Waste Acceptance Criteria

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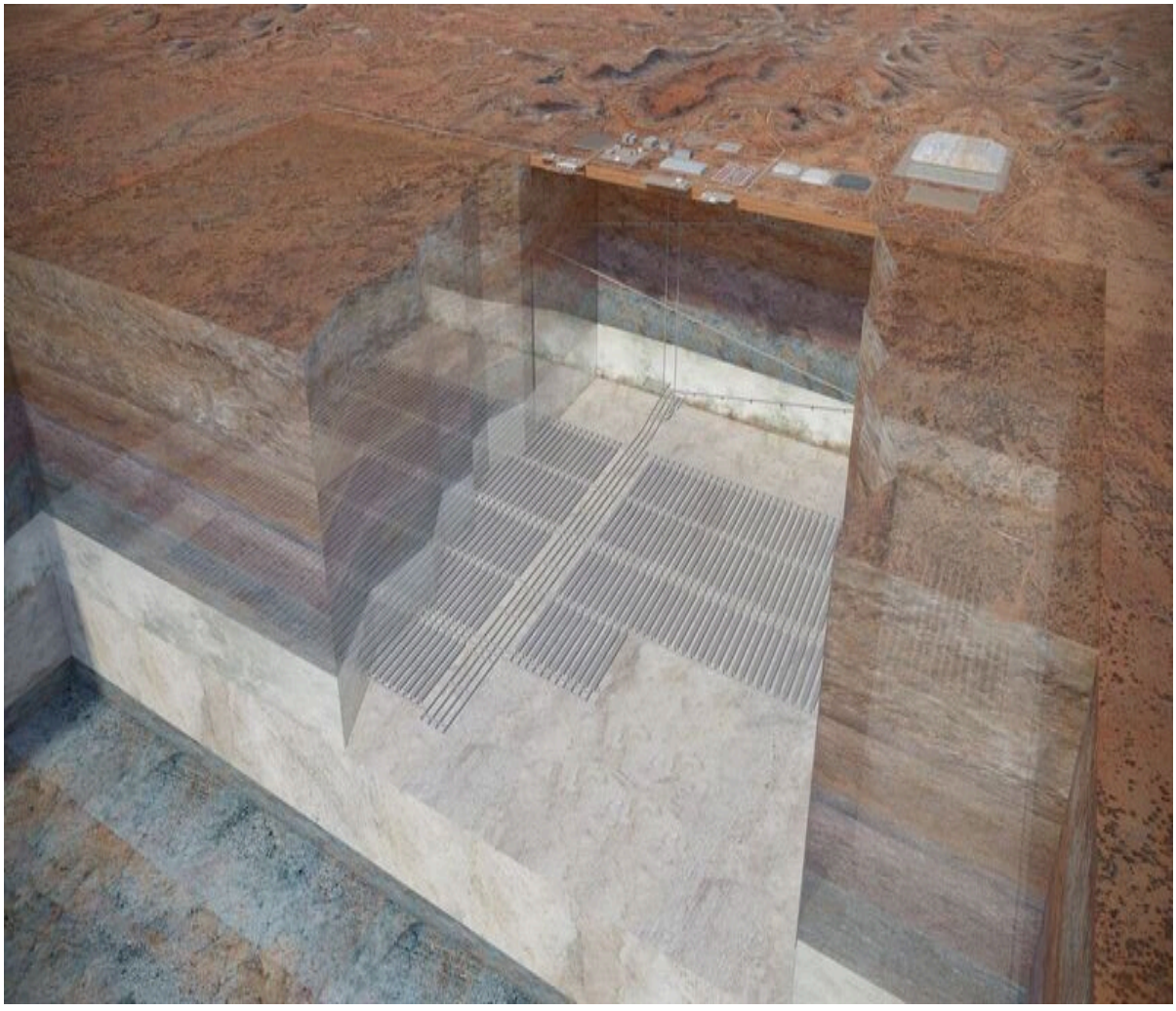
CHANDLER AND APIRNTA FACILITY WASTE ACCEPTANCE POLICY

Final Report | September 2016



Revision	Date	Description	Signatures		
			Originator	Checked	Approved
0	28/09/2016	For issue	Steve Reece	SH, RP	DvM

Table of Contents

LIST OF FIGURES

LIST OF TABLES

No table of figures entries found.

LIST OF APPENDICIES

ABBREVIATIONS

AHMC	Australian Health Ministers' Conference
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
C&I	Commercial and Industrial (waste source)
The Convention	The Basel Convention
EIS	Environmental Impact Statement
EPA	Environmental Protection Authority
EW	Exempt Waste (Radioactive)
The Facility	The Chandler and Apirnta Facility
IAEA	International Atomic Energy Agency
NORM	Naturally Occurring Radioactive Materials
NT	The Northern Territory
RHC	Radiation Health Committee
RPS	Radiation Protection Series
Tellus	Tellus Holdings Ltd.
WAC	Waste Acceptance Criteria
WAP	Waste Acceptance Procedures
WZG	Waste Zoning Guide

DEFINITIONS

Hazardous waste[1] - Waste prescribed by the regulations, where the waste has any of the characteristics mentioned in Annex III to the Basel Convention. These characteristics include:

- Explosive
- Flammable Liquids/Solids
- Poisonous
- Toxic
- Ecotoxic
- Infectious Substances.
- Wastes that belong to any category contained in Annex I to the Basel Convention unless they do not possess any of the hazardous characteristics contained in Annex III. Wastes in Annex I include:
    - Clinical wastes;
    - Waste oils/water, hydrocarbons/water mixtures, emulsions;
    - Wastes from the production, formulation and use of resins, latex, plasticizers, glues/adhesives;
    - Wastes resulting from surface treatment of metals and plastics;
    - Residues arising from industrial waste disposal operations; and
    - Wastes which contain certain compounds such as: copper, zinc, cadmium, mercury, lead and asbestos.
- Household waste; or
- Residues arising from the incineration of household waste

Listed Waste[2] – wastes which pose a threat or risk to public health, safety or the environment and include substances which are toxic, infectious, mutagenic, carcinogenic, teratogenic, explosive, flammable, corrosive, oxidising and radioactive. Listed wastes are ONLY to be disposed of at facilities that are licensed to receive listed waste. For details of what constitutes listed waste refer to the Waste Management and Pollution Control (Administration) Regulations.

Geological repository – a deep salt facility used to permanently isolate waste. The geological barrier provides permanent isolation of wastes from the environment over the very long term in

[1] *Hazardous Waste (Regulation of Exports and Imports) Act 1989,*
[2] *Guidelines for the Siting, Design and Management of Solid Waste Disposal Sites in the Northern Territory*

accordance with Environmentally Sound Management principles and also creates additional opportunities for the future recovery and recycling of valuable materials from the waste which can re-enter the circular economy.

Room – an underground excavation (chamber) in salt which is used for the *storage* or *permanent isolation* of waste

Conditions of storage – The term "in the conditions of storage" is used to differentiate between the generic properties of a material and how those properties may be modified when that material is placed into "storage" or "permanent isolation" within an underground room.

Storage – the above ground storage of materials following delivery and includes the time awaiting sampling, analysis and management prior to movement for "in cell storage".

In Room Storage – medium to long term below ground storage of wastes inside a room with ongoing opportunity to recover waste if required.

Permanent Isolation – indefinite below ground storage or disposal of wastes determined suitable for acceptance

Notice and Certification Assurance program – supported by Tellus' Notices and Certificates that include the following: Customer Dispatch, Arrival and Rejection Notices and Tellus-Acceptance©, Tellus-Storage©, Tellus-Recovery© Tellus-Solidification© and Tellus-Permanent Isolation Certificates.

Title - a legal right to ownership and possession of all items that can be recognized as being owned or belonging to a person or a thing. At a basic level, a title is a document that indicates recognition of ownership.

Management risk – the responsibility for the management of waste materials

Disclaimer:

The information contained in this document is for the purpose of supporting approvals documentation and subsequently for use as an operational document for the Chandler and Apirnta Facility only.

All care and diligence has been exercised in interpreting data for the development of this document. In any event, Tellus accepts no liability for any costs, liabilities or losses arising because of the use of, or reliance upon, the contents of this report by any third party.

Tellus, as part of their continuous improvement activities will review and may update and amend this document from time to time.

1 INTRODUCTION

1.1 The Chandler Facility

The proposed Chandler Facility (hereby referred to as the proposed "Facility") is a salt mining and processing facility, and a hazardous waste storage and permanent isolation facility. The salt bed is located approximately 800m below the surface and is 200-300m thick. The salt bed which is 500 M years old is overlain by a sequence of low permeability sedimentary rocks. The salt bed will be mined in a way that produces "rooms" which are used to house hazardous waste temporarily or permanently. The facility is located approximately 120 kilometres south of Alice Springs and is situated on the Maryvale pastoral lease.

The location for the Facility was chosen as its principal characteristics; natural geological barrier, geologically stable, no regional aquifer, remote location, no special cultural or historic significance, no potential medium to high value agriculture, no sterilization of minerals or hydrocarbons, no special environmental features, and no rare species of flora or fauna, satisfy the requirements for a deep geological repository[3] for hazardous waste storage and isolation purposes.

There are no sensitive receptors within the immediate vicinity of the proposed Facility. The nearest permanent settlement is the small town of Titjikala about 15 kilometres to the north-east. The main land uses that occur on the Maryvale pastoral lease are cattle grazing and Aboriginal land management. The main waterways in the region are the Hugh River, Finke River and Palmer River. At their nearest point, Hugh River is about 10 kilometres east of the site, Finke River is about 15 kilometres south and Palmer River is about 70 kilometres west

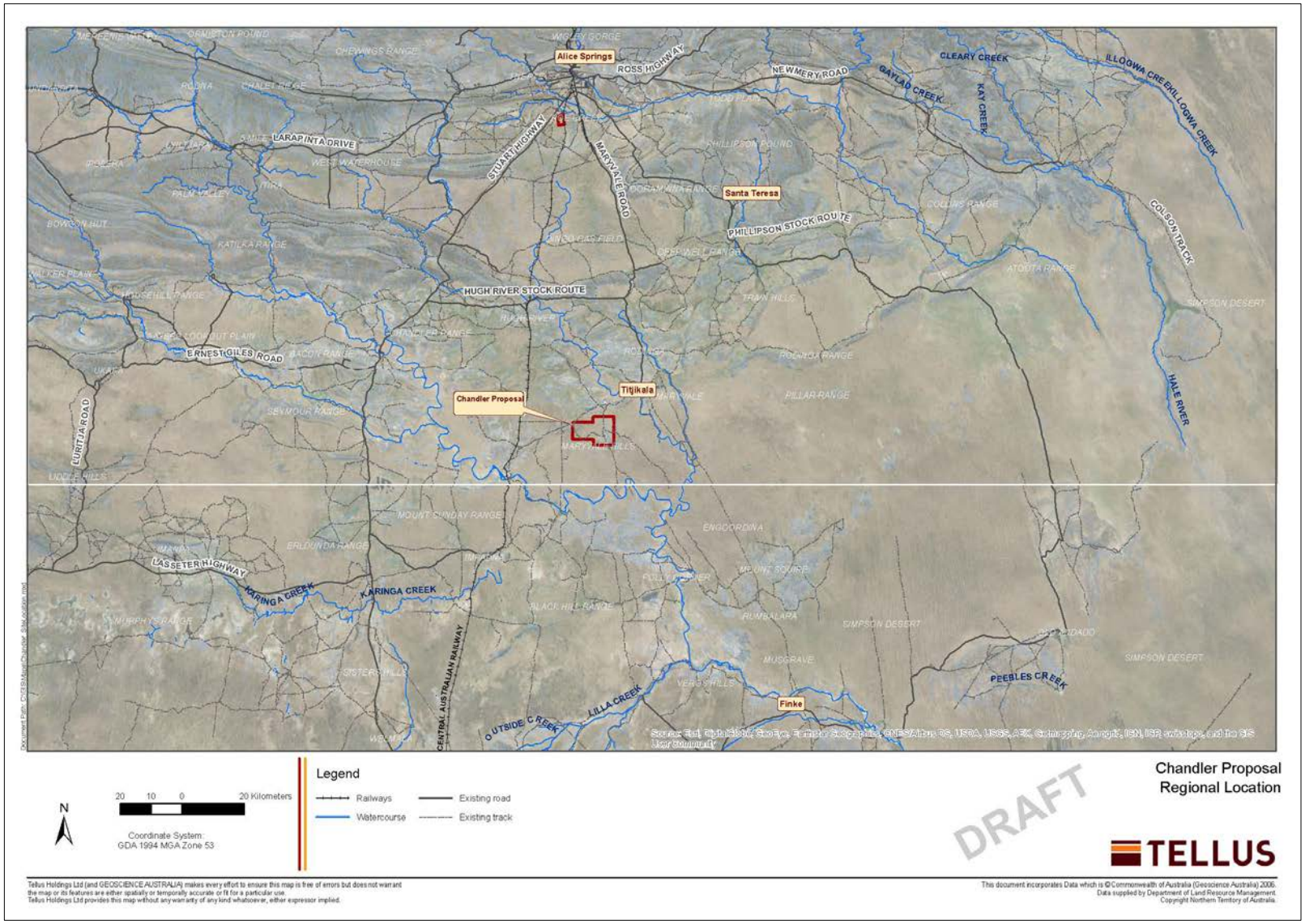
The arid and remote nature of the location, absence of nearby population, coupled with the site characteristics make the site ideal for long-term storage and permanent isolation of hazardous and intractable waste.

1.2 The Apirnta Facility

The Apirnta Facility is located adjacent to the Central Australian Railway approximately 30km to the west of the Chandler Facility and will be connected to Chandler by the Chandler Haul Road. Apirnta will be a Storage and Transfer Facility and will be the location where waste acceptance procedures are performed to confirm that incoming materials meet the waste acceptance criteria for Chandler.

[3] *IAEA guidelines for the siting of geological disposal facilities - adapted to hazardous waste*

Figure 1-1: Chandler site location



1.3 Document aims and objectives

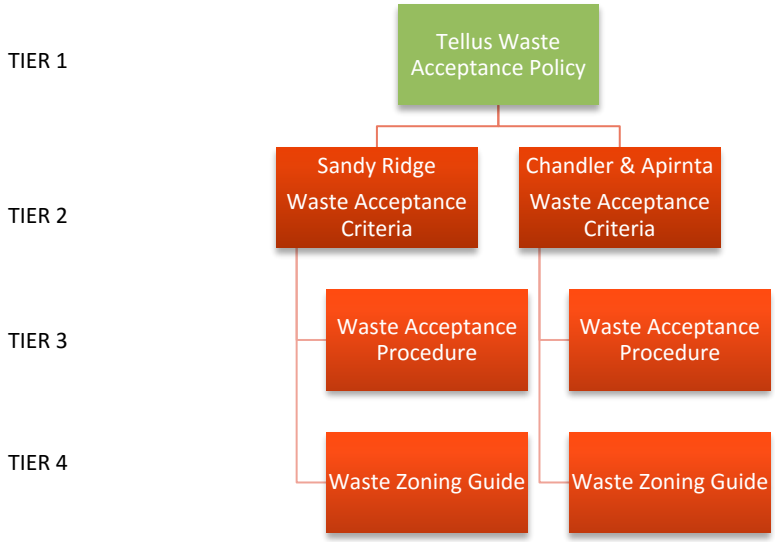
Tellus have developed a suite of waste acceptance documents under which Tellus would operate their facilities; define the type of waste materials that would be accepted by Tellus; explain how waste material will be tested and then how the material would be stored and isolated during operations. The documents are in order of a hierarchy as follows:

- Waste Acceptance Policy, this document.
- Waste Acceptance Criteria (WAC).
- Waste Acceptance Procedure (WAP).
- Waste Zoning Guide (WZG).

The aim of this Waste Acceptance Policy document is to set a framework for each of Tellus' proposed Facilities listed in Figure 1-2. This document also applies to the proposed Apirnta and Chandler Facility.

This Waste Acceptance Policy is the Tier One document within Tellus' Waste Acceptance hierarchy, shown in Figure 1-2. Lower tier documents provide additional detail and procedure relating to operational activities that include acceptance and zoning.

Figure 1-2: Waste Acceptance Criteria document hierarchy



1.4 Intended audience

This document is intended initially for use by regulators responsible for assessing the facility and issuing licences for the operation of the proposed Facility, and for the formation of procedures to control the process by which waste producers and Tellus staff will determine if the waste streams may be suitable for storage or permanent isolation.

The document will also be of interest to other stakeholders who wish to understand the approach being followed by Tellus for waste acceptance, including the safe storage and permanent isolation of wastes.

Finally, this document will be used by Tellus staff and their specialist advisors to establish the framework that incorporates more detailed operational procedures which underpin this document.

2 TELLUS WASTE ACCEPTANCE POLICY

Before waste can be accepted for storage or permanent isolation at the proposed Chandler Facility, Tellus must be satisfied that waste meets the requirements of:

- All environmental approvals and licences issued by regulators:
- The Chandler WAC.
- The Chandler WAP
- The Chandler WZG.

Together, these steps form the basis of Tellus' Waste Acceptance Procedures for the proposed Chandler Facility. These are briefly summarised below and are detailed in separate standalone documents.

2.1 Waste Acceptance Criteria

WAC have been established for the proposed Facility to determine waste types which can and cannot be accepted in order to achieve safe operation. WAC were also established to ensure long term environmental protection through containment of potential pollutants present within the wastes. In some cases, the criteria used will lead to straightforward "go or no go" decisions based on compatibility with the site characteristics and WAC, and in other cases acceptance values and parameters will be used.

Whilst Tellus will ensure that waste generators are aware of the WAC for the proposed Facility, it is recognised that on some occasions particular wastes presented will not conform to set criteria and re-evaluation of appropriate management techniques will be required so as to achieve the objective of safe storage or permanent isolation so that the threat to the receiving environment is minimised or prevented.

2.2 Waste Acceptance Procedure

As part of the WAP it is necessary to first characterise the waste material. Tellus have adopted a three stage approach to waste characterisation[4] which is summarised below. The most detailed characterisation takes place to determine if waste meets the overarching criteria and licence conditions of the site, followed by further ongoing testing at levels 2 and 3 described below.

- **Level 1: Basic characterisation**. This is a thorough determination, according to standardised analysis and behaviour-testing methods, of the characteristic properties of the waste.

[4] *UK Environment Agency Waste acceptance at landfills - 2010*

- **Level 2: Compliance testing**. This is periodic testing of regularly arising wastes by simpler standardised analysis methods to determine whether a waste complies with licence conditions and whether a waste with known properties has changed significantly.

- **Level 3: On-site verification**. This constitutes rapid check methods to confirm that a waste is the same as that which has been subjected to compliance testing and that which is described in the accompanying documents.

2.3 Waste Zoning

After wastes have been accepted at the Facility it is important that they are both stored and permanently isolated in a safe manner. Within the Facility, waste materials would be grouped into compatible waste type groups that can be stored together, Dangerous Goods Segregation protocols will be adopted, in accordance with Australian Standard AS/NZ 3833.

When the waste is placed into an underground room for permanent isolation, waste zoning protocols will be implemented, as presented in the WZG. The WZG have been developed to reflect the conditions of storage within the cell and how the various wastes can be stored or permanently isolated without adverse interaction. Adopting a zoning approach also increases the opportunity for potential future recovery of certain materials for beneficial use.

3 REGULATORY CONTEXT

3.1 Overview

In considering the development of the proposed Chandler Facility, Tellus has taken into account the requirements of both Commonwealth and State legislative provisions. As the proposed Facility is designed to accept hazardous and listed wastes, including small quantities of Naturally Occurring Radioactive Material (NORM), the development of the WAC has consequently considered a wide range of legislative requirements as guidance.

Australian legislation does not explicitly deal with the unique characteristics of deep geological disposal facilities for hazardous wastes as there are currently no such facilities within Australia. In establishing acceptance criteria for the Facility, Tellus has followed Australian guidelines as closely as possible but has also taken into account the objectives and compliance requirements of international legislation; particularly from Europe, where deep geological disposal is common practice in many European countries.

This section sets out applicable legislation, regulation and guidelines for the proposed Chandler Facility that Tellus has considered in the development of the WAC. It should be noted that the volume of hazardous and listed waste received at the proposed Facility is likely to be significantly greater than proposed NORM waste volumes.

3.2 Commonwealth legislation, regulation and guidelines

Environmental

Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* is the principal environmental law administered by the Australian Government. The law regulates actions with regard to matters of national environmental significance. Under the Act, any proposed action that is likely to have an impact on a matter of national environmental significance must be referred to the Minister for the Environment. The proposed Chandler Facility was referred and determined to require assessment due to the clearing and loss of potential habitat and individuals of a number of threatened species listed in the Act and as such the project was required to be assessed at the level of an EIS.

If an environmental assessment is triggered by both the *Environment Protection and Biodiversity Conservation Act 1999* and State environmental law, a single environmental assessment is set as the agreed approval process for the proposal to address a bilateral agreement between the Australian Government and the Northern Territory Government.

National Environment Protection Measures (Implementation) Act 1998

The *National Environment Protection Measures (Implementation) Act 1998* gives force to the national environmental protection measures made by the National Environment Protection Council

by requiring their implementation through State regulatory systems. The national environmental protection measures made by the council cover environmental matters including;

- Air Toxics.
- Ambient Air Quality.
- Assessment of Site Contamination.
- Diesel Vehicle Emissions.
- Movement of Controlled Waste between States and Territories.
- National Pollutant Inventory.
- Used Packaging Materials.

National Environment Protection (Movement of Controlled Waste between States and Territories) Measure 1998.

The National Environmental Protection (movement of controlled wastes between States and Territories) Measure provides a national framework for developing and integrating State and Territory systems for the management of the movement of controlled wastes between States and Territories originating from commercial, trade, industrial or business activities. These management systems include:

- Tracking systems which would provide information to assist agencies and emergency services, and would ensure that controlled wastes are directed to, and reach, appropriate facilities.
- Prior notification systems, which would provide participating States and Territories with access to information, to assess the appropriateness of proposed movements of controlled wastes in terms of transportation and facility selection.
- The licensing of transporters and regulation of producers and facilities so that tracking and notification functions are compatible with participating State and Territory requirements.

For the avoidance of doubt, it is noted that this Measure relates to the movement of wastes between States and Territories within Australia, and is not intended to have any direct or indirect bearing upon Australia's international rights or obligations with respect to the international movement of waste.

The Australian Code for the Transport of Dangerous Goods by Road and Rail (7th Edition)

The *Australian Code for the Transport of Dangerous Goods by Road & Rail* is developed by the National Transport Commission. The code provides classifications of dangerous goods as:

- Class 1 – Explosive.
- Class 2 – Gases.

- Class 3 – Flammable liquids.
- Class 4.1 – Flammable solids, self-reactive substances and solid desensitised explosives.
- Class 4.2 – Substances liable to spontaneous combustion.
- Class 4.3 – Substances which in contact with water emit flammable gases.
- Class 5.1 – Oxidising substances.
- Class 5.2 – Organic peroxides.
- Class 6.1 – Toxic substances.
- Class 6.2 – Infectious substances.
- Class 7 – Radioactive material.
- Class 8 – Corrosive substances.
- Class 9 – Miscellaneous dangerous substances.

The code includes a detailed list of dangerous goods by classification. The code also sets standards for storage and handling of dangerous goods including packaging, labelling, stowage and restraint, segregation and safety equipment. With regard to Class 7 – Radioactive material, the code refers to the *Code of Practice for the Safe Transport of Radioactive Material*. Whilst the Chandler WAC does not deal with transport, there is clearly an interface between transport deliveries to site and the safe acceptance, storage, and disposal of wastes and, as such, due consideration of these regulations has been adopted in the WAC and its supportive documents.

Hazardous Waste (Regulation of Exports and Imports) Act 1989.

The *Hazardous Waste (Regulation of Exports and Imports) Act 1989* aims to regulate the export, import and transit of hazardous waste to ensure that exported, imported or transited waste is managed in an environmentally sound manner so that human beings and the environment, both within and outside Australia, are protected from the harmful effects of the waste.

This Act looks to:

- Give effect to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal.
- Give effect to agreements and arrangements of the kind mentioned in Article 11 of the Basel Convention.

Radioactive materials

Australian Radiation Protection and Nuclear Safety Act 1998

The *Australian Radiation Protection and Nuclear Safety Act 1998* is the principal law regulating radioactive materials and activities. The objective of the law is to protect the health and safety of people, and to protect the environment, from the harmful effects of radiation.

The key provisions of the Act establish the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) and regulate controlled material, apparatus and facilities. ARPANSA is the regulatory body for Commonwealth agencies.

It is noted that the agency is not the regulatory body for activities that are not undertaken by the Commonwealth, instead, these responsibilities are deferred to other authorities that are established in each State or Territory. The agency produces guidance material on radioactive material and is informed by a range of advisory bodies including the Radiation Health and Safety Advisory Council, Radiation Health Committee, and the Nuclear Safety Committee.

Classification of Radioactive Waste Radiation Protection Series Publication No. 20 April 2010

Various methods have evolved for classifying radioactive waste according to the physical, chemical and radiological properties that are relevant to particular facilities, or circumstances, in which radioactive waste is generated and managed. Prior to 2010 Australia had never had a formal method for classifying radioactive waste. Given more recent developments in guidance on classification of radioactive waste, in particular the *IAEA General Safety Guide Classification of Radioactive Waste (No. GSG-1)* published in late 2009, Australia adopted a nationally uniform system of classification of radioactive waste which underpins a range of further guidance of radioactive waste management.

Radioactive waste arises from the industrial, medical and research use of radioactive materials. Some of this waste has such low activity concentrations that it falls below regulatory concern or within discharge limits that allow it to be disposed of to the atmosphere, sewer or landfill. More active radioactive waste can be stored for short periods until it has decayed to very low level radioactive waste or to levels below regulatory concern and disposed of with non-radioactive waste.

RPS 6 - National Directory for Radiation Protection (2014)

The National Directory for Radiation Protection was developed by the Radiation Health Committee and published in August 2004. It was subsequently endorsed by the Australian Health Ministers' Conference (AHMC) as the uniform national framework for radiation protection in Australia. Following publication of Edition 1, the Radiation Health Committee (RHC) agreed that further progression of the Directory would be by individual amendments, and that the consolidated version of the Directory would be maintained as an electronic document via ARPANSA's website. The current Directory includes amendments up to and including amendment 6.

Tellus is intending to accept radioactive materials only **up to exemption level**, Amendment 2 approved in 2008 is therefore particularly pertinent in establishing WAC.

RPS 15 Management of Naturally Occurring Radioactive Material (NORM) 2008

Tellus anticipates receiving NORM material **up to exemption level**. RPS15 states it is appropriate for the Authority to consider exemptions for practices (generally expected to be dealings involving quantities of naturally occurring radioactive materials) resulting in individual doses up to about 1 mSv per year on the basis of an assessment (to be agreed between the operator and the Authority)

that the radiation protection is optimised. Such an exemption may be subject to monitoring and reporting conditions to ensure that the basis for exemption stays in place.

3.3 State legislation, regulation and guidelines

Environmental Assessment Act

The *Environmental Assessment Act* is the principal environmental planning legislation administered by the Northern Territory Government. The law enables the NT Environmental Protection Authority to assess the effect of certain proposed actions on the environment by requiring the preparation of a public environmental report or environmental impact statement. The requirement for a public environmental report or environmental impact statement depends on the scope and scale of a proposed action, as determined by the NT Environment Protection Authority. As stated previously an EIS has been prepared for the Chandler and Apirnta Facilities.

Waste Management and Pollution Control Act

The *Waste Management and Pollution Control Act* is the principal pollution control legislation administered by the Northern Territory Government. The main aspects of the law are:

- General environmental duty.
- Notification of pollution incidents.
- Environment protection objectives.
- Approvals and licenses for scheduled activities.

The general environmental duty requires all persons conducting activities likely to harm the environment to take all reasonable and practicable measures to reduce likelihood of harm occurring. If an incident occurs during an activity that may harm the environment, the responsible person must notify the Northern Territory Environment Protection Authority.

Environment protection objectives may be set under the *Waste Management and Pollution Control Act* with regard to matters including air quality, water quality and waste management. The Northern Territory Environment Protection Authority may grant an environment protection approval, environment protection license or best practice license to certain activities listed in Schedule 2. These activities include collecting, transporting, storing, recycling, treating or disposing of listed waste on a commercial basis.

Listed wastes are defined in Schedule 2 of the subordinate Waste Management and Pollution Control (Administration) Regulations.

Guidelines for the Siting, Design and Management of Solid Waste Disposal Sites in the Northern Territory

The NT EPA *Guidelines for the Siting, Design and Management of Solid Waste Disposal Sites in the Northern Territory (January 2013)* sets out many important factors to be considered in the site

selection, development, design, construction, operation, closure and post-closure management of municipal solid waste, and commercial and industrial (C&I) general waste landfill facilities so that they can comply with the Waste Management and Pollution Control Act. The term "landfill" is defined in these guidelines as *a waste disposal site used for the controlled deposit of solid wastes by burial onto or into land*.

The guidelines deal in large part with surface based facilities but provide important framework that Tellus believe can also be applied to deep geological disposal facilities, which are established in underground voids created by mining, i.e. *into land*. The guidelines, amongst other waste classifications, include listed waste[5] which are defined as wastes that pose a threat or risk to public health, safety or the environment, and include substances which are toxic, infectious, mutagenic, carcinogenic, teratogenic, explosive, flammable, corrosive, oxidising and radioactive. The guidelines make clear that listed wastes are only to be disposed of at facilities that are licensed to receive listed waste, such as the proposed Facility

3.4 International legislation

Basel convention

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal first came into force in 1992. The Convention puts an onus on exporting countries to ensure that hazardous wastes are managed in an **environmentally sound manner** in the country of import.

The Basel Convention places obligations on countries that are party to the Convention. These obligations are to:

- Minimise generation of hazardous waste;
- Ensure adequate disposal facilities are available;
- Control and reduce international movements of hazardous waste;
- Ensure environmentally sound management of wastes; and
- Prevent and punish illegal traffic.

Australia signed the Basel Convention in 1992. The Convention is implemented in Australia by the Hazardous Waste (Regulation of Exports and Imports) Act 1989.

Annex III of The Convention provides a List of Hazardous Characteristics, which can be used as part of a basic waste classification system. Although the Chandler WAC does not involve transport of hazardous waste, international or otherwise, the Basel Convention classification system has been

[5] *Waste Management and Pollution Control (Administration) Regulations – Schedule 2*

utilised in the Zone Selection procedure in order to ensure the Tellus zoning strategy aligns with international examples of waste segregation during final disposal.

European Landfill Directive (1999/31/EC) and the [EUROPEan Council Decision establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 of and Annex II to Directive 1999/31/EC (Council Decision 2003/33/EC [EC Waste Acceptance Criteria])

Appendix A of the EC Waste Acceptance Criteria (included at Appendix A.1 of this document for ease of reference) specifically deals with acceptance criteria for underground storage and provides guidelines on determining suitable criteria based on a facility's characteristics, which makes it particularly helpful to guide the development of both waste acceptance and zoning criteria for the proposed Facility.

For the acceptance of waste into underground storage sites, a site-specific safety assessment is required, waste may be accepted only if it is compatible with that assessment. The site specific risk assessment considers;

- The hazard (in this case the deposited wastes).
- The receptors (in this case the biosphere and possibly groundwater).
- The pathways by which substances from the wastes may reach the biosphere.
- The assessment of impact of substances that may reach the biosphere.

The acceptance criteria for underground storage can only be obtained by referring to the local conditions. This requires a demonstration of the suitability of the strata for establishing the storage zone, i.e. an assessment of the risks to containment, taking into account the overall system of the waste (type and form), engineered structures and the host rock body itself.

The EC Waste Acceptance Criteria makes specific reference to underground salt mines used as geological storage facilities and particularly recognises the importance of the geological barrier. The rock surrounding the waste in a salt mine has a two-fold role:

- It acts as host rock in which the wastes are encapsulated.
- Together with the overlying and underlying impermeable rock strata it acts as a geological barrier to prevent groundwater entering the facility and, where necessary, effectively to stop liquids or gases escaping from the disposal area. Where this geological barrier is penetrated by shafts and boreholes, these must be sealed during operation to secure against ingress of water, and must be hermetically closed after the underground landfill ceases to operate.

In salt mines, the salt is considered to provide total containment. The wastes will only make contact with the biosphere in the case of an accident or an event in geological time such as earth movement or erosion for example, associated with sea-level rise. The waste is unlikely to change significantly in storage over the long term, so the consequences of such a failure scenarios must be considered.

