handling of chemicals used in coal seam gas extraction in Australia	Department of the Environment and Energy

Foreword

Purpose of the Assessment

This report is one in a series of technical reports that make up the National Assessment of Chemicals Associated with Coal Seam Gas Extraction in Australia (the Assessment).

Many chemicals used in the extraction of coal seam gas are also used in other industries. The Assessment was commissioned by the Australian Government in June 2012 in recognition of increased scientific and community interest in understanding the risks of chemical use in this industry. The Assessment aimed to develop an improved understanding of the occupational, public health and environmental risks associated with chemicals used in drilling and hydraulic fracturing for coal seam gas in an Australian context.

This research assessed and characterised the risks to human health and the environment from surface handling of chemicals used in coal seam gas extraction during the period 2010 to 2012. This included the transport, storage and mixing of chemicals, and the storage and handling of water pumped out of coal seam gas wells (flowback or produced water) that can contain chemicals. International evidence¹ showed the risks of chemical use were likely to be greatest during surface handling because the chemicals were undiluted and in the largest volumes. The Assessment did not consider the effects of chemical mixtures that are used in coal seam gas extraction, geogenic chemicals, or potential risks to deeper groundwater.

The Assessment findings significantly strengthen the evidence base and increase the level of knowledge about chemicals used in coal seam gas extraction in Australia. This information directly informs our understanding of which chemicals can continue to be used safely, and which chemicals are likely to require extra monitoring, industry management and regulatory consideration.

Australia's regulatory framework

Australia has a strong framework of regulations and industrial practices which protects people and the environment from adverse effects of industrial chemical use. For coal seam gas extraction, there is existing legislation, regulations, standards and industry codes of practice that cover chemical use, including workplace and public health and safety, environmental protection, and the transport, handling, storage and disposal of chemicals. Coal seam gas projects must be assessed and approved under relevant Commonwealth, state and territory environmental laws, and are subject to conditions including how the companies manage chemical risk.

Approach

Technical experts from the National Industrial Chemicals Notification and Assessment Scheme (NICNAS), the Commonwealth Scientific and Industrial Research Organisation (CSIRO), and the Department of the Environment and Energy conducted the Assessment. The Assessment drew on technical expertise in chemistry, hydrogeology, hydrology, geology, toxicology, ecotoxicology, natural resource management and risk assessment. The Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining

¹ See Mallants et al. 2017; Jeffrey et al. 2017; Adgate et al. 2014; Flewelling and Sharma 2014; DEHP 2014; Stringfellow et al. 2014; Groat and Grimshaw 2012; Vidic et al. 2013; Myers 2012; Rozell and Reaven 2012; The Royal Society and The Royal Academy of Engineering 2012; Rutovitz et al. 2011.

Development (IESC) provided advice on the Assessment. Experts from the United States Environmental Protection Authority, Health Canada and Australia reviewed the Assessment and found the Assessment and its methods to be robust and fit-for-purpose.

The Assessment was a very large and complex scientific undertaking. No comparable studies had been done in Australia or overseas and new models and methodologies were developed and tested in order to complete the Assessment. The Assessment was conducted in a number of iterative steps and inter-related processes, many of which needed to be done in sequence (Figure F.1). There were two separate streams of analysis – one for human health and one for the environment. The steps included for each were: literature reviews; identifying chemicals used in drilling and hydraulic fracturing for coal seam gas extraction; developing conceptual models of exposure pathways; models to predict soil, surface and shallow groundwater concentrations of identified chemicals; reviewing information on human health hazards; and identifying existing Australian work practices, to assess risks to human health and the environment.

The risk assessments did not take into account the full range of safety and handling precautions that are designed to protect people and the environment from the use of chemicals in coal seam gas extraction. This approach is standard practice for this type of assessment. In practice, safety and handling precautions are required, which means the likelihood of a risk occurring would actually be reduced for those chemicals that were identified as a potential risk to humans or the environment.

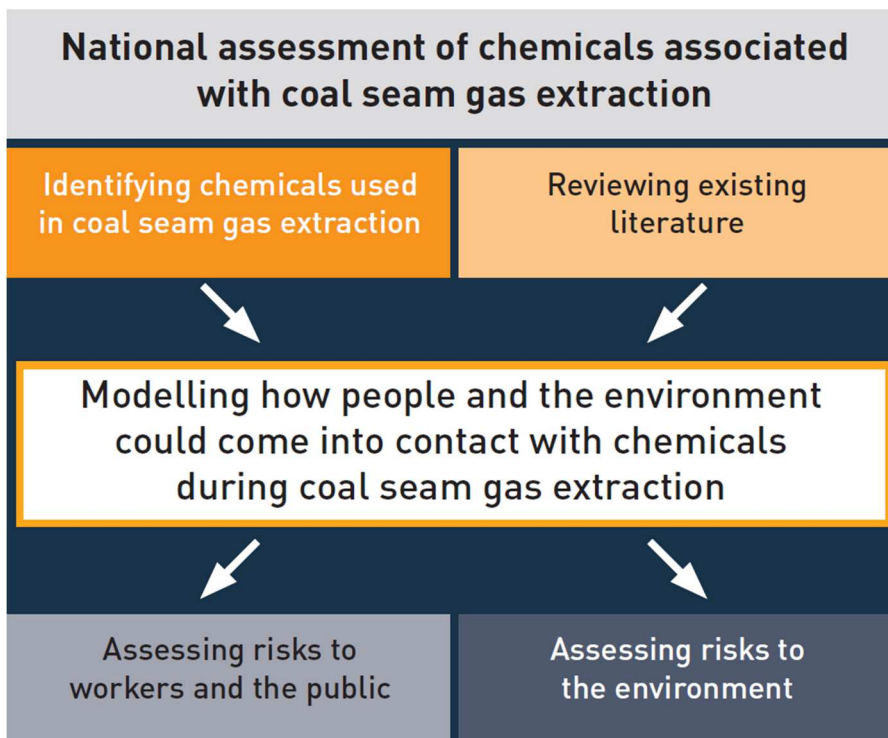


Figure F.1 Steps in the Assessment

Collaborators

The Australian Government Department of the Environment and Energy designs and implements policies and programs, and administers national laws, to protect and conserve the environment and heritage, promote action on climate change, advance Australia's interests in the Antarctic, and improve our water use efficiency and the health of Australia's river systems.

Within the Department, the Office of Water Science is leading the Australian Government's efforts to improve understanding of the water-related impacts of coal seam gas and large coal mining. This includes managing the Australian Government's program of bioregional assessments and other priority research, and providing support to the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (IESC). The IESC provides independent, expert scientific advice on coal seam gas and large coal mining proposals as requested by the Australian Government and state government regulators, and advice to the Australian Government on bioregional assessments and research priorities and projects.

