Waste Acceptance Criteria and Supporting Documents

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SANDY RIDGE FACILITY WASTE ACCEPTANCE POLICY

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ABBREVIATIONS

ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
The Convention	The Basel Convention
The Council	The Radiological Council
DEC	Department of Environment and Conservation
EP	Environmental Protection
The Facility	The Sandy Ridge Facility
IAEA	International Atomic Energy Agency
IWDF	Intractable Waste Disposal Facility
km	Kilometres
NHRMC	National Health and Medical Research Council
RHC	Radiation Health Committee
Tellus	Tellus Holdings Ltd.
WAC	Waste Acceptance Criteria
WAP	Waste Acceptance Procedures
WCD	Waste Classification and Waste Definitions
WZG	Waste Zoning Guidelines

DEFINITIONS

Cell - an excavated area (pit) of kaolin which is below ground level which will be used for *in cell 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 "in cell storage" or "permanent isolation" within a cell.

Dangerous goods – the Dangerous Goods Safety (General) Regulations 2007 defines "dangerous goods" as any substance or article that is:

a) Found to be within any of the following classes or divisions under the Australian Dangerous Goods Code: Class 1, Class 2, Class 3, Class 4, Class 5, Division 6.1, Class 8, or Class 9; unless stated otherwise within the Code.

b) named or described in Schedule 1 of the Environmental Protection (Controlled Waste) Regulations 2004

Geological repository (in the context of Sandy Ridge) - The term geological repository is used to mean a landfill facility constructed and with the equivalent properties of a Class IV or Class V Landfill as defined in Landfill Waste Classification and Waste Definitions 1996 (As amended December 2009) Western Australia Department Of Environment And Conservation. In the context of Sandy Ridge this means an arid near-surface facility used to permanently isolate waste. Geological repositories provide the highest levels of containment through the use of carefully selected natural geological barriers rather than reliance on man-made liner systems and are increasingly recognised as a cost effective and preferred method of permanently isolating difficult to manage wastes. The geological barrier provides permanent isolation of wastes from the environment over the very long term and creates additional opportunities for the future recovery and recycling of valuable materials from the waste which can re-enter the circular economy.

Hazardous waste - Component of the waste stream which by its characteristics poses a threat or risk to public health, safety or the environment (includes substances which are toxic, infectious, mutagenic, carcinogenic, teratogenic, explosive, flammable, corrosive, oxidising and radioactive). As defined in Landfill Waste Classification and Waste Definitions 1996 (As amended December 2009) Western Australia Department of Environment And Conservation

In Cell Storage - medium to long term below ground storage of wastes inside a cell with ongoing opportunity to recover waste if required.

Intractable Waste- Waste which is a management problem by virtue of its toxicity or chemical or physical characteristics which make it difficult to dispose of or treat safely, and is not suitable for disposal in Class I, II, III and IV landfill facilities. As defined in Landfill Waste Classification and Waste

Definitions 1996 (As amended December 2009) Western Australia Department Of Environment And Conservation

Permanent Isolation - indefinite below ground storage of wastes determined suitable for acceptance.

Storage - the short term above ground storage of materials following delivery and includes the time awaiting sampling, analysis and management prior to movement for “in cell storage”.

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 Sandy Ridge 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 Sandy Ridge Facility

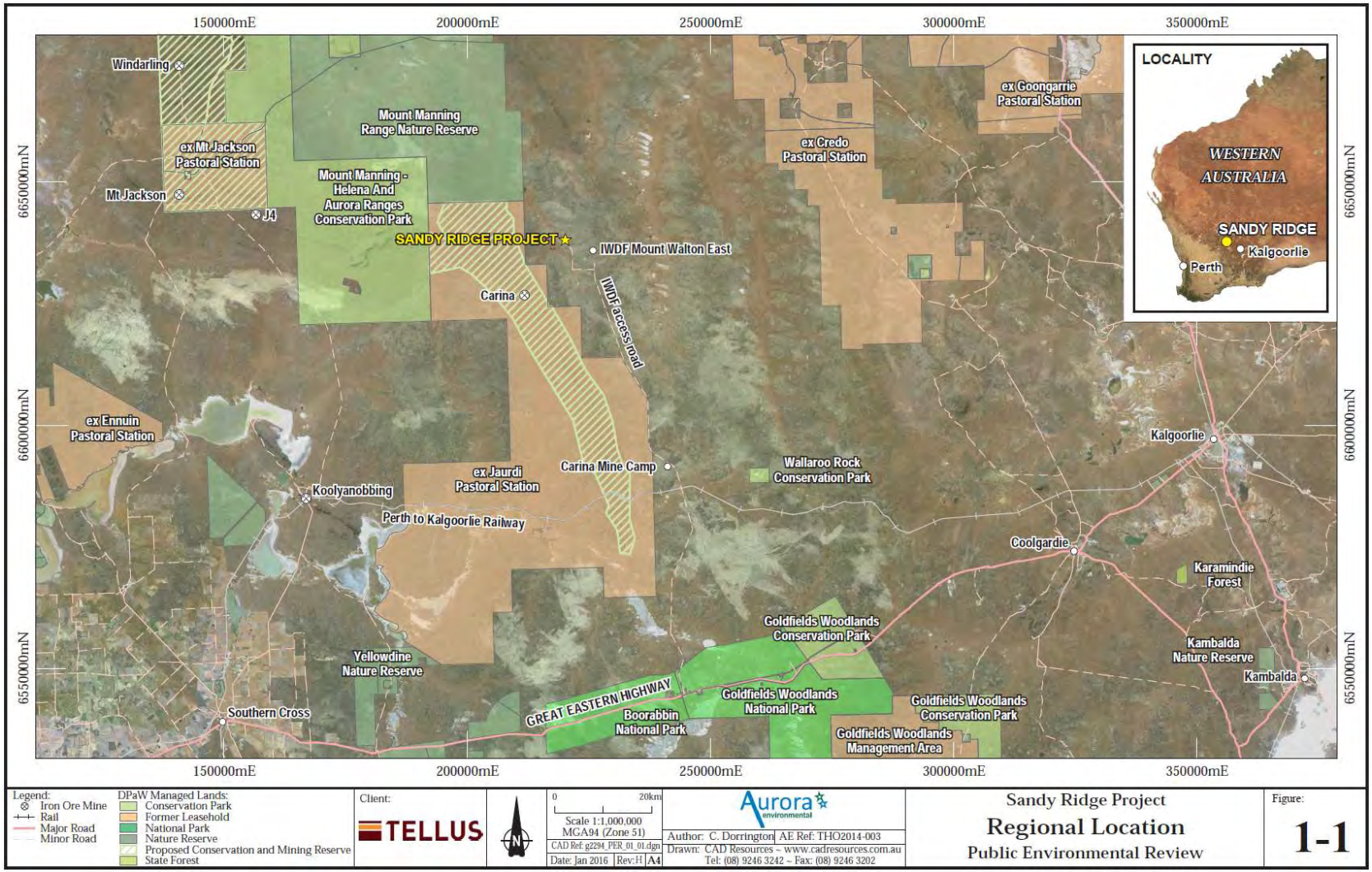
The proposed Sandy Ridge Facility (hereby referred to as the proposed "Facility") is a dual use kaolin mine with the voids created by mining used to store and permanently isolate hazardous and intractable wastes. The site is located approximately 75 km northeast of Koolyanobbing, in the Shire of Coolgardie, within the Goldfields Region of Western Australia (Figure 1-1).

The location for the Facility was specifically chosen as its principal characteristics; semi–arid climate, high rates of evaporation, geologically stable, natural geological barriers, no regional aquifer, no surface water receptors, no flooding, low erosion rates, no heritage values, topography etc. satisfy the requirements for a near surface geological repository for intractable and hazardous waste storage and isolation purposes.

There are no sensitive receptors within the immediate vicinity of the proposed Facility. The nearest operation is the Class V IWDF Mount Walton East Intractable Waste Disposal facility located approximately 6 km to the east, which operates on a campaign basis and does not have permanent residents. The nearest mining camp is the Carina Iron Ore Mine accommodation village located approximately 52 km to the south east of the proposed Facility.

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.

Figure 1-1: Sandy Ridge site location



1.2 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 hierarchy:

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

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

The Waste Acceptance Policy is the Tier One document within Tellus' Waste Acceptance hierarchy, as 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

1.3 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 WASTE ACCEPTANCE POLICY

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

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

Together, these steps form the basis of Tellus' WAP for the proposed Sandy Ridge 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[1] 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.

[1] *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 a cell 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 Sandy Ridge 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 intractable wastes, and small quantities of radioactive wastes, the WAC have consequently considered a wide range of legislative requirements as guidance.

This section sets out applicable legislation, regulation and guidelines for the proposed Sandy Ridge Facility. It is to be noted that the volume of hazardous and intractable wastes received at the proposed Sandy Ridge Facility are likely to be significantly greater than proposed radioactive waste volumes.

3.2 Commonwealth legislation, regulation and guidelines

Licensing of Radioactive Waste Storage and Disposal Facilities March 2013

This Regulatory Guide is directed to proponents applying for a licence under the ARPANS Act (*Australian Radiation Protection and Nuclear Safety Act 1998*) to prepare a site for construction, operation, decommissioning and closure, if that site is intended to be a storage or disposal facility for radioactive waste.

Annex 4 in particular provides guidance on International Best Practice Guidance for the Licence Application for Near-Surface Disposal Facilities. Information is provided from Australian and international guidance documents for consideration in meeting the relevant requirements. It advises that waste acceptance should be undertaken in accordance with Section 2.6 of the *Code of practice for the near-surface disposal of radioactive waste in Australia (1992)*. Guidance on generic waste acceptance criteria for disposal of radioactive waste in Australia is provided in Annex G of *RPS No. 16 Safety Guide for the Predisposal Management of Radioactive Waste (2008)*. There is some additional guidance in *Classification of Radioactive Waste Radiation Protection Series Publication No. 20 (2010).*

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. There was, however, a system of categorising radioactive waste relating to near surface disposal that was included in the *NHMRC Code of practice for the near surface disposal of radioactive waste in Australia (1992) (RHS35)*. At the time, there were three categories of waste recognised to be suitable for near surface disposal, Category A, Category B and Category C, which were pertinent to the IWDF and can be seen in the IWDF waste acceptance criteria (see below). 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. Radioactive waste with higher activity concentrations need to be managed pending access to disposal facilities. It is important that all types of radioactive waste be correctly classified to ensure that appropriate disposal measures can be implemented.

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 a significant impact on a matter of national environmental significance must be referred to the Minister for the Environment. The proposed Sandy Ridge Facility was determined to be a 'controlled action' requiring environmental assessment by one of a number of means, including a Public Environmental Review.

A proposed nuclear action must also be referred to the Minister for the Environment and may be subject to the same environmental assessment processes.

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

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.

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.

Code of practice for the near-surface disposal of radioactive waste in Australia (1992)

The regulatory guidelines for near surface disposal facilities *Code of practice for the near-surface disposal of radioactive waste in Australia (1992)* clearly outline the need to consider the possible

migration of contaminants, especially via leachate formation, over the life of a facility and in geological time frames. It must be safely demonstrated that the proposed Facility can effectively isolate the contaminants from the biosphere

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.

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 Sandy Ridge 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.

Classification and Disposal, Radioactive Waste in Australia - Consideration of Criteria for Near Surface Burial in an Arid Area ARPANSA Technical Report No. 152

In 1986, the National Health and Medical Research Council requested its Radiation Health Standing Committee (RHC) to prepare a code of practice and guidelines on radioactive waste management in order to develop criteria for classifying radioactive waste for disposal and to provide guidance on the selection of sites for near-surface disposal of waste.

This document provides background on the development of the published NHMRC *Code of practice for the near-surface disposal of radioactive waste in Australia* (see above). Although effectively superseded by the *Classification of Radioactive Waste Radiation Protection Series Publication No. 20 April 2010* (see above), this classification is used by the IWDF and has therefore been left in this document as an important reference, and for completeness.

3.3 State legislation, regulation and guidelines

Disposal of Chemical wastes at the Intractable Waste Disposal Facility (Mount Walton East) – Waste Acceptance Guidelines April 2011

Tellus is currently seeking approval for the proposed Facility to be licenced as a Class V landfill. Subject to approval, it will be one of only two Class V landfill sites in Western Australia, the other being the Mount Walton East Intractable Waste Disposal Facility (IWDF), located approximately 6 km East South-East of the proposed Facility. Since first becoming operational in 1992, the IWDF has demonstrated the effective isolation of Class V wastes over many years.

Due to their close proximity, both sites possess very similar geology and environmental conditions, Tellus has carefully considered the WAC and procedures for the IWDF and applied them where appropriate to the proposed Sandy Ridge Facility.

It must be noted that Tellus wishes to have the ability to accept wastes that are excluded from the IWDF provided it can be demonstrated that safe storage or permanent isolation can occur. In order to achieve this, Tellus will formulate strategies for the treatment of certain waste items prior to acceptance.

The IWDF waste acceptance criteria details the generic properties and characteristics that are unsuitable for disposal at the IWDF.

- Liquids.
- Explosive materials.
- Highly flammable materials.

- Highly reactive materials.
- Gases.
- Materials that decompose.

Category S[2] radioactive material.

Department of Environment and Conservation (DEC) Landfill Waste Classification and Waste Definitions 1996 (As amended December 2009)

The Western Australia Department of Environment and Conservation (DEC) Landfill Waste Classification and Waste Definitions 1996 (As amended December 2009) (WCD) is one of the key government issued guidelines utilised to inform the development of the Facility's WAC. It provides detailed descriptions of the five different landfill classifications used in Western Australia, which are presented in Table 3-1

Waste Avoidance and Resource Recovery Regulations 2008

The Waste Avoidance and Resource Recovery Regulation 2008 outlines details of the landfill levy and appoints the landfill owner or licensee as the person liable for payment of the levy for all wastes received.

The Regulation also ensures the operator will record and maintain details of the wastes once received at the facility including:

- The time and date of the delivery.
- The name and licence number of the licensee.
- The volume of the waste disposed of to landfill on the premises and a description of the type of waste.
- Where appropriate and if necessary, the amount of levy payable in respect of the waste.
- Any other particulars relevant to the calculation or verification of the amount of the levy payable by the licensee.

Waste Avoidance and Resource Recovery Levy Regulations 2008

The *Waste Avoidance and Resource Recovery Levy Regulations 2008* sets the levy for waste disposal for all wastes collected within the Perth metropolitan region. Most wastes accepted by the proposed

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[2] *The Code of Practice for the Near Surface Disposal of Radioactive Waste in Australia (1992) states that Category S radioactive material is unacceptable for near-surface disposal. Category S – covers waste that does not meet the specifications of Categories A, B or C. Typically this category will comprise sealed sources, gauges or bulk waste which contains radionuclides at higher concentrations than are allowable under Categories A, B or C.*

Facility will be exempt from the levy by virtue of not being able to be reasonably reused, reprocessed, recycled or used in energy recovery.

Waste Avoidance and Resource Recovery Act 2007

The *Waste Avoidance and Resource Recovery Act 2007* outlines the requirements for the state to develop and maintain a waste strategy, the purpose of which is to provide for long term continuous improvement of waste services, waste avoidance and resource recovery, and set out targets for waste reduction, resource recovery and the diversion of wastes from landfill disposal.

Dangerous Goods Safety Act 2004

The *Dangerous Goods Safety Act 2004* outlines the responsibilities and penalties for persons responsible, directly or indirectly, for storing, handling, or transporting dangerous goods.

