

Minosus

A unique solution for the management of hazardous waste



Only facility of its kind in the UK

In 2005 Veolia took over the operation of Minosus – an underground storage facility within the Winsford salt mine in Cheshire. The unique geology in this area of Cheshire creates an impermeable cavity.

These conditions are ideal for the storage of hazardous wastes which would otherwise require treatment prior to disposal in conventional above ground landfill sites.



Minosus ensures complete containment of hazardous waste with no available pathway to the biosphere.

What makes Minosus unique and how it is different to conventional above ground hazardous landfill:

- 1 It is the only underground storage facility for hazardous waste operating in the UK.
- 2 The impermeable rock surrounding the Minosus waste storage area means that the environment of the mine is dry with no water ingress.
- 3 There are no gases nor leachate produced from Minosus unlike above ground landfills which require gas and leachate management systems to appropriately treat the streams.
- 4 Minosus ensures complete containment of hazardous waste with no available pathway to the biosphere.
- 5 All waste is contained within bags or drums and placed within constructed rooms within the mine enabling complete traceability of waste streams.
- 6 Due to the dry environment, waste acceptance criteria and ability to fully segregate waste streams, these wastes, whilst remaining hazardous, are fully stable once placed in the mine.
- 7 Minosus offers protection against future changes in legislation affecting acceptance criteria and derogations at above ground landfill.
- 8 There are no issues with dust or odour since all offloading and handling of wastes takes place within an enclosed area.
- 9 Since Minosus is underground there is no affect to above ground land uses. The majority of the land above the Minosus operation is used for agricultural purposes such as dairy farming.

The history of the mine

A 50,000 year risk assessment proved the stability of the proposed waste management operation.

The Winsford Rock Salt Mine is Britain's oldest working mine. The Rock salt at Winsford was formed 220 million years ago and the mine lies almost 200 metres under the Cheshire countryside.

Initially looking for coal to heat up naturally occurring brine, mining commenced in 1844 and rock salt was discovered, which has been mined ever since.

Today the mine remains a strategic facility, providing over 65% of the UK's annual de-icing requirements.



1844

1997

NOW

In 1997 a feasibility study commenced to identify alternative mine uses. Whilst the core business was to remain mining for de-icing products, the underground conditions which provide a consistent temperature and are naturally free from the dangers of ultraviolet light, vermin and flooding were ideal for two potential uses: archival storage of high value assets such as treasured paintings, historical

records, architectural models and critical data as well as storage of specific types of hazardous waste requiring secure and sustainable disposal. A series of robust risk and impact assessments then followed. These examined the stability of the proposed waste management operation for 50,000 years following the final waste deposition.

Today the archive business holds around 3 million archive boxes within the Winsford facility. There is a dedicated void space (less than 10% of the overall mine void) 170 metres below the surface and below the water table for hazardous waste storage.

The development of the Minosus underground storage facility provided the security of a long term solution for the management of difficult hazardous waste streams. It gave environmental protection and customer peace of mind by protecting against the impacts of future changes in legislation.

Waste streams managed

The nature of the facility and the unique environment provides the best overall environmental option for a number of specific hazardous waste streams. In order to ensure that the integrity of Minosus is not compromised a site specific testing criteria is used in the pre-acceptance process including mine condition testing. This simulates how the waste will behave in typical mine conditions and includes biodegradability testing and gas evolutions tests.

Wastes accepted today are predominantly Air Pollution Control residues (APCr) from energy recovery facilities and soda slag streams from battery recycling. APCr is just one of the growth areas for the facility.

We believe that salt mine disposal provides hazardous waste producers with a better waste management solution than above ground landfill.

IPPC Permit Application (Environmental Permitting Regulation - EPR) Safety Case:

4.8 'No pathway is considered possible to connect the waste with the biosphere. The net result is therefore one of total safety for the proposed facility in time period T1' (T1 = 500 years post-closure of the facility).

Extract from Planning Permission

(WAC was developed to accommodate these requirements): 37. (xii) 'The only waste types which shall be deposited within the Bostock No. 5 Panel shall be solid (including granular or powder), non-flammable, non-explosive, non-volatile, non-odorous, non-deliquescent, non-radioactive and non-reactive upon exposure to air, salt or moisture within the mine. All such wastes shall be drummed or bagged to provide containment.'