The National Industrial Chemicals Notification and Assessment Scheme (NICNAS) is a statutory scheme administered by the Australian Government Department of Health. NICNAS aids in the protection of the Australian people and the environment by assessing the risks of industrial chemicals and providing information to promote their safe use.

CSIRO, the Commonwealth Scientific and Industrial Research Organisation, is Australia's national science agency and one of the largest and most diverse research agencies in the world. The agency's research is focused on building prosperity, growth, health and sustainability for Australia and the world. CSIRO delivers solutions for agribusiness, energy and transport, environment and natural resources, health, information technology, telecommunications, manufacturing and mineral resources.

This report: *Chemicals of low concern for human health based on an initial assessment of hazards*

This report, together with the reports *Human health hazards of chemicals used in coal seam gas extraction in Australia* and *Human health risks associated with surface handling of chemicals uses in coal seam gas extraction*, describes the 'assessing risks to workers and the public' step in the Assessment.

The 'identifying chemicals used in coal seam gas extraction' step of the Assessment identified 113 chemicals used in drilling and hydraulic fracturing for coal seam gas extraction in Australia during the period 2010 to 2012 (NICNAS 2017a).

This report describes how these 113 chemicals were screened to identify 44 chemicals that are known to be of low human health hazard and therefore inherently of low concern for human health. The 44 chemicals found to be of low concern in the screening process are listed in Table 2.1 and did not require any further assessment.

The remaining 69 (113 - 44) chemicals are not necessarily a risk to human health because further analysis may result in a conclusion that some or all are of low concern for human health. This further analysis was done and is described in the reports *Human health hazards of chemicals used in coal seam gas extraction in Australia* and *Human health risks associated with surface handling of chemicals uses in coal seam gas extraction*.

Abbreviations

General abbreviations	Description
ACGIH	American Conference of Industrial Hygienists
AICS	Australian Inventory of Chemical Substances
ATSDR	Agency for Toxic Substances and Disease Registry
CAS	Chemical Abstracts Service
CBI	Confidential business information
DSL	Domestic Substances List
EC	European Commission
EU	European Union
EU CLP	European Union Regulation on Classification, Labelling and Packaging
FDA	Food and Drug Administration
FGEW	Functional Group Equivalent Weight
FIFRA	US Federal Insecticide, Fungicide, and Rodenticide Act
GHS	Globally Harmonised System of Classification and Labelling of Chemicals
GRAS	Generally Recognized as Safe (US EPA list)
HPV	US EPA High Production Volume Challenge Program
HSIS	Safework Australia's Hazardous Substances Information System
IARC	International Agency for Research on Cancer
IMAP	Inventory Multi-Tiered Assessment and Prioritisation Framework
mg/m ³	Milligram per Cubic Metre
NAMW	Number Average Molecular Weight
n.s.	Not specified
NTP ROC	National Toxicology Program - Report on Carcinogens
OECD	Organisation for Economic Cooperation and Development
PLC	NICNAS New Chemicals Program Polymer of Low Concern criteria
PMRA	Pest Management Regulatory Authority
REACH	Registration, evaluation, authorisation and restriction of chemical substances
RFG	Reactive Functional Groups
SIDS	Screening Information Data Set
US EPA	United States Environmental Protection Agency

Glossary

Term	Description
binary inorganics	Compounds containing two inorganic elements
coal seam	Coal seams or coal deposits are layers containing coal (sedimentary rock). Coal seams store both water and gas. Coal seams generally contain more salty groundwater than aquifers that are used for drinking water or agriculture
coal seam gas	A form of natural gas (generally 95 to 97% pure methane, CH ₄) typically extracted from permeable coal seams at depths of 300 to 1 000 m. Also called coal seam methane (CSM) or coalbed methane (CBM)
hazard	Inherent property of an agent or situation having the potential to cause adverse effects when an organism, system, or (sub)population is exposed to that agent
low concern	A chemical of low human health hazard and therefore inherently low concern for human health. Chemicals of low concern are considered to have a low likelihood of causing adverse human health effects should an exposure occur
polymer	A substance which has a molecular structure built up mainly or completely from a large number of similar units covalently bonded together
risk	The probability of an adverse effect in an organism, system, or (sub)population caused under specified circumstances by exposure to an agent
validation rules	Criteria used to determine if a chemical is of low concern for human health, or not

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1 Methodology

The method used to screen the 113 drilling and hydraulic fracturing chemicals to identify those of low concern for human health was based on that developed by NICNAS for the Inventory Multi-tiered Assessment and Prioritisation (IMAP) Framework (NICNAS 2013a) independently of the *National Assessment of Chemicals Associated with Coal Seam Gas Extraction in Australia*.

The IMAP Framework enables the identification and rapid assessment of chemicals on the Australian Inventory of Chemical Substances (AICS) that have not been subjected to a previous assessment. The use of the IMAP methodology for this task was independently validated by scientific experts in Australia and is based primarily on that used by Health Canada as part of the categorisation of the Canadian chemicals inventory, the Domestic Substances List [DSL (NICNAS 2013a)].

NICNAS considered the IMAP methodology, as adapted for this current assessment, was appropriate for identifying drilling and hydraulic fracturing chemicals of low concern for human health. A single approach was utilised to screen both discrete chemicals and polymers to identify those chemicals and polymers used in coal seam gas extraction that are of low concern for human health. However, different validation rules were subsequently applied for each of these categories.

1.1 Identification of chemicals of low concern for human health

In this report, chemicals of low concern for human health are those considered to be of low likelihood of causing adverse effects upon exposure. The screening process to identify chemicals of low concern for human health involved six steps:

1. review of existing national or international lists of substances considered to be of low concern identified in the IMAP Framework
2. analysis of these lists for their applicability for identifying coal seam gas chemicals of low concern for human health
3. comparison of coal seam gas chemicals with the lists
4. validation rules developed by NICNAS
5. further validation rules, developed by NICNAS, based on expert judgement to identify additional coal seam gas chemicals of low concern for human health
6. validation rules to identify polymers of low concern for human health.

Each of the six steps is discussed further in this section.

1.1.1 **Step 1: Review of existing national or international lists of substances considered to be of low concern**

A review of existing schemes used in Australia and overseas to qualify substances as being of low concern for human health – based on review, critical evaluation of data and expert peer review processes – was undertaken. The review identified six tools as being specifically relevant:

- Canada SimHaz tool

- Annex IV of the European Union (EU) Regulation that deals with Registration, Evaluation, Authorisation and Restriction of Chemical substances (REACH)
- Annex V of the EU REACH Regulation
- United States Environmental Protection Agency (US EPA) High Production Volume (HPV) Challenge Program
- Inert Ingredients Eligible for US Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) 25(b) pesticide products
- US Food and Drug Administration (FDA) Generally Recognized as Safe (GRAS) list.