The demonstration of long-term safety of underground disposal in rock salt is principally undertaken by designating the salt as the barrier rock. The salt, due to its low permeability, fulfils the requirement of being impermeable to gases and liquids, of being able to encase the waste because of its convergent behaviour (creep) and of confining it entirely at the end of the transformation process. The creep behaviour of the salt does not contradict a requirement to have stable cavities in the operation phase. The stability is important, in order to guarantee the operational safety and in order to maintain the integrity of the geological barrier over unlimited time, so that there is continued protection of the biosphere. The wastes should be isolated permanently from the biosphere so it is important that the integrity of the geological barrier is maintained and no pathways are formed by which water would be able to contact the wastes, or by which the wastes, or components of the waste, would be able to migrate to the biosphere.

As salt is considered to provide total containment the EC Waste Acceptance normal leaching limit values that would normally be applied to surface hazardous waste facilities do not apply in the case of establishing criteria for underground storage however waste will be accepted only if it is compatible with the site-specific safety assessment and is subject to the acceptance criteria and procedures.

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A.1 Appendix A of the EC Waste Acceptance Criteria

SAFETY ASSESSMENT FOR ACCEPTANCE OF WASTE IN UNDERGROUND STORAGE

1. SAFETY PHILOSOPHY FOR UNDERGROUND STORAGE: ALL TYPES

1.1. The importance of the geological barrier

Isolation of wastes from the biosphere is the ultimate objective for the final disposal of wastes in underground storage. The wastes, the geological barrier and the cavities, including any engineered structures constitute a system that together with all other technical aspects must fulfil the corresponding requirements.

The requirements of the Water Framework Directive (2000/60/EC) can be fulfilled only by demonstrating the long-term safety of the installation (see section 1.2.7). Article 11(3)(j) of Directive 2000/60/EC generally prohibits the direct discharge of pollutants into groundwater. Article 4(1)(b)(i) of Directive 2000/60/EC requires Member States to take measures to prevent the deterioration of the status of all bodies of groundwater.

1.2. Site-specific risk assessment

The assessment of risk requires the identification of:

- the hazard (in this case the deposited wastes),

- the receptors (in this case the biosphere and possibly groundwater),

- the pathways by which substances from the wastes may reach the biosphere, and

- the assessment of impact of substances that may reach the biosphere.

Acceptance criteria for underground storage are to be derived from, inter alia, the analysis of the host rock, so it must be confirmed that no site-related conditions specified in Annex I to the Landfill Directive (with an exemption of Annex I(2), (3), (4) and (5)) are of relevance.

The acceptance criteria for underground storage can be obtained only by referring to the local conditions. This requires a demonstration of the suitability of the strata for establishing a storage, i.e. an assessment of the risks to containment, taking into account the overall system of the waste, engineered structures and cavities and the host rock body.

The site specific risk assessment of the installation must be carried out for both the operational and post-operational phases. From these assessments, the required control and safety measures can be derived and the acceptance criteria can be developed.

An integrated performance assessment analysis shall be prepared, including the following components:

1. geological assessment;

2. geomechanical assessment;

3. hydrogeological assessment;

4. geochemical assessment;

5. biosphere impact assessment;

6. assessment of the operational phase;

7. long-term assessment;

8. assessment of the impact of all the surface facilities at the site.

1.2.1. Geological assessment

A thorough investigation or knowledge of the geological setting of a site is required. This includes investigations and analyses of kind of rocks, soils and the topography. The geological assessment should demonstrate the suitability of the site for underground storage. The location, frequency and structure of any faulting or fracturing in surrounding geological strata and the potential impact of seismic activity on these structures should be included. Alternative site locations should be considered.

1.2.2. Geomechanical assessment

The stability of the cavities must be demonstrated by appropriate investigations and predictions. The deposited waste must be part of this assessment. The processes should be analysed and documented in a systematic way.

The following should be demonstrated:

1. that during and after the formation of the cavities, no major deformation is to be expected either in the cavity itself or at the earth surface which could impair the operability of the underground storage or provide a pathway to the biosphere;

2. that the load-bearing capacity of the cavity is sufficient to prevent its collapse during operation;

3. that the deposited material must have the necessary stability compatible with the geo-mechanical properties of the host rock.

1.2.3. Hydrogeological assessment

A thorough investigation of the hydraulic properties is required to assess the groundwater flow pattern in the surrounding strata based on information on the hydraulic conductivity of the rock mass, fractures and the hydraulic gradients.

1.2.4. Geochemical assessment

A thorough investigation of the rock and the groundwater composition is required to assess the present groundwater composition and its potential evolution over time, the nature and abundance of fracture filling minerals, as well as a quantitative mineralogical description of the host rock. The impact of variability on the geochemical system should be assessed.

1.2.5. Biosphere impact assessment

An investigation of the biosphere that could be impacted by the underground storage is required. Baseline studies should be performed to define local natural background levels of relevant substances.

1.2.6. Assessment of the operational phase

For the operational phase, the analysis should demonstrate the following:

1. the stability of the cavities as in section 1.2.2;

2. no unacceptable risk of a pathway developing between the wastes and the biosphere;

3. no unacceptable risks affecting the operation of the facility.

When demonstrating operational safety, a systematic analysis of the operation of the facility must be made on the basis of specific data on the waste inventory, facility management and the scheme of operation. It is to be shown that the waste will not react with the rock in any chemical or physical way, which could impair the strength and tightness of the rock and endanger the storage itself. For these reasons, in addition to wastes that are banned by Article 5(3) of the Landfill Directive, wastes that are liable to spontaneous combustion under the storage conditions (temperature, humidity), gaseous products, volatile wastes, wastes coming from collections in the form of unidentified mixtures should not be accepted.

Particular incidents that might lead to the development of a pathway between the wastes and the biosphere in the operational phase should be identified. The different types of potential operational risks should be summarised in specific categories. Their possible effects should be evaluated. It should be shown that there is no unacceptable risk that the containment of the operation will be breached. Contingency measures should be provided.

1.2.7. Long-term assessment

In order to comply with the objectives of sustainable landfilling, risk assessment should cover the long-term. It must be ascertained that no pathways to the biosphere will be generated during the long-term post-operation of the underground storage.

The barriers of the underground storage site (e.g. the waste quality, engineered structures, back filling and sealing of shafts and drillings), the performance of the host rock, the surrounding strata and the overburden should be quantitatively assessed over the long-term and evaluated on the basis of site-specific data or sufficiently conservative assumptions. The geochemical and geohydrological conditions such as groundwater flow (see sections 1.2.3 and 1.2.4), barrier efficiency, natural attenuation as well as leaching of the deposited wastes should be taken into consideration.

The long-term safety of an underground storage should be demonstrated by a safety assessment comprising a description of the initial status at a specified time (e.g. time of closure) followed by a scenario outlining important changes that are expected over geological time. Finally, the consequences of the release of relevant substances from the underground storage should be assessed for different scenarios reflecting the possible long-term evolution of the biosphere, geosphere and the underground storage.

Containers and cavity lining should not be taken into account when assessing the long-term risks of waste deposits because of their limited lifetime.

1.2.8. Impact assessment of the surface reception facilities

Although the wastes taken at the site may be destined for subsurface disposal, wastes will be unloaded, tested and possibly stored on the surface, before reaching their final destination. The reception facilities must be designed and operated in a manner that will prevent harm to human health and the local environment. They must fulfil the same requirements as any other waste reception facility.

1.2.9. Assessment of other risks

For reasons of protection of workers, wastes should be deposited only in an underground storage securely separated from mining activities. Waste should not be accepted if it contains, or could generate, hazardous substances which might harm human health, e.g. pathogenic germs of communicable diseases.

2. ACCEPTANCE CRITERIA FOR UNDERGROUND STORAGE: ALL TYPES

2.1. Excluded wastes

In the light of sections 1.2.1 to 1.2.8, wastes that may undergo undesired physical, chemical or biological transformation after they have been deposited must not be disposed of in underground storage. This includes the following:

(a) wastes listed in Article 5(3) of the Landfill Directive;

(b) wastes and their containers which might react with water or with the host rock under the storage conditions and lead to:

- a change in the volume,

- generation of auto-flammable or toxic or explosive substances or gases, or

- any other reactions which could endanger the operational safety and/or the integrity of the barrier.

Wastes which might react with each other must be defined and classified in groups of compatibility; the different groups of compatibility must be physically separated in the storage;

(c) wastes that are biodegradable;

(d) wastes that have a pungent smell;

(e) wastes that can generate a gas-air mixture which is toxic or explosive. This particularly refers to wastes that:

- cause toxic gas concentrations due to the partial pressures of their components,

- form concentrations when saturated within a container, which are higher than 10 % of the concentration which corresponds to the lower explosive limit;

(f) wastes with insufficient stability to correspond to the geomechanical conditions;

(g) wastes that are auto-flammable or liable to spontaneous combustion under the storage conditions, gaseous products, volatile wastes, wastes coming from collections in the form of unidentified mixtures;

(h) wastes that contain, or could generate, pathogenic germs of communicable diseases (already provided for by Article 5(3)(c) of the Landfill Directive).

2.2. Lists of waste suitable for underground storage

Inert wastes, hazardous and non-hazardous wastes, not excluded by sections 2.1 and 2.2 may be suitable for underground storage.

Member States may produce lists of wastes acceptable at underground storage facilities in accordance with the classes given in Article 4 of the Landfill Directive.

2.3. Site-specific risk assessment

Acceptance of waste at a specific site must be subject to site-specific risk assessment.

The site-specific assessments outlined in section 1.2 for the wastes to be accepted at an underground storage should demonstrate that the level of isolation from the biosphere is acceptable. The criteria have to be fulfilled under storage conditions.

2.4. Acceptance conditions

Wastes can be deposited only in an underground storage securely separated from mining activities.

Wastes that might react with each other must be defined and classified in groups of compatibility; the different groups of compatibility must be physically separated in the storage.

3. ADDITIONAL CONSIDERATIONS: SALT MINES

3.1. Importance of the geological barrier

In the safety philosophy for salt mines, the rock surrounding the waste has a two-fold role:

- it acts as host rock in which the wastes are encapsulated;

- together with the overlying and underlying impermeable rock strata (e.g. anhydrite), it acts as a geological barrier intended to prevent groundwater entering the landfill and, where necessary, effectively to stop liquids or gases escaping from the disposal area. Where this geological barrier is pierced by shafts and boreholes, these must be sealed during operation to secure against ingress of water, and must be hermetically closed after the underground landfill ceases to operate. If mineral extraction continues longer than the landfill operation, the disposal area must, after the landfill has ceased operating, be sealed with a hydraulically impermeable dam which is constructed according to the calculated hydraulically operative pressure corresponding to the depth, so that water which may seep into the still operating mine cannot penetrate through to the landfill area;

- in salt mines, the salt is considered to provide total containment. The wastes will only make contact with the biosphere in the case of an accident or an event in geological time such as earth movement or erosion (for example, associated with sea-level rise). The waste is unlikely to change in storage, and the consequences of such failure scenarios must be considered.

3.2. Long-term assessment

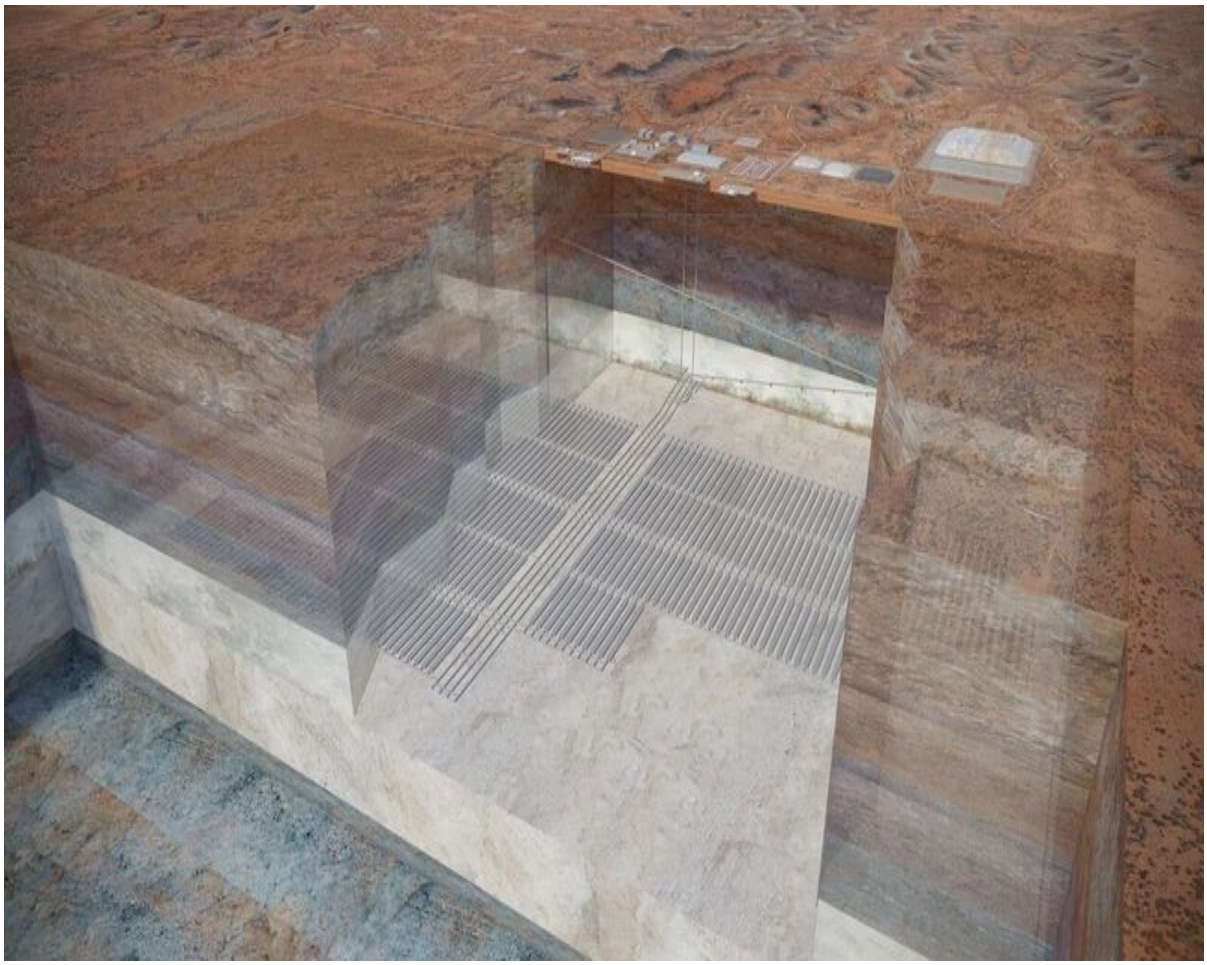
The demonstration of long-term safety of underground disposal in a salt rock should be principally undertaken by designating the salt rock as the barrier rock. Salt rock fulfils the requirement of being impermeable to gases and liquids, of being able to encase the waste because of its convergent behaviour and of confining it entirely at the end of the transformation process.

The convergent behaviour of the salt rock thus does not contradict the requirement to have stable cavities in the operation phase. The stability is important, in order to guarantee the operational safety and in order to maintain the integrity of the geological barrier over unlimited time, so that there is continued protection of the biosphere. The wastes should be isolated permanently from the biosphere. Controlled subsidence of the overburden or other defects over long time are acceptable only if it can be shown, that only rupture-free transformations will occur, the integrity of the geological barrier is maintained and no pathways are formed by which water would be able to contact the wastes or the wastes or components of the waste migrate to the biosphere.

TELLUS

CHANDLER AND APIRNTA FACILITY WASTE ACCEPTANCE CRITERIA

Final Report | September 2016



Revision	Date	Description	Signatures		
			Originator	Checked	Approved
0	28/09/2016	For issue	Steve Reece	SH, RP	DvM

Table of Contents

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

ABBREVIATIONS

Bq	Bequerel
The Facility	The Chandler and Apirnta Facility
IAEA	International Atomic Energy Agency
IBC	Intermediate Bulk Container
ISO	International Organisation for Standardization
NEPM	National Environmental Protection Measure
NORM	Naturally Occurring Radioactive Materials
NRPB	National Radiological Protection Board
O&G	Oil & Gas
RPS	Radiation Protection Series
Tellus	Tellus Holdings Ltd.
WAC	Waste Acceptance Criteria
WAP	Waste Acceptance Procedure
WZG	Waste Zoning Guide

DEFINITIONS

Hazardous waste - Waste prescribed by the regulations[1] where the waste has any of the characteristics mentioned in Annex III to the Basel Convention. These characteristics include:

- Explosive
- Flammable Liquids/Solids
- Poisonous
- Toxic
- Ecotoxic
- Infectious Substances.
- Wastes that belong to any category contained in Annex I to the Basel Convention unless they do not possess any of the hazardous characteristics contained in Annex III. Wastes in Annex I include:
    - Clinical wastes;
    - Waste oils/water, hydrocarbons/water mixtures, emulsions;
    - Wastes from the production, formulation and use of resins, latex, plasticizers, glues/adhesives;
    - Wastes resulting from surface treatment of metals and plastics;
    - Residues arising from industrial waste disposal operations; and
    - Wastes which contain certain compounds such as: copper, zinc, cadmium, mercury, lead and asbestos.
- Household waste; or
- Residues arising from the incineration of household waste

Listed Waste[2] – wastes which pose a threat or risk to public health, safety or the environment and include substances which are toxic, infectious, mutagenic, carcinogenic, teratogenic, explosive, flammable, corrosive, oxidising and radioactive. Listed wastes are ONLY to be disposed of at facilities that are licensed to receive listed waste. For details of what constitutes listed waste refer to the Waste Management and Pollution Control (Administration) Regulations.

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[1] *Hazardous Waste (Regulation of Exports and Imports) Act 1989,*

[2] *Guidelines for the Siting, Design and Management of Solid Waste Disposal Sites in the Northern Territory*

Geological repository – a deep salt facility used to permanently isolate waste. The geological barrier provides permanent isolation of wastes from the environment over the very long term in accordance with Environmentally Sound Management principles and also creates additional opportunities for the future recovery and recycling of valuable materials from the waste which can re-enter the circular economy.

Room – an underground excavation (chamber) in salt which is used for the *storage* or *permanent isolation* of waste

Conditions of storage – The term "in the conditions of storage" is used to differentiate between the generic properties of a material and how those properties may be modified when that material is placed into "storage" or "permanent isolation" within an underground room.

Storage – the above ground storage of materials following delivery and includes the time awaiting sampling, analysis and management prior to movement for "in room storage".

In Room Storage – medium to long term below ground storage of wastes inside a room with ongoing opportunity to recover waste if required.

Permanent Isolation – indefinite below ground storage or disposal of wastes determined suitable for acceptance

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1 INTRODUCTION

1.1 The Chandler Facility

The proposed Chandler Facility (hereby referred to as the proposed "Facility") is a salt mining and processing facility, and a hazardous waste storage and permanent isolation facility. The salt bed is located approximately 800m below the surface and is 200-300m thick. The salt bed which is 500 M years old is overlain by a sequence of low permeability sedimentary rocks. The salt bed will be mined in a way that produces "rooms" which are used to house hazardous waste temporarily or permanently. The facility is located approximately 120 kilometres south of Alice Springs and is situated on the Maryvale pastoral lease.

The location for the Facility was chosen as its principal characteristics; natural geological barrier, geologically stable, no regional aquifer, remote location, no special cultural or historic significance, no potential medium to high value agriculture, no sterilization of minerals or hydrocarbons, no special environmental features, no rare species of flora or fauna, satisfy the requirements for a deep geological repository[3] for hazardous waste storage and isolation purposes.

There are no sensitive receptors within the immediate vicinity of the proposed Facility. The nearest permanent settlement is the small town of Titjikala about 15 kilometres to the north-east. The main land uses that occur on the Maryvale pastoral lease are cattle grazing and Aboriginal land management. The main waterways in the region are the Hugh River, Finke River and Palmer River. At their nearest point, Hugh River is about 10 kilometres east of the site, Finke River is about 15 kilometres south and Palmer River is about 70 kilometres west

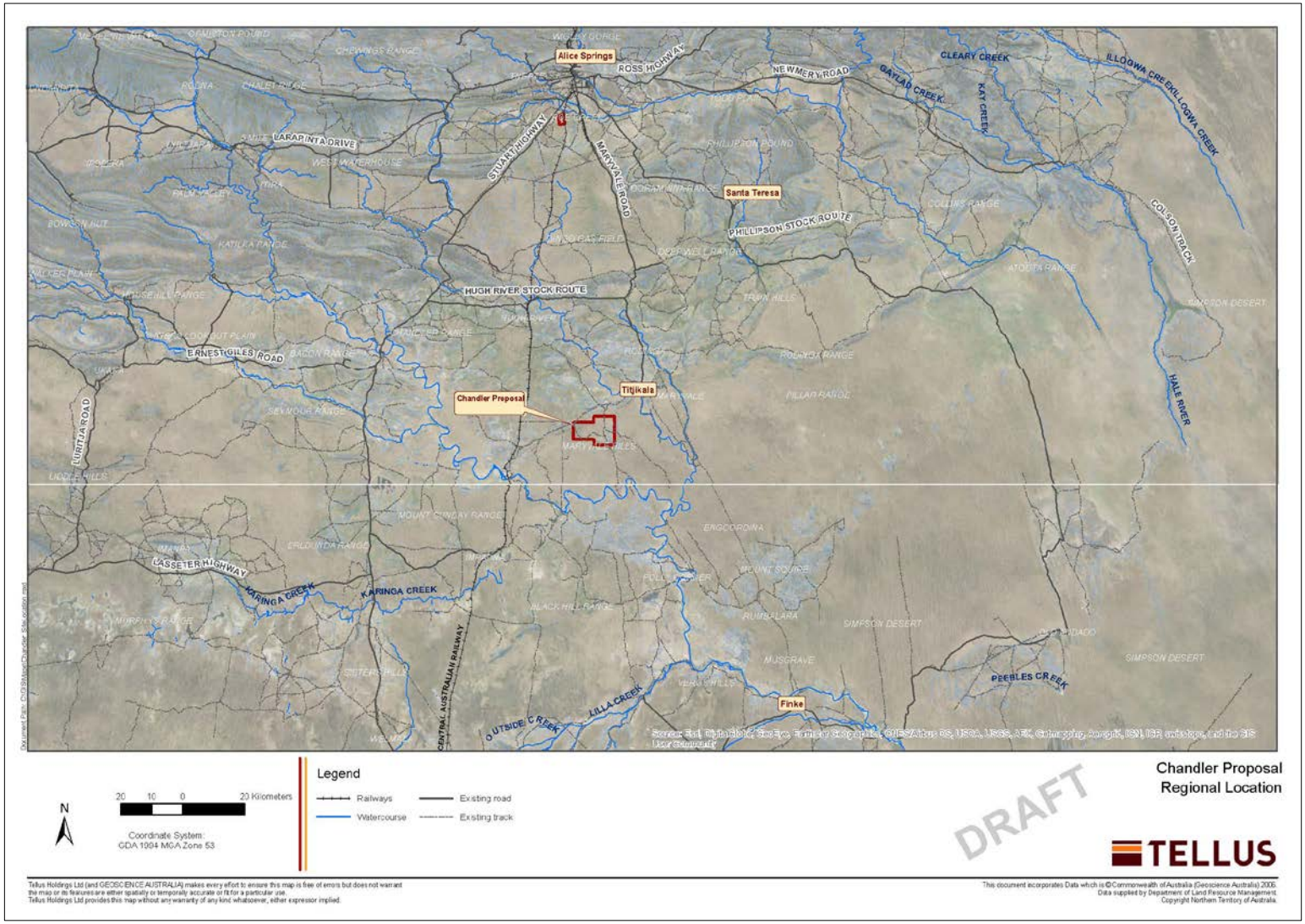
The arid and remote nature of the location, absence of nearby population, coupled with the site characteristics make the site ideal for long-term storage and permanent isolation of hazardous and intractable waste.

1.2 The Apirnta Facility

The Apirnta Facility is located adjacent to the Central Australian Railway approximately 30km to the west of the Chandler Facility and will be connected to Chandler by the Chandler Haul Road. Apirnta will be a Storage and Transfer Facility and will be the location where waste acceptance procedures are performed to confirm that incoming materials meet the waste acceptance criteria for Chandler.

[3] *IAEA guidelines for the siting of geological disposal facilities - adapted to hazardous waste*

Figure 1-1: Chandler site location



1.3 Document Aims and Objectives

The aim of this document is to present the Waste Acceptance Criteria (WAC) that will be applied at the Facility. This document should be read in conjunction with the following documents:

- Waste Acceptance Policy.
- Waste Acceptance Procedure (WAP).
- Waste Zoning Guide (WZG).

This document is part of a hierarchy of documents and is a tier 2 document which covers the WAC. Lower tier documents provide greater detail on acceptance procedures and the approach to safe zoning during storage and permeant isolation of wastes.

The document hierarchy is presented in Figure 1-2, which includes an equivalent suite of documents for Tellus' Western Australian Sandy Ridge Project.

Figure 1-2: Waste Acceptance Criteria Document Hierarchy

The objective of the Chandler WAC is to establish and explain to regulators, customers and other stakeholders;

- The criteria that will be applied for the exclusion of certain types of wastes.
- The criteria that will be applied to the acceptance of certain types of wastes.
- The requirement for suitable packaging and the criteria that will be applied for packaging acceptance.

1.4 Intended Audience

This document is intended initially for use by regulators responsible for assessing the facility and issuing licences for the operation of the proposed Facility, and for the formation of procedures to

control the process by which waste producers and Tellus Staff will determine if the waste streams may be suitable for storage or permanent isolation.

The document will also be of interest to other stakeholders who wish to understand the approach being followed by Tellus for waste acceptance, including the safe storage and permanent isolation of wastes.

Finally, this document will be used by Tellus staff and their specialist advisors to establish the framework which incorporates more detailed operational procedures which underpin this document.

2 WASTE ACCEPTANCE CRITERIA

2.1 Introduction

Tellus is proposing to develop a world's best practice facility designed for the storage and permanent isolation of hazardous chemical waste. Tellus is also planning to accept waste arising from the power, electronics, ceramics, mining, metals and minerals processing, oil and gas, water and agricultural fertiliser industries that contains NORM. The Chandler Environmental Impact Statement states the wastes which will not be disposed of at the proposed Facility which include; infectious materials, nuclear material[4], uncertified waste, and putrescible waste. A summary of the wastes which are proposed to be accepted are presented in Table 2-1.

Table 2-1 Summary of proposed waste acceptance classifications at Chandler

Waste classification	Accepted
Chemical waste (NEPM Schedule A List 1: Waste categories)	Yes
Naturally occurring radioactive material ("NORM")	Yes
Low level radioactive waste	No
Intermediate level radioactive waste	No
High level radioactive waste	No

2.2 Excluded Wastes

It is normal when establishing waste acceptance criteria for storage and permeant isolation to first determine which wastes, under normal circumstances, will not be accepted i.e. will be excluded. In making this determination, and in keeping with best practice in similar facilities, including those developed under Appendix A of the EC Waste Acceptance Criteria, wastes that may undergo undesired physical, chemical or biological transformation after they have been deposited will not be accepted at Chandler.

Materials possessing the following characteristics, unless they pass the WAC tests outlined in the WAP, will normally be excluded from storage and permanent isolation at the Chandler Facility unless they can be modified to a form that makes them suitable for storage or permanent isolation, and they subsequently pass the WAP tests.

[4] *Nuclear material is waste of a nuclear plant; or results from the testing, use or decommissioning of nuclear weapons, whether or not that material has been conditioned or reprocessed*

2.2.1 Liquids

Unless they can undergo solidification/stabilisation processing or be incorporated into the hydraulic backfill mixtures to make them suitable for permanent isolation, liquid wastes are to be excluded from permanent isolation at the proposed Facility. It is assumed that containers containing liquids will eventually fail in the conditions of storage and allow the liquid to seep into the encapsulating salt bed.

The liquid material may cause a portion of the surrounding salt to dissolve, which will create a void and potentially undermine the structural integrity of the facility. Similarly, waste sludges are to be excluded from permanent isolation at the Facility unless treatment can be applied to remove any free liquid and create a waste form which is structurally sound and in keeping with maintaining the integrity of the underground storage rooms.

2.2.2 Explosive materials

The following classes of materials, as defined by *The Australian Code for the Transport of Dangerous Goods by Road and Rail* (2016) are not acceptable in the conditions of storage;

- Class 1.1 – substances and articles that have a mass explosion hazard (a mass explosion is one that affects almost the entire load virtually instantaneously).
- Class 1.2 – substances and articles that have a projection hazard but not a mass explosion hazard.
- Class 1.3 – substances and articles that have a fire hazard and either a minor blast hazard or a minor projection hazard or both, but not a mass explosion hazard. This includes substances and articles that give rise to considerable radiant heat, or that burn one after another, producing minor blast or projection effects or both.

Materials that are not themselves explosive but which have the potential to form or generate an explosive atmosphere of gas or vapour will not be accepted for permanent isolation at the Facility unless they can be treated so that they no longer produce explosive gas which is higher than 10 % of the concentration which corresponds to the lower explosive limit.

2.2.3 Highly flammable materials

The following classes of materials, as defined in The Australian Code for the Transport of Dangerous Goods by Road and Rail (2016), in the conditions of storage will not be accepted;

- **Class 3 – Flammable liquids**. Liquids, or mixtures of liquids, or liquids containing solids in solution or suspension which give off a flammable vapour at temperatures of not more than 60 °C, closed cup test, or not more than 65.6 °C, open-cup test, normally referred to as the flash point.

- **Class 4.1 – Flammable solids**. Solids which, under conditions encountered in transport, are readily combustible or may cause or contribute to fire through friction; self-reactive substances which are liable to undergo a strongly exothermic reaction; solid desensitised explosives which may explode if not diluted sufficiently;

- **Class 4.2 – Substances liable to spontaneous combustion**. Substances which are liable to spontaneous heating under normal conditions encountered in transport, or to heating up in contact with air, and being then liable to catch fire;

- **Class 4.3 – Substances which in contact with water emit flammable gases**. Substances which, by interaction with water, are liable to become spontaneously flammable or to give off flammable gases in dangerous quantities.

Some substances that are flammable, such as wood and synthetic materials, may on a case by case risk assessed basis be acceptable for permanent isolation if they require an open flame and available supply of oxygen for combustion since in the conditions of storage they will be buried in an environment which will become devoid of both these characteristics.

Class 4.3 substances may be suitable in the conditions of storage due to the absence of water at the Facility.

2.2.4 Highly reactive materials

The following classes of materials, as defined in *The Australian Code for the Transport of Dangerous Goods by Road and Rail* (2016), when in the conditions of storage will not be accepted:

- **Class 5 – Oxidising Substances**. Substances that, while in themselves not necessarily combustible, may, generally by yielding oxygen, cause, or contribute to, the combustion of other materials.

- **Class 8 – Corrosive substances**. Substances that, by chemical action, will cause severe damage when in contact with living tissue, or, in the case of leakage, will materially damage or even destroy, other goods or the means of transport; and may cause other hazards

Verification of the oxidising or corrosive nature of the material will be required, by a combination of chemical (pH) and other corrosivity testing.

2.2.5 Gases

Gases will not be accepted at the Facility, even if altered into a liquid or solid form (e.g. compressed, liquefied, dissolved, or adsorbed). Permanent isolation cannot be guaranteed, and gas migration could cause a loss of volume within the permanent isolation room, possibly undermining the structural stability.

2.2.6 Infectious materials

Infectious wastes such as “Clinical wastes” including waste generated by medical, nursing, dental, veterinary, pharmaceutical or other related activity which is;

- Poisonous or infectious.
- Likely to cause injury to public health.
- Contains human tissue or body parts.

2.2.7 Biodegradable materials

The chemical reactions involved in both aerobic and anaerobic decomposition processes produce combustible hazardous gases, and can cause significant volume reduction; therefore biodegradable wastes will generally be deemed to be incompatible with the proposed Facility.

2.2.8 Nuclear material

Wastes classified as nuclear wastes[5] will not be accepted at the proposed Chandler facility. For the avoidance of doubt the definition of nuclear waste does not include waste that results from the use of the products of a nuclear plant.

2.3 Chemical waste acceptance

2.3.1 Introduction

The types and forms of chemical waste that are likely to be managed at the proposed Facility would generally be generated from industry. Examples of these wastes and their NEPM code are listed in Table 2-2 and a more comprehensive list is presented in Appendix 0

Table 2-2: Example chemical wastes likely to be suitable[6] for permanent isolation at Chandler

NEPM code	Waste description
N205	Residues from industrial waste treatment/disposal operations
D110	Inorganic fluorine compounds excluding calcium fluoride
N120	Soils contaminated with a controlled waste
N220	Asbestos
J120	Waste oil/water, hydrocarbons/water mixtures or emulsions
D220	Lead; lead compounds
C100	Basic solutions or bases in solid form
D230	Zinc compounds

[5] *Nuclear material is waste of a nuclear plant; or results from the testing, use or decommissioning of nuclear weapons, whether or not that material has been conditioned or reprocessed*

[6] In some cases following treatment

J100	Waste mineral oils unfit for their original intended use
D300	Non-toxic salts
B100	Acidic solutions or acids in solid form
N160	Encapsulated, chemically-fixed, solidified or polymerised wastes referred to in this list
F100	Waste from the production, formulation and use of inks, dyes, pigments, paints, lacquers and varnish
M100	Waste substances and articles containing or contaminated with polychlorinated biphenyls, polychlorinated napthalenes, polychlorinated terphenyls and/or polybrominated biphenyls
N100	Containers and drums that are contaminated with residues of substances referred to in this list
N190	Filter cake contaminated with residues of substances referred to in this list
G110	Organic solvents excluding halogenated solvents
M250	Surface active agents (surfactants), containing principally organic constituents and which may contain metals and inorganic materials
A100	Waste resulting from surface treatment of metals and plastics
N150	Fly ash, excluding fly ash generated from Australian coal fired power stations

Each potential waste will be subject to detailed screening which is discussed in the WAP document to determine its suitability for permanent isolation at the Chandler Facility.