The responsibilities include the need to notify in certain instances and occurrences, and for those involved in the storage and handling of dangerous goods to have suitable safety management systems, and for licencing of persons and vehicles involved with the transport of dangerous goods.

The WAC and associated procedures will capture details of transporters and outline reporting requirements for items being stored above ground prior to relocation for In Cell Storage or permanent isolation.

Environmental Protection (Controlled Waste) Regulations 2004

Controlled wastes, by definition, include all liquid waste, and any wastes that cannot be disposed of at a Class I, II or III landfill site. Controlled wastes also include asbestos, clinical or related waste, tyres and waste that has been immobilised or encapsulated. The Department of Environment Regulation regulates the transportation of controlled wastes that may cause environmental or health risks. It does so through the application of the Environmental Protection (Controlled Waste) Regulations 2004. The Regulations provide for the licensing of carriers, drivers and vehicles involved in the transportation of controlled wastes on public roads.

Schedule 1 of the Regulations identifies the waste which is classified as controlled. The waste may also be dangerous goods. Regulations relating to transporting dangerous goods are separate from controlled waste.

Nuclear Waste Storage and Transportation (Prohibition) Act 1999

The *Nuclear Waste Storage and Transportation (Prohibition) Act 1999* prohibits the construction or operation of a nuclear waste storage facility in Western Australia or the use of any place in the State for the storage or disposal of nuclear waste. It also prohibits the transport of nuclear waste in the State. Nuclear waste in this case means material that is or contains a radioactive substance which has been derived from a nuclear reactor, a radioisotope enrichment plant involved in the enrichment of uranium or plutonium, a nuclear reprocessing plant or a nuclear weapons facility, or

from the testing, use or decommissioning of nuclear weapons. Tellus has clearly stated it will not store or dispose of such material.

Environmental Protection Act 1986 and Environmental Protection Regulations 1987

The Department of Environment Regulation (DER) has responsibility under Part V of *the Environmental Protection Act 1986* (EP Act) for the licensing and registration of prescribed premises, the issuing of works approvals and administration of a range of regulations. DER also monitors and audits compliance with works approvals, licence conditions and regulations, takes enforcement actions as appropriate, and implements Departmental licensing and industry regulation policy. DER is responsible for regulating industrial emissions and discharges to the environment through the works approval and licensing process.

The EP Act requires a works approval to be obtained before constructing a prescribed industrial premises and makes it an offence to cause an emission or discharge unless a licence or registration is held for the premises. Prescribed premises categories are outlined in Schedule 1 of the Environmental Protection Regulations 1987.

Table 3-1 Landfill classes and waste types in Western Australia

Landfill class	Common name	Waste types permitted for disposal
Class I (Prescribed Premises Category 63)	Inert landfill	• Clean fill. • Type 1 inert waste. • Contaminated solid wastes meeting waste acceptance criteria specified for Class I landfills (possibly with specific licence conditions). • Type 2 inert waste (with specific license conditions). • Type 3 inert waste (subject to DEC approval). • Type 1 special waste.
Class II (Prescribed Premises Category 64 or 89)	Putrescible landfill	• Clean fill. • Type 1 inert waste. • Putrescible wastes. • Contaminated solid waste meeting waste acceptance criteria specified for Class II landfills (possibly with specific license conditions). • Type 2 inert wastes (with specific license conditions). • Type 1 and Type 2 special wastes (for registered sites as approved under the Controlled Waste Regulations).
Class III (Prescribed Premises Category 64)	Putrescible landfill	• Clean fill. • Type 1 inert waste. • Putrescible wastes. • Contaminated solid waste meeting waste acceptance criteria specified for Class II or Class III landfills (possibly with specific license conditions). • Type 2 inert wastes (with specific license conditions). • Type 1 and Type 2 special wastes.
Class IV (Prescribed Premises Category 65)	Secure landfill	• Clean fill. • Type 1 inert waste. • Contaminated solid waste meeting criteria specified for Class II, Class III or Class IV landfills (possibly with specific license conditions). • Type 2 inert wastes (with specific license conditions). • Type 1 and Type 2 special wastes.
Class V (Prescribed Premises Category 66)	Intractable landfill	• Intractable and other wastes in accordance with the approvals for site.

The WCD provides explanation as to the steps that should be taken to classify waste in order to enable its assignment to the appropriate class of landfill. It provides clear examples of waste types and provides specific examples of hazardous and intractable wastes, which is of particular relevance to the Facility's WAC.

Additionally, contaminant thresholds, leachable concentrations, and concentration limits are stipulated for a wide range of contaminants for Class I to Class IV landfills. The Acceptance Criteria stipulated for Intractable Class V Landfills are to store or treat waste as appropriate.

Radiation Safety (General) Regulations 1983

Regulation 31A of the Radiation Safety (General) Regulations 1983 deals with the Near-surface disposal of radioactive waste. The regulations require a disposal facility, in this case the proposed Facility, to comply with the requirements of the *Code of practice for the near-surface disposal of radioactive waste in Australia (1992).*

Radiation Safety Act 1975

The Radiological Council (the Council) is an independent statutory authority appointed under the *Radiation Safety Act* in Western Australia to assist the Minister for Health to protect public health and to maintain safe practices in the use of radiation. The *Radiation Safety Act 1975* regulates the keeping and use of radioactive substances, irradiating apparatus (e.g. x-ray equipment) and certain electronic products (e.g. lasers, sun-tanning units, and UV transilluminators). The Act applies to both ionising and non-ionising radiation. Registration and licensing are the principal means by which the use of radiation is regulated. Daily administration of the Act is handled by personnel of the Radiation Health Branch.

Section 34 of the *Radiation Safety Act 1975* deals with the issuing of disposal permits by the Council. A disposal permit authorises the holder to deal with the substance, apparatus or product in a manner satisfactory to the Council in accordance with the provisions of, and within the period specified in, that permit.

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Waste Acceptance Criteria and Supporting Documents

TELLUS

SANDY RIDGE FACILITY
WASTE ACCEPTANCE CRITERIA

Final Report | August 2016

Version	Date	Description	Signatures		
			Originator	Checked	Approved
0	10/08/2016	For issue	S. Reece	J. Livesey R. Phillips	D van der Merwe

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ABBREVIATIONS

ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
Bq	Bequerel
EW	Exempt Waste (Radioactive)
The Facility	The Sandy Ridge Facility
g	Gram
HLW	High Level Waste (Radioactive)
IAEA	International Atomic Energy Agency
TECDOC	Technical Document published by IAEA
IBC	Intermediate Bulk Container
ILW	Intermediate Level Waste (Radioactive)
ISO	International Organisation for Standardization
IWDF	Intractable Waste Disposal Facility
km	Kilometres
kPa	Kilopascals
L	Litre
LLW	Low Level Waste (Radioactive)
mSv/y	Milli-Sievert per year
NEPM	National Environmental Protection Measure
NHMRC	National Health and Medical Research Council
NORM	Naturally Occurring Radioactive Materials
PPE	Personal Protective Equipment
Tellus	Tellus Holdings Ltd.
VLLW	Very Low Level Waste (Radioactive)

VSLW	Very Short Lived Waste (Radioactive)
WAC	Waste Acceptance Criteria
WAP	Waste Acceptance Procedure
WZG	Waste Zoning Guidelines

DEFINITIONS

Cell - an excavated area (pit) of kaolin which is below ground level which will be used for *in cell 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 "in cell storage" or "permanent isolation" within a cell.

Dangerous goods – the Dangerous Goods Safety (General) Regulations 2007 defines "dangerous goods" as any substance or article that is:

a) Found to be within any of the following classes or divisions under the Australian Dangerous Goods Code: Class 1, Class 2, Class 3, Class 4, Class 5, Division 6.1, Class 8, or Class 9; unless stated otherwise within the Code.

b) named or described in Schedule 1 of the Environmental Protection (Controlled Waste) Regulations 2004

Geological repository (in the context of Sandy Ridge) - The term geological repository is used to mean a landfill facility constructed and with the equivalent properties of a Class IV or Class V Landfill as defined in Landfill Waste Classification and Waste Definitions 1996 (As amended December 2009) Western Australia Department Of Environment And Conservation. In the context of Sandy Ridge this means an arid near-surface facility used to permanently isolate waste. Geological repositories provide the highest levels of containment through the use of carefully selected natural geological barriers rather than reliance on man-made liner systems and are increasingly recognised as a cost effective and preferred method of permanently isolating difficult to manage wastes. The geological barrier provides permanent isolation of wastes from the environment over the very long term and creates additional opportunities for the future recovery and recycling of valuable materials from the waste which can re-enter the circular economy.

Hazardous waste - Component of the waste stream which by its characteristics poses a threat or risk to public health, safety or the environment (includes substances which are toxic, infectious, mutagenic, carcinogenic, teratogenic, explosive, flammable, corrosive, oxidising and radioactive). As defined in Landfill Waste Classification and Waste Definitions 1996 (As amended December 2009) Western Australia Department Of Environment And Conservation

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

Intractable Waste - Waste which is a management problem by virtue of its toxicity or chemical or physical characteristics which make it difficult to dispose of or treat safely, and is not suitable for disposal in Class I, II, III and IV landfill facilities. As defined in Landfill Waste Classification and Waste

Notice and Certification Assurance program - 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©.

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

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

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 Sandy Ridge 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 Sandy Ridge Facility

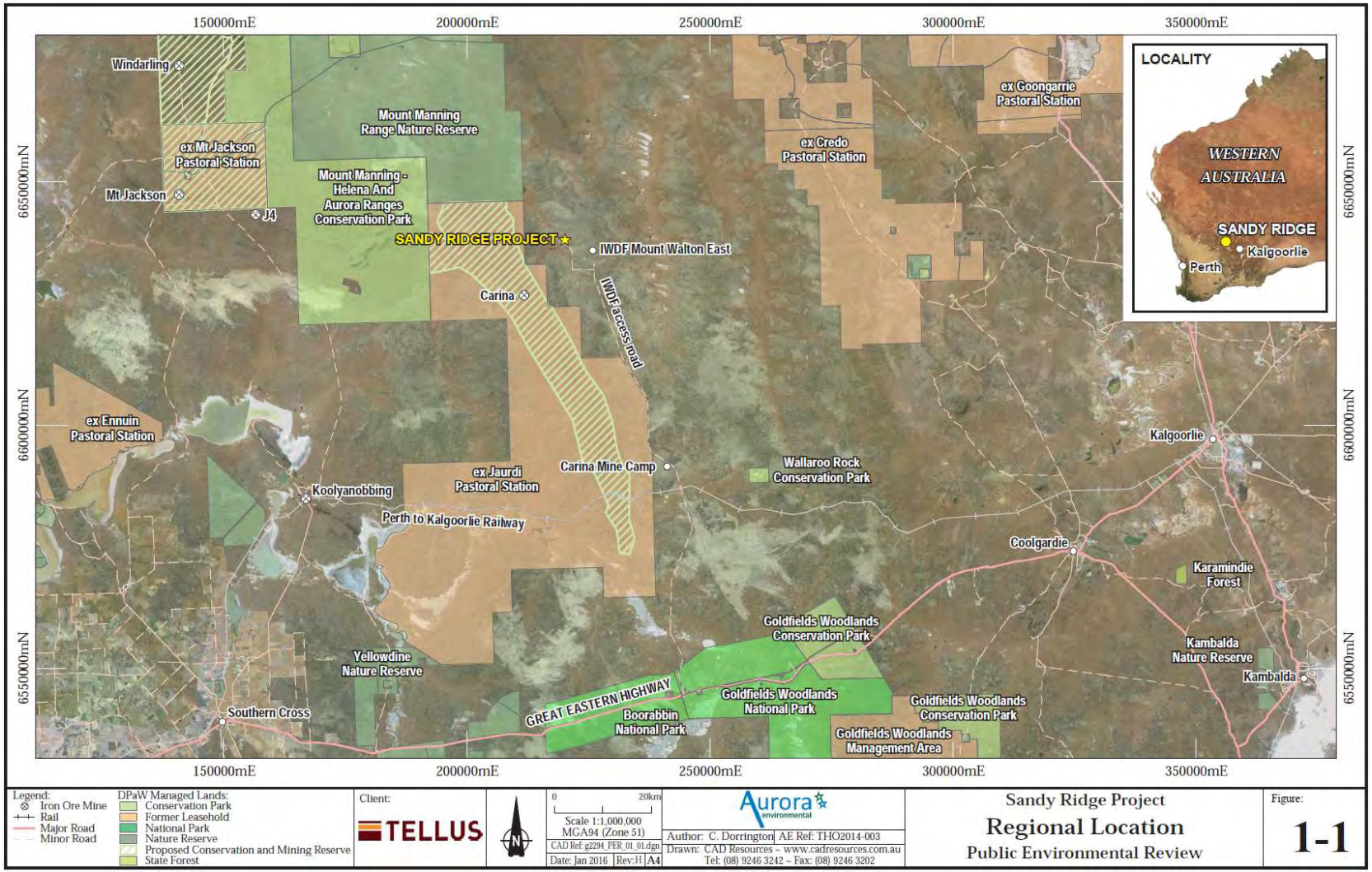
The proposed Sandy Ridge Facility (hereby referred to as the proposed "Facility") is a dual use kaolin mine with the voids created by mining used to store and permanently isolate hazardous and intractable wastes. The site is located approximately 75 km northeast of Koolyanobbing, in the Shire of Coolgardie, within the Goldfields Region of Western Australia (Figure 1-1).

The location for the Facility was specifically chosen as its principal characteristics; semi–arid climate, high rates of evaporation, geologically stable, natural geological barriers, no regional aquifer, no surface water receptors, no flooding, low erosion rates, no heritage values, topography etc. satisfy the requirements for a near surface geological repository for intractable and hazardous waste storage and isolation purposes.

There are no sensitive receptors within the immediate vicinity of the proposed Facility. The nearest operation is the Class V IWDF Mount Walton East Intractable Waste Disposal facility located approximately 6 km to the east, which operates on a campaign basis and does not have permanent residents. The nearest mining camp is the Carina Iron Ore Mine accommodation village located approximately 52 km to the south east of the proposed Facility.

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.

Figure 1-1: Sandy Ridge site location



1.2 Document Aims and Objectives

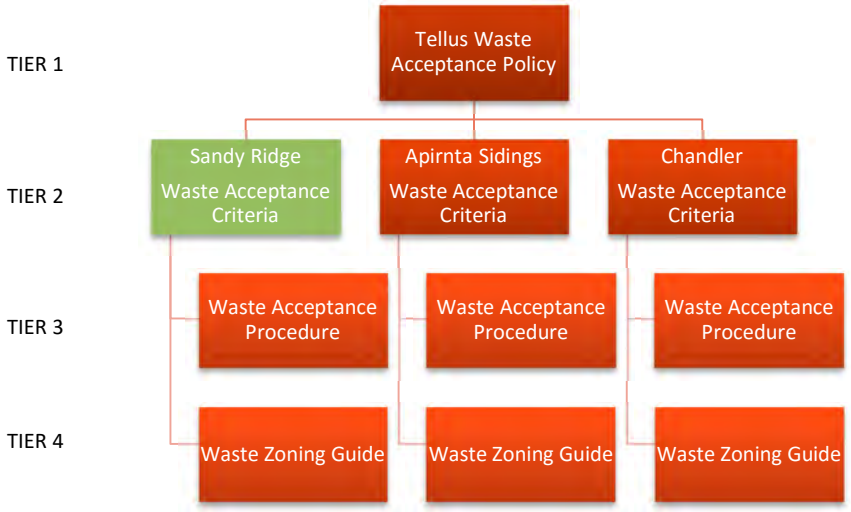
The aim of this document is to present the Waste Acceptance Criteria (WAC) that will be applied at the Facility. This document should be read in conjunction with the following:

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

This document is part of a hierarchy of documents and is the tier 2 document which covers the WAC. Lower tier documents provide greater detail on specific criteria and procedures.