1.1.1.1 Canada SimHaz tool

As part of the categorisation of the DSL by Health Canada, chemicals were assessed using a simple hazard tool (SimHaz tool) where information for identification of high or low-hazard chemicals was sourced from various agencies based on weight of evidence for multiple hazard endpoints. The SimHaz tool was restricted to hazard-based systems that had well-delineated bases and involved some level of expert consensus/international agreement.

The SimHaz tool draws upon information provided by the following four lists to determine low-hazard chemicals:

- Health Canada Pest Management Regulatory Authority (PMRA) Pesticide Formulant List 4A. List 4A is a list of pest control formulants of minimal toxicological concern. The list was based on the US EPA Minimal Risk Inerts List 4A. The 4A list has since been updated with the FIFRA list (described below).
- Draft list of chemicals that do not need assessment in the OECD High Production Volume (HPV) Chemicals Program. The Organisation for Economic Cooperation and Development (OECD) has recognised certain chemicals as low hazard based on their intrinsic properties. These chemicals have been provisionally set aside. This list is not stand-alone, but rather is a compilation of existing lists from the US EPA and EU (described separately below).
- Annex II to Council Regulation (EEC) 793/93 of 23 March 1993 on the evaluation and control of the risks of existing substances. This is a list of substances exempt from the provisions of Articles 3 and 4. This regulation has since been repealed and replaced with Regulation (EC) No 1907/2006. The new regulation replaced Annex II with an updated Annex IV (exemptions from the obligation to register in accordance with article 2(7)(a)). Annex IV is described in Section 2.1.1.2 of this report.
- US EPA HPV Challenge Program. This includes chemicals not considered to be candidates for testing under the HPV Challenge Program, based on a preliminary US EPA review indicating that testing using the Screening Information Data Set (SIDS) base set would not lead to further understanding of the chemicals properties. This included chemicals listed under HPV 'Indicator 1'. This list is described separately in Section 1.1.1.4 of this report.

1.1.1.2 Annex IV of the EU REACH Regulation

Annex IV of REACH contains a list of substances that are exempt from registration on the basis of sufficient information on intrinsic properties for them to be regarded as representing low risk (EC 2006a). Substances included in Annex IV are exempt from registration (as well as downstream user requirements and evaluation) for all possible uses irrespective of the

tonnage at which they are manufactured or imported (currently or in the future). The European Commission (EC) established a set of criteria to determine what was considered sufficient information (EC 2007).

Originally, Annex IV reproduced the list of substances exempt from the obligation to report information under the repealed Existing Substances Regulation (Regulation [EEC] No. 793/93) [i.e. Annex II to Council Regulation EEC 793/93]. In 2008, this list was revised by the EC based on agreed hazard criteria covering data availability, physicochemical and toxicity criteria. The toxicity criteria used for inclusion or non-inclusion are similar or more conservative than those used in the IMAP Framework. As a result of the review (EC 2008), three chemicals were removed from Annex IV; vitamin A was removed due to potential toxicity, and carbon and graphite were removed due to the possibility that the Chemical Abstracts Service (CAS) number for these substances may be used for nanomaterials.

1.1.1.3 Annex V of the EU REACH Regulation

Annex V of Regulation (EC) No. 1907/2006 (REACH) sets out substances that are exempt from the registration, evaluation and downstream user provisions of REACH because registration is deemed inappropriate or unnecessary and their exemption does not prejudice the objectives of REACH (EC 2006b).

Some chemicals covered by the Annex are not exempt from other obligations of REACH. Several entries on this Annex relate to chemicals occurring in nature that are not chemically modified. Some entries make reference to hazardous properties that are included or excluded. Importers and manufacturers must hold data to demonstrate that the hazardous properties criteria are met. Whilst some entries list specific chemicals, others are more generic.

Entries listed in Annex V considered relevant for inclusion in the IMAP Framework and also relevant to this study of coal seam gas chemicals of low concern for human health were:

- substances that occur in nature, if they are not chemically modified. For example, vegetable fats, vegetable oils, vegetable waxes; animal fats, animal oils, animal waxes; fatty acids from C6 to C24 and their potassium, sodium, calcium and magnesium salts; glycerol²
- cement clinker, magnesia
- glass, ceramic frits
- compost and biogas
- hydrogen and oxygen.

1.1.1.4 US EPA HPV Challenge program

The US EPA High Production Volume (HPV) chemicals are those that are manufactured in or imported into the US in amounts greater than one million pounds (453 600 kg) per year. The US EPA HPV Challenge program for data availability used indicators to signify whether the chemical falls outside the scope of the HPV Challenge program. The chemicals under 'Indicator 1' are generally considered safe – that is, these chemicals (based on a preliminary US EPA review) were not considered a candidate for testing under the HPV Challenge

² Unless they meet the criteria for classification as dangerous according to Directive 67/548/EEC with the exception of those only classified as flammable [R10], as a skin irritant [R38] or as an eye irritant [R36], or unless they are persistent, bioaccumulative and toxic or very persistent and very bioaccumulative in accordance with the criteria set out in Annex XIII, or unless they were identified in accordance with Article 59(1) at least two years previously as substances giving rise to an equivalent level of concern as set out in Article 57(f).

program, as testing would not further the understanding of the chemicals' properties. Chemical lists under the US HPV program have been annotated periodically since they were first posted on 9 October 1998.

1.1.1.5 Inert ingredients eligible for FIFRA (Federal Insecticide, Fungicide, and Rodenticide Act) 25(b) pesticide products

The US Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) specifies that all pesticides, with very limited exceptions, are to be registered with the US EPA before they are sold or used in the US.

In 1996, the US EPA exempted certain pesticides that were considered to pose minimal risk to humans and the environment from this requirement, provided that the products satisfy certain conditions. These products were exempted based in part on their minimal risk status, and as an effort on the part of the US EPA to reduce the cost and regulatory burden on businesses so that the EPA could focus its limited resources on pesticides that pose a greater risk. This exemption list updates a previous list called 'US EPA list 4A' under Pesticide Registration Notice 2000-6 (US EPA 2010).

1.1.1.6 US FDA Generally Recognized as Safe (GRAS) list (Type 1)

This list contains food substances that are not subject to pre-market review and approval by the US FDA because they are generally recognised (by qualified experts) to be safe under the intended conditions of use (US FDA 2013). Their safety was established by a long history of use in food or by virtue of their nature. Each substance was evaluated and categorised into types according to conclusions on safety provided by scientific experts external to the FDA. The Type 1 category contains substances that are deemed to not be a hazard to the public when used at levels that are now current or might reasonably be expected in the future. This is on the basis of there being no information available on the substance that demonstrates, or suggests reasonable grounds to suspect, it as hazardous.