2.4 NORM Waste Acceptance

2.4.1 Introduction

The types and forms of radioactive waste that are likely to be managed at the proposed Facility would be generated from mining and processing of mineral ores or other material containing NORM, such as phosphate minerals, mineral sands, coal, some gold bearing rocks and hydrocarbons. These generally contain long lived radionuclides at relatively low concentrations. NORM such as scales arising in the oil and gas industry may have higher activity concentration levels but would need to meet the criteria set for the facility.

All wastes need to be characterised by means of collecting information about the waste in order to build up a picture of its properties. Data will be collected about the radiological, chemical and physical properties of the waste. This information helps to decide how the waste should be handled, packaged, stored and safely disposed of by the facility.

2.4.2 Classification of radioactive waste

The National Directory for Radiation Protection, February 2014 (RPS 6) sets out to provide an overall framework for radiation safety, including both ionizing and non-ionizing radiation.

2.4.3 Acceptance criteria

Tellus intends to only accept radioactive wastes up to exemption level as defined in Section 3.2 of RPS 6. The general criteria for granting an exemption are:

a) the health risks and the risks to the environment associated with the source, practice, or type of person using a source are sufficiently low as to be of no regulatory concern; and

b) radiation protection, including the cost of regulatory control, has been optimised.

The criteria to exempt radioactive material or practices from notification, registration and licensing are:

(a) the radioactive material has an activity concentration less than that prescribed in Schedule 4 of RPS 6 or consists of or contains less than the activity prescribed in Schedule 4 of RPS 6, or

(b) the radioactive material has an activity concentration greater than that prescribed in Schedule 4 of RPS 6 and consists of or contains greater than the activity prescribed in Schedule 4, but causes an annual effective dose to an individual member of the public of less than 10 μSv, and a collective effective dose to the critical group committed by one year of performance of the practice, as determined by the Authority, of less than 1 person.Sv, or

(c) in the case of a mixture of radioactive materials, where each of the radioactive materials present does not exceed the individual activity or activity concentration, the mixture is defined as exempt if the sum of the fractions obtained by dividing the activity of each material present by the appropriate activity value from Schedule 4 of RPS 6, or the sum of the fractions obtained by dividing the activity concentration of each material present by the appropriate activity concentration value from Schedule 4 of RPS 6, does not exceed 1.

(d) in the special case of exposure to naturally-occurring radon-222 in the workplace, the long-term average concentration of radon-222 is less than 1000 Bq/m^3.

The Exempt activity concentrations and exempt activities of radionuclides[7] are presented in Appendix A.2. This table is taken from the IAEA's International Basic Safety Standards for Protection Against Ionizing Radiation and for the Safety of Radiation Sources, Safety Series 115 [IAEA 1996], and is supplemented from NRPB Report R306, Exempt Concentrations and Quantities for Radionuclides not Included in the European Basic Safety Standards Directive [NRPB 1999].

[7] This table is taken from the IAEA's *International Basic Safety Standards for Protection Against Ionizing Radiation and for the Safety of Radiation Sources*, Safety Series 115 [IAEA 1996], and is supplemented from NRPB Report R306, *Exempt Concentrations and Quantities for Radionuclides* not Included in the *European Basic Safety Standards Directive* [NRPB 1999].

3 WASTE PACKAGING CRITERIA

The Australian Code for the Transport of Dangerous Goods by Road and Rail (2016) details the requirements for safe packaging and transport of hazardous materials, based on the classification of the waste. Tellus requires that all customers adhere to the code to ensure packaging is appropriate to the hazardous characteristics of the waste in question. Containment systems should normally consist of one or more of the following packaging options;

- 20' ISO shipping containers or 20' ISO tank-container.
- Bulk bags in containers, on pallets or free standing.
- 215 Litre drums on pallets in containers.
- $1m^3$ IBCs in containers.
- Small palletised goods in containers (e.g. radioactive materials).
- Loose bulk in containers (e.g. contaminated soils).
- Liquid tanker truck (e.g. bulk liquids or pastes) which will undergo solidification or stabilization treatments.
- Pneumatic tanker truck (e.g. bulk dry powder solids).
- Solid materials on flatbed trucks (e.g. railway sleepers, O&G pipe, machinery).

Typical Packaging examples are presented in Appendix A.2

3.1 Packaging criteria

Waste packaging delivered to the proposed Facility must fulfil the following criteria:

- Not have a total measured weight of more than the Safe Working Load.
- Be capable of being disposed of with the waste.
- Be filled so as to contain no significant voids.
- Be free of ruptures and external contamination at the point of delivery.
- Not significantly deteriorate during the duration of storage, transport and handling when in contact with the waste.
- Remain intact during normal transport and handling procedures.
- Be strong enough to be walked on if required.
- Be clearly labelled with the waste owner's name and identification number and material description/name on opposite sides of the waste package.
- Allow no leakage during normal transport and handling operations.
- Be capable of containing all the waste whatever the orientation of the package.

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A.1 Potential Waste Category List

Common industrial hazardous waste (NEPM basis)	
Acidic solutions or acids in solid form	B100
Animal effluent and residues (abattoir effluent, poultry and fish processing wastes)	K100
Antimony; antimony compounds	D170
Arsenic; arsenic compounds	D130
Asbestos	N220
Barium compounds (excluding barium sulphate)	D290
Basic solutions or bases in solid form	C100
Beryllium; beryllium compounds	D160
Boron compounds	D310
Cadmium; cadmium compounds	D150
Ceramic-based fibres with physio-chemical characteristics similar to those of asbestos	N230
Chlorates	D350
Chromium compounds (hexavalent and trivalent)	D140
Clinical and related wastes	R100
Cobalt compounds	D200
Containers and drums that are contaminated with residues of substances referred to in this list	N100
Copper compounds	D190
Cyanides (inorganic)	A130
Cyanides (organic)	M210
Encapsulated, chemically-fixed, solidified or polymerised wastes referred to in this list	N160
Ethers	G100
Filter cake contaminated with residues of substances referred to in this list	N190
Fire debris and fire wash waters	N140
Fly ash, excluding fly ash generated from Australian coal fired power stations	N150
Grease trap waste	K110
Halogenated organic solvents	G150
Highly odorous organic chemicals (including mercaptans and acrylates)	M260
Inorganic fluorine compounds excluding calcium fluoride	D110
Inorganic sulfides	D330
Isocyanate compounds	M220
Lead; lead compounds	D220
Mercury; mercury compounds	D120
Metal carbonyls	D100
Nickel compounds	D210
Non-toxic salts	D300
Organic phosphorous compounds	H110
Organic solvents excluding halogenated solvents	G110
Organo halogen compounds—other than substances referred to in this Table.	M160
Perchlorates	D340
Phenols, phenol compounds including chlorophenols	M150
Phosphorus compounds excluding mineral phosphates	D360

Common industrial hazardous waste (NEPM basis)	
Polychlorinated dibenzo-furan (any congener)	M170
Polychlorinated dibenzo-p-dioxin (any congener)	M180
Residues from industrial waste treatment/disposal operations	N205
Selenium; selenium compounds	D240
Soils contaminated with a controlled waste	N120
Surface active agents (surfactants), containing principally organic constituents and which may contain metals and inorganic materials	M250
Tannery wastes (including leather dust, ash, sludge's and flours)	K140
Tellurium; tellurium compounds	D250
Thallium; thallium compounds	D180
Triethylamine catalysts for setting foundry sands	M230
Tyres	T140
Vanadium compounds	D270
Waste chemical substances arising from research and development or teaching activities, including those which are not identified and/or are new and whose effects on human health and/or the environment are not known	T100
Waste containing peroxides other than hydrogen peroxide	E100
Waste from heat treatment and tempering operations containing cyanides	A110
Waste from manufacture, formulation and use of wood-preserving chemicals	H170
Waste from the production and preparation of pharmaceutical products	R140
Waste from the production, formulation and use of biocides and phytopharmaceuticals	H100
Waste from the production, formulation and use of inks, dyes, pigments, paints, lacquers and varnish	F100
Waste from the production, formulation and use of organic solvents	G160
Waste from the production, formulation and use of photographic chemicals and processing materials	T120
Waste from the production, formulation and use of resins, latex, plasticisers, glues and adhesives	F110
Waste mineral oils unfit for their original intended use	J100
Waste of an explosive nature not subject to other legislation	T200
Waste oil/water, hydrocarbons/water mixtures or emulsions	J120
Waste pharmaceuticals, drugs and medicines	R120
Waste resulting from surface treatment of metals and plastics	A100
Waste substances and articles containing or contaminated with polychlorinated biphenyls, polychlorinated napthalenes, polychlorinated terphenyls and/or polybrominated biphenyls	M100
Waste tarry residues arising from refining, distillation, and any pyrolytic treatment	J160
Wool scouring wastes	K190
Zinc compounds	D230

A.2 Exempt activity concentrations and exempt activities of radionuclides

Nuclide	Activity concentration (Bq/g)	Activity (Bq)
H-3 (tritiated compounds, including OBT)	1×10^{6}	1×10^{9}
H-3 (elemental)	1×10^{6}	1×10^{9}
Be-7	1×10^{3}	1×10^{7}
C-11	1×10^{1}	1×10^{6}
C-14	1×10^{4}	1×10^{7}
N-13	1×10^{2}	1×10^{9}
0-15	1×10^{2}	1×10^{9}
F-18	1×10^{1}	1×10^{6}
Na-22	1×10^{1}	1×10^{6}
Na-24	1×10^{1}	1×10^{5}
Mg-28	1×10^{1}	1×10^{5}
Si-31	1×10^{3}	1×10^{6}
P-32	1×10^{3}	1×10^{5}
P-33	1×10^{5}	1×10^{8}
S-35	1×10^{5}	1×10^{8}
Cl-36	1×10^{4}	1×10^{6}
Cl-38	1×10^{1}	1×10^{5}
Ar-37	1×10^{6}	1×10^{8}
Ar-41	1×10^{2}	1×10^{9}
K-40	1×10^{2}	1×10^{6}
K-42	1×10^{2}	1×10^{6}
K-43	1×10^{1}	1×10^{6}
Ca-45	1×10^{4}	1×10^{7}
Ca-47	1×10^{1}	1×10^{6}
Sc-46	1×10^{1}	1×10^{6}
Sc-47	1×10^{2}	1×10^{6}
Sc-48	1×10^{1}	1×10^{5}
V-48	1×10^{1}	1×10^{5}
Cr-51	1×10^{3}	1×10^{7}
Mn-51	1×10^{1}	1×10^{5}
Mn-52	1×10^{1}	1×10^{5}
Mn-52m	1×10^{1}	1×10^{5}
Mn-53	1×10^{4}	1×10^{9}
Mn-54	1×10^{1}	1×10^{6}
Mn-56	1×10^{1}	1×10^{5}
Fe-52	1×10^{1}	1×10^{6}
Fe-55	1×10^{4}	1×10^{6}
Fe-59	1×10^{1}	1×10^{6}
Co-55	1×10^{1}	1×10^{6}
Co-56	1×10^{1}	1×10^{5}
Co-57	1×10^{2}	1×10^{6}
Co-58	1×10^{1}	1×10^{6}
Co-58m	1×10^{4}	1×10^{7}
Co-60	1×10^{1}	1×10^{5}
Co-60m	1×10^{3}	1×10^{6}
Co-61	1×10^{2}	1×10^{6}
Co-62m	1×10^{1}	1×10^{5}
Ni-59	1×10^{4}	1×10^{8}
Ni-63	1×10^{5}	1×10^{8}
Ni-65	1×10^{1}	1×10^{6}
Cu-64	1×10^{2}	1×10^{6}
Cu-67	1×10^{2}	1×10^{6}
Zn-65	1×10^{1}	1×10^{6}

Nuclide	Activity concentration (Bq/g)	Activity (Bq)
Zn-69	1×10^{4}	1×10^{6}
Zn-69m	1×10^{2}	1×10^{6}
Ga-67	1×10^{2}	1×10^{6}
Ga-72	1×10^{1}	1×10^{5}
Ge-68	1×10^{1}	1×10^{5}
Ge-71	1×10^{4}	1×10^{8}
As-73	1×10^{3}	1×10^{7}
As-74	1×10^{1}	1×10^{6}
As-76	1×10^{2}	1×10^{5}
As-77	1×10^{3}	1×10^{6}
Se-73	1×10^{1}	1×10^{6}
Se-75	1×10^{2}	1×10^{6}
Br-75	1×10^{1}	1×10^{6}
Br-76	1×10^{1}	1×10^{5}
Br-82	1×10^{1}	1×10^{6}
Kr-74	1×10^{2}	1×10^{9}
Kr-76	1×10^{2}	1×10^{9}
Kr-77	1×10^{2}	1×10^{9}
Kr-79	1×10^{3}	1×10^{5}
Kr-81	1×10^{4}	1×10^{7}
Kr-83m	1×10^{5}	1×10^{12}
Kr-85	1×10^{5}	1×10^{4}
Kr-85m	1×10^{3}	1×10^{10}
Kr-87	1×10^{2}	1×10^{9}
Kr-88	1×10^{2}	1×10^{9}
Rb-81	1×10^{1}	1×10^{6}
Rb-86	1×10^{2}	1×10^{5}
Sr-85	1×10^{2}	1×10^{6}
Sr-85m	1×10^{2}	1×10^{7}
Sr-87m	1×10^{2}	1×10^{6}
Sr-89	1×10^{3}	1×10^{6}
Sr-90[a]	1×10^{2}	1×10^{4}
Sr-91	1×10^{1}	1×10^{5}
Sr-92	1×10^{1}	1×10^{6}
Y-88	1×10^{1}	1×10^{6}

Nuclide	Activity concentration (Bq/g)	Activity (Bq)
Y-90	1×10^{3}	1×10^{5}
Y-91	1×10^{3}	1×10^{6}
Y-91m	1×10^{2}	1×10^{6}
Y-92	1×10^{2}	1×10^{5}
Y-93	1×10^{2}	1×10^{5}
Zr-93[a]	1×10^{3}	1×10^{7}
Zr-95	1×10^{1}	1×10^{6}
Zr-97[a]	1×10^{1}	1×10^{5}
Nb-93m	1×10^{4}	1×10^{7}
Nb-94	1×10^{1}	1×10^{6}
Nb-95	1×10^{1}	1×10^{6}
Nb-97	1×10^{1}	1×10^{6}
Nb-98	1×10^{1}	1×10^{5}
Mo-90	1×10^{1}	1×10^{6}
Mo-93	1×10^{3}	1×10^{8}
Mo-99	1×10^{2}	1×10^{6}
Mo-101	1×10^{1}	1×10^{6}
Tc-95m	1×10^{1}	1×10^{6}
Tc-96	1×10^{1}	1×10^{6}
Tc-96m	1×10^{3}	1×10^{7}
Tc-97	1×10^{3}	1×10^{8}
Tc-97m	1×10^{3}	1×10^{7}
Tc-99	1×10^{4}	1×10^{7}
Tc-99m	1×10^{2}	1×10^{7}
Ru-97	1×10^{2}	1×10^{7}
Ru-103	1×10^{2}	1×10^{6}
Ru-105	1×10^{1}	1×10^{6}
Ru-106[a]	1×10^{2}	1×10^{5}
Rh-103m	1×10^{4}	1×10^{8}
Rh-105	1×10^{2}	1×10^{7}
Pd-103	1×10^{3}	1×10^{8}
Pd-109	1×10^{3}	1×10^{6}
Ag-105	1×10^{2}	1×10^{6}
Ag-108m	1×10^{1}	1×10^{6}
Ag-110m	1×10^{1}	1×10^{6}

Nuclide	Activity concentration (Bq/g)	Activity (Bq)
Ag-111	1×10^{3}	1×10^{6}
Cd-109	1×10^{4}	1×10^{6}
Cd-115	1×10^{2}	1×10^{6}
Cd-115m	1×10^{3}	1×10^{6}
In-111	1×10^{2}	1×10^{6}
In-113m	1×10^{2}	1×10^{6}
In-114m	1×10^{2}	1×10^{6}
In-115m	1×10^{2}	1×10^{6}
Sn-113	1×10^{3}	1×10^{7}
Sn-117m	1×10^{2}	1×10^{6}
Sn-121	1×10^{5}	1×10^{7}
Sn-125	1×10^{2}	1×10^{5}
Sb-122	1×10^{2}	1×10^{4}
Sb-124	1×10^{1}	1×10^{6}
Sb-125	1×10^{2}	1×10^{6}
Te-123m	1×10^{2}	1×10^{7}
Te-125m	1×10^{3}	1×10^{7}
Te-127	1×10^{3}	1×10^{6}
Te-127m	1×10^{3}	1×10^{7}
Te-129	1×10^{2}	1×10^{6}
Te-129m	1×10^{3}	1×10^{6}
Te-131	1×10^{2}	1×10^{5}
Te-131m	1×10^{1}	1×10^{6}
Te-132	1×10^{2}	1×10^{7}
Te-133	1×10^{1}	1×10^{5}
Te-133m	1×10^{1}	1×10^{5}
Te-134	1×10^{1}	1×10^{6}
I-123	1×10^{2}	1×10^{7}
I-124	1×10^{1}	1×10^{6}
I-125	1×10^{3}	1×10^{6}
I-126	1×10^{2}	1×10^{6}
I-129	1×10^{2}	1×10^{5}
I-130	1×10^{1}	1×10^{6}
I-131	1×10^{2}	1×10^{6}
I-132	1×10^{1}	1×10^{5}

Nuclide	Activity concentration (Bq/g)	Activity (Bq)
I-133	1×10^{1}	1×10^{6}
I-134	1×10^{1}	1×10^{5}
I-135	1×10^{1}	1×10^{6}
Xe-131m	1×10^{4}	1×10^{4}
Xe-133	1×10^{3}	1×10^{4}
Xe-135	1×10^{3}	1×10^{10}
Cs-129	1×10^{2}	1×10^{5}
Cs-131	1×10^{3}	1×10^{6}
Cs-132	1×10^{1}	1×10^{5}
Cs-134m	1×10^{3}	1×10^{5}
Cs-134	1×10^{1}	1×10^{4}
Cs-135	1×10^{4}	1×10^{7}
Cs-136	1×10^{1}	1×10^{5}
Cs-137[a]	1×10^{1}	1×10^{4}
Cs-138	1×10^{1}	1×10^{4}
Ba-131	1×10^{2}	1×10^{6}
Ba-133	1×10^{2}	1×10^{6}
Ba-140[a]	1×10^{1}	1×10^{5}
La-140	1×10^{1}	1×10^{5}
Ce-139	1×10^{2}	1×10^{6}
Ce-141	1×10^{2}	1×10^{7}
Ce-143	1×10^{2}	1×10^{6}
Ce-144[a]	1×10^{2}	1×10^{5}
Pr-142	1×10^{2}	1×10^{5}
Pr-143	1×10^{4}	1×10^{6}
Nd-147	1×10^{2}	1×10^{6}
Nd-149	1×10^{2}	1×10^{6}
Pm-147	1×10^{4}	1×10^{7}
Pm-149	1×10^{3}	1×10^{6}
Sm-147	1×10^{1}	1×10^{4}
Sm-151	1×10^{4}	1×10^{8}
Sm-153	1×10^{2}	1×10^{6}
Eu-152	1×10^{1}	1×10^{6}
Eu-152m	1×10^{2}	1×10^{6}
Eu-154	1×10^{1}	1×10^{6}

Nuclide	Activity concentration (Bq/g)	Activity (Bq)
Eu-155	1×10^{2}	1×10^{7}
Gd-153	1×10^{2}	1×10^{7}
Gd-159	1×10^{3}	1×10^{6}
Tb-160	1×10^{1}	1×10^{6}
Dy-165	1×10^{3}	1×10^{6}
Dy-166	1×10^{3}	1×10^{6}
Ho-166	1×10^{3}	1×10^{5}
Ho-166m	1×10^{1}	1×10^{6}
Er-161	1×10^{1}	1×10^{6}
Er-169	1×10^{4}	1×10^{7}
Er-171	1×10^{2}	1×10^{6}
Tm-170	1×10^{3}	1×10^{6}
Tm-171	1×10^{4}	1×10^{8}
Yb-169	1×10^{2}	1×10^{7}
Yb-175	1×10^{3}	1×10^{7}
Lu-177	1×10^{3}	1×10^{7}
Hf-181	1×10^{1}	1×10^{6}
Ta-182	1×10^{1}	1×10^{4}
W-181	1×10^{3}	1×10^{7}
W-185	1×10^{4}	1×10^{7}
W-187	1×10^{2}	1×10^{6}
W-188	1×10^{2}	1×10^{5}
Re-186	1×10^{3}	1×10^{6}
Re-188	1×10^{2}	1×10^{5}
Os-185	1×10^{1}	1×10^{6}
Os-191	1×10^{2}	1×10^{7}
Os-191m	1×10^{3}	1×10^{7}
Os-193	1×10^{2}	1×10^{6}
Ir-190	1×10^{1}	1×10^{6}
Ir-192	1×10^{1}	1×10^{4}
Ir-194	1×10^{2}	1×10^{5}
Pt-191	1×10^{2}	1×10^{6}
Pt-193m	1×10^{3}	1×10^{7}
Pt-197	1×10^{3}	1×10^{6}
Pt-197m	1×10^{2}	1×10^{6}

Nuclide	Activity concentration (Bq/g)	Activity (Bq)
Au-198	1×10^{2}	1×10^{6}
Au-199	1×10^{2}	1×10^{6}
Hg-195m	1×10^{2}	1×10^{6}
Hg-197	1×10^{2}	1×10^{7}
Hg-197m	1×10^{2}	1×10^{6}
Hg-203	1×10^{2}	1×10^{5}
Tl-200	1×10^{1}	1×10^{6}
Tl-201	1×10^{2}	1×10^{6}
Tl-202	1×10^{2}	1×10^{6}
Tl-204	1×10^{4}	1×10^{4}
Pb-203	1×10^{2}	1×10^{6}
Pb-210[a]	1×10^{1}	1×10^{4}
Pb-212[a]	1×10^{1}	1×10^{5}
Bi-206	1×10^{1}	1×10^{5}
Bi-207	1×10^{1}	1×10^{6}
Bi-210	1×10^{3}	1×10^{6}
Bi-212[a]	1×10^{1}	1×10^{5}
Bi-213	1×10^{2}	1×10^{6}
Po-203	1×10^{1}	1×10^{6}
Po-205	1×10^{1}	1×10^{6}
Po-207	1×10^{1}	1×10^{6}
Po-210	1×10^{1}	1×10^{4}
At-211	1×10^{3}	1×10^{7}
Rn-220[a]	1×10^{4}	1×10^{7}
Rn-222[a]	1×10^{1}	1×10^{8}
Ra-223[a]	1×10^{2}	1×10^{5}
Ra-224[a]	1×10^{1}	1×10^{5}
Ra-225	1×10^{2}	1×10^{5}
Ra-226[a]	1×10^{1}	1×10^{4}
Ra-227	1×10^{2}	1×10^{6}
Ra-228[a]	1×10^{1}	1×10^{5}
Ac-225	1×10^{1}	1×10^{4}
Ac-227	1×10^{-1}	1×10^{3}
Ac-228	1×10^{1}	1×10^{6}
Th-226[a]	1×10^{3}	1×10^{7}

Nuclide	Activity concentration (Bq/g)	Activity (Bq)
Th-227	1×10^{1}	1×10^{4}
Th-228[a]	1×10^{0}	1×10^{4}
Th-229[a]	1×10^{0}	1×10^{3}
Th-230	1×10^{0}	1×10^{4}
Th-231	1×10^{3}	1×10^{7}
Th-nat (incl Th-232)	1×10^{0}	1×10^{3}
Th-234[a]	1×10^{3}	1×10^{5}
Pa-230	1×10^{1}	1×10^{6}
Pa-231	1×10^{0}	1×10^{3}
Pa-233	1×10^{2}	1×10^{7}
U-230[a]	1×10^{1}	1×10^{5}
U-231	1×10^{2}	1×10^{7}
U-232[a]	1×10^{0}	1×10^{3}
U-233	1×10^{1}	1×10^{4}
U-234	1×10^{1}	1×10^{4}
U-235[a]	1×10^{1}	1×10^{4}
U-236	1×10^{1}	1×10^{4}
U-237	1×10^{2}	1×10^{6}
U-238[a]	1×10^{1}	1×10^{4}
U-nat	1×10^{0}	1×10^{3}
U-239	1×10^{2}	1×10^{6}
U-240	1×10^{3}	1×10^{7}
U-240[a]	1×10^{1}	1×10^{6}
Np-237[a]	1×10^{0}	1×10^{3}
Np-239	1×10^{2}	1×10^{7}
Np-240	1×10^{1}	1×10^{6}
Pu-234	1×10^{2}	1×10^{7}
Pu-235	1×10^{2}	1×10^{7}
Pu-236	1×10^{1}	1×10^{4}
Pu-237	1×10^{3}	1×10^{7}
Pu-238	1×10^{0}	1×10^{4}
Pu-239	1×10^{0}	1×10^{4}
Pu-240	1×10^{0}	1×10^{3}
Pu-241	1×10^{2}	1×10^{5}

Nuclide	Activity concentration (Bq/g)	Activity (Bq)
Pu-242	1×10^{0}	1×10^{4}
Pu-243	1×10^{3}	1×10^{7}
Pu-244	1×10^{0}	1×10^{4}
Am -241	1×10^{0}	1×10^{4}
Am-242	1×10^{3}	1×10^{6}
Am-242m[a]	1×10^{0}	1×10^{4}
Am-243[a]	1×10^{0}	1×10^{3}
Cm-242	1×10^{2}	1×10^{5}
Cm-243	1×10^{0}	1×10^{4}
Cm-244	1×10^{1}	1×10^{4}
Cm-245	1×10^{0}	1×10^{3}
Cm-246	1×10^{0}	1×10^{3}
Cm-247	1×10^{0}	1×10^{4}
Cm-248	1×10^{0}	1×10^{3}
Bk-249	1×10^{3}	1×10^{6}
Cf-246	1×10^{3}	1×10^{6}
Cf-248	1×10^{1}	1×10^{4}
Cf-249	1×10^{0}	1×10^{3}
Cf-250	1×10^{1}	1×10^{4}
Cf-251	1×10^{0}	1×10^{3}
Cf-252	1×10^{1}	1×10^{4}
Cf-253	1×10^{2}	1×10^{5}
Cf-254	1×10^{0}	1×10^{3}
Es-253	1×10^{2}	1×10^{5}
Es-254	1×10^{1}	1×10^{4}
Es-254m	1×10^{2}	1×10^{6}
Fm-254	1×10^{4}	1×10^{7}
Fm-255	1×10^{3}	1×10^{6}
Alpha-emitting radionuclide not mentioned in this Table	1×10^{0}	1×10^{3}
Radionuclide that is not alpha-emitting and not mentioned in this Table	1×10^{1}	1×10^{4}

[a] The exemption levels given in this Schedule for the following radionuclides are for the parent nuclides, which are assumed to be in secular equilibrium with the progeny listed below:

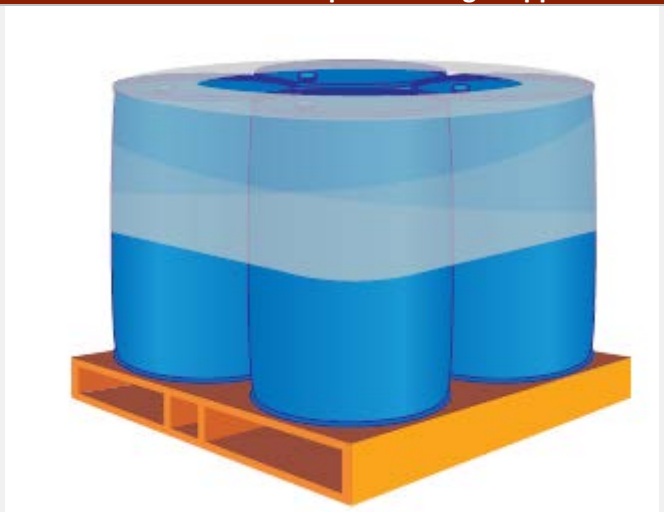
Sr-80	Rb-80
Sr-90	Y-90
Zr-93	Nb-93m
Zr-97	Nb-97
Ru-106	Rh-106
Ag-108m	Ag-108
Cs-137	Ba-137m
Ce-134	La-134
Ce-144	Pr-144
Ba-140	La-140
Bi-212	TI-208 (0.36), Po-212 (0.64)
Bi-212	TI-208 (0.36), Po-212 (0.64)
Pb-210	Bi-210, Po-210
Pb-212	Bi-212, TI-208 (0.36), Po-212 (0.64)
Rn-220	Po-216
Rn-222	Po-218, Pb-214, Bi-214, Po-214
Ra-223	Rn-219, Po-215, Pb-211, Bi-211, TI-207
Ra-224	Rn-220, Po-216, Pb-212, Bi-212, TI-208 (0.36), Po-212 (0.64)
Ra-226	Rn-222, Po-218, Pb-214, Bi-214, Po-214, Pb-210, Bi-210, Po-210
Ra-228	Ac-228
Th-226	Ra-222, Rn-218, Po-214
Th-228	Ra-224, Rn-220, Po-216, Pb-212, Bi-212, TI-208 (0.36), Po-212 (0.64)
Th-229	Ra-225, Ac-225, Fr-221, At-217, Bi-213, Po-213, Pb-209
Th-nat(incl Th-232)	Ra-228, Ac-228, Th-228, Ra-224, Rn-220, Po-216, Pb-212, Bi-212, TI-208 (0.36), Po-212 (0.64)
Th-234	Pa-234m
U-230	Th-226, Ra-222, Rn-218, Po-214
U-232	Th-228, Ra-224, Rn-220, Po-216, Pb-212, Bi-212, TI-208 (0.36), Po-212 (0.64)
U-235	Th-231
U-238	Th-234, Pa-234m
U-nat	Th-234, Pa-234m, U-234, Th-230, Ra-226, Rn-222, Po-218, Pb-214, Bi-214, Po-214, Pb-210, Bi-210, Po-210
U-240	Np-240m
Np-237	Pa-233
Am-242m	Am-242
Am-243	Np-239

NOTE 1: The limits in relation to U(nat) and Th(nat) are to be applied in terms of the parent radionuclides ie. U-238 and Th-232 respectively.