The document hierarchy is presented in Figure 1-2, which includes an equivalent suite of documents for Tellus' Northern Territory Chandler Project.

Figure 1-2: Waste Acceptance Criteria Document Hierarchy



The objective of the Sandy Ridge 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.

1.3 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 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. Tellus will apply for a Licence (Controlled Action under Commonwealth legislation) to accept non-nuclear low level radioactive waste (LLW) such as sealed sources. The Sandy Ridge Environmental Scoping Document and Draft Public Environmental Review state the wastes which will not be disposed of at the proposed Facility which include; infectious materials, nuclear material[1], intermediate and high level radioactive waste, 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 waste acceptance classifications at Sandy Ridge

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

2.2 Excluded waste criteria

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 the Mount Walton East Intractable Waste Disposal Facility (IWDF), wastes that may undergo undesired physical, chemical or biological transformation after they have been deposited will not be accepted at Sandy Ridge.

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 Sandy Ridge Facility

[1] *Nuclear material as defined in the Nuclear Waste Storage and Transportation (Prohibition) Act 1999 - 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*

unless they can be modified to a form that makes them suitable for storage or permanent isolation, and they subsequently pass the WAP tests.

2.2.1 Liquids

Unless they can undergo solidification/stabilisation processing 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 clay.

Although the adsorbent properties of the surrounding kaolin formation will prevent movement of the wastes off-site, it is possible that the loss of volume could damage the cap and allow infiltration of water into the cell. 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 cell capping.

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) **in the conditions of storage**[2] are not acceptable;

- 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 may not be suitable for permanent isolation at the Facility. This would depend on several factors such as the rapidity of vapour or gas generation and the reactions involved and should be assessed by a suitably qualified person prior to acceptance being confirmed.

[2] *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 is permanently isolated within a disposal cell.*

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 be acceptable for permanent isolation if they require an open flame and oxygen for combustion since in the conditions of storage they will be buried in an environment essentially devoid of both these characteristics. Class 4.3 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 may 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 cell, resulting in subsequent damage to the capping system. This, in turn, leads to possible water infiltration into the cell, and uncontrolled escape of the gas to the atmosphere.

2.2.6 Infectious materials

Infectious wastes such as "Clinical wastes" as defined in the *Environmental Protection (Controlled Wastes) Regulation 2004* includes 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.

The "Clinical and Related Waste Management Policy" has been developed and adopted by the Government of Western Australia, Department of Health to control the permanent isolation of clinical wastes.

2.2.7 Biodegradable materials

The IWDF *Waste Acceptance Guidelines*[3] state that materials that are likely to decompose and produce combustible hazardous gases, or wastes that decompose and become compressible are not suitable for near-surface disposal, since any significant volume reduction could compromise the integrity of the capping system. In addition, gases generated within a waste cell have the potential to create subsurface pathways, which could provide a route for subsequent rainwater ingress to the cell. Such materials include organic, domestic wastes.

2.2.8 Nuclear material

The *Nuclear Waste Storage and Transportation (Prohibition) Act 1999,* defines nuclear waste as material that is, or contains, a radioactive substance, provided that the material in question is either waste from a nuclear plant, or waste resulting from the testing, use or decommissioning of nuclear weapons, whether that material has been reprocessed or not. Wastes classified as nuclear wastes will not be accepted at the proposed Sandy Ridge 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.

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[3] *Disposal Of Chemical Wastes At The Intractable Waste Disposal Facility, Mt Walton East Waste Acceptance Guidelines April 2011 Revision*

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 be generated from industry. Examples of these wastes and their NEPM code are listed in Table 2-2.

Table 2-2: Example chemical wastes likely to be suitable for permanent isolation at Sandy Ridge

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
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

2.4 Radioactive 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 still be categorised as low level wastes.

- Intervention actions, which are necessary after accidents or to remediate areas affected by past practices.
- Medicine, research and industry (use of radioisotopes and sealed radioactive sources which contains low activity concentrations).
- Permanent isolation of disused sealed radioactive sources (including orphan sources).

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

Radioactive waste is defined as radioactive material in gaseous, liquid or solid form for which no further use is foreseen, and which is controlled as radioactive waste by a regulatory body.

In Australia there are two principal documents which discuss the classification of radioactive waste:

- The ARPANSA Safety Guide for the *Classification of Radioactive Waste* (2010) (RPS20).
- NHMRC *Code of practice for the near surface disposal of radioactive waste in Australia* (1992) (RHS35).

A system of categorising radioactive waste relating to near surface disposal is proposed in the NHMRC Code of practice. The classification was based on international recommendations for radioactive waste management adapted for the type of waste generated in Australia.

The categories suitable for near surface disposal are Category A, Category B and Category C. Category S is not suitable for near surface disposal. This classification summarised in Table 2-3. The classification is only used by regulatory authorities to classify waste destined for disposal, not as a general classification system.

Table 2-3: Code of practice for the near surface disposal of radioactive waste in Australia (1992) - waste classification summary

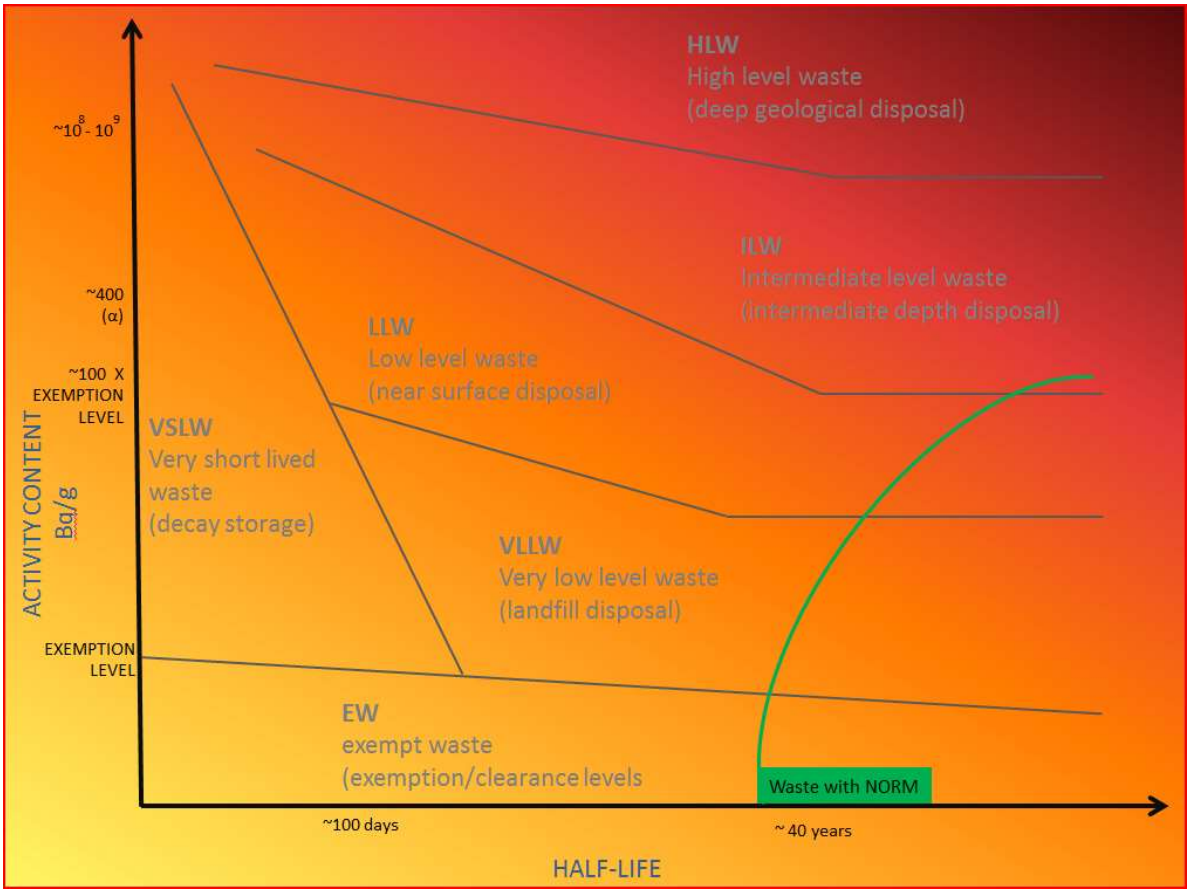
Waste category near surface code	Definition
Category A waste	Category A waste covers solid waste with radioactive constituents, mainly beta or gamma emitting radionuclides. Long-lived alpha-emitting radionuclides should only be present at very low concentrations. This category of waste will comprise, predominantly, lightly contaminated or activated items such as paper, cardboard, plastics, rags, protective clothing, glassware, laboratory trash or equipment, certain consumer products and industrial tools or equipment. It may also comprise lightly contaminated bulk waste from mineral processing or lightly contaminated soils.
Category B waste	Covers solid waste and shielded sources with considerably higher activities of beta- or gamma-emitting radionuclides than Category A waste. Long-lived alpha-emitting radionuclides should be at relatively low levels. This category of waste will comprise, typically, gauges and sealed sources used in industry, medical diagnostic and therapeutic sources or devices, and small items of contaminated equipment.
Category C waste	Covers solid waste containing alpha-, beta- or gamma-emitting radionuclides with activity concentrations similar to those for Category B. However, this waste typically will comp rise bulk materials, such as those arising from downstream processing of radioactive minerals, significantly contaminated soils, or large individual items of contaminated plant or equipment for which conditioning would prove to be impractical
Category S waste	Covers waste that does not meet the specifications of Categories A, B or C. Typically this category will comprise sealed sources, gauges or bulk waste which contains radionuclides at higher concentrations than are allowable under Categories A, B or C.

The classification of radioactive waste has been defined in international standards developed by the International Atomic Energy Agency (IAEA). The ARPANSA *Safety Guide for Classification of Radioactive Waste (2010)* largely reflects this international guidance. It does not include quantitative values of allowable activity content for each significant radionuclide.

Radioactive waste generated in Australia generally falls within the very short lived waste (VSLW), very low level waste (VLLW), low level waste (LLW) or intermediate level waste (ILW) classifications. Australia does not generate any electricity from nuclear power and therefore currently does not generate any used fuel that would be classified as high level waste (HLW).

Figure 2-1 presents a conceptual illustration of the waste classification system and potential permanent isolation options. Tellus is seeking approval to accept radioactive wastes that will fall into the EW, VSLW, SLW and LLW classifications.

Figure 2-1 Conceptual illustration of the waste classification system and potential permanent isolation options



2.4.3 Acceptance criteria

The effective management of EW, VSLW, VLLW and LLW depends on knowledge of the waste characteristics and the contained radioactivity.

The proposed Facility seeks approval for a wide variety of waste, ranging from lightly contaminated soil to sealed sources. The design of the Facility allows for a range of containers to be used for different types of waste, for example 200-litre drums and engineered concrete canisters or other modular containers or structures that meet containment and structural requirements

The property of radioactive waste varies, not only in terms of radioactive content and activity concentration but also in terms of physical and chemical properties. A common characteristic of all radioactive waste is its potential to present a hazard to people and to the environment, and it must be managed so as to reduce any associated risk to acceptable levels as defined by regulations which consider both the operational and post closure phases the Facility.

Predisposal management of radioactive waste

The overall objective of predisposal management of radioactive waste is to produce waste packages that can be handled, transported, stored and disposed securely and safely. In addition to compliance with individual dose limits, the practices that are adopted in waste conditioning, such as grouting, packaging and other containment, shall be carried out so that any potential exposure will be as low as reasonably achievable.

A brief summary of how Tellus proposes to manage radioactive waste accepted at the proposed Facility is presented below. More detail on exposure control and waste management practices is given in the Radioactive Waste Management Plan.

NORM containing pastes, sludges and liquids

Once delivered to site, NORM containing pastes, sludges or liquids will be stored in the radioactive waste warehouse or in sea containers on hardstand (dependent upon activity). In campaigns, waste will be unpacked, inspected and verified by laboratory testing. If required, the waste will then be treated with absorbent and pozzolanic materials to form slurry, which will solidify and stabilise the waste. The slurry can be poured into drums, moulds, or contained sections of the cell where it will set. This waste will then be covered with kaolin or other suitable material which will be compacted to maintain structural integrity of the cell.

Contaminated solid materials

Contaminated solid material such as pipes and valves will be stored in the radioactive waste warehouse or in sea containers on a hardstand (dependent upon activity) until suitable space is available in cell. Depending upon physical size and shape of materials, type and activity of radiation, these wastes will either be:

- Compacted into drums and filled with kaolin or cement grout prior to permanent isolation.
- Crushed or cut to remove void space and remaining voids filled in with cement grout or kaolin solids.
- Placed in a sea-container in the cell, holes cut in top of container and all void space filled with cement grout.

These actions are taken to remove void space in the materials which could cause structural instability within the cell with the potential to disturb the cell cap.

Contaminated soil or sands (bulk material)

Bulk contaminated soils or sands will be delivered to site in either bulk bags, shipping containers or other appropriate transport vehicles, depending on volume and physical characteristics of the material. Where possible, transport will be arranged to coincide with a campaign so it can be disposed of directly into a cell, but if not viable, the material will be stored in the radioactive waste warehouse. For large volumes of material, separate stockpile areas will be set up (ad hoc stockpiles),

and dust control measures introduced. These are discussed in the Radiation Management Plan and include a designated stockpile area with concrete slab and bunded walls, closing stockpile with tarp material, dust suppression agents and a monitoring program to confirm efficiency of controls implemented. The bulk material can be disposed of directly in the cell, diluted or mixed with other material, or set in concrete if required.

NORM and bulk wastes

In order to derive activity concentrations limits for individual radionuclides in NORM and bulk wastes, two criteria have been used:

- Dose rate to a human receptor post closure (with capping material in place) to not exceed a dose constraint of 0.3 mSv in a year. An occupancy of 3.5 days a year was assumed as per ARPANSA TRS No. 141 for an arid and remote site.
- Dose rate to a human receptor upon intrusion (no capping) corresponding to 10mSv/y. as per ICRP guidance on radiological criteria applied to human intrusion.

The RESRAD (Onsite) code was used, to determine radionuclide activity concentration levels in bulk NORM wastes which would give rise to conditions as specified above for post closure and intrusion scenarios. Details of assessment are presented in the Radiological Risk Assessment: Post Closure report. Table 2-4 summarises the radionuclide restrictions that will be applied at the Facility for the disposal of NORM bulk wastes.

For bulk NORM wastes having mixtures of radionuclides, an additional constraint should be adhered to so that the total dose from all radionuclides should not exceed relevant dose limits or constraints. This is referred to as the summation rule and requires the following constraint:

$$\sum_i Q_i / Q_{i,l} <= 1$$

Where Q_i (Bq) is the actual activity of radionuclide i to be disposed and $Q_{i,l}$ (Bq) is the activity limit for radionuclide if it were the only radionuclide to be disposed of.