1.1.2 Step 2: Analysis of lists for applicability for identifying coal seam gas chemicals of low concern for human health

The lists described in Section 1.1.1 were analysed to determine their applicability for identifying coal seam gas chemicals of low concern.

The analysis involved grouping the lists into four categories based on currency / availability, whether conditions of use were required for the low concern status, and reduced regulatory requirements based on origin. The outcome of this grouping task is presented in Table 1.1.

Table 1.1 Identified lists/groups for determining chemicals of low concern

Category	Identified schemes / lists	Used by this study to identify coal seam gas chemicals of low concern for human health?
Updated list available	Pesticide Formulant 4A - Health Canada, PMRA	No
	Annex II to Council Regulation (EEC) 793/93	No
	OECD HPV list	No
Lists of chemicals identified as safe with no condition of	US EPA HPV Indicator 1	Yes

Category	Identified schemes / lists	Used by this study to identify coal seam gas chemicals of low concern for human health?
use		
	REACH Annex IV	Yes
Lists of chemicals identified as low risk under conditions used	Inert Ingredients Eligible for FIFRA	Yes with validation (see below)
	US FDA GRAS	Yes
Lists of chemicals with reduced regulatory requirements based on their origin	REACH Annex V	Yes with validation (see below)

1.1.3 Step 3: Comparison of coal seam gas chemicals with the low concern chemical lists

The 113 chemicals reported to be used in drilling and hydraulic fracturing for coal seam gas were compared with five of the lists identified in Table 1.1. Of the 113 chemicals, 38 were identified as potentially of low concern for human health based on their entries in these lists.

It was considered that the uses of chemicals for extraction of coal seam gas in Australia may be different from those under which they have been considered low risk in other jurisdictions. Therefore, additional validation rules on chemicals identified by the FIFRA and US FDA GRAS lists were applied to ensure that coal seam gas chemicals that warranted more detailed assessment would not be simply classified as chemicals of low concern for human health (described below).

1.1.4 Step 4: Validation rules developed by NICNAS

The 38 chemicals were evaluated against a set of validation rules previously developed by NICNAS for the IMAP Framework. Chemicals meeting the following criteria were considered as requiring further assessment:

1. chemicals identified as a concern or for which regulatory action has been taken overseas
2. chemicals identified in international studies analysing blood in babies' umbilical cords
3. chemicals meeting hazard criteria developed by NICNAS for use in the IMAP Framework based on any of the following sources:
 - Safework Australia's Hazardous Substances Information System (HSIS)
 - European Union (EU) Regulation on Classification, Labelling and Packaging (EU CLP; conversion of old EU classifications to adopted Globally Harmonised System of Classification (GHS))
 - International Agency for Research on Cancer (IARC)
 - National Toxicology Program - Report on Carcinogens (NTP ROC)
 - US EPA Cancer Guidelines

- American Conference of Industrial Hygienists (ACGIH) Categories
 - EU list of endocrine disrupters
 - List of neurotoxic chemicals from the Agency for Toxic Substances and Disease Registry (ATSDR)
4. chemicals included in the Poisons Standard (the Schedule for Uniform Scheduling of Medicines and Poisons [SUSMP]) (TGA 2012) (except where the listing is in Appendix B)
 5. chemicals removed from Annex IV of REACH as part of the review process
 6. strong or moderate acids and bases, quaternary ammonium salts, and anhydrous deliquescent materials.

The results of this evaluation are presented at Appendix A.

1.1.5 Step 5: Further validation rules developed by NICNAS to identify additional chemicals of low concern for human health

An assessment of the chemicals internationally recognised as safe and / or of low risk (Step 2) enabled NICNAS to develop further validation rules (based on expert judgement) for identifying additional chemicals that may be considered of low concern for human health. These rules are described below.

The 75 chemicals were evaluated against this additional set of validation rules defined below. The results of this evaluation are presented at Appendix A.

1.1.5.1 Binary inorganics and organic acid salts

The hazard profiles of binary inorganics and salts of organic acids were characterised taking into consideration the separate toxicities of the anion and the cation components. The following anions, cations and organic acids were identified for potential inclusion in the list of chemicals generally considered of low concern:

- Na^+ , K^+ , Mg^+ , Ca^{+2} , Cl^- , CO_3^{-2} , PO_4^{-3} , NO_3^{-1} , OH^{-1} , O^{-2} and SO_4^{-2} , and simple salts of acetate, citrates, lactates, tartrates, malates and di- and tri- phosphates.

This judgement was based on the occurrence of a number of such simple salts on the lists in Table 1.1, and the absence of Classifications under HSIS for simple salts, except where these were classified for local irritant properties relating to acidity, basicity or desiccation.

1.1.5.2 Hydrates

As hydrates of a substance or hydrated ions are formed by association of a substance with water, the hydrates of chemicals considered as being of low concern for human health are themselves also considered as low concern for human health, as are hydrates where the anhydrous form is ruled out due to desiccation effects.

1.1.5.3 Naturally occurring substances

Naturally occurring substances – that is, unprocessed chemicals occurring in the natural environment – for which there are no known toxicological effects, such as nut hulls or wood dust, were also considered as substances or chemicals of low concern for human health.

However, it should not be assumed that dusts from these substances do not present a hazard to human health. High concentrations of dust in the workplace may cause unpleasant

deposition of dust in the ears, eyes and upper respiratory tract. An exposure standard of 10 mg/m³, measured as inhalable dust (8 h time weighted average) has been assigned for such 'nuisance' dusts. This exposure standard for dusts not otherwise classified is only applicable when the particulate material does not contain other substances that may be toxic or cause physiological impairment at lower concentrations. In these circumstances, the exposure standard for the more toxic substance should be applied. For example, where a dust contains asbestos or crystalline silica, exposure to the materials should not exceed the appropriate value for these substances (Safe Work Australia 2012).

1.1.6 Step 6: Validation rules to identify polymers of low concern

Validation rules developed for discrete chemicals were considered inappropriate to be used for polymers. Therefore, an additional set of validation rules was developed to identify polymers of low concern. Validation for polymers involves a comparison of the polymers to NICNAS' New Chemicals Program Polymer of Low Concern (PLC) criteria.

The PLC criteria used in the NICNAS New Chemicals Program are based on certain characteristics such as Number Average Molecular Weight (NAMW), proportion of low molecular weight species, Functional Group Equivalent Weight (FGEW) for reactive functional groups and the stability of the polymers (NICNAS 2013b).

To apply this validation rule, reactive functional groups (RFGs) are identified in the polymers under consideration. These RFGs are then screened against the RFGs considered to be of low concern as described in the NICNAS PLC criteria. Polymers with RFGs other than those considered of low concern in the PLC criteria were assigned for further assessment by this study.

The results of the polymers evaluated against this additional set of validation rules are presented in Appendix A.