A.3 Packaging examples

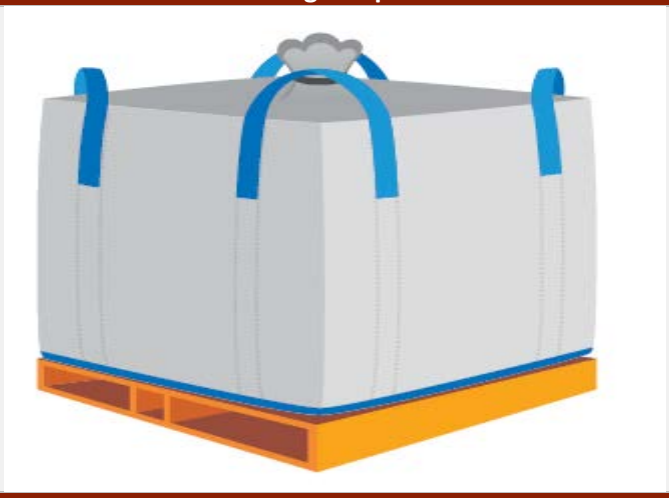
4 Plastic drums on a pallet

4 Plastic drums on a pallet - clingwrapped



4 Steel drums on a pallet

Bulk bags on pallets



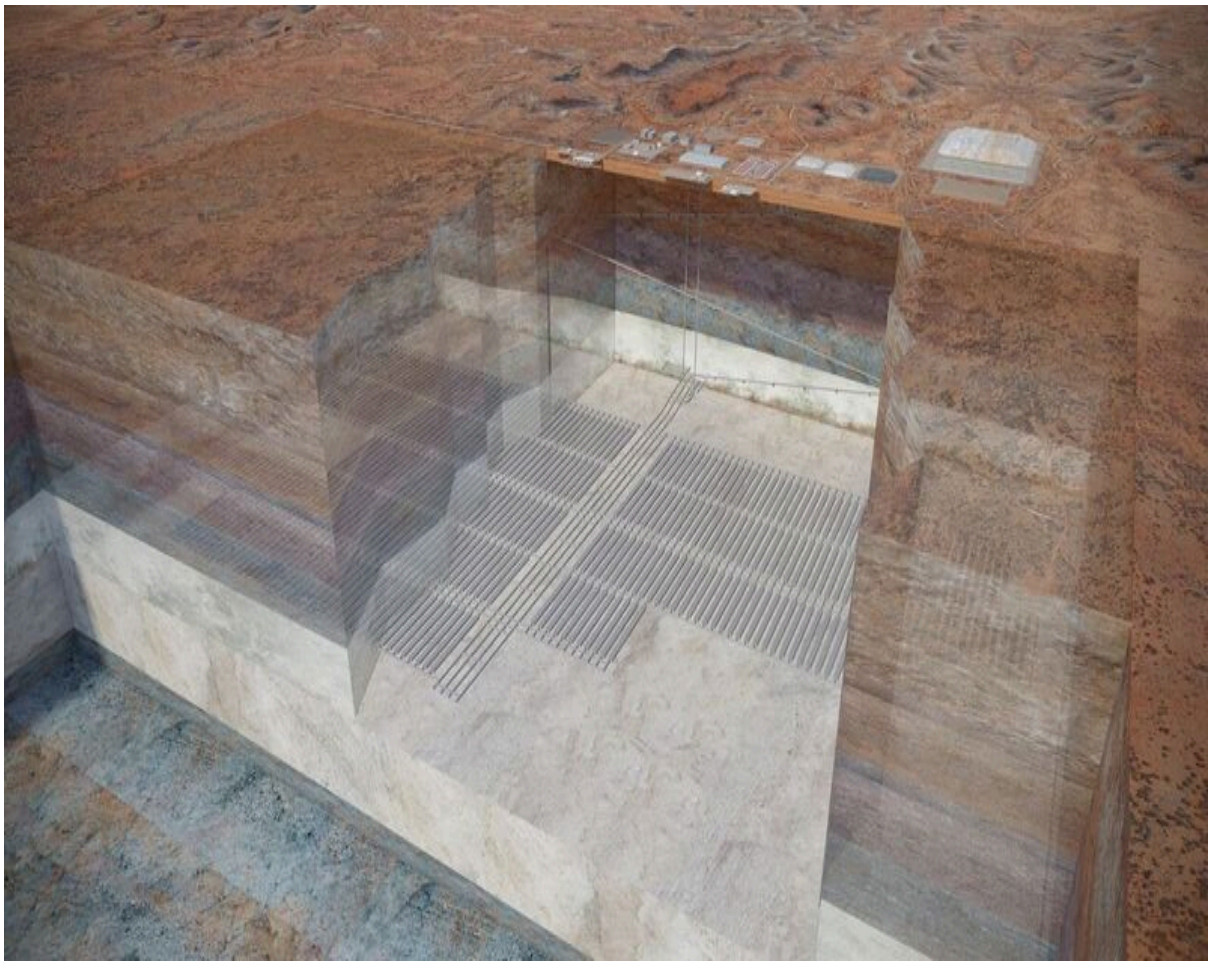
Plastic drums in sea containers

Bulk bags in sea containers

TELLUS

CHANDLER AND APIRNTA FACILITY WASTE ACCEPTANCE PROCEDURE

Final Report | September 2016



Revision	Date	Description	Signatures		
			Originator	Checked	Approved
0	28/09/2016	For issue	S. Reece	SH, RP	DvM

Table of Contents

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICIES

ABBREVIATIONS

ASTM	American Society for Testing and Materials
BS	British Standard
Bq	Becquerel
The Facility	The Chandler and Apirnta Facility
IAEA	International Atomic Energy Agency
IBC	Intermediate Bulk Container
ISO	International Organisation for Standardization
MSDS	Material safety Data Sheet
NEPM	National Environmental Protection Measure
NHMRC	National Health and Medical Research Council
NMP	NORM Management Plan
NORM	Naturally Occurring Radioactive Materials
NRPB	National Radiological Protection Board
O&G	Oil & Gas
RMP	Radiation Management Plan
RWMP	Radioactive Waste Management Plan
RPS	Radiation Protection Series
STP	Standard Temperature and Pressure
Sv	Sieverts
Tellus	Tellus Holdings Ltd.
TOC	Total Organic Carbon
UN	United Nations
WAC	Waste Acceptance Criteria

WAP	Waste Acceptance Procedures
WZG	Waste Zoning Guide

DEFINITIONS

Hazardous waste[1] - Waste prescribed by the regulations, where the waste has any of the characteristics mentioned in Annex III to the Basel Convention. These characteristics include:

- Explosive
- Flammable Liquids/Solids
- Poisonous
- Toxic
- Ecotoxic
- Infectious Substances.
- Wastes that belong to any category contained in Annex I to the Basel Convention unless they do not possess any of the hazardous characteristics contained in Annex III. Wastes in Annex I include:
    - Clinical wastes;
    - Waste oils/water, hydrocarbons/water mixtures, emulsions;
    - Wastes from the production, formulation and use of resins, latex, plasticizers, glues/adhesives;
    - Wastes resulting from surface treatment of metals and plastics;
    - Residues arising from industrial waste disposal operations; and
    - Wastes which contain certain compounds such as: copper, zinc, cadmium, mercury, lead and asbestos.
- Household waste; or
- Residues arising from the incineration of household waste

Listed Waste[2] – wastes which pose a threat or risk to public health, safety or the environment and include substances which are toxic, infectious, mutagenic, carcinogenic, teratogenic, explosive, flammable, corrosive, oxidising and radioactive. Listed wastes are ONLY to be disposed of at facilities that are licensed to receive listed waste. For details of what constitutes listed waste refer to the Waste Management and Pollution Control (Administration) Regulations.

Geological repository – a deep salt facility used to permanently isolate waste. The geological barrier provides permanent isolation of wastes from the environment over the very long term in accordance

[1] *Hazardous Waste (Regulation of Exports and Imports) Act 1989,*
[2] *Guidelines for the Siting, Design and Management of Solid Waste Disposal Sites in the Northern Territory*

with Environmentally Sound Management principles and also creates additional opportunities for the future recovery and recycling of valuable materials from the waste which can re-enter the circular economy.

Room – an underground excavation (chamber) in salt which is used for the *storage* or *permanent isolation* of waste

Conditions of storage – The term "in the conditions of storage" is used to differentiate between the generic properties of a material and how those properties may be modified when that material is placed into "storage" or "permanent isolation" within an underground room.

Storage – the above ground storage of materials following delivery and includes the time awaiting sampling, analysis and management prior to movement for "in cell storage".

In Room Storage – medium to long term below ground storage of wastes inside a room with ongoing opportunity to recover waste if required.

Permanent Isolation – indefinite below ground storage or disposal of wastes determined suitable for acceptance

Notice and Certification Assurance program – supported by Tellus' Notices and Certificates that include the following: Customer Dispatch, Arrival and Rejection Notices and Tellus-Acceptance©, Tellus-Storage©, Tellus-Recovery© Tellus-Solidification© and Tellus-Permanent Isolation Certificates.

Title - a legal right to ownership and possession of all items that can be recognized as being owned or belonging to a person or a thing. At a basic level, a title is a document that indicates recognition of ownership.

Management risk – the responsibility for the mangment of waste materials

Disclaimer:

The information contained in this document is for the purpose of supporting approvals documentation and subsequently for use as an operational document for the Chandler and Apirnta Facility only.

All care and diligence has been exercised in interpreting data for the development of this document. In any event, Tellus accepts no liability for any costs, liabilities or losses arising because of the use of, or reliance upon, the contents of this report by any third party.

Tellus, as part of their continuous improvement activities will review and may update and amend this document from time to time.

1 INTRODUCTION

1.1 The Chandler Facility

The proposed Chandler Facility (hereby referred to as the proposed "Facility") is a salt mining and processing facility, and a hazardous waste storage and permanent isolation facility. The salt bed is located approximately 800m below the surface and is 200-300m thick. The salt bed which is 500 M years old is overlain by a sequence of low permeability sedimentary rocks. The salt bed will be mined in a way that produces "rooms" which are used to house hazardous waste temporarily or permanently. The facility is located approximately 120 kilometres south of Alice Springs and is situated on the Maryvale pastoral lease.

The location for the Facility was chosen as its principal characteristics; natural geological barrier, geologically stable, no regional aquifer, remote location, no special cultural or historic significance, no potential medium to high value agriculture, no sterilization of minerals or hydrocarbons, no special environmental features, no rare species of flora or fauna, satisfy the requirements for a deep geological repository[3] for hazardous waste storage and isolation purposes.

There are no sensitive receptors within the immediate vicinity of the proposed Facility. The nearest permanent settlement is the small town of Titjikala about 15 kilometres to the north-east. The main land uses that occur on the Maryvale pastoral lease are cattle grazing and Aboriginal land management. The main waterways in the region are the Hugh River, Finke River and Palmer River. At their nearest point, Hugh River is about 10 kilometres east of the site, Finke River is about 15 kilometres south and Palmer River is about 70 kilometres west

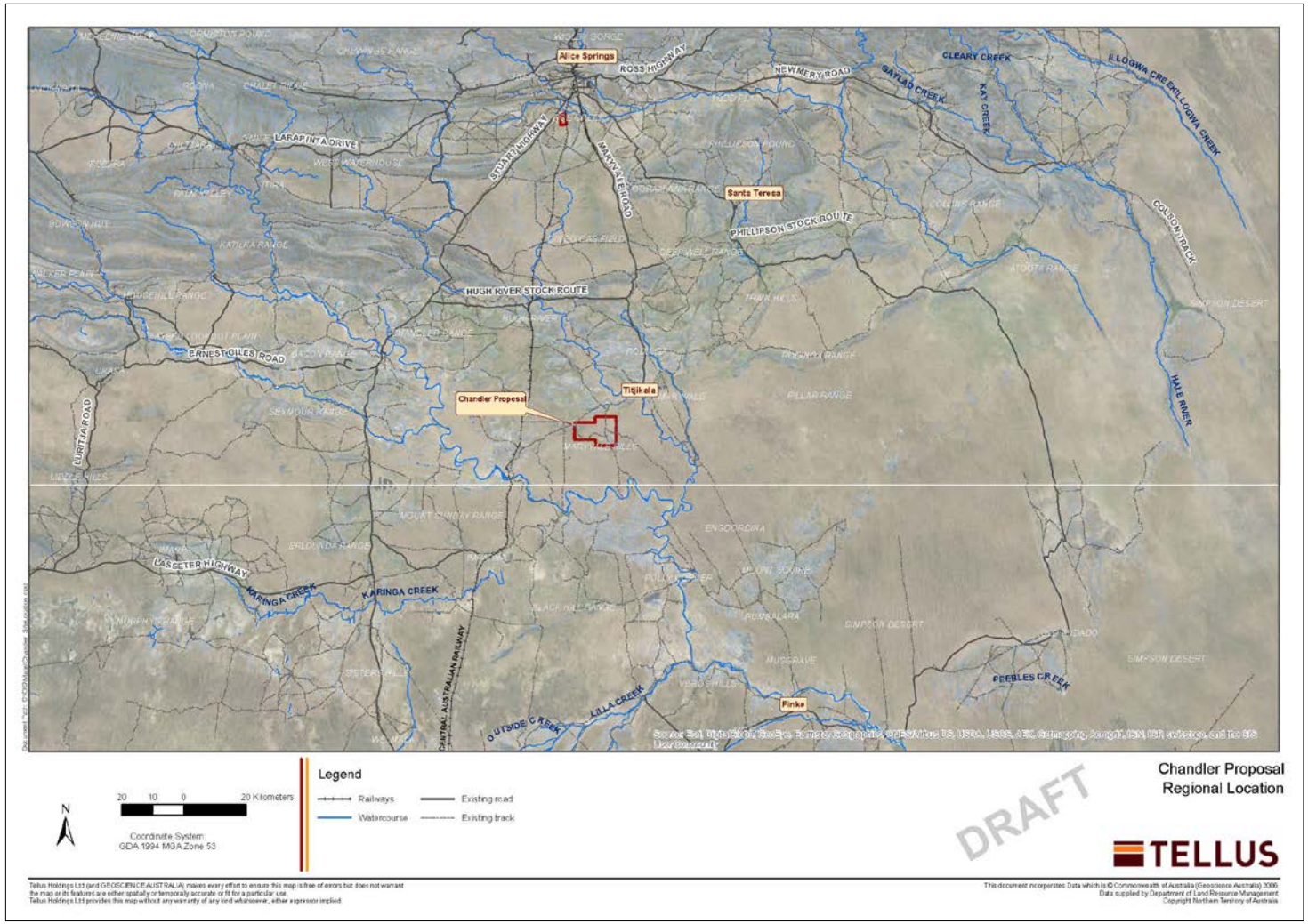
The arid and remote nature of the location, absence of nearby population, coupled with the site characteristics make the site ideal for long-term storage and permanent isolation of hazardous and intractable waste.

1.2 The Apirnta Facility

The Apirnta Facility is located adjacent to the Central Australian Railway approximately 30km to the west of the Chandler Facility and will be connected to Chandler by the Chandler Haul Road. Apirnta will be a Storage and Transfer Facility and will be the location where waste acceptance procedures are performed to confirm that incoming materials meet the waste acceptance criteria for Chandler.

[3] *IAEA guidelines for the siting of geological disposal facilities - adapted to hazardous waste*

Figure 1-1: Chandler site location



1.3 Document aims and objectives

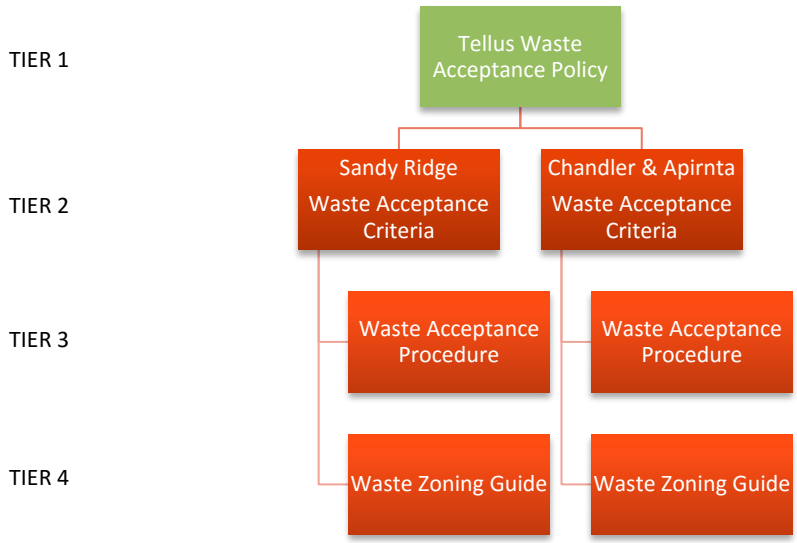
The aim of this document is to present the Waste Acceptance Procedure (WAP) that will be used at the proposed Chandler Facility to determine if wastes meet all of the acceptance criteria. This document should be read in conjunction with the following:

- Tellus Waste Acceptance Policy.
- Chandler Waste Acceptance Criteria (WAC).
- Chandler Waste Zoning Guide (WZG).

This document is part of a hierarchy of documents and is a tier 3 document as highlighted in Figure 1-2 below. Tier 3 documents work together with tier 4 documents to provide details of specific operational procedures and include the development of an assumed inventory[4] for storage and permanent isolation. The assumed inventory will in turn inform the licence application submitted to the regulator.

The document hierarchy is presented in Figure 1-2, and includes an equivalent suite of documents for Tellus' Western Australian Sandy Ridge Project.

Figure 1-2: Waste Acceptance Criteria Document Hierarchy



Having established the overarching waste exclusion criteria to be applied at the proposed Facility (refer to WAC), a gated WAP (this document), using specified test methods and criteria values will be

[4] Due to the variability in the wastes that could be encountered at the proposed Facility, the assumed inventory is likely to be subject to change and should be considered as an initial guide for the acceptance of the various wastes listed. Changes to the inventory are to be controlled by a suitably qualified person(s) making decisions in accordance with the principles presented in this document.

applied to determine if a waste can be accepted. The gated procedure is set out in Appendix A.1, with an explanation of each step and corresponding test method provided in Section 2.3.

In addition to considering the specific characteristics of the waste, consideration is also given to how the wastes will perform in the conditions of storage and permanent isolation. This assessment will be performed by a suitably qualified person who has the necessary skill in determining such matters.

Wastes will need to pass through each waste acceptance "criteria gate" to be accepted for underground storage or permanent isolation at the Chandler facility.

1.4 Intended audience

This document is intended initially for use by regulators responsible for assessing the facility and issuing licences for the operation of the proposed Facility, and for the formation of procedures to control the process by which waste producers and Tellus Staff will determine if the waste streams may be suitable for storage or permanent isolation.

The document will also be of interest to other stakeholders who wish to understand the approach being followed by Tellus for waste acceptance, including the safe storage and permanent isolation of wastes.

Finally, this document will be used by Tellus staff and their specialist advisors to establish the framework that incorporates more detailed operational procedures which underpin this document.

2 CONTEXT

Tellus Waste Acceptance Policy establishes the context and importance of effective Waste Acceptance Procedures. The Policy states before waste can be accepted for storage or permanent isolation at the proposed Chandler Facility, Tellus must be satisfied that the waste meets agreed acceptance criteria, has been subject to the tests set out in the WAP and that the waste can be accepted in accordance with Approvals and Licences issued by regulators.

2.1 Waste Acceptance Criteria

WAC have been established to determine waste types which can and cannot be accepted when considering the characteristics and design of the site to achieve safe operation of the facility and to ensure long term environmental protection through containment of potential pollutants present within the wastes. In some cases the criteria used will lead to straightforward “go or no go” decisions based on compatibility with the site characteristics and WAC, and in other cases acceptance values and parameters will be used.

Whilst Tellus will ensure that waste generators are aware of the WAC for the Facility, it is recognised that on some occasions particular wastes presented will not conform to set criteria and re-evaluation of appropriate management techniques will be required so as to achieve the objective of safe storage or permanent isolation so that the threat to the receiving environment is minimised or prevented.

2.2 Waste Acceptance Procedure

As part of the WAP it is necessary to first characterise the waste material. Tellus have adopted a three stage approach to waste characterisation[5], which is summarised below. The most detailed characterisation takes place to determine if waste meets the overarching criteria and licence conditions of the site, followed by further ongoing testing at levels 2 and 3 described below.

- **Level 1: Basic characterisation**. This is a thorough determination, according to standardised analysis and behaviour-testing methods, of the characteristic properties of the waste.
- **Level 2: Compliance testing**. This is periodic testing of regularly arising wastes by simpler standardised analysis methods to determine whether a waste complies with licence conditions and whether a waste with known properties has changed significantly.
- **Level 3: On-site verification**. This constitutes rapid check methods to confirm that a waste is the same as that which has been subjected to compliance testing and that which is described in the accompanying documents.

[5] UK Environment Agency Waste acceptance at landfills - 2010

For acceptance at the proposed Chandler Facility wastes need to continually meet the acceptance criteria laid down for the site in the WAC document. Criteria compliance is therefore continually tested by using the three levels of basic characterisation, compliance testing and on-site verification, which is outlined in detail in this document.

2.3 Waste Zoning

After wastes have been accepted at the proposed Facility, it is important that they are both stored and disposed of in a safe manner. The wastes that Tellus are planning to accept, many of which are classified as Dangerous Goods, will be grouped into compatible waste type groups that can be stored and disposed of together. Whilst in transit and surface storage Dangerous Goods Segregation protocols will be adopted (AS/NZ 3833 Figure 6.1).

When the waste is placed into an underground room for permanent isolation, waste zoning protocols will be implemented, as presented in the WZG. The WZG have been developed to reflect the conditions of storage within the cell and how the various wastes can be stored or permanently isolated without adverse interaction. Adopting a zoning approach also increases the opportunity for potential future recovery of certain materials for beneficial use.

3 WASTE CHARACTERISATION

As part of the WAP it is necessary to first characterise the waste material. Tellus have adopted a three stage approach to waste characterisation[6] which is summarised below. The most detailed characterisation takes place to determine if waste meets the overarching criteria and licence conditions of the site, followed by further ongoing testing at levels 2 and 3 described below.

- **Level 1: Basic characterisation**. This is a thorough determination, according to standardised analysis and behaviour-testing methods, of the characteristic properties of the waste.

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- **Level 3: On-site verification**. This constitutes rapid check methods to confirm that a waste is the same as that which has been subjected to compliance testing and that which is described in the accompanying documents.

3.1 Basic characterisation[7]

Basic characterisation is the first step in the acceptance procedure and constitutes a full characterisation of the waste by the waste producer by gathering all the necessary information for safe disposal of the waste in the long term. Basic characterisation is required for each waste stream and involves using test methods outlined in the gated acceptance procedure (see Section 4) to determine whether the wastes pass all of the acceptance criteria.

3.1.1 Functions of basic characterisation

- Establish basic information on the waste (physical form, origin, composition, consistency, and, where necessary and available, other relevant characteristic properties).

- Provide basic information for understanding the behaviour of waste in the Facility conditions of storage and options for treatment.

- Detection of key variables (critical parameters) for compliance testing and options for simplification of compliance testing (leading to a significant decrease of constituents to be measured, but only after demonstration of relevant information). Characterisation may

[6] *UK Environment Agency Waste acceptance at landfills - 2010*
[7] *(2003/33/EC) COUNCIL DECISION of 19 December 2002 establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 of and Annex II to Directive 1999/31/EC*

deliver relationships between basic characterisation and results of simplified test procedures as well as frequency for compliance testing.

If the basic characterisation of waste shows that the waste fulfils the criteria for the Facility set out in the WAC, the waste will be deemed to be acceptable. If this is not the case, the waste is not acceptable. The producer of the waste (client) or the person responsible for its management, is responsible for ensuring that the characterisation information is correct.

The content of the characterisation, the extent of laboratory testing required and the relationship between basic characterisation and compliance checking depends on the type of waste. A differentiation can be made between wastes that are regularly generated in the same process and wastes that are not regularly generated.

Wastes regularly generated in the same process

These are individual and consistent wastes regularly generated in the same process, where:

- The installation and the process generating the waste are well known and the input materials to the process, and the process itself, are well defined.
- The operator of the installation provides all necessary information and informs Tellus of changes to the process (especially changes to the input material).

The process will often be at a single installation; however, the waste may also be from different installations, if it can be identified as single stream with common characteristics within known boundaries (e.g. bottom ash from the incineration of municipal waste). For these wastes the basic characterisation will comprise the fundamental requirements listed in Gate 1 of section 4 of this document, and especially the following:

- Chemical composition range for the individual wastes.
- Range and variability of characteristic properties.

If the waste is produced in the same process but at different sites, information must be given on the scope of the evaluation. Consequently, a sufficient number of measurements must be taken to show the range and variability of the characteristic properties of the waste. The waste can then be considered characterised and shall subsequently be subject to compliance testing only, unless significant change in the generation processes occur.

For wastes generated from the same process at the same site, the results of the measurements may show only minor variations in the properties of the waste, in comparison with the relevant acceptance parameters. The waste can then be considered characterised, and shall subsequently be subject to compliance testing only, unless significant changes in the generation process occur.

Waste sourced from facilities for the bulking or mixing of waste, from waste transfer stations or mixed waste streams from waste collectors, can vary considerably in their properties. This must be taken into consideration in the basic characterisation. Such wastes may fall under the following case.

Wastes that are not regularly generated

These wastes are not regularly generated in the same process in the same installation and are hence not part of a well-characterised waste stream. Each batch produced of such waste will need to be characterised. The basic characterisation shall include the same fundamental requirements as for basic characterisation. As each batch produced has to be characterised, no compliance testing is needed in this case.

3.2 Compliance testing

When waste has been deemed acceptable on the basis of a basic characterisation it shall subsequently be subject to compliance testing to determine if it complies with the results of the basic characterisation and the relevant acceptance criteria as laid down in the WAC. Compliance testing, as with basic characterisation, will also normally be carried out at the waste producer (client) site.

The function of compliance testing is to periodically check regularly arising waste streams are compliant with the WAC. The initial basic characterisation will have identified critical parameters (key waste properties) for each waste stream. Only a check on these critical parameters, as determined in the basic characterisation, is necessary. The check has to show that the waste meets the limits of acceptance for the identified critical parameters. The tests used for compliance testing shall be one or more of those used in the basic characterisation.

Compliance testing shall be carried out at a frequency to be agreed with Tellus and must, in any event, ensure that compliance testing is carried out in the scope and frequency determined by basic characterisation.

3.3 On-site verification

Each load of waste delivered to Apirnta shall be visually inspected before and after unloading, and the required documentation shall be checked.

The waste may be accepted at the Facility, if it is the same as that which has been subjected to basic characterisation and compliance testing, and which is described in the accompanying documents. If this is not the case, the waste must not be accepted. Tellus will determine the testing requirements for on-site verification, including where appropriate rapid test methods.

Upon delivery, samples will be taken periodically. The samples taken will be kept after acceptance of the waste for a period that will be determined by Tellus.

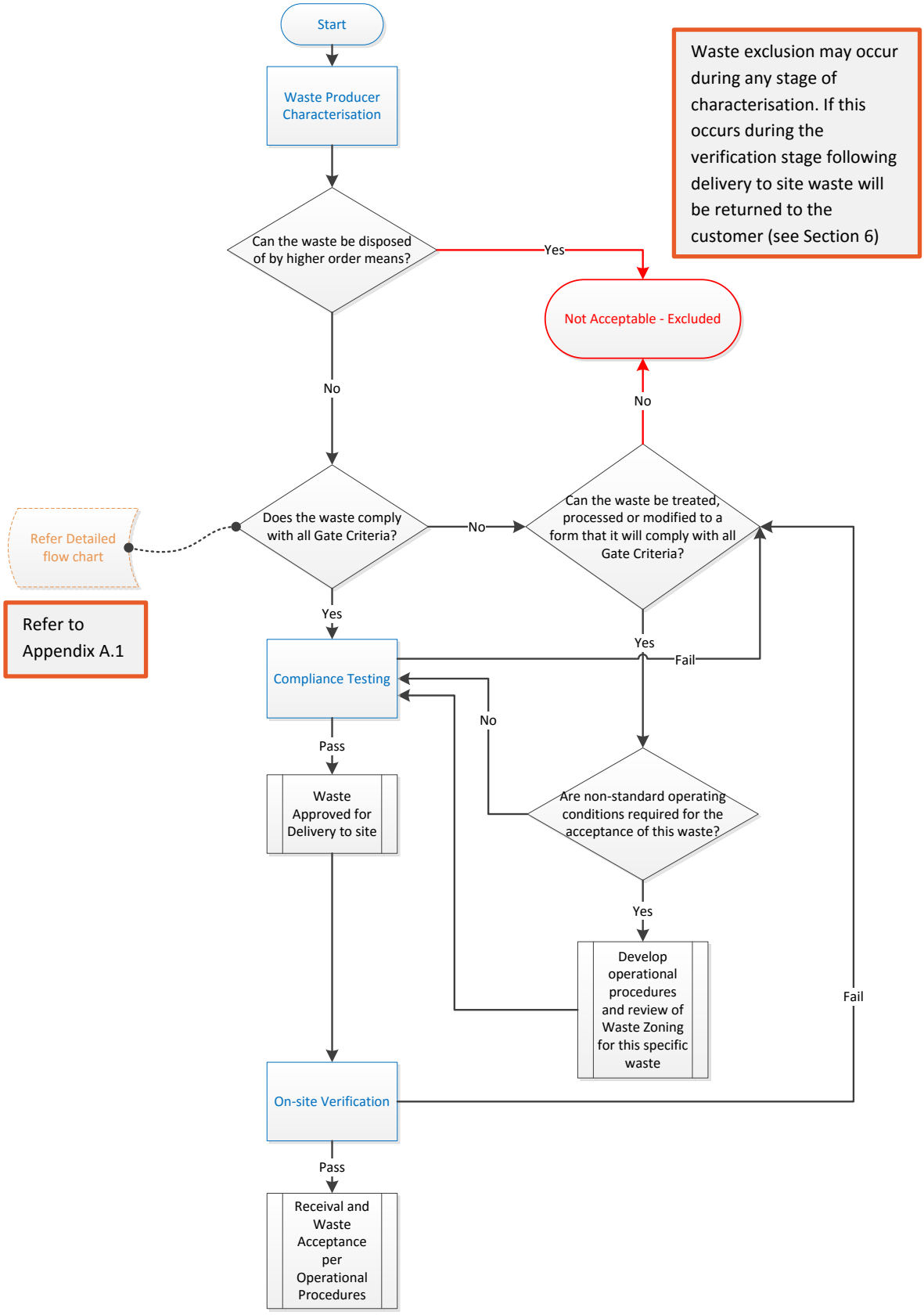
4 WASTE ACCEPTANCE PROCEDURE

A gated WAP using specified test methods and criteriawill be applied to determine if a waste can be accepted. Detailed explanations of each gate, its associated criteria and an applicable test method(s) required to be used to confirm acceptance, are presented below, with a corresponding detailed flow chart included in Appendix A.1. A summary of the overall procedure for characterisation, compliance, acceptance and verification is set out in Figure 4-1 below.

In addition to considering the specific characteristics of the waste for the purpose of permanent isolation, consideration is also given to how the wastes will perform in the conditions of storage. This assessment will be performed by a suitably qualified person who has the necessary skill in determining such matters. Wastes will need to pass through all waste acceptance “criteria gates” to be accepted for storage or permanent isolation at the Chandler facility.

From the point of waste generation, the flow diagram highlights that characterisation is performed in accordance with the principles outlined above with the option to develop non-standard operating procedures for the management of non-conforming wastes prior to or following receipt at the proposed Facility.

Figure 4-1: Waste Acceptance Procedure summary – Refer to Section 2.3 and Appendix A.1 for detailed Procedure



Gate 1 – Is the waste on the potential waste category list

The first stage of assessing the potential suitability of a waste for storage and permanent isolation is to determine whether the waste is on the facility's potential waste category list. The list has been developed by Tellus based on wastes that broadly have the physical and chemical properties that meet the criteria for storage and permanent isolation at the facility. The list aims, insofar as is possible at the outset, to exclude categories of wastes that would fail the site's acceptance criteria and are therefore considered unacceptable. In developing this list Tellus has referred to the National Environment Protection (Movement of Controlled Waste between States and Territories) Measure 1998 Schedule A and the Northern Territory Waste Management and Pollution control (Administration) Regulations (Schedule 2 – Listed Wastes). A client will be requested to provide information on the waste, using the Level 1 - Basic Characterisation Form presented in Figure 4-2. The form contains the following elements of basic characterisation;

- Source and origin of the waste.
- Information on the process producing the waste (description and characteristics of raw materials and products).
- Appearance of the waste (smell, colour, physical form).
- Radiological assessment of the waste.
- Dangerous Goods Code
- Code according to the Basel Convention (Annex III) list of hazardous characteristics [Annex III of the Basel Convention is included as Appendix A.2 of this document for ease of reference].

If the waste is deemed to be on the Potential Waste Category List, the remaining elements of basic characterisation will be undertaken to provide the necessary information to allow the further steps in the site's acceptance procedure to be undertaken.

If the waste is deemed not to be on the Potential Waste Category List, Tellus may advise the regulator that after modification or treatment, a waste not on the list would be acceptable for storage and treatment. Advice would include a report from the suitably qualified person that demonstrates that hazards have been reduced or managed to make that waste suitable for underground storage or permanent isolation.

The remaining elements of basic characterisation include;

- Description of any waste treatment applied or to be applied, or a statement of reasons why such treatment is not considered necessary.
- Data on the composition of the waste.
- Additional precautions to be taken when handling the material, particularly if classified as a dangerous good.
- An indication if the waste could be recycled or recovered now or in the future.