Table 2-4: Waste Acceptance Criteria (WAC) for the Facility for bulk NORM waste

Radionuclides	Half Life	Individual Radionuclide Activity Concentration of Bulk NORM Waste (Bq/g)
		(Bq/g) to achieve 10 mSv/y upon Intrusion
U-238	4.468 billion years	1.0E+05
U-234	246,000 years	2.0E+06
Th-230	75,380 years	1.2E+04

U-235	703.8 million	2.2E+04
Pa-231	32,760 years	7.1E+03
Ra-226	1600 years	1.8E+03
Th-232	14.05 billion years	1.1E+03

Sealed sources

Sealed sources will, upon receipt, be stored in the radioactive waste warehouse, unpacked, inspected and verified. After verification, sources will be secured in a 60 L drum inside a 200 L drum. Cement slurry will be added to the 60 L drum to fill all the void spaces and to cover all the items. The cement filled 60 L drums will be placed in the centre of a 200 L drum, which will then be filled with concrete or equivalent materials. The 200 L drum will be marked with its identification number and labelled. These drums will be stored until the shaft is prepared for disposal. Drums will then be transferred to the cell, loaded into the shaft and covered with fill/grout.

WAC for the facility are based on the design of the facility, including, but not limited to, such items as the engineered barriers, duration of institutional control and site specific characteristics such as geology, low rainfall, lack of receptors, etc.

The activity of the radionuclides present in the radioactive waste packages will be limited in such a way that the radiological impact of the site remains within acceptable levels during the operational and post-closure phases of the site. In accordance with International Atomic Energy Agency (IAEA) waste are considered as a function of their half-life and activity concentration. Radiation doses to the public and workers as a consequence of waste management, storage and disposal activities are not to exceed the dose limits in Regulations 59 and 60 of the ARPANS Regulations. The effective dose limit for occupational exposure is 20 mSv annually, averaged over 5 consecutive calendar years. However, the effective dose for a person subject to occupational exposure must not, in a year, be greater than 50 mSv. The effective dose limit for public exposure is 1 mSv annually).

The ARPANSA *Licensing of Radioactive Waste Storage and Disposal Facilities March 2013* explains that waste acceptance should be undertaken in accordance with Section 2.6 of the Near-Surface Disposal Code, Specific criteria and requirements for waste acceptance and disposal. Guidance on determining waste activity limits for low level waste in near-surface disposal facilities is found in the IAEA TECDOC *Derivation of Activity Limits for the Disposal of Radioactive Waste in near Surface Disposal Facilities* (IAEA-TECDOC-1380, 2003).

The following generic limits will be adopted for the Sandy Ridge Facility (Category B levels as per NHMRC (1992) and ARPANSA (2010)). Waste packages with activity concentration greater than those specified in Table 2-5 will not be accepted for disposal without reassessing the safety case and seeking approval from the relevant regulatory bodies.

Waste acceptance criteria, and the specific limitations on activity, will follow the safety analysis, during operations and for the long term, taking into account the applicable radiological criteria. The

Sandy Ridge site meets the general criteria for a near surface geological repository set by the NHMRC (1992).

Table 2-5: Generic Concentration Limits for Sealed sources-LLW for 100 year Institutional Control Period (ICP) [Ref NHMRC (1992)]

LLW	Concentration limit (Bq/kg)	Concentration limit (Bq)[4]
	100 years	100 years ICP
Tritium	1.00E+11	2.00E+13
Carbon-14	5.00E+08	1.00E+11
Radium-226	5.00E+06	1.00E+09
Alpha (α) emitting radionuclides (Am-241,U-238,PU-239)	1.00E+08	2.00E+10
Beta (B) /gamma (γ)emitters with half-lives > 5y	1.00E+09	2.00E+11
Beta (B) /gamma (γ)emitters with half-lives ≤ 5y	no limit	no limit

Table 2-6 summarises the Waste Acceptance Criteria (WAC) proposed for the disposal of Sealed Sources. The activity of the radionuclides present in the radioactive waste packages will be limited in such a way that the radiological impact of the site is within the dose constraint limits under foreseeable circumstances. Sources at activity Concentration levels above those specified in the table will not be accepted for permanent isolation without re-assessing the safety case and seeking approval from the relevant regulatory bodies.

[4] *Assumes a bulk density of 1 kg/L. The concentration of a radionuclide in the waste package as presented for disposal is calculated by averaging the activity of the source over the weight of the whole conditioned package. For example, the activity of sealed sources, which have been conditioned by being embedded in a solid matrix, can be averaged over the weight of the solid waste matrix. However, to reduce the risks from any future inadvertent intrusion, only one sealed source should be incorporated in a single conditioned package. An industrial gauge source in its approved housing will most likely meet the requirements for disposal if embedded in concrete. In practice, a limit on the maximum activity per package for beta/gamma emitting radionuclides with half-lives of 5 years or less, including cobalt-60, will be imposed by occupational and transport considerations. ARPANSA (2010) Technical Report No. 152)*

Table 2-6: limits for common sources based on NHMRC near surface code (1992)

Radioisotope	Symbol	Half-life	Decay	Concentration limit (Bq)*
				100 years ICP
Americium-241	Am-241	432.17 y	α	2.00E+10
Barium-133	Ba-133	10.74 years	EC	no limit
Caesium-137	Cs-137	30.07 years	γ/β	2.00E+11
Californium-252	Cf-252	2.6 years	α	2.00E+10
Carbon-14	C-14	5 715 years	β	2.00E+11
Chlorine-36	Cl-36	301,000 years	β	2.00E+11
Chromium-51	Cr-51	2.7 days	EC	no limit
Cobalt 57	Co-57	271.8 days	EC	no limit
Cobalt-60	Co-60	5.27 years	γ	no limit
Gold-198	Au-198	2.7 days	β	no limit
Hydrogen-3 (tritium)	H-3	12.32 years	β	2.00E+11
Indium-111	In-111	2.80 days	EC	no limit
Iodine-129	I-129	15.7 million years	β	2.00E+10
Iridium-192	Ir-192	73.8 days	γ/B	2.00E+10
Krypton-85	Kr-85	10.5 years	β	2.00E+11
Iron-55	Fe-55	2.74years	EC	no limit
Lead-210	Pb-210	22.6 years	β	2.00E+11
Manganese-54	Mn-54	312.1 days	EC	no limit
Molybdenum-99	Mo-99	66 hours	β	no limit
Nickel-63	Ni-63	96 Years	β	2.00E+11
Polonium-210	Po-210	138 days	α	2.00E+10
Radium-226	Ra-226	1,600 years	α	1.00E+09
Selenium-75	Se-75	120 days	γ	no limit
Sodium-22	Na-22	2.6 years	γ	no limit
Strontium-90	Sr-90	28.8 years	β	2.00E+11
Technetium-99m	Tc-99m	6.01 days	γ	no limit
Thallium-204	Tl-204	3.78 years	β	no limit
Thulium-170	Tm-170	129 days	β	no limit
Ytterbium-169	Yb-169	32 days	EC	no limit
Zinc-65	Zn-65	243.87 days	EC	no limit

**(alpha (α), Beta (β), Gamma (γ) or Electro capturing (EC))*

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.1

3.1 Packaging criteria

The original IWDF *Waste Acceptance Guidelines* 2011 provide clear criteria for the packaging of waste for delivery to the Mount Walton East site, which is presented below. Tellus have considered the IWDF packaging requirements to be consistent with industry best practices; therefore 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 at the point of delivery.
- Be free of 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.

3.2 Mitigating package failure

It can be anticipated that packaging containers have the potential to fail in the conditions of storage if no other consideration is given to the form of the packaging and wastes contained therein. To minimise the likelihood and potential impacts of packaging failure, the following measures are required to be undertaken:

- Void spaces inside containers are to be minimised – packages shall be grout filled or similar to remove voids inside any container that will be disposed with the waste.
- Low density wastes (PPE etc.) should be baled or similarly compacted to the highest density reasonably and practicably achieved (as close to 200 kPa as practical to be consistent with the available backfill materials). This compaction activity should be undertaken prior to any grout filling.
- Low density wastes should be identified so that, as far as practicable during the receival activity at site, be segregate for special attention in the development of the cell filling plan.
- Low density waste should be packaged in smaller vessels, or should be packaged and disposed as long shallow packages to reduce the scale of any settlement or failure.

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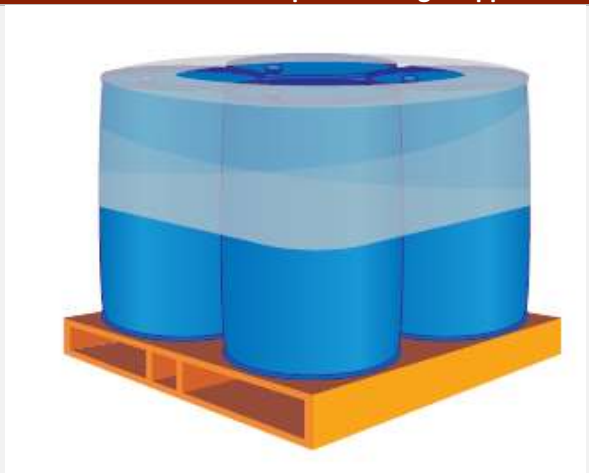
A.1 Potential waste category list

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

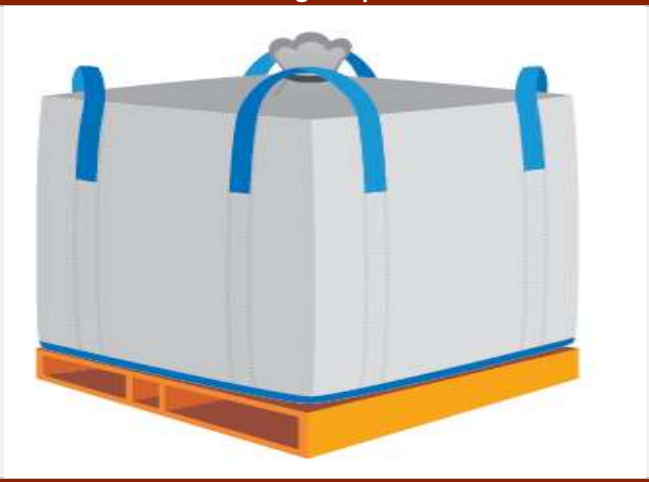
Common industrial hazardous waste (NEPM basis)	
Phosphorus compounds excluding mineral phosphates	D360
Polychlorinated dibenzo-furan (any congener)	M170
Polychlorinated dibenzo-p-dioxin (any congener)	M180
Residues from industrial waste treatment/disposal operations	N205
Selenium; selenium compounds	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.2 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

Waste Acceptance Criteria and Supporting Documents

TELLUS

TELLUS

SANDY RIDGE FACILITY WASTE ACCEPTANCE PROCEDURE

Final Report | August 2016

Version	Date	Description	Signatures		
			Originator	Checked	Approved
0	10/08/2016	Issued for use	S. Reece	J.Livesey R.Phillips	D van der Merwe

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ABBREVIATIONS

AC	Acceptance Certificate
ASTM	American Society for Testing and Materials
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
Bq	Becquerel
The Facility	The Sandy Ridge Facility
IAEA	International Atomic Energy Agency
IAEA TECDOC	Technical Document published by IAEA
IBC	Intermediate Bulk Container
ISO	International Organisation for Standardization
IWDF	Intractable Waste Disposal Facility
kPa	Kilopascals
m	metre
MSDS	Material Safety Data Sheet
NEPM	National Environmental Protection Measure
NHRMC	National Health and Medical Research Council
NORM	Naturally Occurring Radioactive Materials
PIC	Permanent Isolation Certificate
PPE	Personal Protective Equipment
SC	Storage Certificate
Tellus	Tellus Holdings Ltd.
TOC	Total Organic Carbon
WAC	Waste Acceptance Criteria
WAP	Waste Acceptance Procedures

WCD	Waste Classification Definitions
WZG	Waste Zoning Guidelines

DEFINITIONS

Cell - an excavated area (pit) of kaolin which is below ground level which will be used for *in cell 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 "in cell storage" or "permanent isolation" within a cell.

Dangerous goods – the Dangerous Goods Safety (General) Regulations 2007 defines "dangerous goods" as any substance or article that is:

a) Found to be within any of the following classes or divisions under the Australian Dangerous Goods Code: Class 1, Class 2, Class 3, Class 4, Class 5, Division 6.1, Class 8, or Class 9; unless stated otherwise within the Code.

b) named or described in Schedule 1 of the Environmental Protection (Controlled Waste) Regulations 2004

Geological repository (in the context of Sandy Ridge) - The term geological repository is used to mean a landfill facility constructed and with the equivalent properties of a Class IV or Class V Landfill as defined in Landfill Waste Classification and Waste Definitions 1996 (As amended December 2009) Western Australia Department Of Environment And Conservation. In the context of Sandy Ridge this means an arid near-surface facility used to permanently isolate waste. Geological repositories provide the highest levels of containment through the use of carefully selected natural geological barriers rather than reliance on man-made liner systems and are increasingly recognised as a cost effective and preferred method of permanently isolating difficult to manage wastes. The geological barrier provides permanent isolation of wastes from the environment over the very long term and creates additional opportunities for the future recovery and recycling of valuable materials from the waste which can re-enter the circular economy.

Hazardous waste - Component of the waste stream which by its characteristics poses a threat or risk to public health, safety or the environment (includes substances which are toxic, infectious, mutagenic, carcinogenic, teratogenic, explosive, flammable, corrosive, oxidising and radioactive). As defined in Landfill Waste Classification and Waste Definitions 1996 (As amended December 2009) Western Australia Department Of Environment And Conservation

In Cell Storage - medium to long term below ground storage of wastes inside a cell with ongoing opportunity to recover waste if required.

Intractable Waste- Waste which is a management problem by virtue of its toxicity or chemical or physical characteristics which make it difficult to dispose of or treat safely, and is not suitable for disposal in Class I, II, III and IV landfill facilities. As defined in Landfill Waste Classification and Waste

Definitions 1996 (As amended December 2009) Western Australia Department Of Environment And Conservation

Permanent Isolation - indefinite below ground storage of wastes determined suitable for acceptance.

Storage - the short term above ground storage of materials following delivery and includes the time awaiting sampling, analysis and management prior to movement for “in cell storage”.