2 Results

2.1 Application of the approach to identify coal seam gas chemicals of low concern

The 113 chemicals identified from the industry survey and other sources as being used (or proposed for use) in drilling and hydraulic fracturing in Australia between 2010 and 2012 (NICNAS 2017a), were compared with the lists of chemicals of low concern identified above (Step 3). Of the 113 chemicals, 38 were identified as potentially of low concern based on their entries on existing lists for chemicals of low concern (Step 3). The remaining 75 chemicals were identified as requiring further screening through validation processes.

Next, the set of validation rules developed by NICNAS to identify chemicals requiring further assessment was applied to the 38 chemicals (Step 4) for confirmation of their potential low concern. From this evaluation, 12 chemicals were identified as requiring more detailed assessment. These 12 chemicals were removed from the list of 38 chemicals, resulting in 26 chemicals of low concern.

Further validation rules, developed by NICNAS, based on expert judgement, were applied to the 75 chemicals identified as requiring further screening (Step 3) to determine if any were chemicals of low concern (Step 5). From this evaluation, 11 chemicals were identified as of low concern for human health. A total of 37 (26 + 11) chemicals were thus identified to be of low concern for human health based on this approach.

The 75 chemicals consisted of both discrete chemicals as well as polymers. The specific set of validation rules to identify polymers of low concern was applied to the polymers (Step 6). The RFGs in the polymers were identified and screened against RFGs considered to be of low concern as described in the NICNAS PLC criteria. Seven polymers were identified as PLCs by application of this validation rule.

In total, 44 chemicals including polymers (26 + 11 + 7) were identified as being chemicals of low concern for human health. The remaining 69 chemicals were assessed further (NICNAS 2017b).

Figure 2.1 provides a schematic representation of the outcome of the application of the hazard screening approach and the associated validation rules. The 113 chemicals and the results of the screening process are presented in Appendix A.

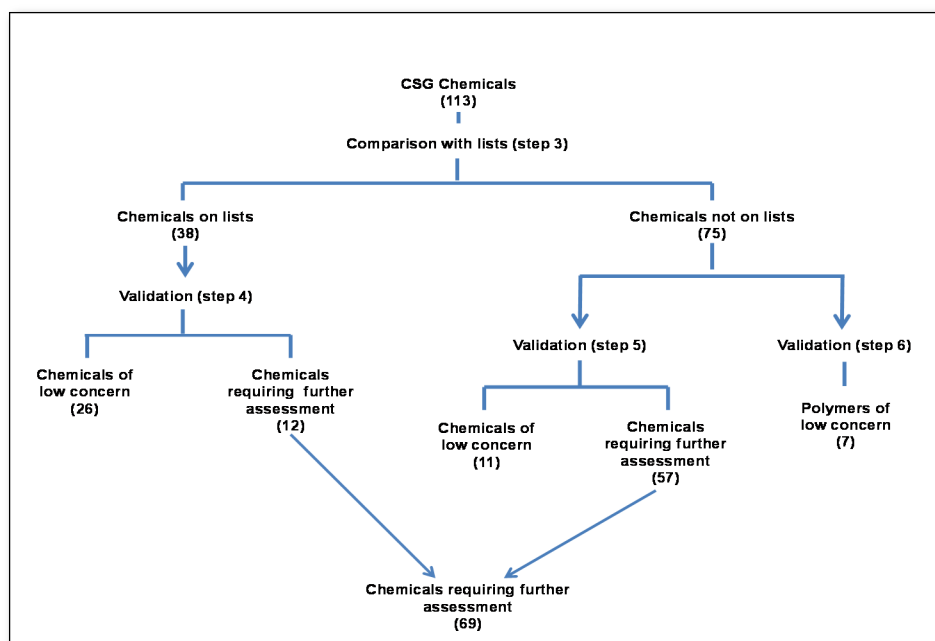


Figure 2.1 Application of the approach and the validation rules, and the results

A total of 44 chemicals (i.e. 37 discrete chemicals and seven polymers) were identified to be of low concern for human health based on this approach and validation rules. The 44 chemicals are presented in Table 2.1.

Chemicals requiring further assessment are presented in Table 2.2. The common names of the chemicals, where available and different from the chemical names, are provided.

Table 2.1 Chemicals identified as of low concern for human health

	CAS RN	CAS chemical name	Common name
1	10377-60-3	Nitric acid, magnesium salt (2:1)	Magnesium nitrate
2	11138-66-2	Xanthan gum	
3	124-38-9	Carbon dioxide	
4	127-09-3	Acetic acid, sodium salt (1:1)	Sodium acetate
5	1302-78-9	Bentonite	Bentonite clay
6	1317-65-3	Limestone	Limestone
7	144-55-8	Carbonic acid sodium salt (1:1)	Sodium bicarbonate, baking soda
8	14807-96-6	Talc (Mg ₃ H ₂ (SiO ₃) ₄)	Talc
9	25038-72-6	2-Propenoic acid, methyl ester, polymer with 1,1-dichloroethene	Vinylidene chloride, methyl acrylate polymer
10	463-79-6	Carbonic acid	Carbonated water
11	533-96-0	Carbonic acid, sodium salt (2:3)	Sodium sesquicarbonate
12	56-81-5	1,2,3-Propanetriol	Glycerol

Chemicals of low concern for human health based on an initial assessment of hazards

CAS RN		CAS chemical name	Common name
13	6381-77-7	D-erythro-Hex-2-enonic acid, γ -lactone, sodium salt (1:1)	Sodium erythorbate
14	67-48-1	Ethanaminium, 2-hydroxy-N,N,N-trimethyl-, chloride (1:1)	Choline chloride
15	68130-15-4	Guar gum, carboxymethyl 2-hydroxypropyl ether, sodium salt	Sodium carboxymethyl hydroxypropyl guar
16	7447-40-7	Potassium chloride (KCl)	Sylvite
17	7647-14-5	Sodium chloride (NaCl)	Common salt
18	7727-37-9	Nitrogen	Nitrogen
19	7727-43-7	Sulfuric acid, barium salt (1:1)	Barium sulfate
20	7732-18-5	Water	Water
21	7757-82-6	Sulfuric acid sodium salt (1:2)	Sodium sulfate
22	7758-16-9	Diphosphoric acid, sodium salt (1:2)	Sodium pyrophosphate
23	7778-80-5	Sulfuric acid potassium salt (1:2)	Potassium sulfate
24	7783-20-2	Sulfuric acid ammonium salt (1:2)	Ammonium sulfate
25	7786-30-3	Magnesium chloride (MgCl ₂)	
26	77-92-9	1,2,3-Propanetricarboxylic acid, 2-hydroxy-	Citric acid
27	9000-30-0	Guar gum	Guar gum
28	9000-70-8	Gelatins	Gelatins
29	9003-05-8	2-Propenamide, homopolymer	
30	9003-06-9	2-Propenoic acid, polymer with 2-propenamide	Polyacrylamide
31	9004-62-0	Cellulose, 2-hydroxyethyl ether	Hydroxyethyl cellulose
32	n.s.	Natural fibres I	
33	n.s.	Natural fibres II	
34	CBI	Natural fibres III	
35	n.s.	Nut hulls	
36	CBI	Polyacrylamide/polyacrylate copolymer	
37	n.s.	Polyanionic cellulose PAC	
38	n.s.	Polyesters	
39	CBI	Polymer I	
40	CBI	Polymer II	
41	CBI	Polysaccharide	