Figure 4-2 Basic Characterisation Form

TO BE COMPLETED IN BLOCK CAPITALS OR TYPED	No. of attached sheets:	Sheets of analysis:

Waste Producer's full name: ……
Address: ……
……
……
Postcode: …… **Tel No:** ……

Place of collection (if different). Full name and address:
……
……
……
Postcode: …… **Tel No:** ……

Quantity: **Method of Containment** **Collection Frequency:**

Full chemical description:……
……
……

Colour: **Approx. pH:**

Physical form: **Approx. strength:**

Process from which waste/material is derived, including details of any pre-treatment: ……
……

Will the waste/material vary? YES/NO if YES, in what way? ……

Does the waste/material smell? YES/NO if YES, give possible cause(s) ……

CLIENT'S DECLARATION OF CONSTITUENTS OF THE WASTE/MATERIAL (Delete as appropriate)
Include and specify any know toxic, dangerous or objectionable contaminants either against the entry or in additional information box below

No. of samples taken

CONSTITUENT	PRESENT		IF YES, PLEASE SPECIFY	CONSTITUENT	PRESENT		**IF YES, PLEASE SPECIFY**
Acids	YES	NO		Controlled drugs/POMs	YES	NO	
Alkalis	YES	NO		Oxidizing agents	YES	NO	
Flammable liquids/Solids	YES	NO		Reducing agents	YES	NO	
Spontaneously combustibles	YES	NO		Radioactive	YES	NO	
Water-reactive materials	YES	NO		Cyanides (free/complex)	YES	NO	
Oils, Fats, greases	YES	NO		Ammonia/amines	YES	NO	
Halogenated solvents	YES	NO		Nitrates/nitrites	YES	NO	
Phenols/halogenated phenols	YES	NO		Agrochemicals	YES	NO	
Sulphur compounds	YES	NO		PCBs/PCTs	YES	NO	
Explosives	YES	NO		Bio-hazardous materials	YES	NO	
Metals/metal compounds	YES	NO		Hazardous Characteristics (Basel Convention Annex III)			
Additional information;				Dangerous Goods Code			

Signed on behalf of the Waste Producer's Name: **Job Title:** **Date:**
…… …… …… ……

Test methods:

Review of waste information provided by customer and MSDS as supplied against the Potential Waste Category list presented in Appendix A.3

Limit of acceptance:

Identified on Potential Waste Category list.

Gate 2 – Has the waste been identified as having potential for future recovery?

If a waste stream has the potential to be recycled or recovered in the future but there is currently no viable process available, that will be noted and the viability/availability of that option will be periodically reviewed. The absence of a current viable route in accordance with the principles of "Environmentally Sound Management[8]" will enable the waste to be accepted at the Chandler site for storage or permeant isolation.

Test methods:

Review of waste type, information supplied and MSDS against listed wastes.

Limit of acceptance:

Not applicable

Gate 3 – Gases, liquids and sludges

Gas and liquid are assumed to mean the physical state of the waste at 25°C and 1 atm (STP), with a sludge being a homogeneous mixture of solid and liquid materials which requires containment to prevent the material from flowing.

Gate 3.1 – Is the waste a gas?

Gases will not be accepted for permanent isolation, this includes wastes which could reasonably be expected to be gases in a free phase condition in the conditions of permanent isolation. This exclusion will include wastes received as aerosols, liquids, or solids which may change form during or following emplacement.

Test methods:

Review of MSDS.

[8] The Basel Convention on the Control of Transboundary Movement of Hazardous Waste and their Disposal, which came into force in 1992, defines "environmentally sound management" as "taking all practical steps to ensure that hazardous wastes or other wastes are managed in a manner which will protect human health and the environment against adverse effects, which might result from such wastes."

Limit of acceptance:

The Australian Code for the Transport of Dangerous Goods by Road and Rail defines “gases” as substances that have a vapour pressure greater than 300 kPa at 50°C, or are completely gaseous at 20°C and standard pressure of 101.3 kPa (STP).

Gate 3.2 – Is the waste a liquid or sludge?

Liquid and sludge wastes will not be accepted directly for permanent isolation at the proposed Facility. This includes wastes received as liquids, or solids which may change form during or following emplacement (i.e. may return to liquid phase during long term storage). Should a suitable technology and process be available to permanently solidify the liquid to a suitable consistency then it may be possible to dispose of the waste at the proposed Facility.

Test methods:

MSDS Review

Liquids test ASTM D 4359-90:

Slump test (BS 1881: Part 102 or equivalent). A slump test involves the placing of a sample of material into an inverted cone of known height. This is then placed the correct way onto a flat surface. The surrounding cone is then slowly removed and the height of the resulting waste form will be measured. The slump is calculated as the original height minus the height of the resultant waste form and reported in mm.

Limit of acceptance:

The Australian Code for the Transport of Dangerous Goods by Road and Rail (2007) defines “liquids” as substances that have a vapour pressure of not more than 300 kPa at 50°C, are not completely gaseous at 20°C and standard pressure of 101.3 kPa, and have a melting point or initial melting point of 20°C or less at standard pressure of 101.3 kPa. The code continues to state that a viscous substance for which a specific melting point cannot be determined must be subjected to the ASTM D 4359-90 test; or to the test for determining fluidity (penetrometer test).

Slump Test: The waste will fail the test and be deemed unsuitable for the facility, if the height has dropped by 25% or more of the original height.

Gate 4 - Does the waste possess hazardous characteristics which, in the conditions of storage, are explosive, corrosive, oxidizing, or highly flammable?

Gate 4 sets out a number of generic exclusion properties of potential wastes, based on the reactivity of the wastes. Each property should be considered independently from the others through the gating process. A waste that fails in any one of these sub-gates will be deemed as failing Gate 4 and will not be accepted for permanent isolation at the proposed Facility. The hazardous characteristics

list is presented at Appendix A.2. The conditions of storage will be considered when assessing these criteria.

Gate 4.1 – Is the waste Explosive (H1)?

Wastes which are explosive will not be accepted directly for permanent isolation at the proposed Facility. Should a suitable treatment or encapsulation method be identified to treat or manage the wastes such that it is no longer explosive in the conditions of storage, it may be possible to accept the waste material for permanent isolation or in cell storage. A suitably qualified person will be required to determine if and when such wastes may be received and disposed at the proposed Facility. Any treatment methodology for the stabilisation of the waste must be controlled and undertaken by suitably qualified persons. Detailed risk assessment will be undertaken to ensure the stabilisation and subsequent storage can be undertaken safely.

Test methods:

The United Nations *Recommendations On The Transport Of Dangerous Goods, Manual Of Tests And Criteria* (United Nations Test Manual) gives a series of laboratory tests to determine whether a substance is classified as explosive, and if so, what division falls into. As Tellus will not be accepting any explosive material, irrespective of which division it falls into, only test types 1 and 2 will be utilized at the proposed Facility.

The following Type 1 tests answer the question “is it an explosive substance?”

- Test 1 (a): UN Gap test – assess ability of substance to propagate a detonation;
- Test 1 (b): Koenen test – effects of intense heat under high confinement;
- Test 1 (c) (i): Time/Pressure test – effects of ignition under confinement;
- Test 1 (c) (ii): Internal ignition test – tendency to transition from deflagration to detonation.

If every test yields a negative result the waste is classified as non-explosive and can be considered for acceptance; however, if any of these tests give a positive result, the waste is then subjected to Type 2 testing to determine the sensitivity.

Type 2 tests answer the question “is it too insensitive for acceptance into Class 1?” These tests use the same basic apparatus and method but with minor variations, or less stringent criteria.

Limit of acceptance:

The substance is classified as "explosive" under the following conditions and will not be accepted:

- Type 1: if any of the tests yields a positive (+) result; and
- Type 2: if any of the tests yields a positive (+) result

Gate 4.2 – Is the waste Highly Corrosive (H8)?

Highly corrosive wastes will not be accepted for direct permanent isolation at Chandler. Should a suitable treatment or encapsulation method be identified to treat or manage the wastes such that they do not remain highly corrosive under the conditions of storage, it may be possible to accept the waste material for permanent isolation or underground storage. Any stabilisation shall be undertaken under the instruction of the suitably qualified person.

Test methods:

The United Nations Test Manual recommends Test C.1 to determine the corrosive properties of liquids and solids that may become liquids during storage and/or transport.

A representative sample of the waste is placed in contact with a minimum of 3 metal plates (one test using steel, and another using aluminium) measuring 20 x 50 x 2 mm. One plate is submerged in the solution, another is half submerged, and the final plate is suspended in the gas phase. The test temperature is maintained at 55°C for at least one week before the metal plates are removed and analysed for mass loss.

Limit of acceptance:

The results are based on both localised, and uniform corrosion. The material will be classified as highly corrosive under the following conditions:

- Uniform corrosion: the mass loss of the most corroded sample exceeds the values given in Table 4-1; or

Table 4-1: Uniform corrosion mass loss criteria

Exposure time	Mass loss
7 days	13.5%
14 days	26.5%
21 days	39.2%
28 days	51.5%

- Localised corrosion: the depth of the deepest intrusion (to be determined metallographically) into the metal surface exceeds the values given in Table 4-2

Table 4-2: Localised corrosion intrusion criteria

Exposure time	Min. intrusion depth
7 days	120 µm
14 days	240 µm
21 days	360 µm
28 days	480 µm

Gate 4.3 – Does the waste have oxidising potential (H5.1)?

Oxidizing wastes will not normally be accepted directly for permanent isolation at the proposed Facility. Should a suitable treatment or encapsulation method be identified to treat or manage the wastes such that little or no oxidizing potential remains under the conditions of storage, it may be possible to accept the waste material. Any stabilisation shall be undertaken under the instruction of the suitably qualified person.

Test methods:

The United Nations Test Manual recommends using Test O.1 to classify oxidizing solids. This test is designed to measure the potential for the material to increase the burning rate or burning intensity of a combustible substance when they are thoroughly mixed, and to compare these characteristics with that of potassium bromate.

The *Recommendations On The Transport Of Dangerous Goods, Manual Of Tests And Criteria* also gives test methods for determining the oxidization potential of a liquid substance; however these materials will be excluded in Gate 3.2 and therefore the tests will not be utilized at the proposed facility

Limit of acceptance:

Substances that fail to ignite and burn under test conditions, or exhibits mean burning times greater than that of a 3:7 mixture (by mass) of potassium bromate and cellulose, will not to be classified as oxidising (H5.1).

Gate 4.4 – Is the waste a flammable liquids (H3)?

Flammable liquids will not be accepted directly for permanent isolation at the proposed Facility. Should a suitable treatment or encapsulation method be identified to treat or manage the wastes such that it is not flammable or liquid under the conditions of storage, it may be possible to accept the waste material for permanent isolation or in cell storage.

The processing of flammable liquid waste materials should be undertaken only if safe to do so, and if appropriate risk management and controls are in place. A suitably qualified person will be required to determine if and when any potentially flammable wastes may be received and disposed at the proposed Facility. Any treatment methodology for the stabilisation of the waste must be controlled and undertaken by suitably qualified persons. Detailed risk assessment will be undertaken to ensure the stabilisation and subsequent storage can be undertaken safely. Any treatment option must also address the state of the waste such that the stabilised waste will be solid in the conditions of storage.

Test methods:

Substances are classified as flammable liquids when their flash point is lower than 60°C in a closed-cup test, or lower than 65.6°C in an open-cup test. It is expected that flash point tests will be

completed for liquids suspected to be flammable as part of the initial characterisation testing via one or more of the following international standards:

- ISO 1516 Determination of flash/no flash – closed cup equilibrium method
- ISO 1523 Determination of flash point – Closed cup equilibrium method
- ISO 2719 Determination of flash point – Pensky-Martens closed cup method
- ISO 13736 Determination of flash point – Abel closed cup method
- ISO 3679 Determination of flash no flash and flash point – Rapid equilibrium closed cup method

Material that is found to be a flammable liquid must undergo treatment to ensure that it is unable to sustain combustion, and is no longer liquid. Test L.2 is designed to test the ability of a liquid to sustain combustion, by exposing a small portion to flame under controlled conditions. The full procedure and apparatus is given in *Recommendations On The Transport Of Dangerous Goods, Manual Of Tests And Criteria*.

Even if the waste is modified so that it passes Test L.2, it will not be accepted at the proposed Facility until Tellus is certain that it meets all other acceptance criteria.

Limit of acceptance:

The waste will be found to be capable of sustaining combustion if the following behavior is observed:

- The test sample ignites and sustains combustion when the test flame is off; or
- The test sample ignites while the test flame is applied for 15 seconds and maintains combustion for a minimum of 15 seconds after the flame has been turned off.

Intermittent flashing of the test sample material should not be interpreted as sustained combustion.

Gate 4.5 – Is the waste a flammable solid (H4.1)?

Highly flammable solid wastes will not normally be accepted directly for permanent isolation at the proposed Facility. Should a suitable treatment or encapsulation method be identified to treat or manage the wastes such that it is not flammable under the conditions of storage, it may be possible to accept the waste material for permanent isolation or underground storage. The processing of flammable waste materials should be undertaken only if safe to do so, and if appropriate risk management and controls are in place. A suitably qualified person will be required to determine if and when any potentially flammable wastes may be received and disposed at the proposed Facility. Any treatment methodology for the stabilisation of the waste must be controlled and undertaken by suitably qualified persons.

Test methods:

Test N.1, taken from the *Recommendations On The Transport Of Dangerous Goods, Manual Of Tests And Criteria* published by the United Nations, assesses the ability of a substance to propagate combustion by igniting it and measuring the burning time.

Limit of acceptance:

Powdered, granular or pasty substances should be classified as Division 4.1 when the time of burning of one or more of the test runs, in accordance with the test method is less than 45 seconds or the rate of burning is more than 2.2 mm/s. Powders of metals or metal alloys should be classified when they can be ignited and the reaction spreads over the whole length of the sample in 10 minutes or less.

Gate 5 – Is the waste potentially self combustible and liable to Auto-Ignition?

Wastes which are self combustible and/or prone to self-ignition **in the conditions of storage** will not be accepted for underground storage or permenant isolation at the proposed Facility. Such wastes may be reactive with soil moisture or incompatible with other waste types received at the facility for permanent isolation. If it can be demonstrated that the waste can be encapsulated or isolated, or transformed chemically and or physically to a form that is no longer combustible or prone to self-ignition, the waste may be able to be accepted for permanent isolation with controls in place.

The processing of self combustible and self-igniting waste materials should be undertaken only if safe to do so, and if appropriate risk management and controls are in place. A suitably qualified person will be required to determine if and when any potentially combustible and self-igniting wastes may be received and disposed at proposed Facility. Any treatment methodology for the stabilisation of the waste must be controlled and undertaken by suitably qualified persons. Detailed risk assessment will be undertaken to ensure the stabilisation and subsequent storage can be undertaken safely.

Test methods:

The *Recommendations On The Transport Of Dangerous Goods, Manual Of Tests And Criteria* outlines test methods to identify two different types of spontaneous combustion properties:

- Pyrophoric: Substances which ignite within five minutes of coming into contact with air. These are the most liable to spontaneous combustion.
- Self-heating: substances which, in contact with air and without an energy supply, are liable to self-heating. These substances will ignite only when in large quantities (kilograms) and after long periods of time (hours, days).

Solid pyrophoric substances are classified based on results from Test N.2. The test involves exposing the material to air for 5 minutes to determine whether the material ignites, and the time taken for ignition to occur.

Self-heating substances are classified based on the results from Test N.4. The test involves exposing samples of the material to air temperatures between 100°C and 140°C and measuring the temperature of the material compared to the air temperature.

Limit of acceptance:

Test N.2: if the material does not ignite within 5 minutes of air contact, the material is not pyrophoric.

Test N.4: a positive result is obtained if the material temperature exceeds that of the oven temperature by 60°C during the testing time. Otherwise it will be negative. The material will not be classified as self-heating if:

- A negative result is obtained in a test using 100mm cube sample at 140°C;
- A positive result is obtained in a test using a 100mm cube sample at 140°C and a negative result is obtained in a test using a 25mm cube sample at 140°C.

Gate 6 – Can the waste generate a gas-air mixture which is toxic or explosive?

Gate 3.1 prevents the acceptance of gases for permanent isolation. Wastes that can generate a gas air mixture that is toxic or explosive will also not be accepted at the proposed Facility for underground storage or permanent isolation. Some wastes which may react with water or other wastes to release gases may be specifically excluded from permanent isolation. Alternatively, they may be managed through encapsulation, or physically and chemically transformed to a form which is no longer capable of releasing the toxic or explosive gases. In such cases, the method of management shall be developed specifically for that waste type, and managed and recorded by the supervising chemist or suitably qualified person. Materials that are not themselves explosive but which have the potential to form or generate an explosive atmosphere of gas or vapour will not be accepted for permanent isolation at the Facility unless they can be treated so that they no longer produce explosive gas which is higher than 10 % of the concentration which corresponds to the lower explosive limit.

Test methods:

The United Nations recommends Test N.5 to assess whether the substance will react with water to produce a flammable gas. A small sample of the material is brought into contact with water under controlled conditions.

A representative 500g sample of the waste will be reacted with concentrated hydrochloric acid (or sodium hydroxide to determine ammonia release from wastes with pH>10) for a period of 1 hour and absorption solutions used to absorb any toxic gases evolved. Appropriate analytical methods will then be used to quantify the gases present which values are then compared with thresholds based on concentrations required to create a toxic atmosphere at the bottom of the cell.

Limit of acceptance:

Based on the results from test N.5, the substance is classified as Class 4.3 if:

- Spontaneous ignition takes place in any step of the test procedure
- There is evolution of flammable gas at a rate greater than 1 Litre per Kilogram of the substance per hour

Suplemenatryl Limit of acceptance:

- Cannot produce explosive gas which is higher than 10 % of the concentration which corresponds to the lower explosive limit.

Gate 7 – Is the waste biodegradable?

Waste that is biodegrade, either by aerobic or anaerobic decomposition, are considered unacceptable for underground storage or permeant isolation. Therefore such wastes are excluded from the facility. The wastes covered by this exclusion include:

- Vegetable matter (including food and garden waste).
- Animal matter (including food, animal parts, excreta, sanitary waste, animal fibre).
- Mixed household, commercial and industrial waste.
- Clinical waste (excluding pharmaceuticals).

Test methods:

Depending on the waste type, the total organic carbon (TOC) will be determined as part of the testing under basic characterisation. It is envisaged that, in general, TOC will be the parameter used as the organic content of any waste is of primary interest. The test method to be used will be based on BS EN 13137:2001 or equivalent.

Limit of acceptance:

If the TOC content of the waste is <6%[9] then it will be deemed acceptable for storage and permanent isolation at Chandler by this criterion. Certain wastes that contain organic carbon, for example railway sleepers impregnated with pesticides or certain hydrocarbon containing wastes, will be treated on a case by case basis to determine a suitable permanent isolation concept that in the conditions of storage will not compromise the integrity of the facility.

[9] the maximum TOC level permitted at a hazardous waste site - EC Waste Acceptance Criteria Section 2.4.2

Gate 8 – Is the waste an infectious hospital or clinical waste (H6.2)?

Hospital waste or other clinical waste arising from medical or veterinary establishments which are infections as defined by property H6.2 in Annex III will not be accepted for permanent isolation at the proposed Facility. Alternative higher order methods of management are generally available for these wastes.

Test methods:

Material source identified. Visual inspection of waste.

Limit of acceptance:

Zero hospital or clinical waste present in the waste load.

Gate 9 – Does the waste have the potential to be infectious to animals or humans (H6.2)?

Substances or wastes containing viable micro-organisms or their toxins which are known or suspected to cause disease in animals or humans will not be accepted for permanent isolation at the proposed Facility. Alternative higher order methods of management are generally available for these wastes.

Test methods:

Material source identified. Visual inspection of waste.

Limit of acceptance:

Zero infectious waste present in the waste load.

Gate 10 – Tyres

Used tyres pose an environmental pollution risk mainly due the potential discharges and emissions from tyre fires. They can also pose a health risk when water ponds in them. In certain circumstances tyres, or the products of tyre reprocessing may be accepted for storage or permanent isolation at the Facility but only if it can be demonstrated that the waste can be encapsulated or isolated, or transformed chemically and or physically to a form that is no longer flammable (see Gate 4.1)

Test methods:

Visual Inspection

Limit of acceptance:

Compliance with all other criteria gates

Gate 11 – Conditions of Storage criteria - can the waste and/or its container, release liquid, or react with the host salt in the facility which could affect either the operational and/or post closure safety of the facility?

Gate 11.1 – Can the waste release free liquid in the conditions of storage?

Wastes that possess the ability to release liquid, *self-transport* or move in the conditions of storage will be excluded from the Facility. Typical examples include hygroscopic materials, which have the ability to absorb water from the air, and wastes that may separate into two phases, i.e. solid phase and liquid phase.

Test methods:

A pressure test will be used to determine if a waste will separate into two phases, with the pressure used being in excess of the maximum loading a waste could experience in underground storage conditions prior to room closure (e.g. the pressure experienced by a bulk bag at the bottom of a stack prior to room closure). A further test will be carried out on wastes that pass the pressure test, but are considered to have the potential to separate into two phases. This would include wastes that have the potential to retain liquid in interstitial spaces, such as sand/water mixture and ion exchange resins. This test does not apply to watstes which are placed by the hydraulic backfill method as any liquid phase incorporated in the backfill will have been selected on the basis of not being detrimental to the host salt environment.

A representative sample of the waste will be thoroughly mixed and subjected to a differential pressure equivalent to the pressure on the bottom bag of a stack for 15 minutes. This will be done by either applying pressure to the material on a filter or applying suction to the filter holding the material. Any displaced liquid will be measured as a volume and reported as a percentage of the whole.

A representative sample of the waste will be thoroughly mixed and be stood on a glass sinter for a period of 24 hours. If a liquid phase separates, the liquid will be measured as a volume and reported as a percentage of the whole.

Limit of acceptance:

The waste will fail the test and be deemed unsuitable for the facility if greater than 1% w/w of liquid is released.

Gate 11.2 – Does the waste possess the potential for an adverse reaction with the host rock salt?

Wastes may have the potential to react with the host salt. If basic characterisation indicates the presence of any substance that is known to have the potential to react adversely with rock salt, the

waste will be tested to determine if there is any reaction that may adversely affect the integrity of the salt barrier. Wastes exhibiting these properties that cannot be suitably modified or contained will be excluded.

Test methods:

A representative sample of the waste will be mixed with salt from the Chandler mine and left to stand for a period of 24 hours in a sealed container. The pressure and temperature within the container will be monitored to determine if a reaction has occurred.

Limit of acceptance:

Changes in pressure compared to ambient conditions indicates a reaction involving gas formation is occurring, while changes in temperature compared to ambient conditions indicates exothermic or endothermic reaction is occurring, even if no gas is generated. Any wastes which is found to react with salt will not be accepted for permanent isolation without stabilization treatment to make it unreactive.

Gate 11.3 – Does the waste have the potential to yield another hazardous substance (H13)?

Some wastes may change with time and produce intermediate products with differing properties to the initial disposed product. Wastes may also react with the containers to produce products with undesirable properties in the conditions of storage. Substances or wastes which, by interaction with air, water or other wastes that are liable to yield other hazardous substances in dangerous quantities need to be identified. Any waste which has the potential to yield other hazardous substances will not be accepted at the proposed Facility. Wastes exhibiting or expected to exhibit these properties that *cannot* be suitably modified or contained will be excluded.

Test methods:

To be determined on a case by case basis by competent person.

Limit of acceptance:

To be determined depending on waste streams considered.

Gate 12 – Is the waste radioactive?

Gate 12.1 – Generic waste acceptance criteria for radioactive waste

The following is a list of generic *waste acceptance criteria* for radioactive waste that will be accepted at the proposed Facility. For waste to be acceptable for permanent isolation, the following physical and chemical characteristics shall apply to all categories of waste. These requirements are specified to minimise the potential hazard to personnel at the site, and to facilitate safe handling during

operations. The intention is to ensure the long-term stability of the waste and reduce the potential for dispersal of radionuclides from the site.

- Waste shall not contain corrosive materials; waste containing inorganic acids, alkalis and corrosive salts shall be treated to neutralise them and thereby to nullify the chemical effect of these materials.

- Where practicable, flammable or combustible materials, such as paper, plastics, cloth or resins, shall be separated from non-flammable solids and packaged, contained and labelled in a proper manner.

- Waste shall not contain or be capable of generating gaseous materials in quantities which might lead to the release of harmful vapours or fumes, or compromise the integrity of the facility.

- Waste shall not contain material which will readily detonate upon impact, decompose explosively, react violently with water or undergo vigorous exothermic reaction at normal temperatures and pressures.

- Waste containing pyrophoric material shall be treated, conditioned or packaged to render it non-flammable.

- Liquid waste shall be solidified to be acceptable for permanent isolation. The final package for permanent isolation shall comply with the stability requirements for the particular category of waste.

- As far as practicable, waste materials being disposed of should be free of biological materials.

- Radioactive waste contaminated with toxic, pathogenic or infectious material shall be treated or conditioned to minimise both the potential hazard to site personnel and the long-term health risks to members of the public. Any treatment should be carried out in accordance with relevant NHMRC guidelines such as National guidelines for the management of clinical and related wastes (Australian Government Publishing Service, Canberra, 1988) and Guidelines for laboratory personnel working with carcinogenic or highly toxic chemicals (Australian Government Publishing Service, Canberra, 1990).

- Waste which contains chelating agents shall be treated or conditioned to reduce the possible long-term effects of leaching by water, although water in the Chandler facility is not expected.

Gate 12.2 – Radiological acceptance criteria

Tellus intends to only accept radioactive wastes up to exemption level as defined in Section 3.2 of RPS 6[10]. The general criteria for granting an exemption are:

(a) the health risks and the risks to the environment associated with the source, practice, or type of person using a source are sufficiently low as to be of no regulatory concern; and

(b) radiation protection, including the cost of regulatory control, has been optimised.

The criteria to exempt radioactive material or practices from notification, registration and licensing are:

(a) the radioactive material has an activity concentration less than that prescribed in Schedule 4 of RPS 6 or consists of or contains less than the activity prescribed in Schedule 4 of RPS 6, or

(b) the radioactive material has an activity concentration greater than that prescribed in Schedule 4 of RPS 6 and consists of or contains greater than the activity prescribed in Schedule 4, but causes an annual effective dose to an individual member of the public of less than 10 μSv, and a collective effective dose to the critical group committed by one year of performance of the practice, as determined by the Authority, of less than 1 person.Sv, or

(c) in the case of a mixture of radioactive materials, where each of the radioactive materials present does not exceed the individual activity or activity concentration, the mixture is defined as exempt if the sum of the fractions obtained by dividing the activity of each material present by the appropriate activity value from Schedule 4 of RPS 6, or the sum of the fractions obtained by dividing the activity concentration of each material present by the appropriate activity concentration value from Schedule 4 of RPS 6, does not exceed 1.

(d) in the special case of exposure to naturally-occurring radon-222 in the workplace, the long-term average concentration of radon-222 is less than 1000 Bq/m3.

The Exempt activity concentrations and exempt activities of radionuclides are presented in Appendix 3. This table is taken from the IAEA's International Basic Safety Standards for Protection Against Ionizing Radiation and for the Safety of Radiation Sources, Safety Series 115 [IAEA 1996], and is supplemented from NRPB Report R306, Exempt Concentrations and Quantities for Radionuclides not Included in the European Basic Safety Standards Directive [NRPB 1999].

[10] National Directory for Radiation Protection - Radiation Protection Series Publication No. 6

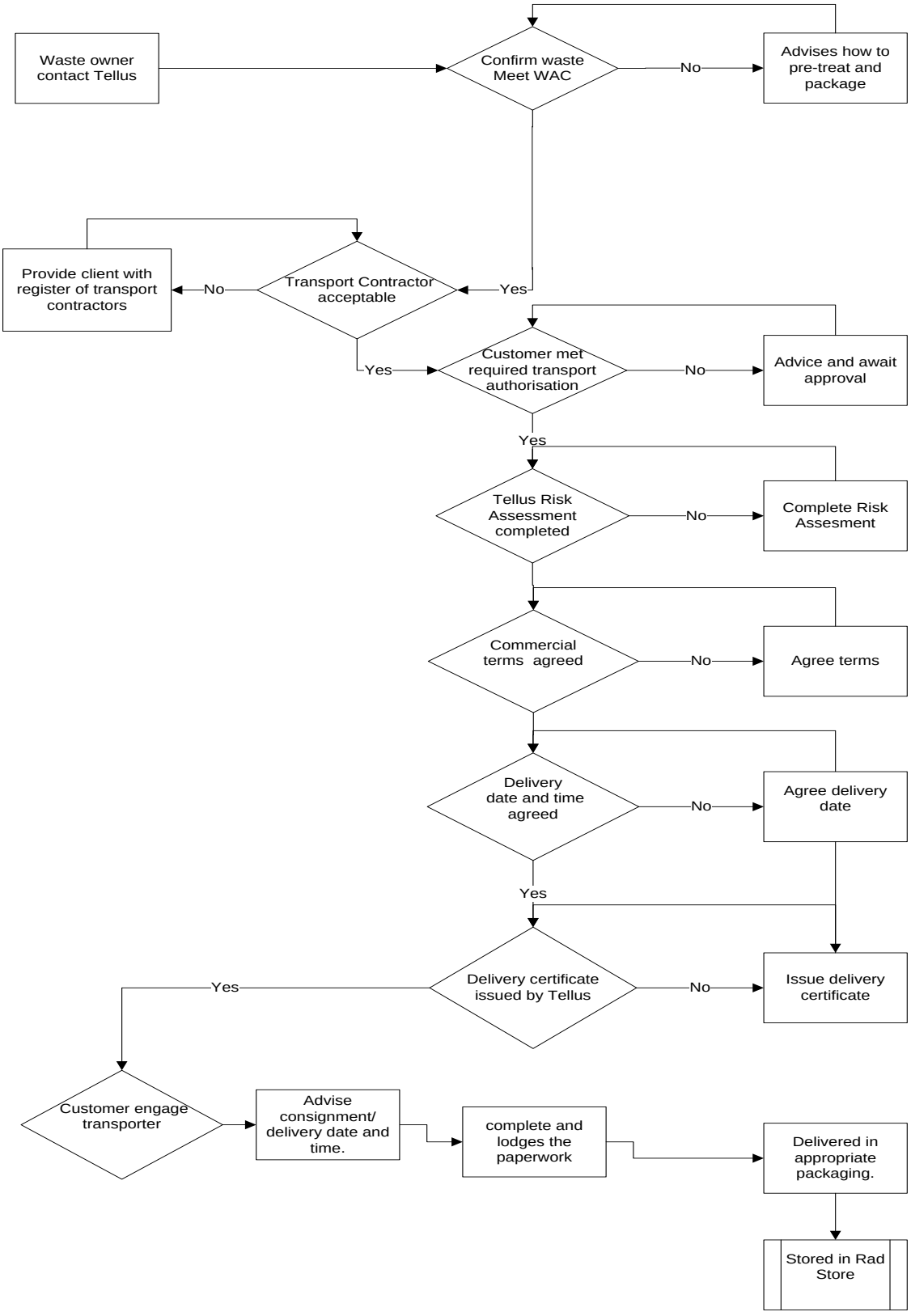
Tellus will develop in the next pahse of its work a NORM Management Plan (NMP), that consists of a Radiation Management Plan (RMP) and Radioactive Waste Management Plan (RWMP), and other project specific management arrangements as agreed with the Authority.

The NORM management plan will include:

- a description of operation/process including a description of where in the process doses may arise;
- a demonstration of compliance with relevant radiation protection standards;
- the relevant elements of a radiation management plan;
- the relevant elements of a radioactive waste management plan;

Before a radioactive waste can be accepted, Tellus must be satisfied that the waste meets its WAC (refer to WAC). The WAP for radioactive waste is summarised in Figure 4-3 below.

Figure 4-3: Radioactive waste acceptance procedure



Gate 13 – Does the waste meet the packaging criteria?

The Australian Code for the Transport of Dangerous Goods by Road and Rail (2016) details the requirements for safe packaging and transport of hazardous materials, based on the classification of the waste. Tellus requires that all customers adhere to the code to ensure packaging is appropriate to the hazardous characteristics of the waste in question. Containment systems should normally consist of one or more of the following packaging options;

- 20' ISO shipping containers or 20' ISO tank containers
- Bulk bags in containers, on pallets or free standing
- 215 Litre drums on pallets in containers
- $1m^3$ IBCs in containers
- Small palletised goods in containers (e.g. radioactive materials)
- Loose bulk in containers (e.g. contaminated soils)
- Liquid tanker truck (e.g. bulk liquids or pastes) which will undergo solidification or stabilization treatments
- Pneumatic tanker truck (e.g. bulk dry powder solids)
- Solid materials on flatbed trucks (e.g. railway sleepers, O&G pipe, machinery).

Waste packaging delivered to the proposed Facility must fulfil the following criteria:

- Not have a total measured weight of more than the Safe Working Load.
- Be capable of being disposed of with the waste.
- Be filled so as to contain no significant voids.
- Be free of ruptures and external contamination at the point of delivery.
- Not significantly deteriorate during the duration of storage, transport and handling when in contact with the waste.
- Remain intact during normal transport and handling procedures.
- Be strong enough to be walked on if required.
- Be clearly labelled with the waste owner's name and identification number and material description/name on opposite sides of the waste package.
- Allow no leakage during normal transport and handling operations.
- Be capable of containing all the waste whatever the orientation of the package.

5 REJECTED WASTES

Wastes that do not meet the acceptance criteria may need to be rejected. This should not occur frequently due to the first two Levels, basic characterisation and compliance testing that will take place. Level 3 on-site verification may occasionally identify wastes that need to be rejected or some wastes may fail waste packaging criteria tests.