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 Sandy Ridge 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 Sandy Ridge Facility

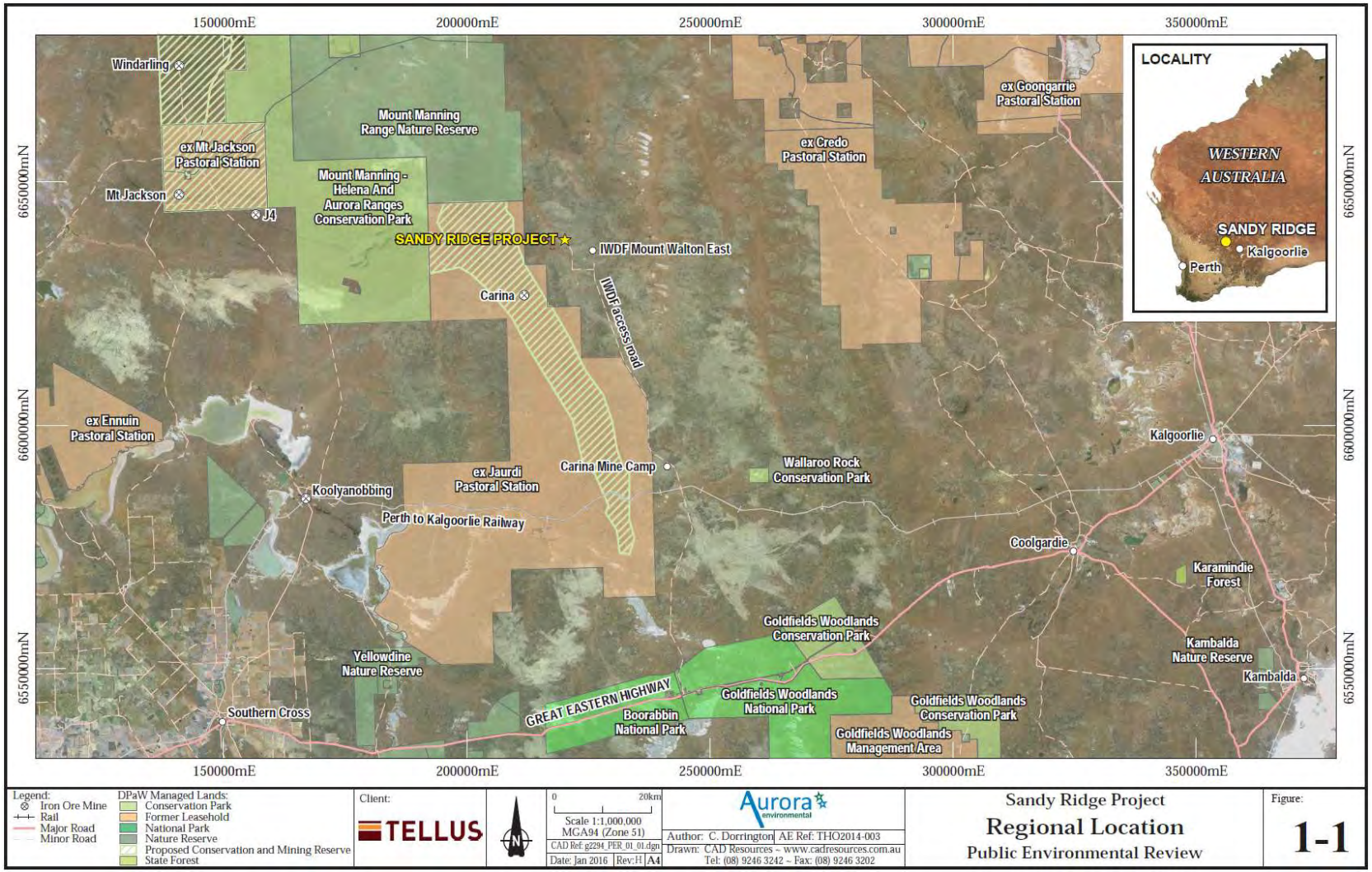
The proposed Sandy Ridge Facility (hereby referred to as the proposed "Facility") is a dual use kaolin mine with the voids created by mining used to store and permanently isolate hazardous and intractable wastes. The site is located approximately 75 km northeast of Koolyanobbing, in the Shire of Coolgardie, within the Goldfields Region of Western Australia (Figure 1-1).

The location for the Facility was specifically chosen as its principal characteristics; semi–arid climate, high rates of evaporation, geologically stable, natural geological barriers, no regional aquifer, no surface water receptors, no flooding, low erosion rates, no heritage values, topography etc. satisfy the requirements for a near surface geological repository for intractable and hazardous waste storage and isolation purposes.

There are no sensitive receptors within the immediate vicinity of the proposed Facility. The nearest operation is the Class V IWDF Mount Walton East Intractable Waste Disposal facility located approximately 6 km to the east, which operates on a campaign basis and does not have permanent residents. The nearest mining camp is the Carina Iron Ore Mine accommodation village located approximately 52 km to the south east of the proposed Facility.

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.

Figure 1-1: Sandy Ridge site location



1.2 Document aims and objectives

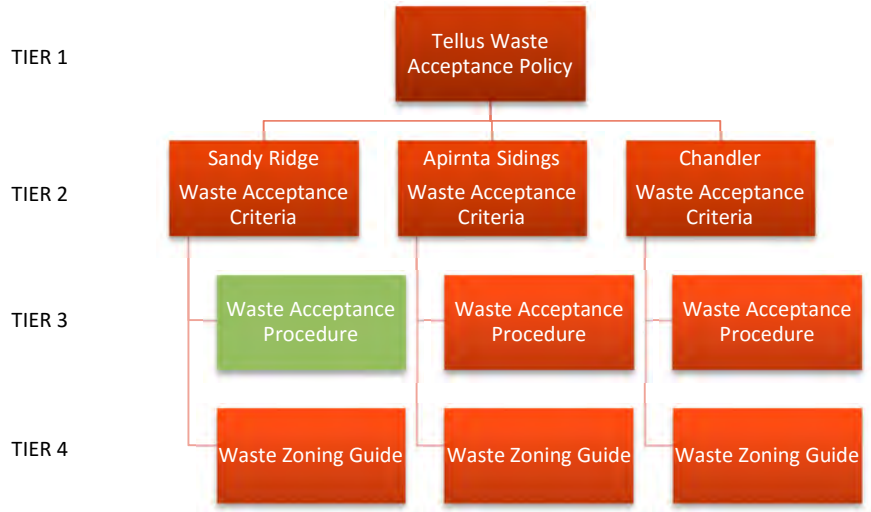
The aim of this document is to present the Waste Acceptance Procedure (WAP) that will be used at the proposed Sandy Ridge Facility to determine if wastes meet all of the acceptance criteria. This document should be read in conjunction with the following:

- Tellus Waste Acceptance Policy.
- Sandy Ridge Waste Acceptance Criteria (WAC).
- Sandy Ridge 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[1] 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' Northern Territory Chandler Project which includes the Apirnta rail sidings where waste acceptance will be carried out..

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

[1] *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 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 in cell storage or permanent isolation at the Sandy Ridge facility.

1.3 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 Sandy Ridge 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[2], 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.

For acceptance at the proposed Sandy Ridge Facility wastes need to continually meet the acceptance criteria laid down for the site in 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 a cell 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[3] 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.

3.1 Basic characterisation[4]

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

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

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 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 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 Sandy Ridge 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.

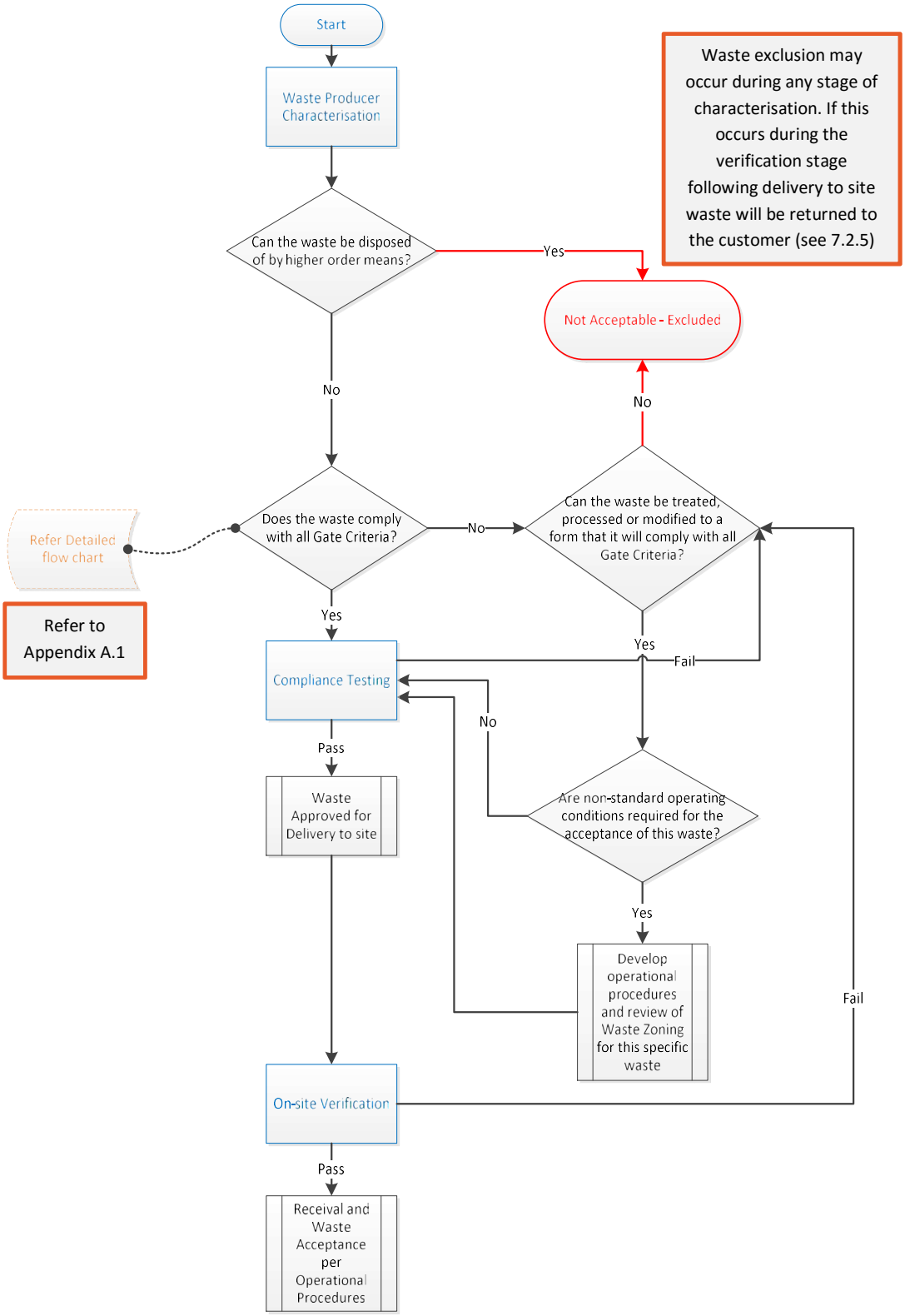
4 GATED WASTE ACCEPTANCE PROCEDURE

A gated WAP using specified test methods and criteria values will 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 Sandy Ridge 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 Appendix A.1 for Detailed Flow Chart)



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 have referred to the National Environment Protection (Movement of Controlled Waste between States and Territories) Measure 1998 Schedule A and the Western Australia Environmental Protection (Controlled Waste) Regulations 2004 Schedule 1 Controlled waste list.

A waste producer 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 in cell 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 likely 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[5]" will enable the waste to be accepted at the Sandy Ridge site for storage.

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.

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[5] *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 . 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 <u>any</u> 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 Sandy Ridge. 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 in cell 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 in cell 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 in cell 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 in cell 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.

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

Gate 7 – Is the waste biodegradable?

Waste that is biodegrade, either by aerobic or anaerobic decomposition, are considered unacceptable for in cell 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%[6] then it will be deemed acceptable for storage and permanent isolation at Sandy Ridge 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.

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.

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

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 are a controlled waste, as listed in Schedule 1 of the Environmental Protection (Controlled Waste) Regulations 2004.

Used tyres pose an environmental pollution risk mainly due the potential discharges and emissions from tyre fires. In certain circumstances tyres, or the products of tyre reprocessing may be accepted for 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 clay 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 containing persistent organic pollutants 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 the cell storage conditions (i.e. the pressure experienced by a the bottom bulk bag at the bottom of the cell). 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.

A representative sample of the waste will be thoroughly mixed and subjected to a differential pressure of 1.5 bar 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 clay?

Wastes may have the potential to react with the host Kaolin clay. If basic characterisation indicates the presence of any substance that is known to have the potential to react adversely with kaolin clay, the waste will be tested to determine if there is any reaction that may adversely affect the integrity of the clay 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 kaolin clay from the Sandy Ridge 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 kaolin 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*[7] 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

[7] *Section 2.6 of the Near-Surface Disposal Code, Specific criteria and requirements for waste acceptance and disposal.*

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 Sandy Ridge cells is not expected.

Gate 12.2 – Radiological acceptance criteria

Refer to Section 5 of this procedure for specific activity and half-life values for radioactive waste acceptance.

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).

The original IWDF *Waste Acceptance Guidelines* 2011 provide clear criteria for the packaging of waste for delivery to the Mount Walton East site, which is presented below. Tellus have considered the IWDF packaging requirements to be consistent with industry best practices; therefore waste packaging delivered to the proposed Facility should 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 at the point of delivery
- Be free of 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.

It should be anticipated that packaging containers have the potential to fail in the conditions of storage if no other consideration is given to the form of the packaging and wastes contained therein. To minimise the likelihood and potential impacts of packaging failure, the following measures are required to be undertaken:

- Void spaces inside containers are to be minimised – packages shall be grout filled or similar to remove voids inside any container that will be disposed with the waste.
- Low density wastes (PPE etc.) should be baled or similarly compacted to the highest density reasonably and practicably achieved (as close to 200kPa as practical to be consistent with the available backfill materials). This compaction activity should be undertaken prior to any grout filling.
- Low density wastes should be identified so that, as far as practicable during the receival activity at site, be segregate for special attention in the development of the filling plan.
- Low density waste should be packaged in smaller vessels, or should be packaged and disposed as long shallow packages to reduce the scale of any settlement or failure.

5 RADIOACTIVE WASTE

5.1 Waste Acceptance Procedure for radioactive waste

WAC for the facility are based on the design of the facility, including, but not limited to, such items as the engineered barriers, duration of institutional control and site specific characteristics such as geology, low rainfall, lack of receptors, etc.

The activity of the radionuclides present in the radioactive waste packages will be limited in such a way that the radiological impact of the site remains within acceptable levels during the operational and post-closure phases of the site. In accordance with international atomic energy agency (IAEA) waste are considered as a function of their half-life and activity concentration. Radiation doses to the public and workers as a consequence of waste management, storage and disposal activities are not to exceed the dose limits in Regulations 59 and 60 of the ARPANS Regulations. The effective dose limit for occupational exposure is 20 mSv annually, averaged over 5 consecutive calendar years. However, the effective dose for a person subject to occupational exposure must not, in a year, be greater than 50 mSv. The effective dose limit for public exposure is 1 mSv annually).

The ARPANSA *Licensing of Radioactive Waste Storage and Disposal Facilities March 2013* explains that waste acceptance should be undertaken in accordance with Section 2.6 of the Near-Surface Disposal Code, Specific criteria and requirements for waste acceptance and disposal. Guidance on determining waste activity limits for low level waste in near-surface disposal facilities is found in the IAEA TECDOC *Derivation of Activity Limits for the Disposal of Radioactive Waste in near Surface Disposal Facilities* (IAEA-TECDOC-1380, 2003).

The following sections provide details on how the regulatory guidance has been applied in establishing criteria for acceptance of NORM and bulk wastes and also for sealed sources.

5.2 Norm and bulk wastes

In order to derive activity concentrations limits for individual radionuclides in NORM and bulk wastes, two criteria have been used:

- Dose rate to a human receptor post closure (with capping material in place) to not exceed a dose constraint of 0.3 mSv in a year. Occupancy of 3.5 days a year was assumed as per ARPANSA TRS No. 141 for an arid and remote site.
- Dose rate to a human receptor upon intrusion (no capping) corresponding to 10mSv/y as per ICRP guidance on radiological criteria applied to human intrusion.

The RESRAD (Onsite) code was used, to determine radionuclide activity concentration levels in bulk NORM wastes which would give rise to conditions as specified above for post closure and intrusion scenarios. Details of assessment are presented in the Radiological Risk Assessment: Post Closure

report. Table 5-1 summaries the Radionuclide restrictions that should be applied in the Waste Acceptance Criteria (WAC) for the Facility for the disposal of NORM bulk wastes.