Chemicals of low concern for human health based on an initial assessment of hazards

CAS RN		CAS chemical name	Common name
42	n.s.	Walnut hulls	
43	n.s.	Wood dust	
44	n.s.	Wood fibre	

n.s. = not specified; CBI = confidential business information

Table 2.2 Chemicals requiring further human health hazard assessment following screening

	CAS RN	CAS chemical name	Common name
1	10043-35-3	Boric acid (H ₃ BO ₃)	Boric acid
2	10043-52-4	Calcium chloride (CaCl ₂)	Calcium chloride
3	102-71-6	Ethanol, 2,2',2''-nitrilotris -	Triethanolamine
4	107-21-1	1,2-Ethanedial	Ethylene glycol
5	107-22-2	Ethanedial	Ethanedial
6	108-10-1	2-Pentanone, 4-methyl-	Methyl pentanone
7	111-30-8	Pentanedial	Glutaraldehyde
8	111-76-2	Ethanol, 2-butoxy-	Butoxyethanol
9	111-90-0	Ethanol, 2-(2-ethoxyethoxy)-	Diethylene glycol ethyl ether
10	112926-00-8	Silica gel, pptd., cryst.-free	Precipitated silica
11	12008-41-2	Boron sodium oxide (B ₈ Na ₂ O ₁₃)	Sodium borate
12	1303-96-4	Borax (B ₄ Na ₂ O ₇ .10H ₂ O)	Sodium tetraborate
13	1305-62-0	Calcium hydroxide (Ca(OH) ₂)	Slaked lime
14	1305-78-8	Calcium oxide (CaO)	Lime
15	1310-73-2	Sodium hydroxide (Na(OH))	Caustic soda
16	141-43-5	Ethanol, 2-amino-	Ethanolamine
17	144588-68-1	Bauxite (Al ₂ O ₃ .xH ₂ O), sintered	Sintered bauxite
18	14464-46-1	Cristobalite (SiO ₂)	Cristobalite
19	14808-60-7	Quartz (SiO ₂)	Quartz
20	15468-32-3	Tridymite (SiO ₂) (9Cl)	Tridymite
21	26038-87-9	Boric acid (H ₃ BO ₃), compd. with 2-aminoethanol (1:?)	MEA polyborate
22	26062-79-3	2-Propen-1-aminium, N,N-dimethyl-N-2-propen-1-yl-, chloride (1:1), homopolymer	Polydimethyldiallylammonium chloride
23	26172-55-4	3(2H)-Isothiazolone, 5-chloro-2-methyl-	Methylchloroisothiazolinone
24	2634-33-5	1,2-Benzisothiazol-3(2H)-one	Benzisothiazolinone
25	2682-20-4	3(2H)-Isothiazolone, 2-methyl-	Methylisothiazolone

Chemicals of low concern for human health based on an initial assessment of hazards

	CAS RN	CAS chemical name	Common name
26	497-19-8	Carbonic acid sodium salt (1:2)	Soda ash
27	52-51-7	1,3-Propanediol, 2-bromo-2-nitro-	Bronopol
28	55566-30-8	Phosphonium, tetrakis(hydroxymethyl)-, sulfate (2:1)	THPS
29	584-08-7	Carbonic acid, potassium salt (1:2)	Potassium carbonate
30	64-02-8	Glycine, N,N'-1,2-ethanediylbis[N-(carboxymethyl)-, sodium salt (1:4)	Tetrasodium EDTA
31	6410-41-9	2-Naphthalenecarboxamide, N-(5-chloro-2,4-dimethoxyphenyl)-4-[2-[5-[(diethylamino)sulfonyl]-2-methoxyphenyl]diazanyl]-3-hydroxy-	Pigment Red 5
32	64-17-5	Ethanol	Ethanol
33	64-19-7	Acetic acid	Acetic acid
34	64742-47-8	Distillates (petroleum), hydrotreated light	Deodorised kerosene
35	67-56-1	Methanol	Methanol
36	67-63-0	2-Propanol	Isopropanol
37	68187-17-7	Sulfuric acid, mono-C ₆ -C ₁₀ -alkyl esters, ammonium salts	C ₆ -C ₁₀ linear alkyl sulfate, ammonium salt
38	68439-45-2	Alcohols, C ₆ -C ₁₂ , ethoxylated	C ₆ -C ₁₂ ethoxylated alcohols
39	68647-72-3	Terpenes and Terpenoids, sweet orange-oil	Sweet orange oil terpenes
40	75-57-0	Methanaminium, N,N,N-trimethyl-, chloride (1:1)	Tetramethylammonium chloride
41	7631-86-9	Silica	Amorphous silica
42	7647-01-0	Hydrochloric acid	Hydrochloric acid
43	7681-52-9	Hypochlorous acid, sodium salt (1:1)	Sodium hypochlorite
44	7722-84-1	Hydrogen peroxide (H ₂ O ₂)	Hydrogen peroxide
45	7727-54-0	Peroxydisulfuric acid ((HO)S(O) ₂) ₂ O ₂), ammonium salt (1:2)	Ammonium persulfate
46	7757-83-7	Sulfurous acid, sodium salt (1:2)	Sodium sulfite
47	7758-19-2	Chlorous acid, sodium salt (1:1)	Sodium chlorite
48	7772-98-7	Thiosulfuric acid (H ₂ S ₂ O ₃), sodium salt (1:2)	Sodium thiosulfate
49	7775-27-1	Peroxydisulfuric acid ((HO)S(O) ₂) ₂ O ₂), sodium salt (1:2)	Sodium persulfate
50	81741-28-8	Phosphonium, tributyltetradecyl-, chloride (1:1)	Tributyltetradecyl phosphonium chloride
51	9012-54-8	Cellulase	Cellulase

Chemicals of low concern for human health based on an initial assessment of hazards