- **Level 1: Basic characterisation**. This is a thorough determination, according to standardised analysis and behaviour-testing methods, of the characteristic properties of the waste. This is the key decision step in determining whether a waste can or cannot be accepted. This stage takes place at the waste supplier site and only if the waste passes all of the WAC gates can Tellus agree to accept the waste at the Chandler Facility.

- **Level 2: Compliance testing**. After a waste stream has been accepted as meeting the Chandler WAC Level 2 compliance testing is then periodically performed on regularly arising wastes by simpler standardised analysis and behaviour-testing methods to determine whether a waste complies with licence conditions and whether a waste with known properties has changed significantly. The tests focus on key variables and behaviour identified by basic characterisation.

- **Level 3: On-site verification**. This constitutes rapid check methods to confirm that a waste is the same as that which has been subjected to compliance testing and that which is described in the accompanying documents.

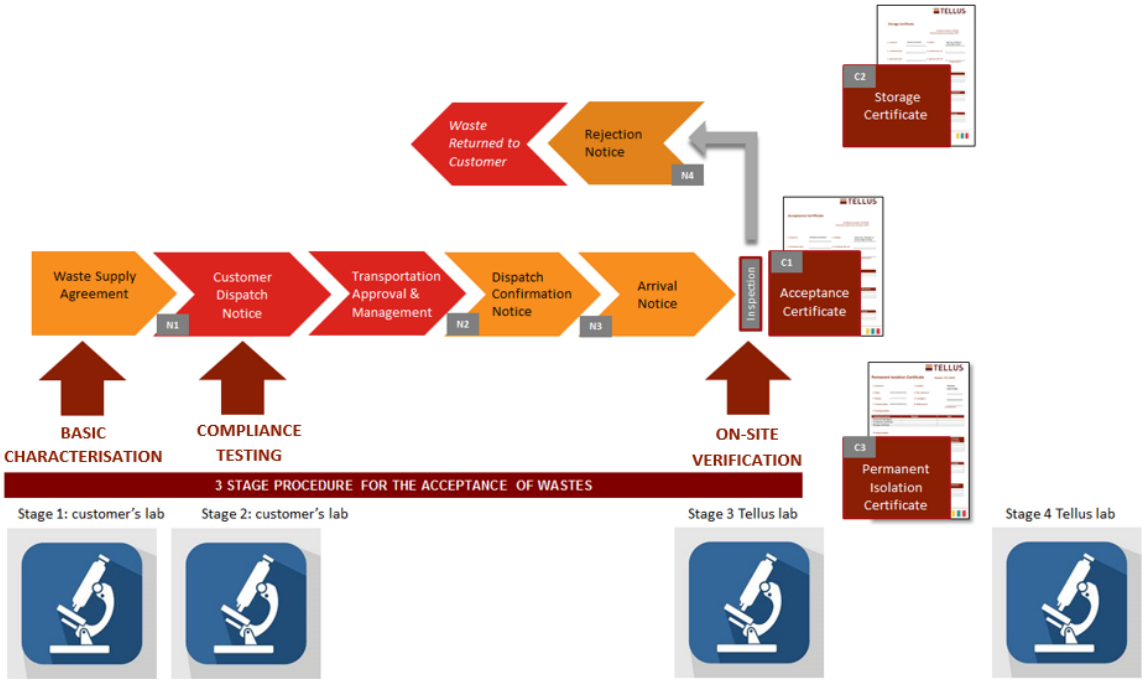
In the event that waste that cannot be accepted arrives at the site it will be placed into a specifically identified quarantine area until arrangements can be made to modify it into a waste form suitable for storage and disposal or to safely return it to the customer.

6 NOTIFICATION AND CERTIFICATION

6.1 Traceability, Approval System and Documents

At all of its facilities, Tellus will adopt a rigid Quality Assurance, Traceability, Notification and Certification System. This process is summarised in Figure 6-1 and is designed to complement tracking systems required by other legislation such as the *Australian Code for the Transport of Dangerous Goods by Road and Rail* and the *National Environmental Protection (movement of controlled wastes between States and Territories) Measure.*

Figure 6-1: Tellus' traceability process



6.2 Notification Service

Tellus will implement a notification service for management of the waste that is delivered to Chandler. This will include;

- N1 - Dispatch Notice issued by Customer
- N2 - Dispatch Confirmation issued by Tellus
- N3 - Arrival Notice issued by Tellus
- N4 - Rejection Notice issued by Tellus if necessary

6.2.1 N1 - Dispatch notice issued by Customer

Prior to dispatching waste to the Facility, the Customer must issue a Dispatch Notice to Tellus. The Dispatch Notices must be issued so that deliveries are in accordance with the Waste Delivery Plan. The Dispatch Notice will include information on the waste code, description, weight, volume, MSDS, proposed date of delivery and Transport Plan. It is anticipated that following the issue of a Dispatch Notice the Customer will secure all required approvals for transportation (e.g. NEPM approvals for movement of controlled substances and Dangerous Goods), arranging packing and accredited transporters.

6.2.2 N2 - Dispatch confirmation notice issued by Tellus

Tellus will issue a Dispatch Confirmation Notice to the Customer, either confirming that the dispatch may proceed; or may not proceed, including reasons (example: resources or space temporarily not available). This will normally be issued within 5 Business Days of Tellus receiving evidence from the Customer of all required approvals for transportation. Tellus is not required to accept waste at the Facility unless Tellus has issued a Dispatch Confirmation Notice.

6.2.3 N3 - Arrival notice issued by Tellus

All deliveries of waste must be booked in at least 48 hours prior to the arrival of the delivery. This is to ensure that sufficient segregated storage is available for any particular waste stream. Un-booked deliveries may be subject to delays in unloading and/or may incur additional charges. Tellus will issue an Arrival Notice to the customer confirming arrival of the delivery at the Nominated Facility (provided that Tellus has issued a Dispatch Confirmation Notice in relation to that delivery). The Arrival Notice will be generated at the weighbridge (in real time).

6.2.4 Inspection point

Following the issue of an Arrival Notice, at the Chandler Delivery Point, the waste will be subjected to weighing, visual inspection of containers, and sampling. On-site laboratory testing (Level 3, On-site verification checks) will be performed by qualified persons to analyse the waste streams to determine if the waste acceptance criteria are satisfied and to ensure compliance with any site licence Conditions of Acceptance. If the waste is accepted, this is the point of risk transfer and an **Acceptance Certificate** is issued. If the waste is rejected, there is no transfer of risk, and a **Rejection Notice** is issued. A representative sample will be taken from each delivery batch and waste type. Details of third party analysis and a Material Safety Data Sheet will assist in the correct identification.

The Conditions of Acceptance for the Nominated Facility will specify that the Customer must provide:

- Prior to unloading, documentation supporting that Waste was transported in accordance with all required Approvals;
- the weight card, which provides evidence of the gross weight of the delivery to be used as the basis for billing;

- documentation of Waste volume, and waste codes; and
- acceptable packaging;

The waste must not comprise any unlawful material. The delivery must be consistent with the Dispatch Notice from the Customer

6.2.5 N4 Rejection Notice N4 - Rejection Notice issued by Tellus (if necessary)

If an Acceptance Certificate is not issued, the Customer will be issued a Rejection Notice and will remain responsible for the delivery; and the rejected delivery will be managed in accordance with the Rejection Procedure. The Procedure will provide that, amongst other things, Tellus may procure the return of the delivery to the address in the Dispatch Notice (at the cost and risk of the Customer).

Tellus may (in its sole discretion) elect, by notice in writing, to accept the delivery in which case Tellus may treat and or repackage the waste at the cost of the Customer. If Tellus makes this election, the waste will be deemed to be Acceptable Waste and an Acceptance Certificate will be issued.

6.3 Documents - Certification Service

Tellus will implement a certification process post inspection for Acceptable Waste that is delivered to the delivery point within the proposed Facility. This will include;

- C1 - Acceptance Certificate.
- C2 - Storage Certificate.
- C3 - Permanent Isolation Certificate.

C1 - Acceptance certification (AC)

Assuming that the delivery of waste is compliant with the Conditions of Acceptance for the Nominated Facility and has been taken to have been accepted at the Nominated Facility by both the Inspection Manager and the Facility Manager then an Acceptance Certificate is issued

C2 - Storage certificate (SC)

Tellus must place Acceptable Waste in a Storage Location and issue a Storage Certificate to the Customer. This certificate will be issued within twenty business days of placement in the Storage Location

C3 - Permanent isolation certificate (PIC)

Tellus will isolate Acceptable Waste, and issue a PIC once that waste is in its final destination (underground room or cell in the geological repository part of the Nominated Facility). This certificate will be issued within twenty business days of placement in the final destination (refer to Annexure).

6.4 Title and management risk

Title to the waste and management risk of the waste varies depending on whether the waste is rejected, placed into storage or permanently isolated. This is summarised below;

Rejected waste:

Title and mangement risk remains with Customer and accordingly, neither title nor risk pass to Tellus at any time.

Storage service:

Title in the waste remains at all times with the Customer (whether short or long term storage) and the ***management risk*** in the waste passes to Tellus on issue of the Acceptance Certificate, for so long as the Waste continues to comply with the Conditions of Acceptance. Risk passes back to Customer at the end of the Storage Term.

Permanent isolation service:

Title and ***management risk*** in the waste passes to Tellus on the issue of an Acceptance Certificate.

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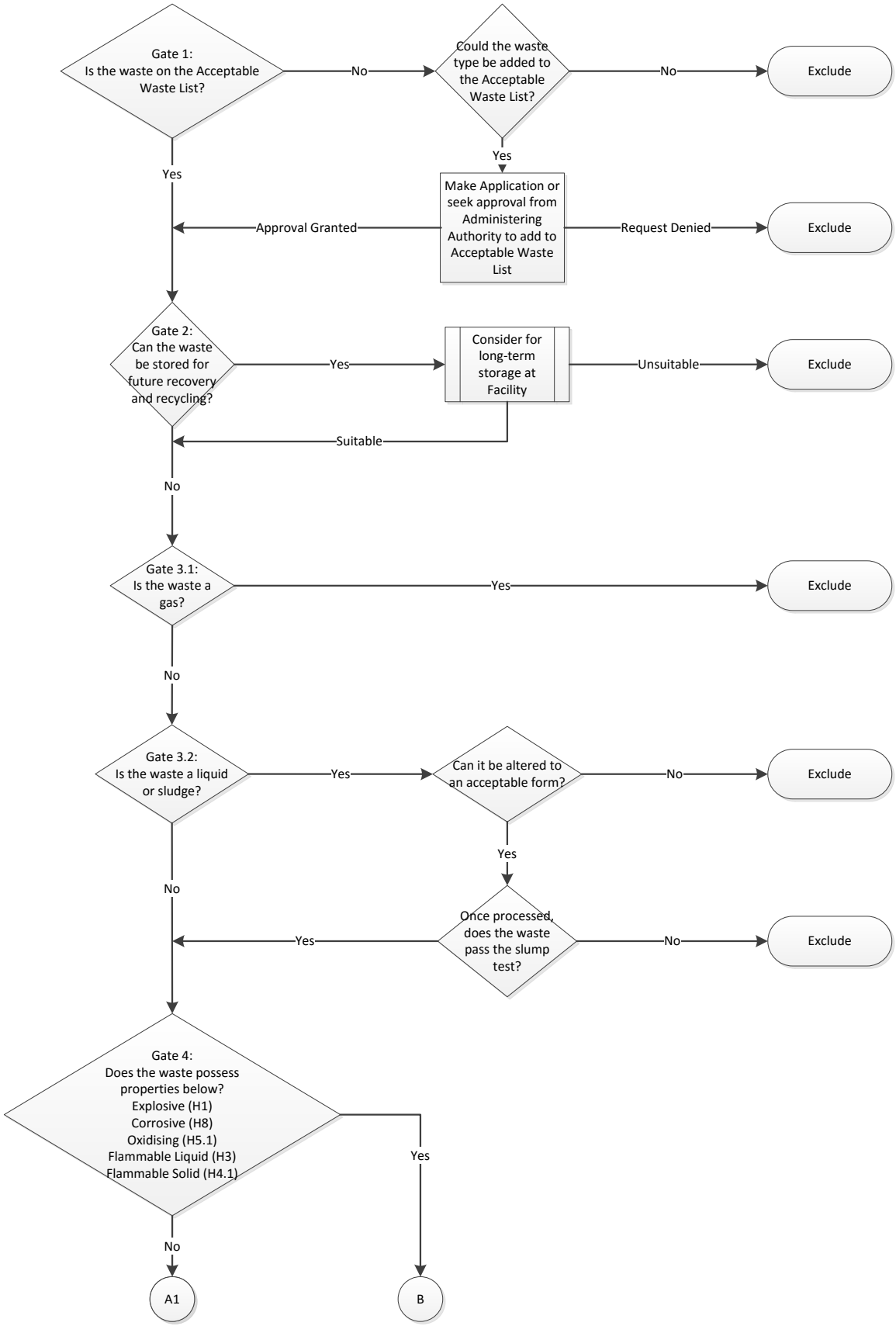
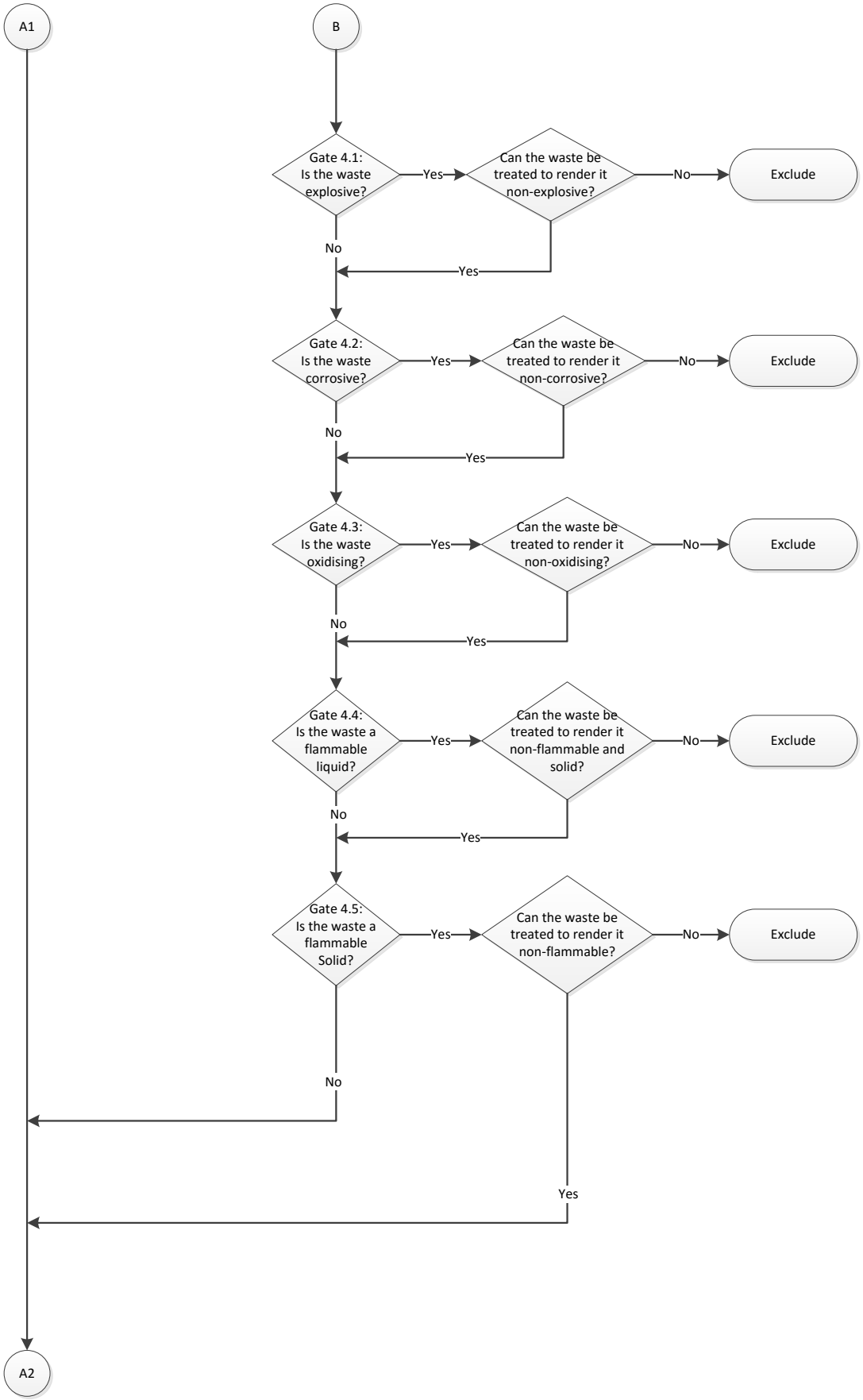
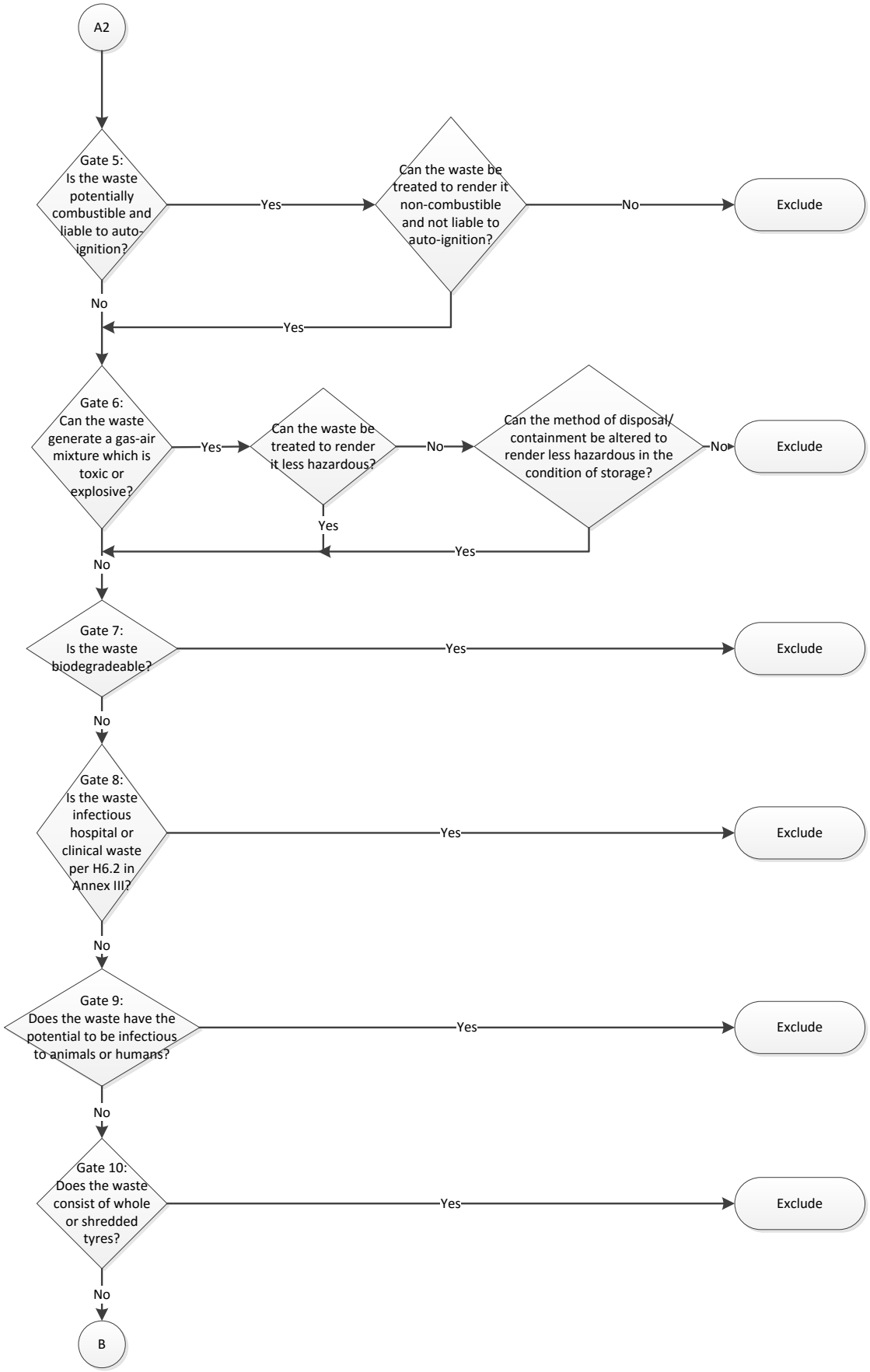
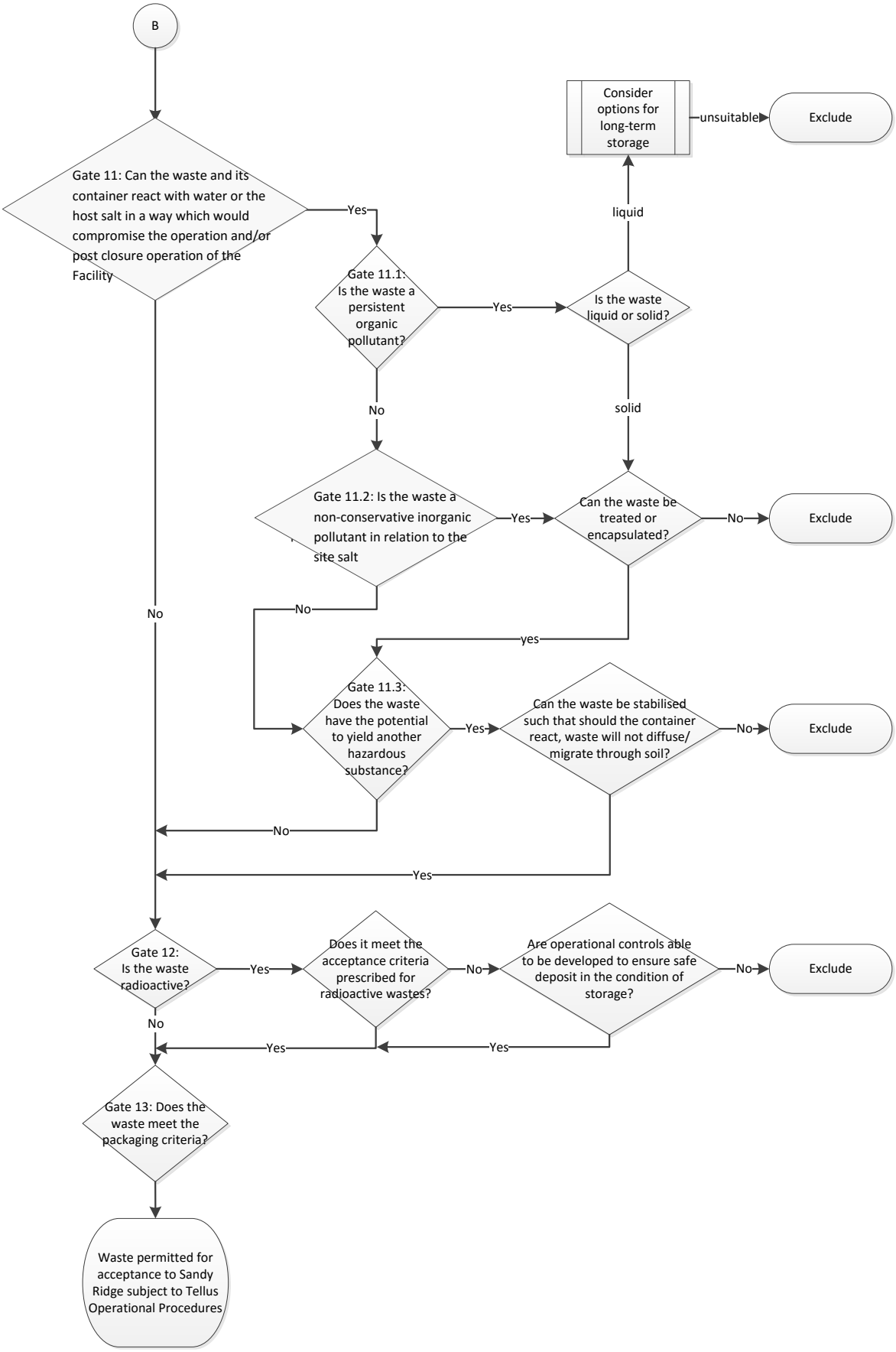
A.1 Gated Waste Acceptance Process Flow Chart




A1
B
Gate 4.1: Is the waste explosive?
Yes
Can the waste be treated to render it non-explosive?
No
Exclude
No
Yes
Gate 4.2: Is the waste corrosive?
Yes
Can the waste be treated to render it non-corrosive?
No
Exclude
No
Yes
Gate 4.3: Is the waste oxidising?
Yes
Can the waste be treated to render it non-oxidising?
No
Exclude
No
Yes
Gate 4.4: Is the waste a flammable liquid?
Yes
Can the waste be treated to render it non-flammable and solid?
No
Exclude
No
Yes
Gate 4.5: Is the waste a flammable Solid?
Yes
Can the waste be treated to render it non-flammable?
No
Exclude
No
Yes
A2


A2
Gate 5: Is the waste potentially combustible and liable to auto-ignition?
Yes
Can the waste be treated to render it non-combustible and not liable to auto-ignition?
No
Exclude
No
Yes
Gate 6: Can the waste generate a gas-air mixture which is toxic or explosive?
Yes
Can the waste be treated to render it less hazardous?
No
Can the method of disposal/ containment be altered to render less hazardous in the condition of storage?
No
Exclude
Yes
Yes
No
Gate 7: Is the waste biodegradeable?
Yes
Exclude
No
Gate 8: Is the waste infectious hospital or clinical waste per H6.2 in Annex III?
Yes
Exclude
No
Gate 9: Does the waste have the potential to be infectious to animals or humans?
Yes
Exclude
No
Gate 10: Does the waste consist of whole or shredded tyres?
Yes
Exclude
No
B


B
Gate 11: Can the waste and its container react with water or the host salt in a way which would compromise the operation and/or post closure operation of the Facility
Yes
No
Gate 11.1: Is the waste a persistent organic pollutant?
Yes
No
Is the waste liquid or solid?
liquid
solid
Consider options for long-term storage
unsuitable
Exclude
Gate 11.2: Is the waste a non-conservative inorganic pollutant in relation to the site salt
Yes
No
Can the waste be treated or encapsulated?
No
Exclude
yes
No
Gate 11.3: Does the waste have the potential to yield another hazardous substance?
Yes
No
Can the waste be stabilised such that should the container react, waste will not diffuse/ migrate through soil?
No
Exclude
No
Yes
Gate 12: Is the waste radioactive?
Yes
No
Does it meet the acceptance criteria prescribed for radioactive wastes?
No
Are operational controls able to be developed to ensure safe deposit in the condition of storage?
No
Exclude
Yes
Yes
Gate 13: Does the waste meet the packaging criteria?
Waste permitted for acceptance to Sandy Ridge subject to Tellus Operational Procedures

A.2 Basel Convention Annex III: List Of Hazardous Characteristics

UN Class	Code	Characteristics
1	H1	Explosive An explosive substance or waste is a solid or liquid substance or waste (or mixture of substances or wastes) which is in itself capable by chemical reaction of producing gas at such a temperature and pressure and at such a speed as to cause damage to the surroundings.
3	H3	Flammable Liquids The word "flammable" has the same meaning as "inflammable". Flammable liquids are liquids, or mixtures of liquids, or liquids containing solids in solution or suspension (for example, paints, varnishes, lacquers, etc., but not including substances or wastes otherwise classified on account of their dangerous characteristics) which give off a flammable vapour at temperatures of not more than 60.5ºC, closed-cup test, or not more than 65.6ºC, open-cup test. (Since the results of open-cup tests and of closed-cup tests are not strictly comparable and even individual results by the same test are often variable, regulations varying from the above figures to make allowance for such differences would be within the spirit of this definition.)
4.1	H4.1	Flammable Solids Solids, or waste solids, other than those classed as explosives, which under conditions encountered in transport are readily combustible, or may cause or contribute to fire through friction
4.2	H4.2	Substances or wastes liable to spontaneous combustion Substances or wastes which are liable to spontaneous heating under normal conditions encountered in transport, or to heating up on contact with air, and being then liable to catch fire
4.3	H4.3	Substances or wastes which, in contact with water, emit flammable gases Substances or wastes which, by interaction with water, are liable to become spontaneously flammable or to give off flammable gases in dangerous quantities
5.1	H5.1	Oxidising Substances or wastes which, while in themselves not necessarily combustible, may, generally by yielding oxygen, cause or contribute to, the combustion of other materials.
5.2	H5.2	Organic Peroxides Organic substances or wastes which contain the bivalent-o-o-structure are thermally unstable substances which may undergo exothermic self-accelerating decomposition.
6.1	H6.1	Poisonous (Acute) Substances or wastes liable either to cause death or serious injury or to harm human health if swallowed or inhaled or by skin contact
6.2	H6.2	Infectious Substances Substances or wastes containing viable microorganisms or their toxins which are known or suspected to cause disease in animals or humans

8	H8	Corrosives Substances or wastes which, by chemical action, will cause severe damage when in contact with living tissue, or, in the case of leakage, will materially damage, or even destroy, other goods or the means of transport; they may also cause other hazards
9	H10	Liberation of toxic gases in contact with air or water Substances or wastes which, by interaction with air or water, are liable to give off toxic gases in dangerous quantities
9	H11	Toxic (Delayed or chronic) Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity
9	H12	Ecotoxic Substances or wastes which, if released, present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems
9	H13	Capable, by any means, after disposal, of yielding another material, e.g. leachate, which possess any of the characteristics listed above

A.3 Potential Waste Category List

Common industrial hazardous waste (NEPM basis)	
Acidic solutions or acids in solid form	B100
Animal effluent and residues (abattoir effluent, poultry and fish processing wastes)	K100
Antimony; antimony compounds	D170
Arsenic; arsenic compounds	D130
Asbestos	N220
Barium compounds (excluding barium sulphate)	D290
Basic solutions or bases in solid form	C100
Beryllium; beryllium compounds	D160
Boron compounds	D310
Cadmium; cadmium compounds	D150
Ceramic-based fibres with physio-chemical characteristics similar to those of asbestos	N230
Chlorates	D350
Chromium compounds (hexavalent and trivalent)	D140
Clinical and related wastes	R100
Cobalt compounds	D200
Containers and drums that are contaminated with residues of substances referred to in this list	N100
Copper compounds	D190
Cyanides (inorganic)	A130
Cyanides (organic)	M210
Encapsulated, chemically-fixed, solidified or polymerised wastes referred to in this list	N160
Ethers	G100
Filter cake contaminated with residues of substances referred to in this list	N190
Fire debris and fire wash waters	N140
Fly ash, excluding fly ash generated from Australian coal fired power stations	N150
Grease trap waste	K110
Halogenated organic solvents	G150
Highly odorous organic chemicals (including mercaptans and acrylates)	M260
Inorganic fluorine compounds excluding calcium fluoride	D110
Inorganic sulfides	D330
Isocyanate compounds	M220
Lead; lead compounds	D220
Mercury; mercury compounds	D120
Metal carbonyls	D100
Nickel compounds	D210
Non-toxic salts	D300
Organic phosphorous compounds	H110
Organic solvents excluding halogenated solvents	G110
Organo halogen compounds—other than substances referred to in this Table.	M160
Perchlorates	D340

Common industrial hazardous waste (NEPM basis)	
Phenols, phenol compounds including chlorophenols	M150
Phosphorus compounds excluding mineral phosphates	D360
Polychlorinated dibenzo-furan (any congener)	M170
Polychlorinated dibenzo-p-dioxin (any congener)	M180
Residues from industrial waste treatment/disposal operations	N205
Selenium; selenium compounds	D240
Soils contaminated with a controlled waste	N120
Surface active agents (surfactants), containing principally organic constituents and which may contain metals and inorganic materials	M250
Tannery wastes (including leather dust, ash, sludge's and flours)	K140
Tellurium; tellurium compounds	D250
Thallium; thallium compounds	D180
Triethylamine catalysts for setting foundry sands	M230
Tyres	T140
Vanadium compounds	D270
Waste chemical substances arising from research and development or teaching activities, including those which are not identified and/or are new and whose effects on human health and/or the environment are not known	T100
Waste containing peroxides other than hydrogen peroxide	E100
Waste from heat treatment and tempering operations containing cyanides	A110
Waste from manufacture, formulation and use of wood-preserving chemicals	H170
Waste from the production and preparation of pharmaceutical products	R140
Waste from the production, formulation and use of biocides and phytopharmaceuticals	H100
Waste from the production, formulation and use of inks, dyes, pigments, paints, lacquers and varnish	F100
Waste from the production, formulation and use of organic solvents	G160
Waste from the production, formulation and use of photographic chemicals and processing materials	T120
Waste from the production, formulation and use of resins, latex, plasticisers, glues and adhesives	F110
Waste mineral oils unfit for their original intended use	J100
Waste of an explosive nature not subject to other legislation	T200
Waste oil/water, hydrocarbons/water mixtures or emulsions	J120
Waste pharmaceuticals, drugs and medicines	R120
Waste resulting from surface treatment of metals and plastics	A100
Waste substances and articles containing or contaminated with polychlorinated biphenyls, polychlorinated napthalenes, polychlorinated terphenyls and/or polybrominated biphenyls	M100
Waste tarry residues arising from refining, distillation, and any pyrolytic treatment	J160
Wool scouring wastes	K190
Zinc compounds	D230