For bulk NORM wastes having mixtures of radionuclides, an additional constraint should be adhered to so that the total dose from all the radionuclides should not exceed relevant dose limits or constraints. This is referred to as the summation rule and requires the following constraint:

$$\sum_i Q_i / Q_{i,l} <= 1$$

Where Q_i (Bq) is the actual activity of radionuclide i to be disposed and $Q_{i,l}$ (Bq) is the activity limit for radionuclide i if it were the only radionuclide to be disposed of.

Table 5-1: Waste Acceptance Criteria (WAC) for the Facility for bulk NORM waste

Radionuclides	Half Life	Individual Radionuclide Activity Concentration of Bulk NORM Waste (Bq/g)
		(Bq/g) to achieve 10 mSv/y upon Intrusion
U-238	4.468 billion years	1.0E+05
U-234	246,000 years	2.0E+06
Th-230	75,380 years	1.2E+04
U-235	703.8 million	2.2E+04
Pa-231	32,760 years	7.1E+03
Ra-226	1600 years	1.8E+03
Th-232	14.05 billion years	1.1E+03

5.3 Sealed Sources

Table 5-2 summarises the Waste Acceptance Criteria (WAC) proposed for the disposal of Sealed Sources. The activity of the radionuclides present in the radioactive waste packages will be limited in such a way that the radiological impact of the site is within the dose constraint limits set by the facility, under any foreseeable set of circumstances. Sources at activity Concentration levels above those specified in the table will not be accepted for disposal without re-assessing the safety case and seeking approval from the relevant regulatory bodies.

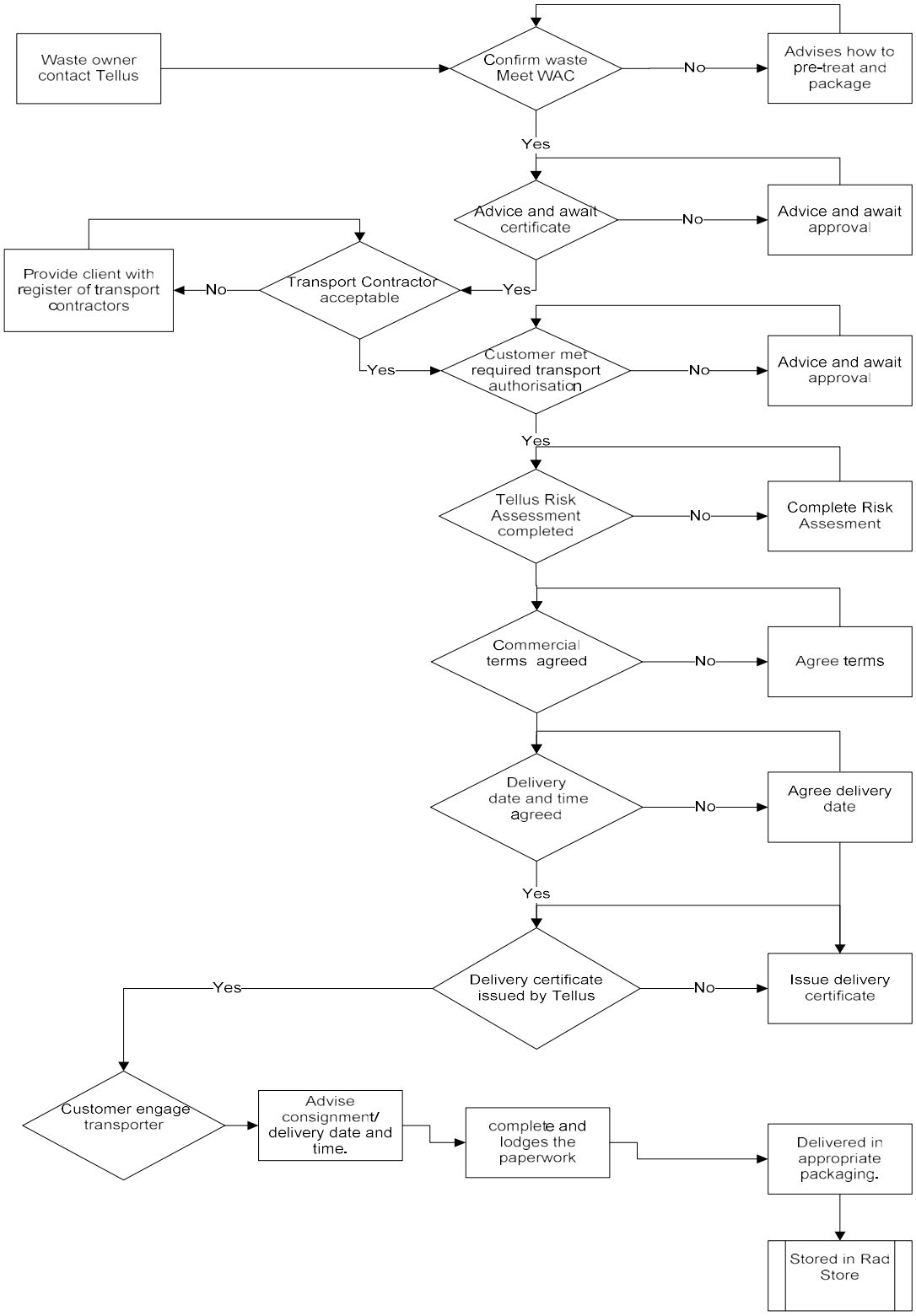
Table 5-2: Limits for common sources based on NHMRC near surface code (1992)

Radioisotope	Symbol	Half-life	Decay	Concentration limit (Bq)*
				100 years ICP
Americium-241	Am-241	432.17 y	α	2.00E+10
Barium-133	Ba-133	10.74 years	EC	no limit
Caesium-137	Cs-137	30.07 years	γ/β	2.00E+11
Californium-252	Cf-252	2.6 years	α	2.00E+10
Carbon-14	C-14	5 715 years	β	2.00E+11
Chlorine-36	Cl-36	301 000 years	β	2.00E+11
Chromium-51	Cr-51	2.7 days	EC	no limit
Cobalt 57	Co-57	271.8 days	EC	no limit
Cobalt-60	Co-60	5.27 years	γ	no limit
Gold-198	Au-198	2.7 days	β	no limit
Hydrogen-3 (tritium)	H-3	12.32 years	β	2.00E+11
Indium-111	In-111	2.80 days	EC	no limit
Iodine-129	I-129	15.7 million years	β	2.00E+10
Iridium-192	Ir-192	73.8 days	γ/B	2.00E+10
Krypton-85	Kr-85	10.5 years	β	2.00E+11
Iron-55	Fe-55	2.74years	EC	no limit
Lead-210	Pb-210	22.6 years	β	2.00E+11
Manganese-54	Mn-54	312.1 days	EC	no limit
molybdenum-99	Mo-99	66 hours	β	no limit
Nickel-63	Ni-63	96 Years	β	2.00E+11
Polonium-210	Po-210	138 days	α	2.00E+10
Radium-226	Ra-226	1,600 years	α	1.00E+09
Selenium-75	Se-75	120 days	γ	no limit
Sodium-22	Na-22	2.6 years	γ	no limit
Strontium-90	Sr-90	28.8 years	β	2.00E+11
Technetium-99m	Tc-99m	6.01 days	γ	no limit
Thallium-204	Tl-204	3.78 years	β	no limit
Thulium-170	Tm-170	129 days	β	no limit
Ytterbium-169	Yb-169	32 days	EC	no limit
Zinc-65	Zn-65	243.87 days	EC	no limit

**(alpha (α), Beta (β), Gamma (γ) or Electro capturing (EC))*

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 5-1 below and discussed in more detail in the WAP document. It should be noted that the second step on the flow chart "Advice and await certificate" is a regulator step where a review of the permanent isolation application is carried out prior to the issuing of a disposal certificate.

Figure 5-1: Radioactive waste acceptance procedure



6 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, compliance and verification 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 Sandy Ridge Facility.

- **Level 2: Compliance testing**. After a waste stream has been accepted as meeting the Sandy Ridge 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.

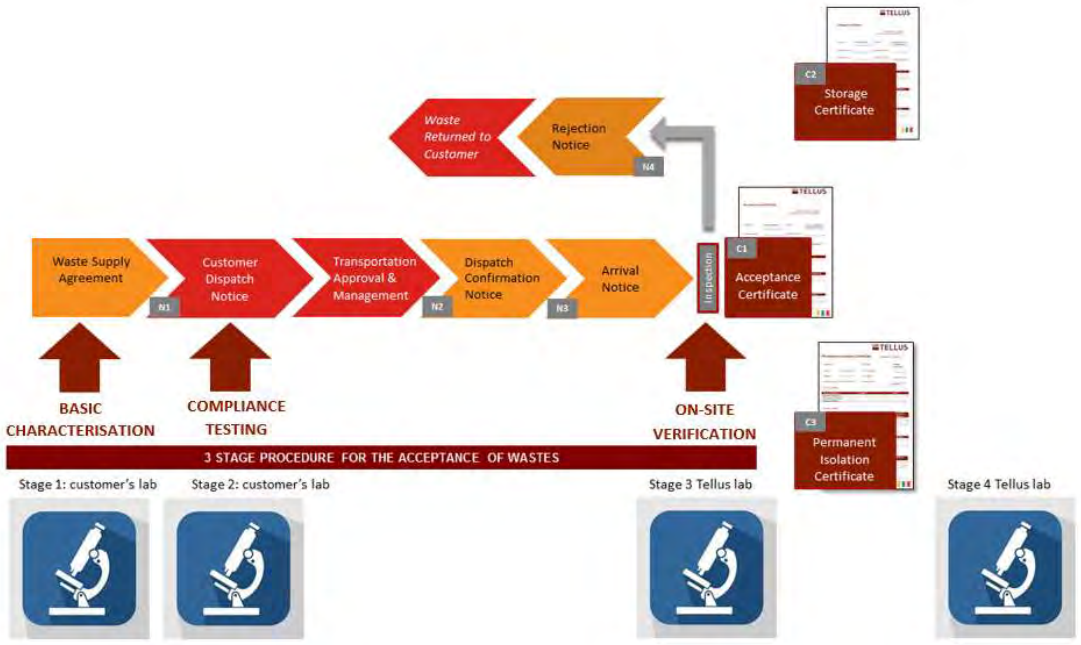
In the event that waste that cannot be accepted arrives at the site it will be placed into a specifically identified quarantine area until arrangements can be made to modify it into a waste form suitable for storage and disposal or to safely return it to the customer.

7 NOTIFICATION AND CERTIFICATION

7.1 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 7-1 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 7-1: Tellus' traceability process



7.2 Notification Service

Tellus will implement a notification service for management of the waste that is delivered to Sandy Ridge. 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

7.2.1 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.

7.2.2 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.

7.2.3 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).

7.2.4 Inspection point

Following the issue of an Arrival Notice, at the Sandy Ridge 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

7.2.5 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.

7.3 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).

7.4 Waste Title and Management risk

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

Rejected waste:

Title to the waste and management 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 until the site is handed back to government.