	CAS RN	CAS chemical name	Common name
52	9025-56-3	Hemicellulase	Hemicellulase
53	91053-39-3	Diatomite, calcined	Calcined silica
54	90622-53-0	Alkanes, C ₁₂ -C ₂₆ branched and linear	Alkanes, C ₁₂ -C ₂₆ branched and linear
55	CBI	2-Ethylhexanol heavies	
56	CBI	Amine salt	
57	CBI	Enzyme	
58	CBI	Ester alcohol	
59	CBI	Ethoxylated fatty acid I	
60	CBI	Ethoxylated fatty acid II	
61	CBI	Ethoxylated fatty acid III	
62	CBI	Fatty acids ester	
63	CBI	Inner salt of alkyl amines	
64	CBI	Organic acid salt	
65	CBI	Organic sulfate	
66	CBI	Polyamine	
67	CBI	Polymer with substituted alkylacrylamide salt	
68	CBI	Quaternary amine	
69	CBI	Terpenes and terpenoids	

CBI = confidential business information

3 Conclusions

A total of 113 chemicals consisting of discrete chemicals and polymers were identified as being used in coal seam gas extraction in Australia between 2010 and 2012. The chemicals were screened to identify those of low human health hazard and therefore inherently of low concern for human health. Based on a comparison with authoritative lists of low concern chemicals and the application of validation rules, 37 of the discrete chemicals were determined to be of low concern for human health. A further seven polymers reported as being used in Australia in the extraction of coal seam gas were determined to be of low concern for human health, based on application of NICNAS PLC criteria.

Thus in total, 44 of the 113 chemicals used in coal seam gas operations were considered to be of low concern for human health based on this initial screening approach and therefore require no further assessment. Exclusion of the remaining 69 chemicals from the low concern for human health list does not imply that these chemicals represent an actual risk to human health. Some of these chemicals may have not been previously evaluated by the agencies that developed the existing lists of substances considered to be of low concern. Further analysis of their hazards may result in a conclusion of low concern for human health for some chemicals.

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Appendix A - Application of approach and validation rules to identify chemicals of low concern

The application of approach and validation rules to identify chemicals of low concern through Steps 3 to 6 (known common names of some of the chemicals are provided in brackets) are shown in Table A 1 and Table A 2.

Table A 1 Chemicals reported in the industry survey

	CAS RN	Chemical name	Step 3	Step 4	Step 5	Step 6 (PLC Criteria)
1	10043-35-3	Boric acid (H ₃ BO ₃)				
2	10043-52-4	Calcium chloride (CaCl ₂)				
3	10377-60-3	Nitric acid, magnesium salt (2:1)			Low concern	
4	107-21-1	1,2-Ethanedial				
5	107-22-2	Ethanedial				
6	108-10-1	2-Pentanone, 4-methyl-				
7	111-30-8	Pentanedial				
8	111-76-2	Ethanol, 2-butoxy-				
9	11138-66-2	Xanthan gum	Listed in FIFRA 25(b), US EPA List 4A	Low concern		
10	111-90-0	Ethanol, 2-(2-ethoxyethoxy)-				
11	12008-41-2	Boron sodium oxide (B ₈ Na ₂ O ₁₃)				
12	124-38-9	Carbon dioxide	Listed in FIFRA 25(b), US EPA List 4A, GRAS	Low concern		

Chemicals of low concern for human health based on an initial assessment of hazards

CAS RN		Chemical name	Step 3	Step 4	Step 5	Step 6 (PLC Criteria)
13	1302-78-9	Bentonite	Listed in FIFRA 25(b), US EPA List 4A, GRAS	Low concern		
14	1303-96-4	Borax (B ₄ Na ₂ O ₇ ·10H ₂ O)				
15	1305-62-0	Calcium hydroxide (Ca(OH) ₂)	Listed in GRAS			
16	1305-78-8	Calcium oxide (CaO)	Listed in GRAS			
17	1310-73-2	Sodium hydroxide (Na(OH))	Listed in GRAS			
18	1317-65-3	Limestone	Listed in FIFRA 25(b), US EPA List 4A	Low concern		
19	141-43-5	Ethanol, 2-amino-				
20	144-55-8	Carbonic acid sodium salt (1:1)	Listed in FIFRA 25(b), US EPA List 4A, GRAS	Low concern		
21	144588-68-1	Bauxite (Al ₂ O ₃ ·xH ₂ O), sintered				
22	14464-46-1	Cristobalite (SiO ₂)				
23	14807-96-6	Talc (Mg ₃ H ₂ (SiO ₃) ₄)	Listed in GRAS	Low concern		
24	14808-60-7	Quartz (SiO ₂)	Listed in GRAS			
25	15468-32-3	Tridymite (SiO ₂) (9CI)				
26	25038-72-6	2-Propenoic acid, methyl ester, polymer with 1,1-dichloroethene				Low concern
27	26038-87-9	Boric acid (H ₃ BO ₃), compound with 2-aminoethanol (1:?)				
28	26062-79-3	2-Propen-1-aminium, N,N-dimethyl-N-2-propen-1-yl-, chloride (1:1), homopolymer				
29	26172-55-4	3(2H)-Isothiazolone, 5-chloro-2-methyl-				

Chemicals of low concern for human health based on an initial assessment of hazards

CAS RN		Chemical name	Step 3	Step 4	Step 5	Step 6 (PLC Criteria)
30	2634-33-5	1,2-Benzisothiazol-3(2H)-one				
31	2682-20-4	3(2H)-Isothiazolone, 2-methyl-				
32	497-19-8	Carbonic acid sodium salt (1:2)	Listed in GRAS			
33	52-51-7	1,3-Propanediol, 2-bromo-2-nitro-				
34	533-96-0	Carbonic acid, sodium salt (2:3)	Listed in GRAS	Low concern		
35	55566-30-8	Phosphonium, tetrakis(hydroxymethyl)-, sulfate (2:1) [THPS]				
36	56-81-5	1,2,3-Propanetriol [Glycerol]	Listed in FIFRA 25(b), US EPA List 4A, GRAS	Low concern		
37	584-08-7	Carbonic acid, potassium salt (1:2)				
38	6381-77-7	D-erythro-Hex-2-enonic acid, γ -lactone, sodium salt (1:1)	Listed in GRAS	Low concern		
39	6410-41-9	2-Naphthalenecarboxamide, N-(5-chloro-2,4-dimethoxyphenyl)-4-[2-[5-[(diethylamino)sulfonyl]-2-methoxyphenyl]diazonyl]-3-hydroxy-				
40	64-17-5	Ethanol				
41	64-19-7	Acetic acid	Listed in GRAS			
42	64742-47-8	Distillates (petroleum), hydrotreated light				
43	67-56-1	Methanol				
44	67-63-0	2-Propanol	Listed in FIFRA 25(b)			
45	68130-15-4	Guar gum,				Low concern

Chemicals of low concern for human health based on an initial assessment of hazards