A.4 Exempt activity concentrations and exempt activities of radionuclides

Nuclide	Activity concentration (Bq/g)	Activity (Bq)
H-3 (tritiated compounds, including OBT)	1×10^{6}	1×10^{9}
H-3 (elemental)	1×10^{6}	1×10^{9}
Be-7	1×10^{3}	1×10^{7}
C-11	1×10^{1}	1×10^{6}
C-14	1×10^{4}	1×10^{7}
N-13	1×10^{2}	1×10^{9}
0-15	1×10^{2}	1×10^{9}
F-18	1×10^{1}	1×10^{6}
Na-22	1×10^{1}	1×10^{6}
Na-24	1×10^{1}	1×10^{5}
Mg-28	1×10^{1}	1×10^{5}
Si-31	1×10^{3}	1×10^{6}
P-32	1×10^{3}	1×10^{5}
P-33	1×10^{5}	1×10^{8}
S-35	1×10^{5}	1×10^{8}
Cl-36	1×10^{4}	1×10^{6}
Cl-38	1×10^{1}	1×10^{5}
Ar-37	1×10^{6}	1×10^{8}
Ar-41	1×10^{2}	1×10^{9}
K-40	1×10^{2}	1×10^{6}
K-42	1×10^{2}	1×10^{6}
K-43	1×10^{1}	1×10^{6}
Ca-45	1×10^{4}	1×10^{7}
Ca-47	1×10^{1}	1×10^{6}
Sc-46	1×10^{1}	1×10^{6}
Sc-47	1×10^{2}	1×10^{6}
Sc-48	1×10^{1}	1×10^{5}
V-48	1×10^{1}	1×10^{5}
Cr-51	1×10^{3}	1×10^{7}
Mn-51	1×10^{1}	1×10^{5}
Mn-52	1×10^{1}	1×10^{5}
Mn-52m	1×10^{1}	1×10^{5}
Mn-53	1×10^{4}	1×10^{9}
Mn-54	1×10^{1}	1×10^{6}
Mn-56	1×10^{1}	1×10^{5}
Fe-52	1×10^{1}	1×10^{6}
Fe-55	1×10^{4}	1×10^{6}
Fe-59	1×10^{1}	1×10^{6}
Co-55	1×10^{1}	1×10^{6}
Co-56	1×10^{1}	1×10^{5}
Co-57	1×10^{2}	1×10^{6}
Co-58	1×10^{1}	1×10^{6}
Co-58m	1×10^{4}	1×10^{7}
Co-60	1×10^{1}	1×10^{5}
Co-60m	1×10^{3}	1×10^{6}
Co-61	1×10^{2}	1×10^{6}
Co-62m	1×10^{1}	1×10^{5}
Ni-59	1×10^{4}	1×10^{8}
Ni-63	1×10^{5}	1×10^{8}
Ni-65	1×10^{1}	1×10^{6}
Cu-64	1×10^{2}	1×10^{6}
Cu-67	1×10^{2}	1×10^{6}
Zn-65	1×10^{1}	1×10^{6}

Nuclide	Activity concentration (Bq/g)	Activity (Bq)
Zn-69	1×10^{4}	1×10^{6}
Zn-69m	1×10^{2}	1×10^{6}
Ga-67	1×10^{2}	1×10^{6}
Ga-72	1×10^{1}	1×10^{5}
Ge-68	1×10^{1}	1×10^{5}
Ge-71	1×10^{4}	1×10^{8}
As-73	1×10^{3}	1×10^{7}
As-74	1×10^{1}	1×10^{6}
As-76	1×10^{2}	1×10^{5}
As-77	1×10^{3}	1×10^{6}
Se-73	1×10^{1}	1×10^{6}
Se-75	1×10^{2}	1×10^{6}
Br-75	1×10^{1}	1×10^{6}
Br-76	1×10^{1}	1×10^{5}
Br-82	1×10^{1}	1×10^{6}
Kr-74	1×10^{2}	1×10^{9}
Kr-76	1×10^{2}	1×10^{9}
Kr-77	1×10^{2}	1×10^{9}
Kr-79	1×10^{3}	1×10^{5}
Kr-81	1×10^{4}	1×10^{7}
Kr-83m	1×10^{5}	1×10^{12}
Kr-85	1×10^{5}	1×10^{4}
Kr-85m	1×10^{3}	1×10^{10}
Kr-87	1×10^{2}	1×10^{9}
Kr-88	1×10^{2}	1×10^{9}
Rb-81	1×10^{1}	1×10^{6}
Rb-86	1×10^{2}	1×10^{5}
Sr-85	1×10^{2}	1×10^{6}
Sr-85m	1×10^{2}	1×10^{7}
Sr-87m	1×10^{2}	1×10^{6}
Sr-89	1×10^{3}	1×10^{6}
Sr-90[a]	1×10^{2}	1×10^{4}
Sr-91	1×10^{1}	1×10^{5}
Sr-92	1×10^{1}	1×10^{6}
Y-88	1×10^{1}	1×10^{6}
Y-90	1×10^{3}	1×10^{5}
Y-91	1×10^{3}	1×10^{6}
Y-91m	1×10^{2}	1×10^{6}
Y-92	1×10^{2}	1×10^{5}
Y-93	1×10^{2}	1×10^{5}
Zr-93[a]	1×10^{3}	1×10^{7}
Zr-95	1×10^{1}	1×10^{6}
Zr-97[a]	1×10^{1}	1×10^{5}
Nb-93m	1×10^{4}	1×10^{7}
Nb-94	1×10^{1}	1×10^{6}
Nb-95	1×10^{1}	1×10^{6}
Nb-97	1×10^{1}	1×10^{6}
Nb-98	1×10^{1}	1×10^{5}
Mo-90	1×10^{1}	1×10^{6}
Mo-93	1×10^{3}	1×10^{8}
Mo-99	1×10^{2}	1×10^{6}
Mo-101	1×10^{1}	1×10^{6}
Tc-95m	1×10^{1}	1×10^{6}
Tc-96	1×10^{1}	1×10^{6}
Tc-96m	1×10^{3}	1×10^{7}
Tc-97	1×10^{3}	1×10^{8}
Tc-97m	1×10^{3}	1×10^{7}
Tc-99	1×10^{4}	1×10^{7}
Tc-99m	1×10^{2}	1×10^{7}
Ru-97	1×10^{2}	1×10^{7}
Ru-103	1×10^{2}	1×10^{6}
Ru-105	1×10^{1}	1×10^{6}
Ru-106[a]	1×10^{2}	1×10^{5}
Rh-103m	1×10^{4}	1×10^{8}
Rh-105	1×10^{2}	1×10^{7}
Pd-103	1×10^{3}	1×10^{8}
Pd-109	1×10^{3}	1×10^{6}
Ag-105	1×10^{2}	1×10^{6}
Ag-108m	1×10^{1}	1×10^{6}
Ag-110m	1×10^{1}	1×10^{6}

Nuclide	Activity concentration (Bq/g)	Activity (Bq)
Ag-111	1×10^{3}	1×10^{6}
Cd-109	1×10^{4}	1×10^{6}
Cd-115	1×10^{2}	1×10^{6}
Cd-115m	1×10^{3}	1×10^{6}
In-111	1×10^{2}	1×10^{6}
In-113m	1×10^{2}	1×10^{6}
In-114m	1×10^{2}	1×10^{6}
In-115m	1×10^{2}	1×10^{6}
Sn-113	1×10^{3}	1×10^{7}
Sn-117m	1×10^{2}	1×10^{6}
Sn-121	1×10^{5}	1×10^{7}
Sn-125	1×10^{2}	1×10^{5}
Sb-122	1×10^{2}	1×10^{4}
Sb-124	1×10^{1}	1×10^{6}
Sb-125	1×10^{2}	1×10^{6}
Te-123m	1×10^{2}	1×10^{7}
Te-125m	1×10^{3}	1×10^{7}
Te-127	1×10^{3}	1×10^{6}
Te-127m	1×10^{3}	1×10^{7}
Te-129	1×10^{2}	1×10^{6}
Te-129m	1×10^{3}	1×10^{6}
Te-131	1×10^{2}	1×10^{5}
Te-131m	1×10^{1}	1×10^{6}
Te-132	1×10^{2}	1×10^{7}
Te-133	1×10^{1}	1×10^{5}
Te-133m	1×10^{1}	1×10^{5}
Te-134	1×10^{1}	1×10^{6}
I-123	1×10^{2}	1×10^{7}
I-124	1×10^{1}	1×10^{6}
I-125	1×10^{3}	1×10^{6}
I-126	1×10^{2}	1×10^{6}
I-129	1×10^{2}	1×10^{5}
I-130	1×10^{1}	1×10^{6}
I-131	1×10^{2}	1×10^{6}
I-132	1×10^{1}	1×10^{5}

Nuclide	Activity concentration (Bq/g)	Activity (Bq)
I-133	1×10^{1}	1×10^{6}
I-134	1×10^{1}	1×10^{5}
I-135	1×10^{1}	1×10^{6}
Xe-131m	1×10^{4}	1×10^{4}
Xe-133	1×10^{3}	1×10^{4}
Xe-135	1×10^{3}	1×10^{10}
Cs-129	1×10^{2}	1×10^{5}
Cs-131	1×10^{3}	1×10^{6}
Cs-132	1×10^{1}	1×10^{5}
Cs-134m	1×10^{3}	1×10^{5}
Cs-134	1×10^{1}	1×10^{4}
Cs-135	1×10^{4}	1×10^{7}
Cs-136	1×10^{1}	1×10^{5}
Cs-137[a]	1×10^{1}	1×10^{4}
Cs-138	1×10^{1}	1×10^{4}
Ba-131	1×10^{2}	1×10^{6}
Ba-133	1×10^{2}	1×10^{6}
Ba-140[a]	1×10^{1}	1×10^{5}
La-140	1×10^{1}	1×10^{5}
Ce-139	1×10^{2}	1×10^{6}
Ce-141	1×10^{2}	1×10^{7}
Ce-143	1×10^{2}	1×10^{6}
Ce-144[a]	1×10^{2}	1×10^{5}
Pr-142	1×10^{2}	1×10^{5}
Pr-143	1×10^{4}	1×10^{6}
Nd-147	1×10^{2}	1×10^{6}
Nd-149	1×10^{2}	1×10^{6}
Pm-147	1×10^{4}	1×10^{7}
Pm-149	1×10^{3}	1×10^{6}
Sm-147	1×10^{1}	1×10^{4}
Sm-151	1×10^{4}	1×10^{8}
Sm-153	1×10^{2}	1×10^{6}
Eu-152	1×10^{1}	1×10^{6}
Eu-152m	1×10^{2}	1×10^{6}
Eu-154	1×10^{1}	1×10^{6}

Nuclide	Activity concentration (Bq/g)	Activity (Bq)	Nuclide	Activity concentration (Bq/g)	Activity (Bq)
Eu-155	1×10^{2}	1×10^{7}	Au-198	1×10^{2}	1×10^{6}
Gd-153	1×10^{2}	1×10^{7}	Au-199	1×10^{2}	1×10^{6}
Gd-159	1×10^{3}	1×10^{6}	Hg-195m	1×10^{2}	1×10^{6}
Tb-160	1×10^{1}	1×10^{6}	Hg-197	1×10^{2}	1×10^{7}
Dy-165	1×10^{3}	1×10^{6}	Hg-197m	1×10^{2}	1×10^{6}
Dy-166	1×10^{3}	1×10^{6}	Hg-203	1×10^{2}	1×10^{5}
Ho-166	1×10^{3}	1×10^{5}	Tl-200	1×10^{1}	1×10^{6}
Ho-166m	1×10^{1}	1×10^{6}	Tl-201	1×10^{2}	1×10^{6}
Er-161	1×10^{1}	1×10^{6}	Tl-202	1×10^{2}	1×10^{6}
Er-169	1×10^{4}	1×10^{7}	Tl-204	1×10^{4}	1×10^{4}
Er-171	1×10^{2}	1×10^{6}	Pb-203	1×10^{2}	1×10^{6}
Tm-170	1×10^{3}	1×10^{6}	Pb-210[a]	1×10^{1}	1×10^{4}
Tm-171	1×10^{4}	1×10^{8}	Pb-212[a]	1×10^{1}	1×10^{5}
Yb-169	1×10^{2}	1×10^{7}	Bi-206	1×10^{1}	1×10^{5}
Yb-175	1×10^{3}	1×10^{7}	Bi-207	1×10^{1}	1×10^{6}
Lu-177	1×10^{3}	1×10^{7}	Bi-210	1×10^{3}	1×10^{6}
Hf-181	1×10^{1}	1×10^{6}	Bi-212[a]	1×10^{1}	1×10^{5}
Ta-182	1×10^{1}	1×10^{4}	Bi-213	1×10^{2}	1×10^{6}
W-181	1×10^{3}	1×10^{7}	Po-203	1×10^{1}	1×10^{6}
W-185	1×10^{4}	1×10^{7}	Po-205	1×10^{1}	1×10^{6}
W-187	1×10^{2}	1×10^{6}	Po-207	1×10^{1}	1×10^{6}
W-188	1×10^{2}	1×10^{5}	Po-210	1×10^{1}	1×10^{4}
Re-186	1×10^{3}	1×10^{6}	At-211	1×10^{3}	1×10^{7}
Re-188	1×10^{2}	1×10^{5}	Rn-220[a]	1×10^{4}	1×10^{7}
Os-185	1×10^{1}	1×10^{6}	Rn-222[a]	1×10^{1}	1×10^{8}
Os-191	1×10^{2}	1×10^{7}	Ra-223[a]	1×10^{2}	1×10^{5}
Os-191m	1×10^{3}	1×10^{7}	Ra-224[a]	1×10^{1}	1×10^{5}
Os-193	1×10^{2}	1×10^{6}	Ra-225	1×10^{2}	1×10^{5}
Ir-190	1×10^{1}	1×10^{6}	Ra-226[a]	1×10^{1}	1×10^{4}
Ir-192	1×10^{1}	1×10^{4}	Ra-227	1×10^{2}	1×10^{6}
Ir-194	1×10^{2}	1×10^{5}	Ra-228[a]	1×10^{1}	1×10^{5}
Pt-191	1×10^{2}	1×10^{6}	Ac-225	1×10^{1}	1×10^{4}
Pt-193m	1×10^{3}	1×10^{7}	Ac-227	1×10^{-1}	1×10^{3}
Pt-197	1×10^{3}	1×10^{6}	Ac-228	1×10^{1}	1×10^{6}
Pt-197m	1×10^{2}	1×10^{6}	Th-226[a]	1×10^{3}	1×10^{7}

Nuclide	Activity concentration (Bq/g)	Activity (Bq)
Th-227	1×10^{1}	1×10^{4}
Th-228[a]	1×10^{0}	1×10^{4}
Th-229[a]	1×10^{0}	1×10^{3}
Th-230	1×10^{0}	1×10^{4}
Th-231	1×10^{3}	1×10^{7}
Th-nat (incl Th-232)	1×10^{0}	1×10^{3}
Th-234[a]	1×10^{3}	1×10^{5}
Pa-230	1×10^{1}	1×10^{6}
Pa-231	1×10^{0}	1×10^{3}
Pa-233	1×10^{2}	1×10^{7}
U-230[a]	1×10^{1}	1×10^{5}
U-231	1×10^{2}	1×10^{7}
U-232[a]	1×10^{0}	1×10^{3}
U-233	1×10^{1}	1×10^{4}
U-234	1×10^{1}	1×10^{4}
U-235[a]	1×10^{1}	1×10^{4}
U-236	1×10^{1}	1×10^{4}
U-237	1×10^{2}	1×10^{6}
U-238[a]	1×10^{1}	1×10^{4}
U-nat	1×10^{0}	1×10^{3}
U-239	1×10^{2}	1×10^{6}
U-240	1×10^{3}	1×10^{7}
U-240[a]	1×10^{1}	1×10^{6}
Np-237[a]	1×10^{0}	1×10^{3}
Np-239	1×10^{2}	1×10^{7}
Np-240	1×10^{1}	1×10^{6}
Pu-234	1×10^{2}	1×10^{7}
Pu-235	1×10^{2}	1×10^{7}
Pu-236	1×10^{1}	1×10^{4}
Pu-237	1×10^{3}	1×10^{7}
Pu-238	1×10^{0}	1×10^{4}
Pu-239	1×10^{0}	1×10^{4}
Pu-240	1×10^{0}	1×10^{3}
Pu-241	1×10^{2}	1×10^{5}
Pu-242	1×10^{0}	1×10^{4}
Pu-243	1×10^{3}	1×10^{7}
Pu-244	1×10^{0}	1×10^{4}
Am -241	1×10^{0}	1×10^{4}
Am-242	1×10^{3}	1×10^{6}
Am-242m[a]	1×10^{0}	1×10^{4}
Am-243[a]	1×10^{0}	1×10^{3}
Cm-242	1×10^{2}	1×10^{5}
Cm-243	1×10^{0}	1×10^{4}
Cm-244	1×10^{1}	1×10^{4}
Cm-245	1×10^{0}	1×10^{3}
Cm-246	1×10^{0}	1×10^{3}
Cm-247	1×10^{0}	1×10^{4}
Cm-248	1×10^{0}	1×10^{3}
Bk-249	1×10^{3}	1×10^{6}
Cf-246	1×10^{3}	1×10^{6}
Cf-248	1×10^{1}	1×10^{4}
Cf-249	1×10^{0}	1×10^{3}
Cf-250	1×10^{1}	1×10^{4}
Cf-251	1×10^{0}	1×10^{3}
Cf-252	1×10^{1}	1×10^{4}
Cf-253	1×10^{2}	1×10^{5}
Cf-254	1×10^{0}	1×10^{3}
Es-253	1×10^{2}	1×10^{5}
Es-254	1×10^{1}	1×10^{4}
Es-254m	1×10^{2}	1×10^{6}
Fm-254	1×10^{4}	1×10^{7}
Fm-255	1×10^{3}	1×10^{6}
Alpha-emitting radionuclide not mentioned in this Table	1×10^{0}	1×10^{3}
Radionuclide that is not alpha-emitting and not mentioned in this Table	1×10^{1}	1×10^{4}

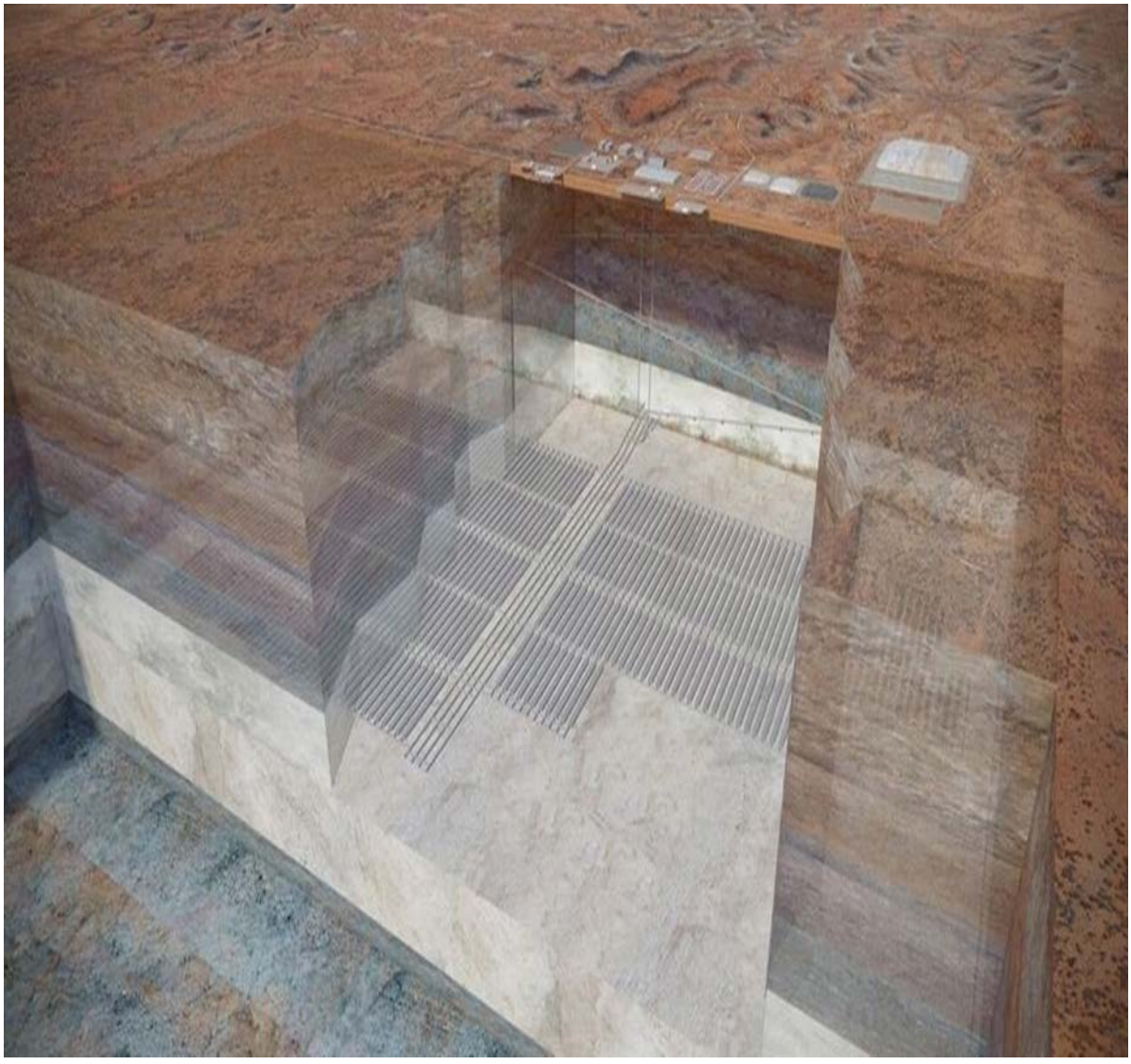
[a] The exemption levels given in this Schedule for the following radionuclides are for the parent nuclides, which are assumed to be in secular equilibrium with the progeny listed below:

Sr-80	Rb-80
Sr-90	Y-90
Zr-93	Nb-93m
Zr-97	Nb-97
Ru-106	Rh-106
Ag-108m	Ag-108
Cs-137	Ba-137m
Ce-134	La-134
Ce-144	Pr-144
Ba-140	La-140
Bi-212	TI-208 (0.36), Po-212 (0.64)
Bi-212	TI-208 (0.36), Po-212 (0.64)
Pb-210	Bi-210, Po-210
Pb-212	Bi-212, TI-208 (0.36), Po-212 (0.64)
Rn-220	Po-216
Rn-222	Po-218, Pb-214, Bi-214, Po-214
Ra-223	Rn-219, Po-215, Pb-211, Bi-211, TI-207
Ra-224	Rn-220, Po-216, Pb-212, Bi-212, TI-208 (0.36), Po-212 (0.64)
Ra-226	Rn-222, Po-218, Pb-214, Bi-214, Po-214, Pb-210, Bi-210, Po-210
Ra-228	Ac-228
Th-226	Ra-222, Rn-218, Po-214
Th-228	Ra-224, Rn-220, Po-216, Pb-212, Bi-212, TI-208 (0.36), Po-212 (0.64)
Th-229	Ra-225, Ac-225, Fr-221, At-217, Bi-213, Po-213, Pb-209
Th-nat(incl Th-232)	Ra-228, Ac-228, Th-228, Ra-224, Rn-220, Po-216, Pb-212, Bi-212, TI-208 (0.36), Po-212 (0.64)
Th-234	Pa-234m
U-230	Th-226, Ra-222, Rn-218, Po-214
U-232	Th-228, Ra-224, Rn-220, Po-216, Pb-212, Bi-212, TI-208 (0.36), Po-212 (0.64)
U-235	Th-231
U-238	Th-234, Pa-234m
U-nat	Th-234, Pa-234m, U-234, Th-230, Ra-226, Rn-222, Po-218, Pb-214, Bi-214, Po-214, Pb-210, Bi-210, Po-210
U-240	Np-240m
Np-237	Pa-233
Am-242m	Am-242
Am-243	Np-239

NOTE 1: The limits in relation to U(nat) and Th(nat) are to be applied in terms of the parent radionuclides ie. U-238 and Th-232 respectively.

CHANDLER AND APIRNTA FACILITY WASTE ZONING GUIDE

Final Report | September 2016



Revision	Date	Description	Signatures		
			Originator	Checked	Approved
0	28/09/2016	For issue	S. Reece	SH, RP	DvM

Table of Contents

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICIES

ABBREVIATIONS

ADG	Australian Dangerous Goods
The Facility	The Chandler and Apirnta Facility
FIBC	Flexible Intermediate Bulk Container
IAEA	International Atomic Energy Agency
LNG	Liquid Natural gas
LPG	Liquid Petroleum gas
MHF	Major Hazard Facility
NORM	Naturally Occurring Radioactive Materials
Tellus	Tellus Holdings Ltd.
UN	United Nations
WAC	Waste Acceptance Criteria
WAP	Waste Acceptance Procedures
WHS	Work Health Safety
WZG	Waste Zoning Guide
Zone PT	Poisonous and/or Toxic Zone
Zone S	Ecotoxic Zone
Zone R	Radioactive Zone
Zone AC	Irritant (acidic nature) Zone
Zone AL	Irritant (alkaline nature) Zone

DEFINITIONS

Hazardous waste[1] - Waste prescribed by the regulations, where the waste has any of the characteristics mentioned in Annex III to the Basel Convention. These characteristics include:

- Explosive
- Flammable Liquids/Solids
- Poisonous
- Toxic
- Ecotoxic
- Infectious Substances.
- Wastes that belong to any category contained in Annex I to the Basel Convention unless they do not possess any of the hazardous characteristics contained in Annex III. Wastes in Annex I include:
    - Clinical wastes;
    - Waste oils/water, hydrocarbons/water mixtures, emulsions;
    - Wastes from the production, formulation and use of resins, latex, plasticizers, glues/adhesives;
    - Wastes resulting from surface treatment of metals and plastics;
    - Residues arising from industrial waste disposal operations; and
    - Wastes which contain certain compounds such as: copper, zinc, cadmium, mercury, lead and asbestos.
- Household waste; or
- Residues arising from the incineration of household waste

Listed Waste[2] – wastes which pose a threat or risk to public health, safety or the environment and include substances which are toxic, infectious, mutagenic, carcinogenic, teratogenic, explosive, flammable, corrosive, oxidising and radioactive. Listed wastes are ONLY to be disposed of at facilities that are licensed to receive listed waste. For details of what constitutes listed waste refer to the Waste Management and Pollution Control (Administration) Regulations.

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[1] *Hazardous Waste (Regulation of Exports and Imports) Act 1989,*

[2] *Guidelines for the Siting, Design and Management of Solid Waste Disposal Sites in the Northern Territory*

Geological repository – a deep salt facility used to permanently isolate waste. The geological barrier provides permanent isolation of wastes from the environment over the very long term in accordance with Environmentally Sound Management principles and also creates additional opportunities for the future recovery and recycling of valuable materials from the waste which can re-enter the circular economy.

Room – an underground excavation (chamber) in salt which is used for the *storage* or *permanent isolation* of waste

Conditions of storage – The term "in the conditions of storage" is used to differentiate between the generic properties of a material and how those properties may be modified when that material is placed into "storage" or "permanent isolation" within an underground room.

Storage – the above ground storage of materials following delivery and includes the time awaiting sampling, analysis and management prior to movement for "in cell storage".

In Room Storage – medium to long term below ground storage of wastes inside a room with ongoing opportunity to recover waste if required.

Permanent Isolation – indefinite below ground storage or disposal of wastes determined suitable for acceptance

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Title - a legal right to ownership and possession of all items that can be recognized as being owned or belonging to a person or a thing. At a basic level, a title is a document that indicates recognition of ownership.

Management risk – the responsibility for the management of waste materials

Disclaimer:

The information contained in this document is for the purpose of supporting approvals documentation and subsequently for use as an operational document for the Chandler and Apirnta Facility only.

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Tellus, as part of their continuous improvement activities will review and may update and amend this document from time to time.

1 INTRODUCTION

1.1 The Chandler Facility

The proposed Chandler Facility (hereby referred to as the proposed "Facility") is a salt mining and processing facility, and a hazardous waste storage and permanent isolation facility. The salt bed is located approximately 800m below the surface and is 200-300m thick. The salt bed which is 500 M years old is overlain by a sequence of low permeability sedimentary rocks. The salt bed will be mined in a way that produces "rooms" which are used to house hazardous waste temporarily or permanently. The facility is located approximately 120 kilometres south of Alice Springs and is situated on the Maryvale pastoral lease.

The location for the Facility was chosen as its principal characteristics; natural geological barrier, geologically stable, no regional aquifer, remote location, no special cultural or historic significance, no potential medium to high value agriculture, no sterilization of minerals or hydrocarbons, no special environmental features, no rare species of flora or fauna, satisfy the requirements for a deep geological repository[3] for hazardous waste storage and isolation purposes.

There are no sensitive receptors within the immediate vicinity of the proposed Facility. The nearest permanent settlement is the small town of Titjikala about 15 kilometres to the north-east. The main land uses that occur on the Maryvale pastoral lease are cattle grazing and Aboriginal land management. The main waterways in the region are the Hugh River, Finke River and Palmer River. At their nearest point, Hugh River is about 10 kilometres east of the site, Finke River is about 15 kilometres south and Palmer River is about 70 kilometres west

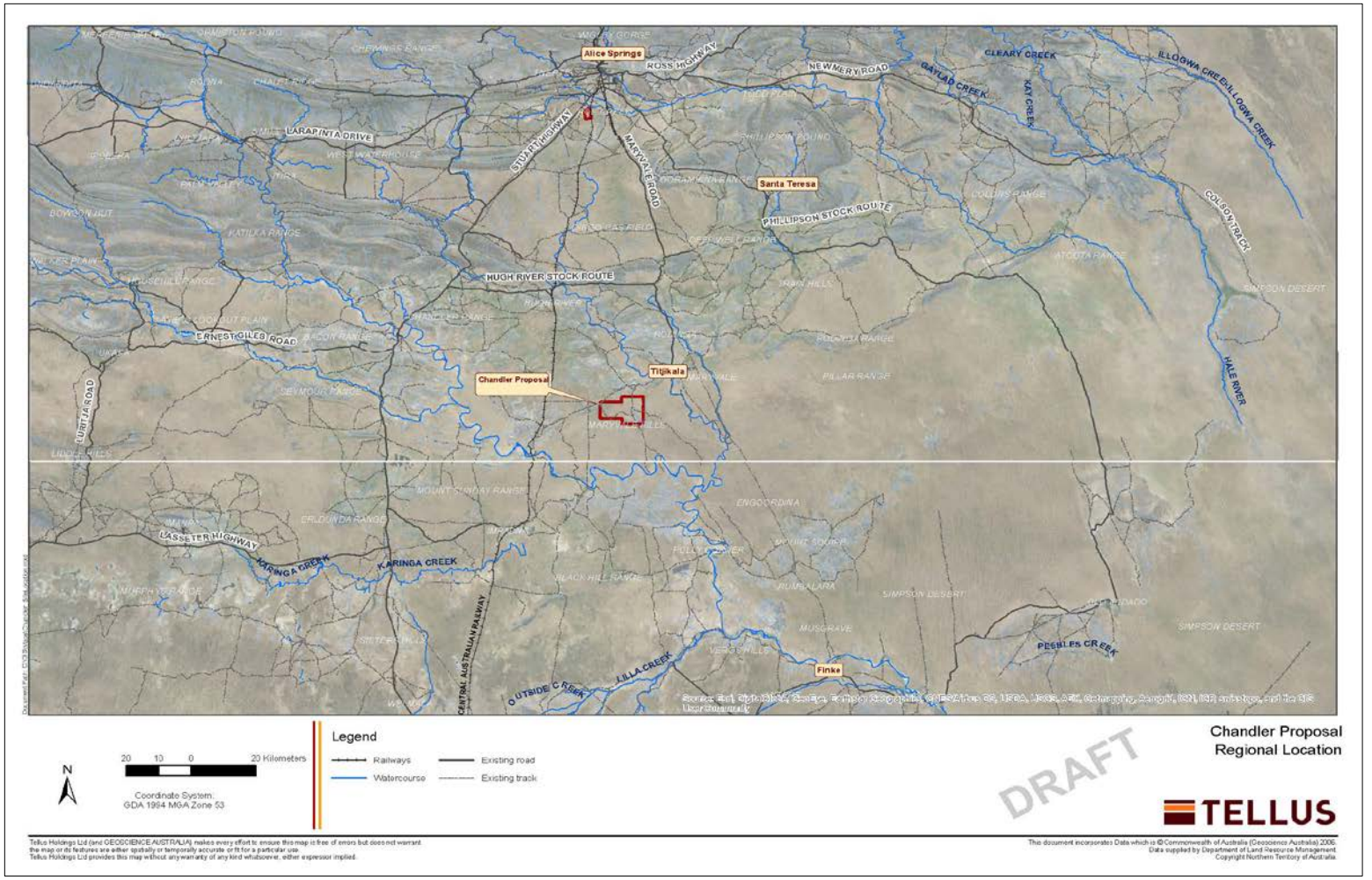
The arid and remote nature of the location, absence of nearby population, coupled with the site characteristics make the site ideal for long-term storage and permanent isolation of hazardous and intractable waste.