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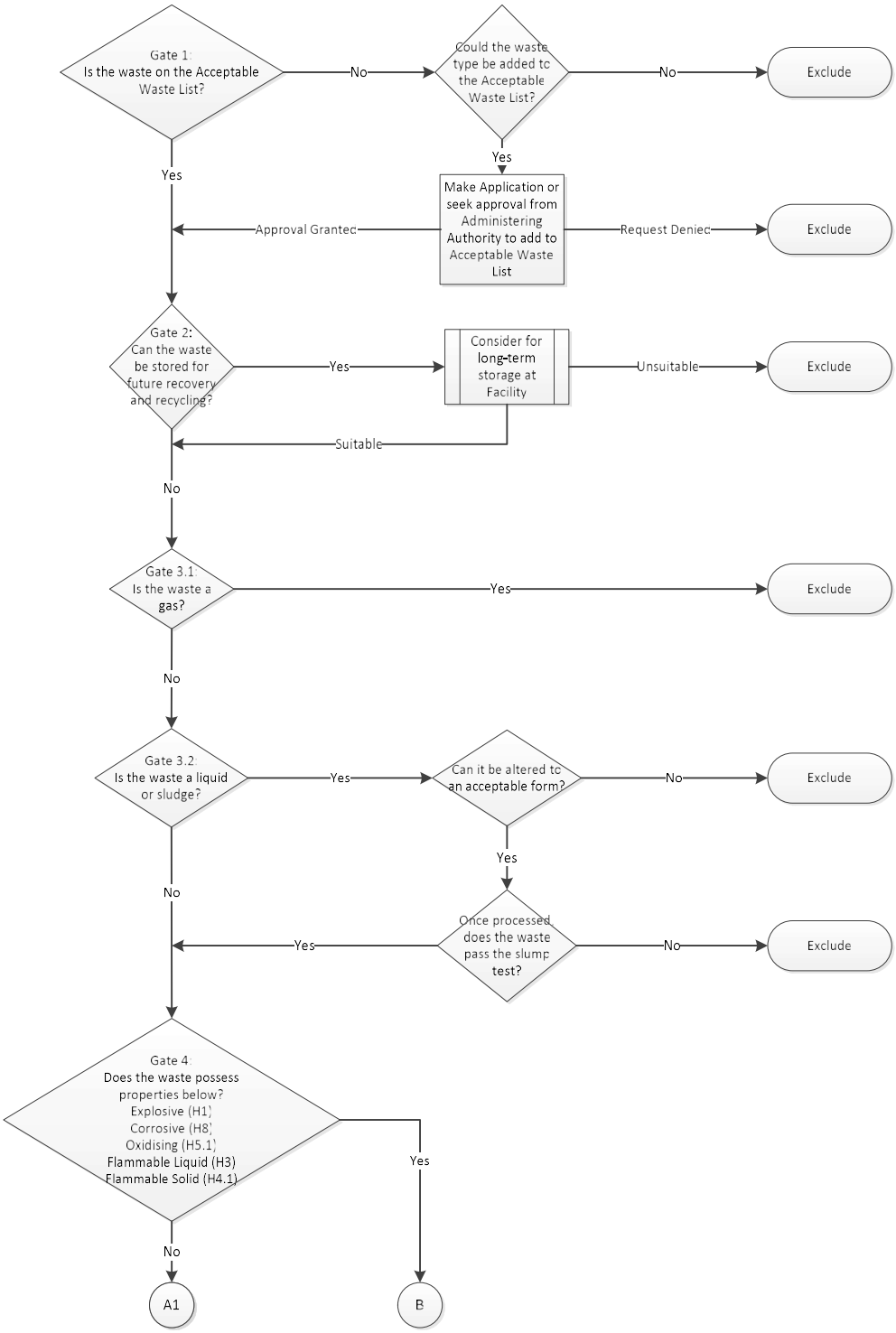
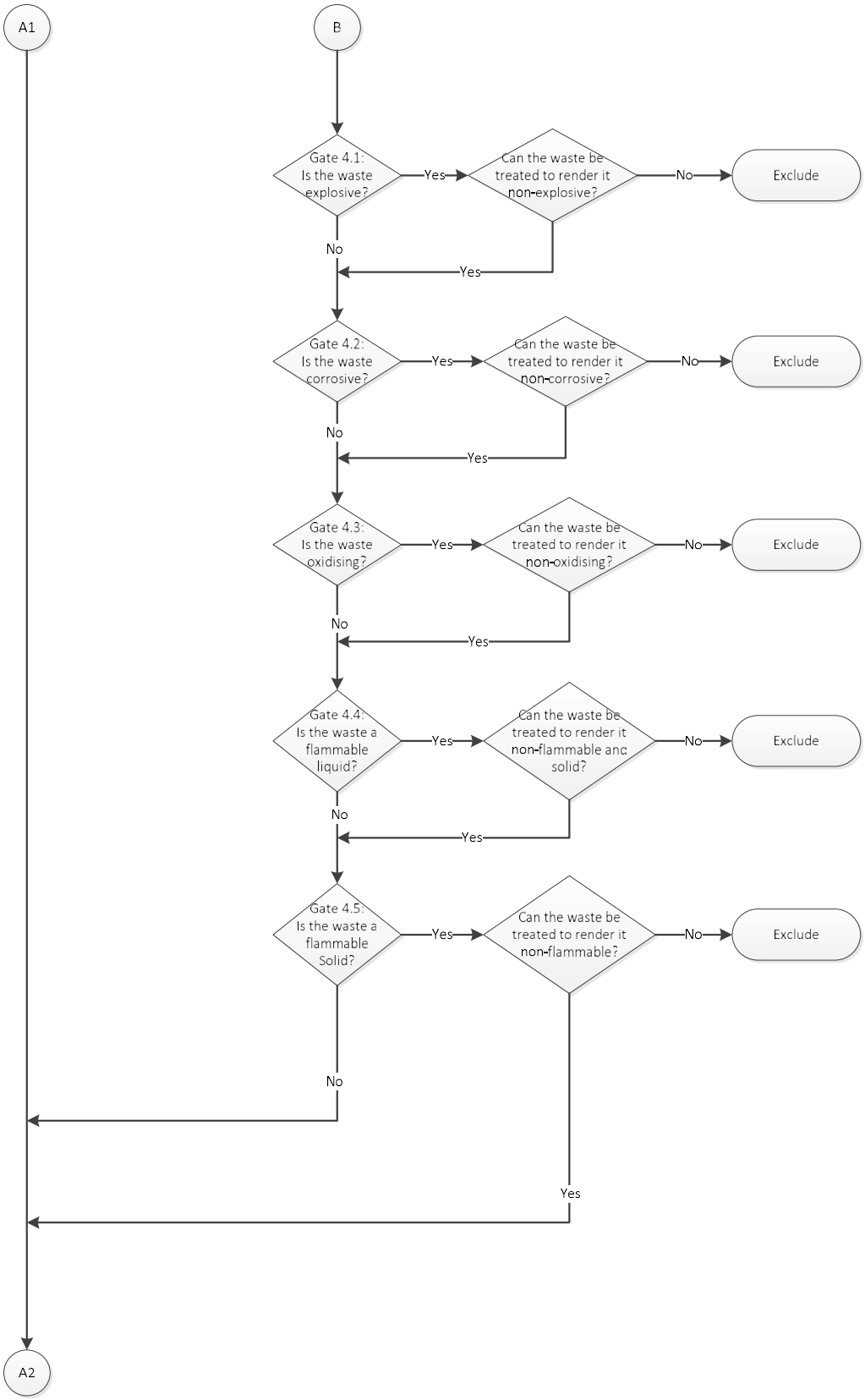
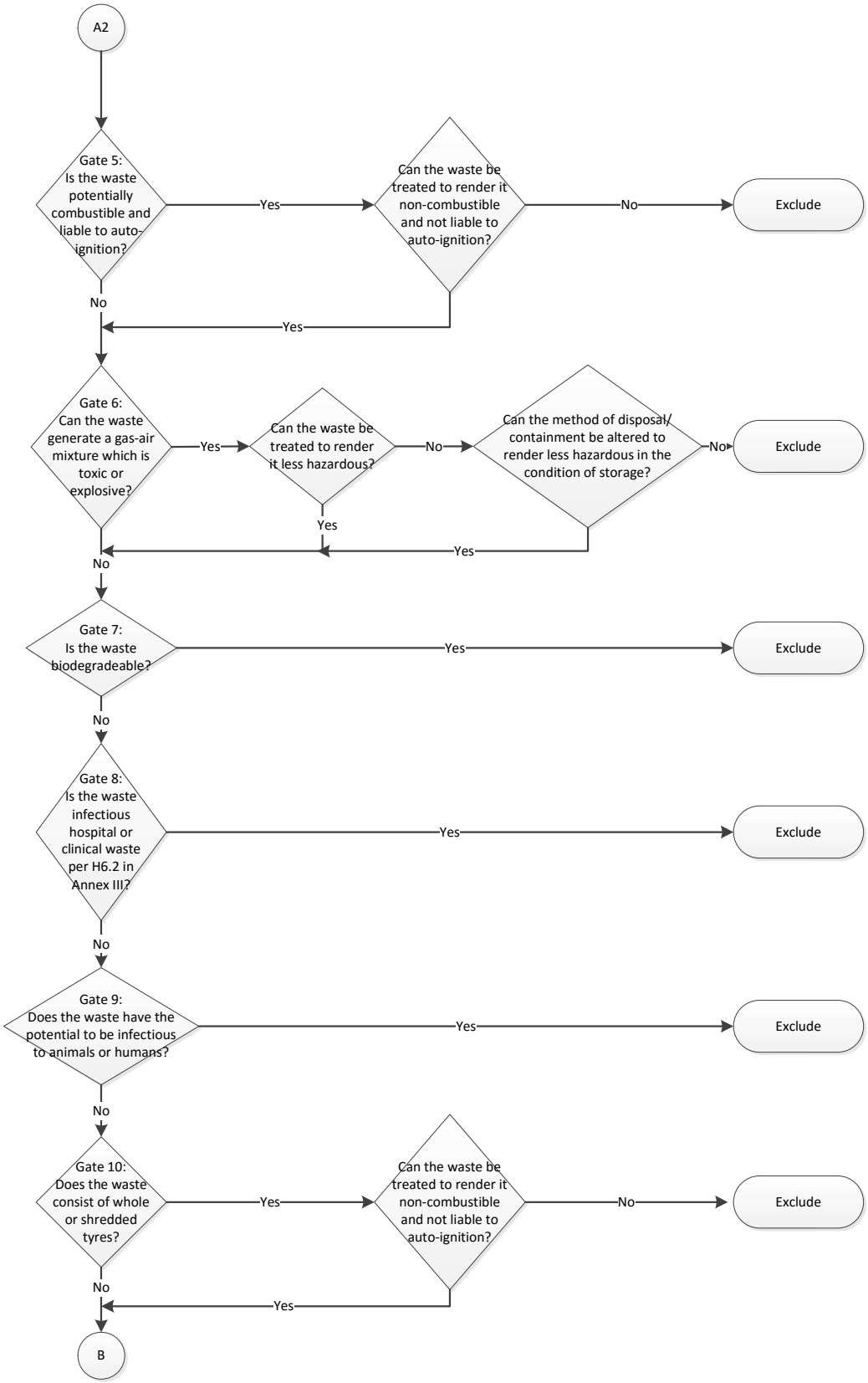
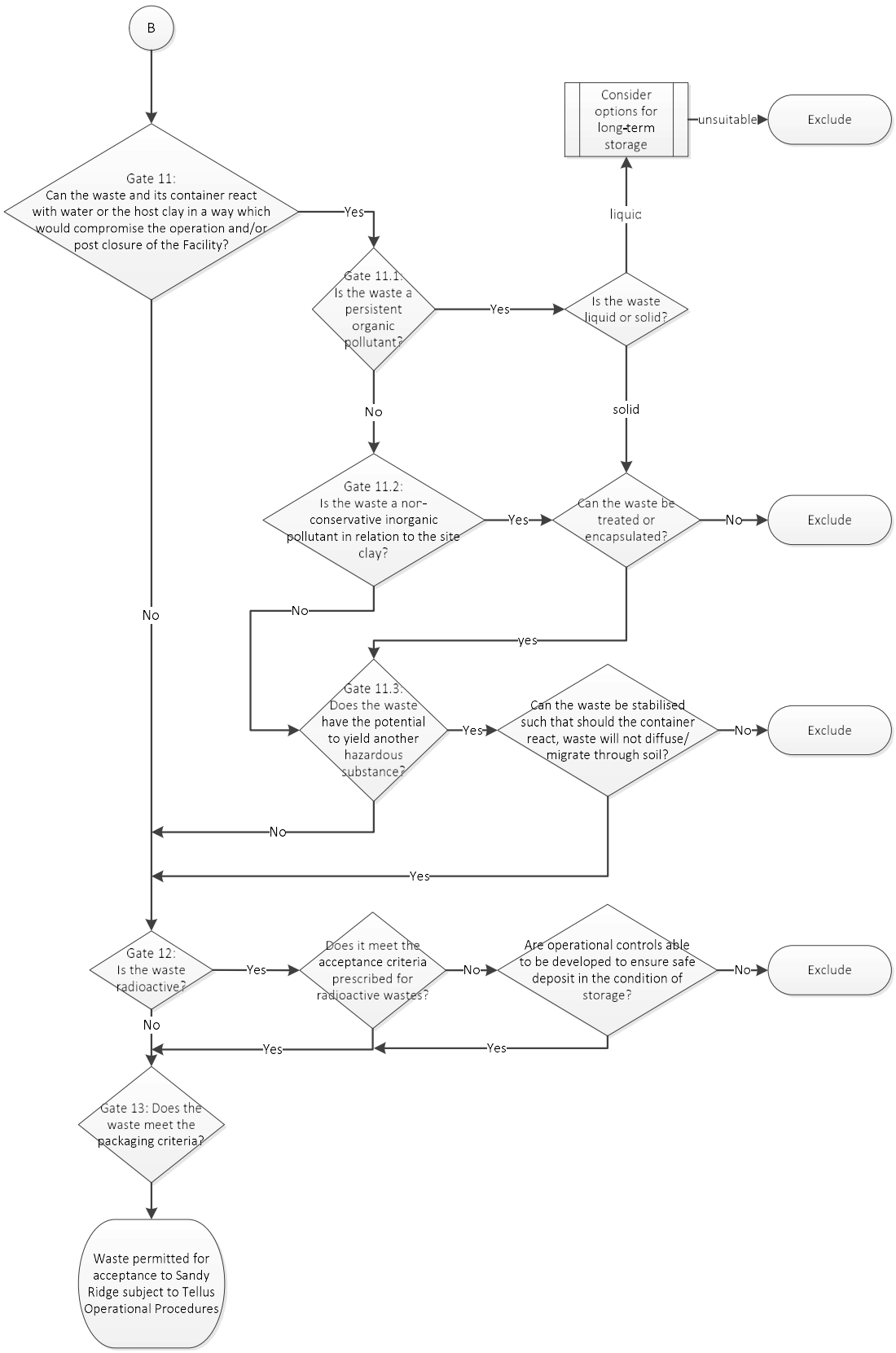
A.1 Gated waste acceptance process flow chart




A1
B
Gate 4.1: Is the waste explosive?
Yes
Can the waste be treated to render it non-explosive?
No
Exclude
Yes
No
Gate 4.2: Is the waste corrosive?
Yes
Can the waste be treated to render it non-corrosive?
No
Exclude
Yes
No
Gate 4.3: Is the waste oxidising?
Yes
Can the waste be treated to render it non-oxidising?
No
Exclude
Yes
No
Gate 4.4: Is the waste a flammable liquid?
Yes
Can the waste be treated to render it non-flammable and solid?
No
Exclude
Yes
No
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
Yes
No
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
Can the waste be treated to render it non-combustible and not liable to auto-ignition?
No
Exclude
Yes
No
B


B
Gate 11:
Can the waste and its container react with water or the host clay in a way which would compromise the operation and/or post closure 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 clay?
Yes
No
Can the waste be treated or encapsulated?
No
Exclude
yes
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
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
Phenols, phenol compounds including chlorophenols	M150

Common industrial hazardous waste (NEPM basis)	
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

Waste Acceptance Criteria and Supporting Documents

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SANDY RIDGE FACILITY WASTE ZONING GUIDE

Final Report | August 2016

Version	Date	Description	Signatures		
			Originator	Checked	Approved
0	10/08/2016	For issue	S. Reece	J. Livesey R. Phillips	D van der Merwe

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ABBREVIATIONS

ASCC	Australian Safety and Compensation Council
The Facility	The Sandy Ridge Facility
FIBC	Flexible Intermediate Bulk Container
IWDF	Intractable Waste Disposal Facility
km	kilometres
L	Litres
m	metres
NEPM	National Environmental Protection Measure
NOHSC	National Occupational Health and Safety
NORM	Naturally Occurring Radioactive Materials
Tellus	Tellus Holdings Ltd.
WAC	Waste Acceptance Criteria
WAP	Waste Acceptance Procedures
WZG	Waste Zoning Guidelines
Zone AC	Acidic Nature
Zone AL	Alkaline Nature
Zone PT	Poisonous or Toxic
Zone R	Radioactive
Zone S	Other

DEFINITIONS

Cell - an excavated area (pit) of kaolin which is below ground level which will be used for *in cell 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 "in cell storage" or "permanent isolation" within a cell.

Dangerous goods – the Dangerous Goods Safety (General) Regulations 2007 defines "dangerous goods" as any substance or article that is:

a) Found to be within any of the following classes or divisions under the Australian Dangerous Goods Code: Class 1, Class 2, Class 3, Class 4, Class 5, Division 6.1, Class 8, or Class 9; unless stated otherwise within the Code.

b) named or described in Schedule 1 of the Environmental Protection (Controlled Waste) Regulations 2004

Geological repository (in the context of Sandy Ridge) - The term geological repository is used to mean a landfill facility constructed and with the equivalent properties of a Class IV or Class V Landfill as defined in Landfill Waste Classification and Waste Definitions 1996 (As amended December 2009) Western Australia Department Of Environment And Conservation. In the context of Sandy Ridge this means an arid near-surface facility used to permanently isolate waste. Geological repositories provide the highest levels of containment through the use of carefully selected natural geological barriers rather than reliance on man-made liner systems and are increasingly recognised as a cost effective and preferred method of permanently isolating difficult to manage wastes. The geological barrier provides permanent isolation of wastes from the environment over the very long term and creates additional opportunities for the future recovery and recycling of valuable materials from the waste which can re-enter the circular economy.

Hazardous waste - Component of the waste stream which by its characteristics poses a threat or risk to public health, safety or the environment (includes substances which are toxic, infectious, mutagenic, carcinogenic, teratogenic, explosive, flammable, corrosive, oxidising and radioactive). As defined in Landfill Waste Classification and Waste Definitions 1996 (As amended December 2009) Western Australia Department Of Environment And Conservation

In Cell Storage - medium to long term below ground storage of wastes inside a cell with ongoing opportunity to recover waste if required.

Intractable Waste- Waste which is a management problem by virtue of its toxicity or chemical or physical characteristics which make it difficult to dispose of or treat safely, and is not suitable for disposal in Class I, II, III and IV landfill facilities. As defined in Landfill Waste Classification and Waste

Definitions 1996 (As amended December 2009) Western Australia Department Of Environment And Conservation

Permanent Isolation - indefinite below ground storage of wastes determined suitable for acceptance.

Storage - the short term above ground storage of materials following delivery and includes the time awaiting sampling, analysis and management prior to movement for “in cell storage”.

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 Sandy Ridge 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 Sandy Ridge Facility

The proposed Sandy Ridge Facility (hereby referred to as the proposed "Facility") is a dual use kaolin mine with the voids created by mining used to store and dispose of hazardous and intractable wastes. The site is located approximately 75 km northeast of Koolyanobbing, in the Shire of Coolgardie, within the Goldfields Region of Western Australia (Figure 1-1).