CAS RN		Chemical name	Step 3	Step 4	Step 5	Step 6 (PLC Criteria)
		carboxymethyl 2-hydroxypropyl ether, sodium salt				
46	68647-72-3	Terpenes and Terpenoids, sweet orange-oil				
47	7447-40-7	Potassium chloride (KCl)	Listed in FIFRA 25(b), US EPA List 4A, GRAS	Low concern		
48	75-57-0	Methanaminium, N,N,N-trimethyl-, chloride (1:1)				
49	7631-86-9	Silica	Listed in FIFRA 25(b), US EPA List 4A			
50	7647-01-0	Hydrochloric acid	Listed in GRAS			
51	7647-14-5	Sodium chloride (NaCl)	Listed in FIFRA 25(b), US EPA List 4A, GRAS	Low concern		
52	7681-52-9	Hypochlorous acid, sodium salt (1:1)				
53	7727-37-9	Nitrogen	Listed in REACH Annex IV, FIFRA 25(b), US EPA List 4A	Low concern		
54	7727-43-7	Sulfuric acid, barium salt (1:1)			Low concern	
55	7727-54-0	Peroxydisulfuric acid ($[(HO)S(O)_2]_2O_2$), ammonium salt (1:2)				
56	7732-18-5	Water	Listed in REACH Annex IV, US EPA List 4A	Low concern		
57	7757-82-6	Sulfuric acid sodium salt (1:2)	Listed in FIFRA 25(b), US EPA List 4A	Low concern		
58	7757-83-7	Sulfurous acid, sodium salt (1:2)	Listed in GRAS			
59	7758-16-9	Diphosphoric acid, sodium salt (1:2)	Listed in GRAS	Low concern		

Chemicals of low concern for human health based on an initial assessment of hazards

CAS RN		Chemical name	Step 3	Step 4	Step 5	Step 6 (PLC Criteria)
60	7758-19-2	Chlorous acid, sodium salt (1:1)				
61	7772-98-7	Thiosulfuric acid (H ₂ S ₂ O ₃), sodium salt (1:2)				
62	7775-27-1	Peroxydisulfuric acid ([[(HO)S(O) ₂] ₂ O ₂), sodium salt (1:2)				
63	7778-80-5	Sulfuric acid potassium salt (1:2)	Listed in FIFRA 25(b), US EPA List 4A	Low concern		
64	7783-20-2	Sulfuric acid ammonium salt (1:2)	Listed in GRAS	Low concern		
65	7786-30-3	Magnesium chloride (MgCl ₂)	Listed in GRAS	Low concern		
66	77-92-9	1,2,3-Propanetricarboxylic acid, 2-hydroxy-	Listed in FIFRA 25(b), US EPA List 4A, GRAS	Low concern		
67	81741-28-8	Phosphonium, tributyltetradecyl-, chloride (1:1)				
68	9000-30-0	Guar gum	Listed in FIFRA 25(b), US EPA List 4A, GRAS	Low concern		
69	9000-70-8	Gelatins	Listed in FIFRA 25(b), GRAS	Low concern		
70	9003-05-8	2-Propenamide, homopolymer				Low concern
71	9003-06-9	2-Propenoic acid, polymer with 2-propenamide				Low concern
72	9004-62-0	Cellulose, 2-hydroxyethyl ether	Listed in FIFRA 25(b), US EPA List 4A	Low concern		
73	9012-54-8	Cellulase				
74	9025-56-3	Hemicellulase				
75	91053-39-3	Diatomite, calcined				

Chemicals of low concern for human health based on an initial assessment of hazards

CAS RN		Chemical name	Step 3	Step 4	Step 5	Step 6 (PLC Criteria)
76	90622-53-0	Alkanes, C12-26-branched and linear				
77	CBI	2-Ethylhexanol heavies				
78	CBI	Amine salt				
79	CBI	Enzyme				
80	CBI	Ester alcohol				
81	CBI	Ethoxylated fatty acid I				
82	CBI	Ethoxylated fatty acid II				
83	CBI	Ethoxylated fatty acid III				
84	CBI	Fatty acids ester				
85	CBI	Inner salt of alkyl amines				
86	n.s.	Natural fibres I			Low concern	
87	n.s.	Natural fibres II			Low concern	
88	CBI	Natural fibres III	Listed in FIFRA 25(b), US EPA List 4A	Low concern		
89	n.s.	Nut hulls			Low concern	
90	CBI	Organic acid salt				
91	CBI	Organic sulfate				
92	CBI	Polyamine				
93	CBI	Polyacrylamide/polyacrylate copolymer				Low concern
94	n.s.	Polyanionic cellulose PAC			Low concern	
95	n.s.	Polyesters			Low concern	

Chemicals of low concern for human health based on an initial assessment of hazards

CAS RN		Chemical name	Step 3	Step 4	Step 5	Step 6 (PLC Criteria)
96	CBI	Polymer I				Low concern
97	CBI	Polymer II				Low concern
98	CBI	Polymer with substituted alkylacrylamide salt				
99	CBI	Polysaccharide	Listed in FIFRA 25(b), US EPA List 4A, GRAS	Low concern		
100	CBI	Quaternary amine				
101	CBI	Terpenes and terpenoids				
102	CBI	Treated vegetable oil ³				
103	n.s.	Walnut hulls			Low concern	
104	n.s.	Wood dust			Low concern	
105	n.s.	Wood fibre			Low concern	

n.s. = not specified; CBI = confidential business information

³ Initially, treated vegetable oil was identified as being used in drilling and hydraulic fracturing (NICNAS 2017a). Industry subsequently confirmed that this chemical had erroneously been reported as being used in coal seam gas extraction. It was therefore removed from the assessment.

Table A 2 Chemicals on publicly available lists in Australia not notified to NICNAS

CAS No.		Chemical Name	Step 3	Step 4	Step 5	Step 6 (PLC Criteria)
1	102-71-6	Ethanol, 2,2',2''-nitrotris-				
2	112926-00-8	Silica gel, pptd., cryst.-free	Listed in FIFRA 25(b), US EPA List 4A			
3	127-09-3	Acetic acid, sodium salt (1:1)	Listed in FIFRA 25(b), US EPA List 4A	Low concern		
4	463-79-6	Carbonic acid			Low concern	
5	64-02-8	Glycine, N,N'-1,2-ethanediybis[N-(carboxymethyl)-, sodium salt (1:4)				
6	67-48-1	Ethanaminium, 2-hydroxy-N,N,N-trimethyl-, chloride (1:1)	Listed in GRAS	Low concern		
7	68187-17-7	Sulfuric acid, mono-C ₆ -C ₁₀ -alkyl esters, ammonium salts				
8	68439-45-2	Alcohols, C ₆₋₁₂ , ethoxylated				
9	7722-84-1	Hydrogen peroxide (H ₂ O ₂)	Listed in GRAS			