1.2 The Apirnta Facility

The Apirnta Facility is located adjacent to the Central Australian Railway approximately 30km to the west of the Chandler Facility and will be connected to Chandler by the Chandler Haul Road. Apirnta will be a Storage and Transfer Facility and will be the location where waste acceptance procedures are performed to confirm that incoming materials meet the waste acceptance criteria for Chandler.

[3] *IAEA guidelines for the siting of geological disposal facilities - adapted to hazardous waste*

Figure 1-1: Chandler site location



1.3 Document Aims and Objectives

The aim of this document is to present the Waste Zoning Guide (WZG) that will be applied at the proposed Facility. This document should be read in conjunction with the following:

- Waste Acceptance Policy.
- Waste Acceptance Criteria (WAC).
- Waste Acceptance Procedure (WAP).

This document is part of a hierarchy of documents and is a Tier 4 document, and is highlighted in Figure 1-2 below, which includes an equivalent suite of documents for Tellus' western Australian Sandy Ridge project. Tier 4 documents work together with Tier 3 documents to provide an outline of operational procedures. The WZG has been developed in response to the assumed inventory for disposal which is presented as a Potential Waste Category List in Appendix A.1 of this document.

Figure 1-2: Waste Acceptance Criteria Document Hierarchy

Having established the overarching exclusion criteria to be applied at the proposed Facility in the WAC, a gated WAP using specified test methods and criteria values will be applied to determine if a waste can be accepted and to ensure that wastes which may react with each other are identified and grouped according to the principles of compatibility.

Reactive groups must be physically separated during the transport, receipt, storage and during permanent isolation, this document outlines the procedure of waste segregation and zoning.

1.4 Intended Audience

This document is intended initially for use by regulators responsible for assessing the facility and issuing licences for the operation of the proposed Facility. It will be used to support the formation of more detailed procedures to control the process by which waste producers and Tellus Staff will

determine if the waste streams may be suitable for storage or permanent isolation and how they should be stored or permanently isolated in a safe manner.

The document will also be of interest to other stakeholders who wish to understand the approach being followed by Tellus for waste acceptance, including the safe storage and permanent isolation of wastes.

2 DANGEROUS GOODS SEGREGATION

2.1 Introduction

To prevent dangerous interactions, dangerous goods should be kept apart (segregated) from all other goods with which they are not compatible. Segregation can be achieved by storing and handling incompatible goods in separate areas or by the use of physical barriers or distances within the same area. Systems and procedures will be developed and enforced, and personnel involved in the storage and handling of dangerous goods will be trained and supervised to ensure segregation is maintained at all times.

2.2 Regulatory Context

In the Northern Territory Major hazard facilities (MHF) are sites that store, handle and process large quantities of hazardous chemicals and dangerous goods, including explosives and fuels. These sites are regulated under the Work Health and Safety (National Uniform Legislation Act (WHS Act) and the Work Health and Safety (National Uniform Legislation) Regulations (WHS Regulations).

Examples include:

- chemical plants
- gas processing
- LPG and LNG facilities
- some warehouses and transport depots
- mines which have large volumes of hazardous chemicals / dangerous goods.

All Northern Territory sites that are determined as MHFs are required to hold a licence under the WHS Act and must comply with stringent requirements, including preparation of a safety case, to ensure they are operated safely. The Chandler and Apirnta Facilities are anticipated to be classified as Major Hazard Facilities and an outline Safety Case is currently in preparation.

The National Transport Commission in collaboration with all the states and territories developed a Model Law on the Transport of Dangerous Goods by Road or Rail and a Model Subordinate Law on the Transport of Dangerous Goods by Road or Rail. These documents, heavily based on the UN Model Regulations, form the framework for the regulation of the transport of dangerous goods in Australia today.

The Northern Territory has passed laws that mirror the Model Law and the Model Subordinate Law. These are the:

- Transport of Dangerous Goods by Road and Rail (National Uniform Legislation) Act
- Transport of Dangerous Goods by Road and Rail (National Uniform Legislation) Regulations

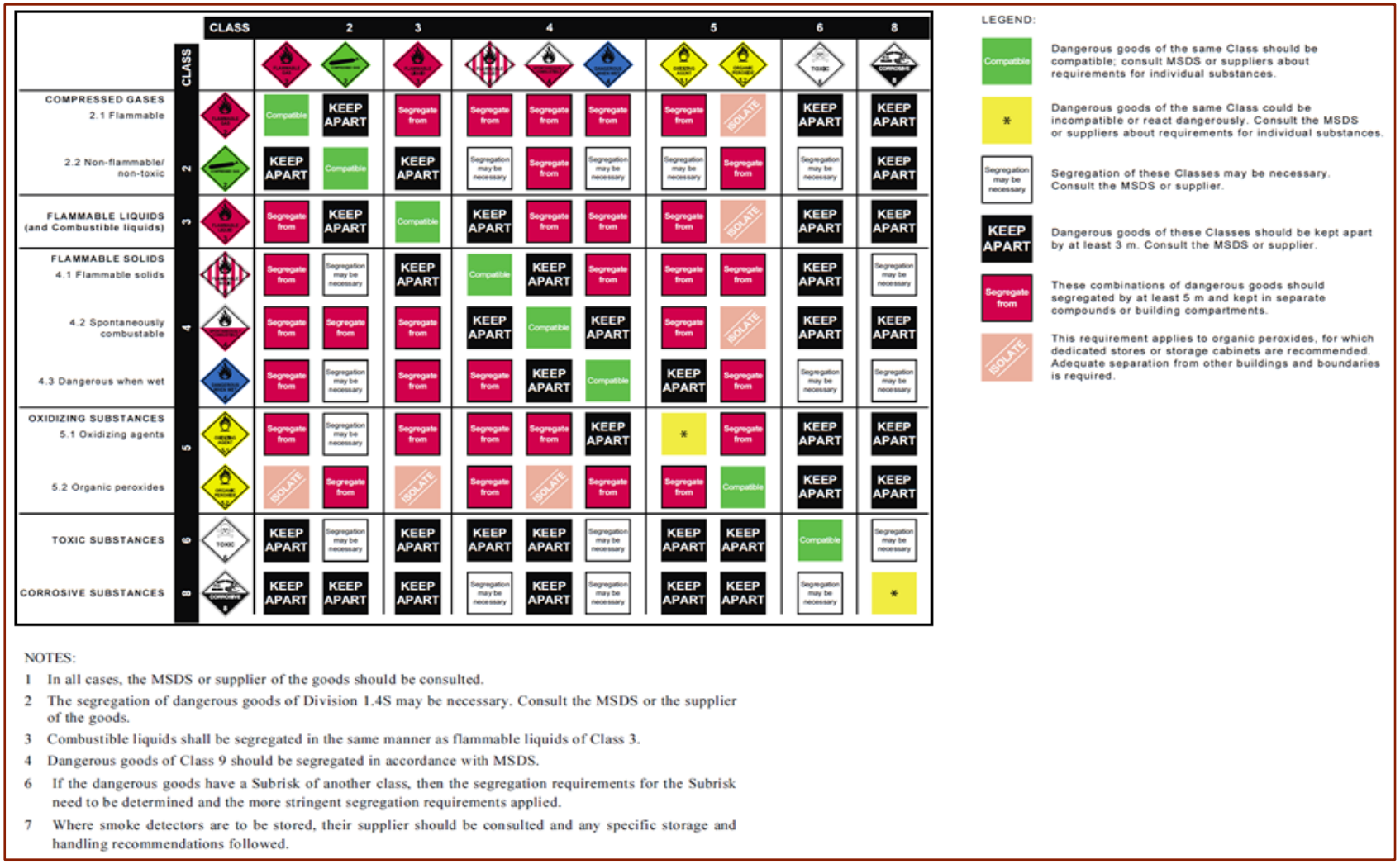
Those laws adopt the Australian Dangerous Goods (ADG) Code. The ADG code identifies certain classes of DG. A 'class' means the number assigned to dangerous goods which exhibit a common single or most significant hazard determined by the criteria or listing in the Australian Dangerous Goods Code. Tellus will use these classes as the basis for guiding the segregation of DG, an extract of the classes is included at Appendix A.2

2.3 Segregation Approach

It is important to recognise some wastes, which may be dangerous goods, may be delivered to site and be stored at Apirnta before being transferred to the Chandler facility, arrangements therefore need to be made for the safe storage of these wastes. Useful guidance for segregating incompatible dangerous goods is provided in *Australian/New Zealand Standard AS/NZS 3833 The Storage and Handling of Mixed Classes of Dangerous Goods in Packages and Intermediate Bulk Containers* which is referenced in the code of practice[4] which, in turn, supports the National Standard. Tellus will adopt the segregation protocols presented in AS/NZS 3833 for all waste materials that are stored on site at either Apirnta or at the surface of Chandler prior to underground permanent isolation. The Dangerous Goods segregation chart is presented in Appendix A.3

[4] *Page 29 The National Code of Practice for the Storage and Handling of Workplace Dangerous Goods NOHSC:2017(2001)*

Figure 2-1: Dangerous Goods Segregation Chart (Australian Standard AS3833 figure 6.1)



NOTES:

1 In all cases, the MSDS or supplier of the goods should be consulted.

2 The segregation of dangerous goods of Division 1.4S may be necessary. Consult the MSDS or the supplier of the goods.

3 Combustible liquids shall be segregated in the same manner as flammable liquids of Class 3.

4 Dangerous goods of Class 9 should be segregated in accordance with MSDS.

6 If the dangerous goods have a Subrisk of another class, then the segregation requirements for the Subrisk need to be determined and the more stringent segregation requirements applied.

7 Where smoke detectors are to be stored, their supplier should be consulted and any specific storage and handling recommendations followed.

3 CHEMICAL WASTE ZONING

3.1 Overview

Applying the WAC (refer to WAC document) will result in a set of wastes that can be safely placed in underground storage rooms for permanent isolation. The application of the criteria in effect limits the hazardous properties and physical form of the wastes.

When analysing waste for acceptance, it is essential to ensure that wastes which may react with each other are identified and classified into compatible groups

Following acceptance, wastes will be segregated into zones to ensure wastes that have the potential to react together are kept apart.

As well as segregating wastes during initial receipt and storage (refer to Section 2), accepted wastes must be physically separated during permanent isolation, the most appropriate zone in the facility in which to dispose of the waste will be selected based on the zone selection principles and methodology outlined below.

Waste placement at Chandler will normally occur as individual packages which are transported underground, and placed package by package in the assigned zones within the underground rooms. In certain situations, bulk placement of wastes using dry or hydraulic backfill techniques may be utilised when it has been determined as appropriate to do so by a suitably qualified person(s).

Isolation as a control measure is usually used to control physicochemical risks for hazardous chemicals because of the consequences when incompatible materials interact. Hazardous chemicals should be physically separated from any chemicals or other things that may be incompatible[5]. This is achieved by a physical separation distance, barriers, or a combination of both. At the proposed Facility these barriers may include the waste packaging, clay barriers, solidified and stabilised wastes, passive chemical barriers such as lime, calcium apatite or zeolite and prior to backfilling the use of separation distance.

3.2 Principles

There are three key principles behind zone selection:

[5] *section 4.1 Managing the Risks of Hazardous Chemicals in the Workplace – Code of Practice 2012*

Principle 1 - Keep materials with different hazardous characteristics apart.

This is a general principle resulting in the zones presented in Table 3-1. Hazardous characteristics for wastes in the poisonous, toxic and special waste zones are defined by the Basel convention presented in Appendix A.3.

Table 3-1: Zones and generic hazards

Zone #	Zone	Generic Reason
PT	Poisonous (H6.1)	Acute health effects
	Toxic (delayed or chronic) (H11)	
S	Ecotoxic (H12) and other special waste	Long term health effects and/or environmental risk (hazards often shared by substances)
R	Radioactive waste	Long term health effects and/or environmental risk

Principle 2 - Prevent the mixing of acidic and alkaline wastes.

The mixing of acid and alkaline wastes could result in a chemical reaction, although the permitted physical forms and containment of the wastes would make this highly unlikely. To ensure that wastes which are acid or alkaline in nature are stored separately two zones are to be used for irritant wastes:

Zone #	Zone	Generic Reason
AC	Irritant (acidic nature)	Chemical properties
AL	Irritant (alkaline nature)	Chemical properties

These zones take into account the potential for wastes that may be classed as **PT** [poisonous (H6.1), toxic (delayed or chronic) (H11)] or **S** [Ecotoxic (H12) and other special waste] to also display acidic or alkaline properties. Therefore, wastes which if mixed with water would generate an acidic pH leachate may need to be placed in the Irritant (acidic) Zone. Wastes which when mixed with water would generate an alkaline pH leachate may need to be placed in the Irritant (alkaline) Zone. It is not physically possible for a waste to be both acidic and alkaline in nature.

Principle 3 - Prevent the mixing of multi-hazard incompatible materials.

The first stage in minimising the risk of incompatible materials mixing is to ensure that distinctly acidic and alkaline materials are stored separately from other wastes as described in Principle 2 - Prevent the mixing of acidic and alkaline wastes.

The next stage is to minimise the risk from incompatible multi-hazard wastes. In general the combinations of hazards within the cell will result in negligible risk of reaction, as the majority of the residual hazards after the application of WAC relate to potential health and environmental effects and not reactivity.

Therefore waste possessing combinations of the following hazardous characteristics could be stored together: Poisonous (H6.1), Toxic (delayed or chronic) (H11), and Ecotoxic (H12). The Zone for multi-hazard wastes with these properties will be selected in accordance with the predominant hazard property. This will be based on hazardous property threshold concentrations for the substances in the waste.

Wastes that are an irritant and possess other hazardous properties will be considered for storage in the appropriate Irritant Zone (acidic or alkaline). This is because the substances in the waste that give rise to other hazardous properties should be stable in either the acidic or alkaline environment. Therefore if such substances escaped from containment and mixed with other acid or alkaline wastes in the same zone, it is unlikely to give rise to an incompatible reaction.

The Dangerous Goods Segregation protocols (AS/NZ 3833 Figure 6.1) will be utilised as a secondary check to ensure the substances to be located within a zone are compatible, and to determine if further risk mitigation is required within the cell such as suitable barriers between zones, or to determine any subzones that may be required within a zone, particularly with respect to the “Other Special Waste’ zone.

Finally the safety data sheets for substances within the wastes will be assessed in terms of reactivity data, to determine if any of the substances possess any unusual reactive properties. Any waste with unusual reactive properties would be subjected to further tests to determine stability, and rejected if the suitability of the waste cannot be guaranteed.

3.3 Methodology

Based on the above principles the zone for a particular waste will be selected using the following steps.

Step 1 – Single hazard waste

Wastes that have been identified as possessing one hazardous property will be placed in the appropriate zone as shown in Table 3-2 below. Safety data sheets for substances within the waste will be consulted for reactivity data, to ensure that the substances within the waste do not possess any unusual reactive properties.

Zoning in accordance with Step 1 supports compliance with principles 1 and 2 outlined above.

Table 3-2: Zones for single hazard wastes

Single Hazardous Characteristic	Zone	Zone #
Poisonous (H6.1)	Poisonous & Toxic (delayed or chronic) Zone	**PT**
Toxic (delayed or chronic) (H11)		
Irritant – acidic in nature	Irritant (acidic) Zone	**AC**
Irritant – alkaline in nature	Irritant (alkaline) Zone	**AL**
Ecotoxic (H12)	Ecotoxic and other Special Waste Zone	**S**
Radioactive waste	Long term health effects and/or environmental risk	**R**

Step 2 - Multi-hazard Hazard Wastes

The zone selected for waste possessing more than one hazardous characteristic will be determined using Table 3-3. A suitably qualified person shall make any final determination on zone selection.

Waste subjected to further tests will be re-assessed using the full acceptance decision tree.

Table 3-3: Zones for multi-hazard wastes

Hazardous Characteristics	*Poisonous (H6.1)*	Toxic (delayed or chronic)(H11)	Irritant – acidic in nature[1]	Irritant – alkaline in nature[2]	Ecotoxic (H14)	Radioactive Waste
Poisonous (H6.1)	*PT*					
Toxic (delayed or chronic)(H11)	*PT*	*PT*				
Irritant – acidic in nature[1]	*AC*	*AC*	*AC*			
Irritant – alkaline in nature[2]	*AL*	*AL*	*Not Permitted*	*AL*		
Ecotoxic (H14)	*PT*	*PT*	*AC*	*AL*	*S*	
Rad Waste	*Not Possible*	*Not Possible*	*Not Possible*	*Not Possible*	*Not Possible*	*R*

[1] Including wastes whose leachates during tests would be acidic pH [2] Including wastes whose leachates during tests would be alkaline pH	

Zoning in accordance with Step 2 supports compliance with principle 3 outlined above.

The use of this zoning methodology provides guidance for a suitably qualified and experienced person to categorise and instruct the safe segregation of wastes expected at the proposed Facility for storage and permanent isolation. The suitably qualified person shall make final judgements and zoning based on their knowledge and experience.

4 RADIOACTIVE WASTE ZONING

The Chandler facility will only accept radioactive waste classified as NORM below exemption level. The zoning approach is summarised below.

4.1 NORM Waste

NORM waste is assumed to contain relatively long-lived radioisotopes such as Ra, U, and Th. NORM waste is expected to be delivered to site and placed in the following forms and placed in the appropriate R zone in accordance with the following procedure;

4.1.1 Dry solids packaged in FIBCs or drums.

Packaged would be transported underground in sealed shipping containers and placed in the appropriate room where it would be covered with fine salt backfill immediately after placement.

4.1.2 Bulk solids (e.g. contaminated soils or mineral concentrates such as monazite sand).

Bulk solids would be transported underground in sealed shipping containers and placed in the appropriate room where it would be covered with fine salt backfill immediately after placement.

4.1.3 Sludge's and liquids requiring solidification and stabilisation prior to placement.

Following any treatment the packaged material would be transported underground in sealed shipping containers and placed in the appropriate room where it would be covered with fine salt backfill immediately after placement.

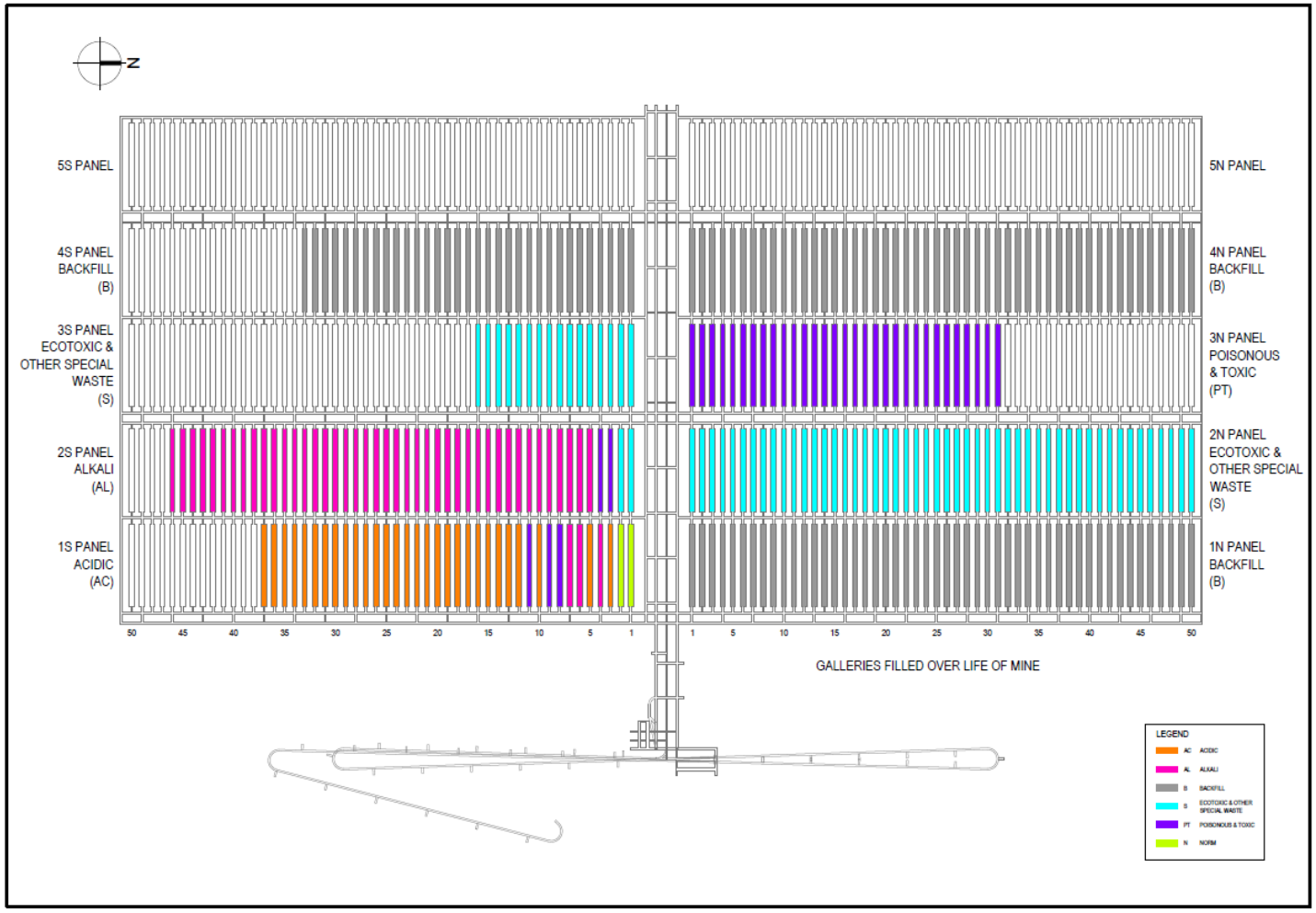
4.1.4 Contaminated equipment.

Usually the nature of these materials is such that activity levels are low, and will be made lower by adding fill (grout etc.). Following any treatment the material would be transported underground in sealed shipping containers and placed in the appropriate room where it would be covered with fine salt backfill immediately after placement.

4.1.5 Use of NORM in backfill

Radiation Protection Series Publication No. 15, *Management of Naturally Occurring Radioactive Material (NORM)* recognises that disposal of NORM into underground cemented backfill may in certain circumstances be appropriate. Tellus is proposing to use hydraulic backfill for part of its waste placement process and will examine the feasibility of introducing NORM materials into this process if safe to do so.

5 INDICATIVE WASTE ZONING PLAN



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A.1 Potential Waste Category List

National Environment Protection (Movement of Controlled Waste between States and Territories) Measure 1998 Schedule A List 1: Waste categories	
A100	Waste resulting from surface treatment of metals and plastics
A110	Waste from heat treatment and tempering operations containing cyanides
A130	Cyanides (inorganic)
B100	Acidic solutions or acids in solid form
C100	Basic solutions or bases in solid form
D110	Inorganic fluorine compounds excluding calcium fluoride
D120	Mercury; mercury compounds
D130	Arsenic; arsenic compounds
D140	Chromium compounds (hexavalent and trivalent)
D150	Cadmium; cadmium compounds
D160	Beryllium; beryllium compounds
D170	Antimony; antimony compounds
D180	Thallium; thallium compounds
D190	Copper compounds
D200	Cobalt compounds
D210	Nickel compounds
D220	Lead; lead compounds
D230	Zinc compounds
D240	Selenium; selenium compounds
D250	Tellurium; tellurium compounds
D270	Vanadium compounds
D290	Barium compounds (excluding barium sulphate)
D300	Non-toxic salts
D310	Boron compounds
D330	Inorganic sulphides
D340	Perchlorates
D350	Chlorates
D360	Phosphorus compounds excluding mineral phosphates

E100	Waste containing peroxides other than hydrogen peroxide
F100	Waste from the production, formulation and use of inks, dyes, pigments, paints, lacquers and varnish
F110	Waste from the production, formulation and use of resins, latex, plasticisers, glues and adhesives
G100	Ethers
G110	Organic solvents excluding halogenated solvents
G150	Halogenated organic solvents
G160	Waste from the production, formulation and use of organic solvents
H100	Waste from the production, formulation and use of biocides and phytopharmaceuticals
H110	Organic phosphorous compounds
H170	Waste from manufacture, formulation and use of wood-preserving chemicals
J100	Waste mineral oils unfit for their original intended use
J120	Waste oil/water, hydrocarbons/water mixtures or emulsions
J160	Waste tarry residues arising from refining, distillation, and any pyrolytic treatment
K140	Tannery wastes (including leather dust, ash, sludge's and flours)
K190	Wool scouring wastes
M100	Waste substances and articles containing or contaminated with polychlorinated biphenyls, polychlorinated napthalenes, polychlorinated terphenyls and/or polybrominated biphenyls
M150	Phenols, phenol compounds including chlorophenols
M160	Organo halogen compounds—other than substances referred to in this Table or Table 2
M170	Polychlorinated dibenzo-furan (any congener)
M180	Polychlorinated dibenzo-p-dioxin (any congener)
M210	Cyanides (organic)
M220	Isocyanate compounds
M230	Triethylamine catalysts for setting foundry sands
M250	Surface active agents (surfactants), containing principally organic constituents and which may contain metals and inorganic materials
M260	Highly odorous organic chemicals (including mercaptans and acrylates)
N100	Containers and drums that are contaminated with residues of substances referred to in this list
N120	Soils contaminated with a controlled waste
N140	Fire debris and fire wash waters
N150	Fly ash, excluding fly ash generated from Australian coal fired power stations
N160	Encapsulated, chemically-fixed, solidified or polymerised wastes referred to in this list

N190	Filter cake contaminated with residues of substances referred to in this list
N205	Residues from industrial waste treatment/disposal operations
N220	Asbestos
N230	Ceramic-based fibres with physico-chemical characteristics similar to those of asbestos
R120	Waste pharmaceuticals, drugs and medicines
R140	Waste from the production and preparation of pharmaceutical products
T100	Waste chemical substances arising from research and development or teaching activities, including those which are not identified and/or are new and whose effects on human health and/or the environment are not known
T120	Waste from the production, formulation and use of photographic chemicals and processing materials
T200	Waste of an explosive nature not subject to other legislation

A.2 Dangerous Goods Codes

Extract from pages 44-46 of Australian Code for the Transport of Dangerous Goods by Road & Rail Edition 7.4 Update, June 2016

Substances (including mixtures and solutions) and articles subject to this Code are assigned to one of nine classes according to the hazard or the most predominant of the hazards they present. Some of these classes are subdivided into divisions. These classes and divisions are:

Class 1: Explosives

Division 1.1: Substances and articles which have a mass explosion hazard

Division 1.2: Substances and articles which have a projection hazard but not a mass explosion hazard

Division 1.3: Substances and articles which have a fire hazard and either a minor blast hazard or a minor projection hazard or both, but not a mass explosion hazard

Division 1.4: Substances and articles which present no significant hazard

Division 1.5: Very insensitive substances which have a mass explosion hazard

Division 1.6: Extremely insensitive articles which do not have a mass explosion hazard

Class 2: Gases

Division 2.1: Flammable gases

Division 2.2: Non-flammable, non-toxic gases

Division 2.3: Toxic gases

Class 3: Flammable liquids

Class 4: Flammable solids; substances liable to spontaneous combustion; substances which, on contact with water, emit flammable gases

Division 4.1: Flammable solids, self-reactive substances and solid desensitised explosives

Division 4.2: Substances liable to spontaneous combustion

Division 4.3: Substances which in contact with water emit flammable gases

Class 5: Oxidising substances and organic peroxides

Division 5.1: Oxidising substances

Division 5.2: Organic peroxides

Class 6: Toxic and infectious substances

Division 6.1: Toxic substances

Division 6.2: Infectious substances

Class 7: Radioactive material

Class 8: Corrosive substances

Class 9: Miscellaneous dangerous substances and articles, including environmentally hazardous substances.

The numerical order of the classes and divisions is not that of the degree of danger.

Many of the substances assigned to Classes 1 to 9 are deemed, without additional labelling, as being environmentally hazardous. Wastes must be transported under the requirements of the appropriate class considering their hazards and the criteria in this Code.

Wastes not otherwise subject to this Code but covered under the Basel Convention may be transported under Class 9.

For packing purposes, substances other than those of Classes 1, 2 and 7, Divisions 5.2 and 6.2, and other than self-reactive substances of Division 4.1, are assigned to three packing groups in accordance with the degree of danger they present:

Packing group I: Substances presenting high danger;

Packing group II: Substances presenting medium danger; and

Packing group III: Substances presenting low danger.

The packing group to which a substance is assigned is indicated in the Dangerous Goods List in Chapter 3.2.

Articles are not assigned to packing groups. For packing purposes any requirement for a specific packaging performance level is set out in the applicable packing instruction.

Dangerous goods are determined to present one or more of the dangers represented by Classes 1 to 9 and divisions and, if applicable, the degree of danger on the basis of the requirements in Chapters 2.1 to 2.9.

Dangerous goods presenting a danger of a single class and division are assigned to that class and division and the degree of danger (packing group), if applicable, determined. When an article or substance is specifically listed by name in the Dangerous Goods List in Chapter 3.2, its class or division, its subsidiary risk(s) and, when applicable, its packing group are taken from this list.

Dangerous goods meeting the defining criteria of more than one hazard class or division and which are not listed by name in the Dangerous Goods List, are assigned to a class and division and subsidiary risk(s) on the basis of the precedence of hazards in 2.0.3.

A.3 ANNEX III: LIST OF HAZARDOUS CHARACTERISTICS

UN Class	Code	Characteristics
1	**H1**	**Explosive** An explosive substance or waste is a solid or liquid substance or waste (or mixture of substances or wastes) which is in itself capable by chemical reaction of producing gas at such a temperature and pressure and at such a speed as to cause damage to the surroundings.
3	**H3**	**Flammable Liquids** The word "flammable" has the same meaning as "inflammable". Flammable liquids are liquids, or mixtures of liquids, or liquids containing solids in solution or suspension (for example, paints, varnishes, lacquers, etc., but not including substances or wastes otherwise classified on account of their dangerous characteristics) which give off a flammable vapour at temperatures of not more than 60.5ºC, closed-cup test, or not more than 65.6ºC, open-cup test. (Since the results of open-cup tests and of closed-cup tests are not strictly comparable and even individual results by the same test are often variable, regulations varying from the above figures to make allowance for such differences would be within the spirit of this definition.)
4.1	**H4.1**	**Flammable Solids** Solids, or waste solids, other than those classed as explosives, which under conditions encountered in transport are readily combustible, or may cause or contribute to fire through friction
4.2	**H4.2**	Substances or wastes liable to spontaneous combustion Substances or wastes which are liable to spontaneous heating under normal conditions encountered in transport, or to heating up on contact with air, and being then liable to catch fire
4.3	**H4.3**	**Substances or wastes which, in contact with water, emit flammable gases** Substances or wastes which, by interaction with water, are liable to become spontaneously flammable or to give off flammable gases in dangerous quantities
5.1	**H5.1**	**Oxidising** Substances or wastes which, while in themselves not necessarily combustible, may, generally by yielding oxygen, cause or contribute to, the combustion of other materials.
5.2	**H5.2**	**Organic Peroxides** Organic substances or wastes which contain the bivalent-o-o-structure are thermally unstable substances which may undergo exothermic self-accelerating decomposition.
6.1	**H6.1**	**Poisonous (Acute)** Substances or wastes liable either to cause death or serious injury or to harm human health if swallowed or inhaled or by skin contact
6.2	**H6.2**	**Infectious Substances** Substances or wastes containing viable microorganisms or their toxins which are known or suspected to cause disease in animals or humans

8	**H8**	**Corrosives** Substances or wastes which, by chemical action, will cause severe damage when in contact with living tissue, or, in the case of leakage, will materially damage, or even destroy, other goods or the means of transport; they may also cause other hazards
9	**H10**	**Liberation of toxic gases in contact with air or water** Substances or wastes which, by interaction with air or water, are liable to give off toxic gases in dangerous quantities
9	**H11**	**Toxic (Delayed or chronic)** Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity
9	**H12**	**Ecotoxic** Substances or wastes which, if released, present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems
9	**H13**	Capable, by any means, after disposal, of yielding another material, e.g. leachate, which possess any of the characteristics listed above