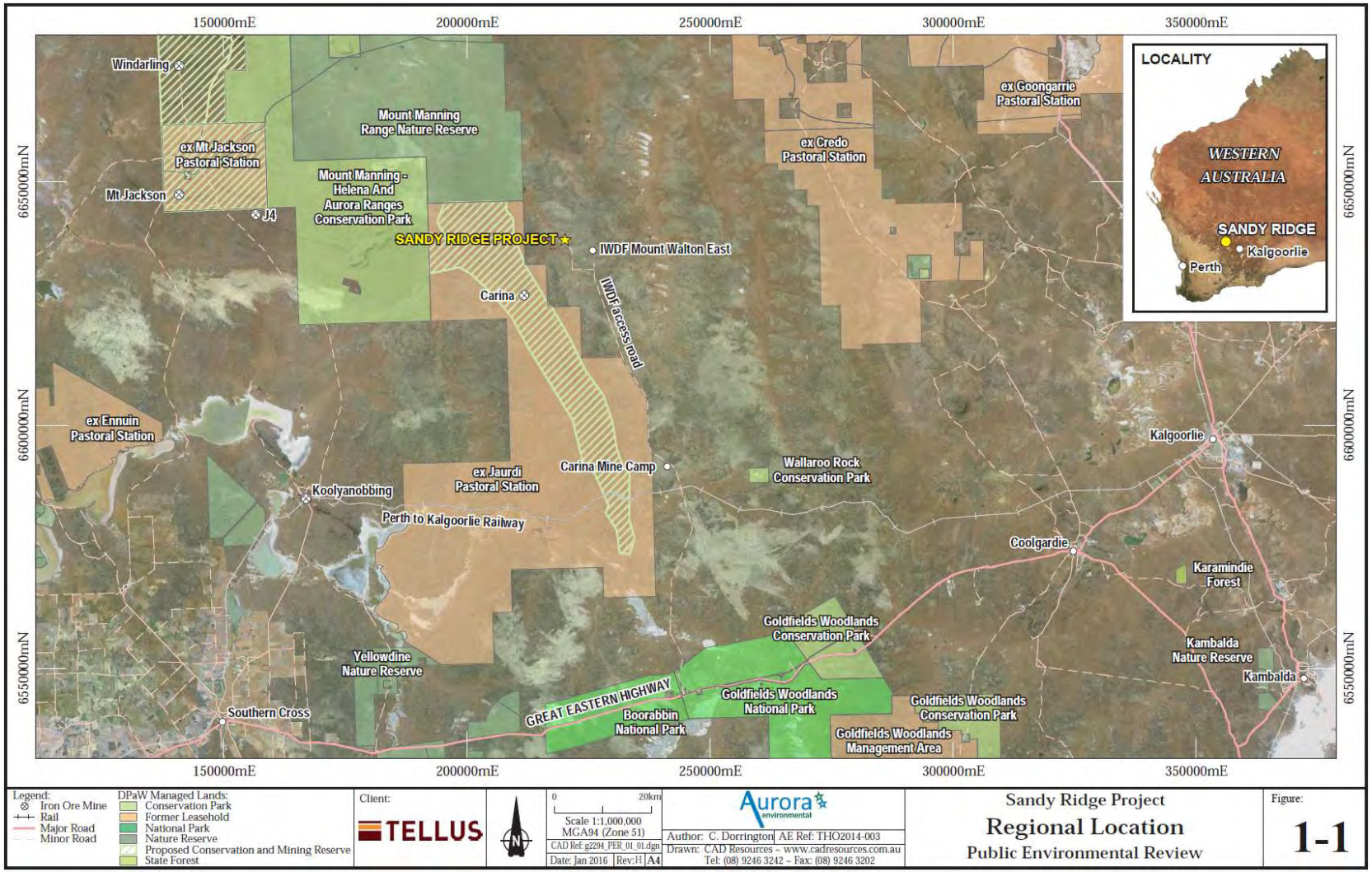
The location for the Facility was specifically chosen as its principal characteristics; semi–arid climate, high rates of evaporation, geologically stable, natural geological barriers, no regional aquifer, no surface water receptors, no flooding, low erosion rates, no heritage values, topography etc. satisfy the requirements for a near surface geological repository[1] for intractable and hazardous waste storage and isolation purposes.

There are no sensitive receptors within the immediate vicinity of the proposed Facility. The nearest operation is the Class V IWDF Mount Walton East Intractable Waste Disposal facility located approximately 6 km to the east, which operates on a campaign basis and does not have permanent residents. The nearest mining camp is the Carina Iron Ore Mine accommodation village located approximately 52 km to the south east of the proposed Facility.

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] *The term geological repository is used to mean a landfill facility constructed and with the equivalent properties of a Class IV or Class V Landfill as defined in Landfill Waste Classification and Waste Definitions 1996 (As amended December 2009) Western Australia Department Of Environment And Conservation*

Figure 1-1: Sandy Ridge site location



1.2 Document aims and objectives

The aim of this document is to present guidance on the development of 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' Northern Territory Chandler 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.

1.3 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 interaction, 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 Western Australia, Dangerous Goods management is enforced under the *Dangerous Goods Safety Act 2004* and is regulated under the *Dangerous Goods Safety (Storage and Handling of Non-Explosives) Regulations 2007* (the Storage and Handling Regulations). The Storage and Handling Regulations introduce modern safety standards for the manufacture, processing, storage, use and disposal of dangerous goods.

The regulations adopt, with only minor variance, the National Standard for the *Storage and Handling of Workplace Dangerous Goods* (the National Standard), as produced by the National Occupational Health and Safety Commission (NOHSC; now the Australian Safety and Compensation Council, ASCC). Western Australia has retained a licensing system for dangerous goods.

In relation to dangerous goods, 'handling' includes manufacture, process, pack, use, sell, supply, carry (including by pipeline) and disposal of dangerous goods. '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*, an extract of the classes is included at Appendix A.2

2.3 Segregation approach

The application of waste acceptance criteria will exclude many dangerous goods from being accepted for permeant isolation at site. It is however important to recognise some wastes, which may be dangerous goods, may be delivered to site and undergo treatment on site (e.g. blending with Kaolin clay) to make a waste form which meets Tellus' WAC and is suitable for in-cell permanent isolation.

Therefore, arrangements 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[2] which, in turn, supports the National

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

Standard. Tellus will adopt the segregation protocols presented in AS/NZS 3833 for all waste materials that are stored on site prior to in cell permanent isolation. The Dangerous Goods segregation chart is presented in Figure 2-1

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

CLASS		2	3	4		5		6	8
COMPRESSED GASES 2.1 Flammable	Compatible	KEEP APART	Segregate from	Segregate from	Segregate from	Segregate from		KEEP APART	KEEP APART
2.2 Non-flammable/ non-toxic	KEEP APART	Compatible	KEEP APART	Segregation may be necessary	Segregate from	Segregation may be necessary	Segregate from	Segregation may be necessary	KEEP APART
FLAMMABLE LIQUIDS (and Combustible liquids)	Segregate from	KEEP APART	Compatible	KEEP APART	Segregate from	Segregate from	Segregate from	KEEP APART	KEEP APART
FLAMMABLE SOLIDS 4.1 Flammable solids	Segregate from	Segregation may be necessary	KEEP APART	Compatible	KEEP APART	Segregate from	Segregate from	KEEP APART	Segregation may be necessary
4.2 Spontaneously combustable	Segregate from	Segregate from	Segregate from	KEEP APART	Compatible	KEEP APART	Segregate from	KEEP APART	KEEP APART
4.3 Dangerous when wet	Segregate from	Segregation may be necessary	Segregate from	Segregate from	KEEP APART	Compatible	KEEP APART	Segregate from	Segregation may be necessary	Segregation may be necessary
OXIDIZING SUBSTANCES 5.1 Oxidizing agents	Segregate from	Segregation may be necessary	Segregate from	Segregate from	Segregate from	KEEP APART	*	Segregate from	KEEP APART	KEEP APART
5.2 Organic peroxides		Segregate from		Segregate from		Segregate from	Segregate from	Compatible	KEEP APART	KEEP APART
TOXIC SUBSTANCES	KEEP APART	Segregation may be necessary	KEEP APART	KEEP APART	KEEP APART	Segregation may be necessary	KEEP APART	KEEP APART	Compatible	Segregation may be necessary
CORROSIVE SUBSTANCES	KEEP APART	KEEP APART	KEEP APART	Segregation may be necessary	KEEP APART	Segregation may be necessary	KEEP APART	KEEP APART	Segregation may be necessary	*

LEGEND:

- Compatible — Dangerous goods of the same Class should be compatible: consult MSDS or suppliers about requirements for individual substances.
- * — Dangerous goods of the same Class could be incompatible or react dangerously. Consult the MSDS or suppliers about requirements for individual substances.
- Segregation may be necessary — Segregation of these Classes may be necessary. Consult the MSDS or supplier.
- KEEP APART — Dangerous goods of these Classes should be kept apart by at least 3 m. Consult the MSDS or supplier.
- Segregate from — These combinations of dangerous goods should segregated by at least 5 m and kept in separate compounds or building compartments.
- This requirement applies to organic peroxides, for which dedicated stores or storage cabinets are recommended. Adequate separation from other buildings and boundaries is required.

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 placed in a cell 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 by the competent person based on zone selection principles and methodology.

Waste placement at Sandy Ridge will normally occur as individual packages which are transported into the cell, and placed package by package in the assigned zones within the cells. In certain situations, bulk placement of wastes 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[3]. 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:

[3] *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

Radioactive waste accepted for permanent isolation at Sandy Ridge falls into two broad categories of NORM and sealed sources. The zoning approach differs for each category and is summarised below.

4.1 NORM Waste

NORM waste is (unless otherwise proven) 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.

These would be placed the cell (not shaft) unless of particularly high activity concentration. Higher activity NORM wastes will always be placed as deep as possible in the cell, with lower activity wastes being located closer to the surface. The minimum depth of cover required will be assessed during each waste campaign.

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

These will be assessed by activity level and radionuclide/particle emitter type. Higher activity materials will generally be placed deeper in the cell, but consideration will also be given to placing alpha and beta particle emitters at shallower depths as the requirement for shielding at the surface is less.

4.1.3 Sludges and liquids requiring solidification and stabilisation prior to placement.

Higher activity materials will generally be placed deeper in the cell, but consideration will also be given to placing alpha and beta particle emitters at shallower depths as the requirement for shielding at the surface is less.

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 or compacted kaolinised granite). Higher activity materials will generally be placed deeper in the cell, but consideration will also be given to placing alpha and beta particle emitters at shallower depths as the requirement for shielding at the surface is less. The materials of construction of the waste (e.g., steel pipe) and grout fill may provide a reasonable level of shielding and allow relatively shallow placement.

4.1.5 Use of NORM as backfill

Bulk solids, and solidified sludges and solidified liquid NORM wastes may be used as interstitial fill around 215 litre (L) drums inside the radioactive waste disposal shafts.

4.2 Sealed sources

Sealed sources will, whenever possible, be placed in their original shielding package or 60 L drum and cemented inside a 215 L steel drum. Depending upon the source activity and isotope, more than one source may be placed inside a 215 L cemented drum.

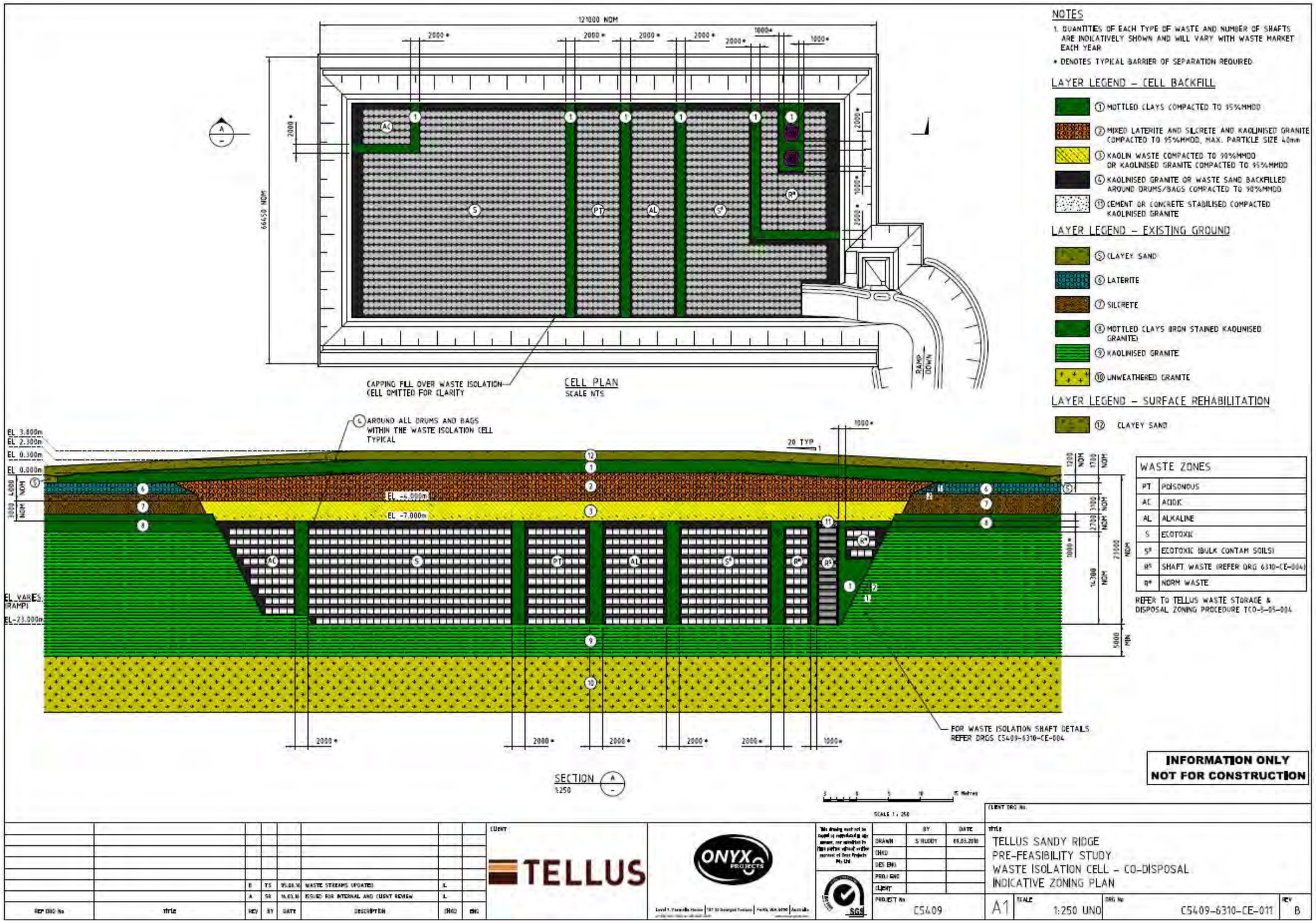
The primary requirements of the 215 L drum cementing process will be to provide short term source security and operational shielding for the staff handling and placing the waste. A secondary requirement of the 215 L drum cementing process is to provide long-term shielding and security against human intrusion.

Sealed sources will be placed in the cell according to the following hierarchy.

Table 4-1: Sealed source emplacement hierarchy

Sealed Source Characteristic	In-shaft Placement Criteria
Half-life > 3 years	Greater than 10m below natural ground level
Half-life > 20 years	Greater than 15m below natural ground level
Half-life > 30 years	Greater than 20m below natural ground level. Packages will be placed in order of half-life, with the longest lived radionuclides at the bottom.

5 INDICATIVE WASTE ZONING PLAN



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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

Common industrial hazardous waste (NEPM basis)	
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.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