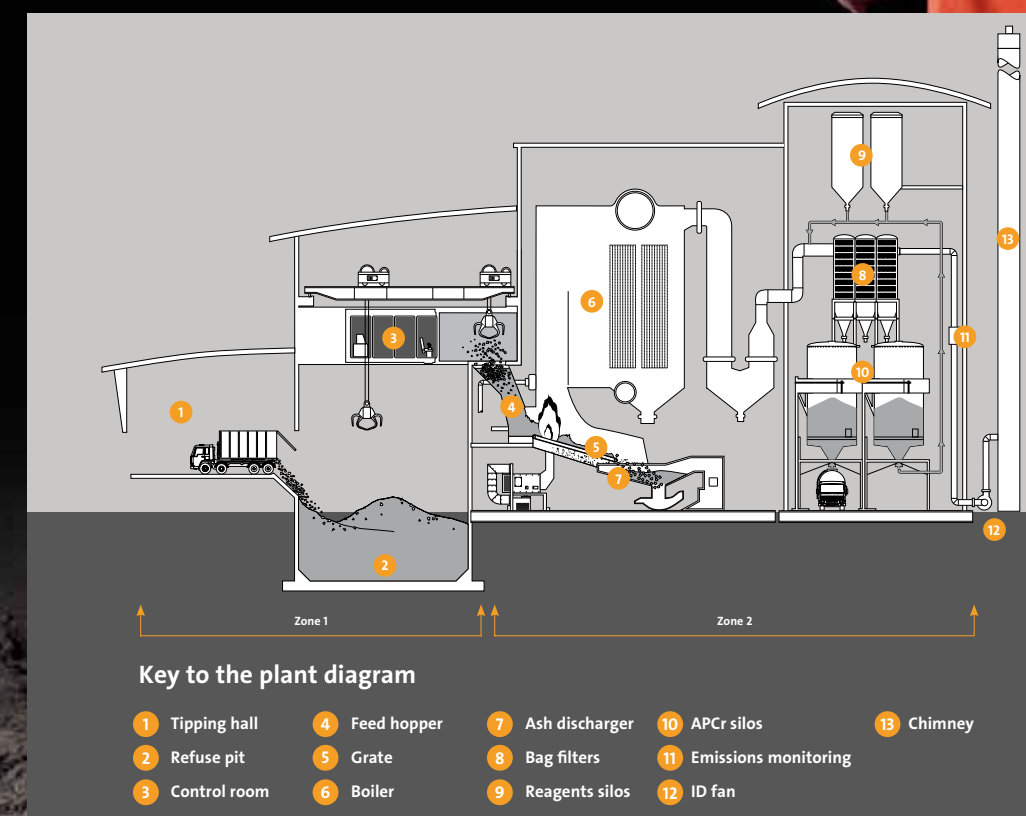
What is APCr?

Energy Recovery Facilities provide a process to recover embedded energy from residual (non-recyclable) wastes. Similar to when coal is combusted to produce heat and power, the waste is combusted into hot gas (from which energy is recovered). The exhaust combustion gases are treated within the facility (flue gas treatment) to remove contaminants. These contaminants are removed as a solid ash – Air Pollution Control Residue (APCr).

The most common alternative outlet for APCr is above ground landfill following treatment. Whilst treatment prior to disposal in above ground landfill provides a safe route, Veolia believes that this salt mine deposit option provides the waste producer with a better environmentally performing option.

The purpose of the flue gas treatment system in energy recovery facilities is to recover and trap potentially hazardous elements arising in the municipal waste and to remove these elements from the environment. The Minosus salt mine deposit delivers this in depositing the APCr in an environment that has no pathway to the biosphere.

In the future processes may be developed that enable the removal of the potentially hazardous elements in APCr. However, at this time and for the foreseeable future it has not been demonstrated as commercially viable on an industrial scale. Unless the potentially toxic elements are removed, recycling of this waste stream will simply result in release of these elements to the environment over time.



Why did we invest in the Minosus facility?

Over the past 10 years the landfill directive has brought about ongoing changes to the way we manage hazardous waste and the rules governing classification of waste.

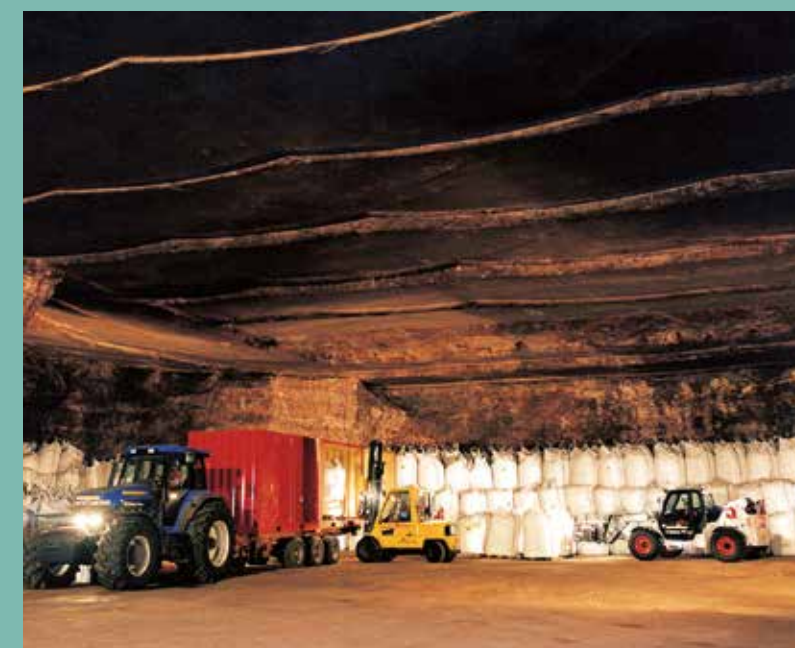


Veolia is dedicated to ensuring environmental protection and standards. We research alternative methods of waste management to ensure we offer the most technically, environmentally and commercially sustainable solution to our customers.

For the producers of a number of hazardous waste streams Minosus offers long-term secure hazardous waste disposal representing the best practicable environmental option. In terms of compliance, Minosus is unaffected by future changes in

implementation of the landfill directive and therefore offers a long term solution meaning our customers can be confident in the selection of this waste management option.

The use of saltmines for disposal of hazardous waste have been common place across Europe since 1972 (Herfa-Neurode, Germany) where similar geological formations occur. Minosus offers this bespoke methodology for hazardous waste arising in the UK.



Minosus offers a bespoke methodology for hazardous waste arising in the UK.

What makes Minosus so unique?

Geology

Minosus differs significantly from above ground landfill due to its location and associated geology. Minosus is the only facility of its kind in the UK with no other locations offering the same geological structure and stable environment.

Winsford's rock formation consists of four layers of salt with layers of Keuper Marl rock in between. The salt layers were formed over 200 million years ago and the structure is such that there is no available pathway between the area of waste deposition and the biosphere.

Above ground hazardous landfills are engineered in such a way that the waste deposited in them will

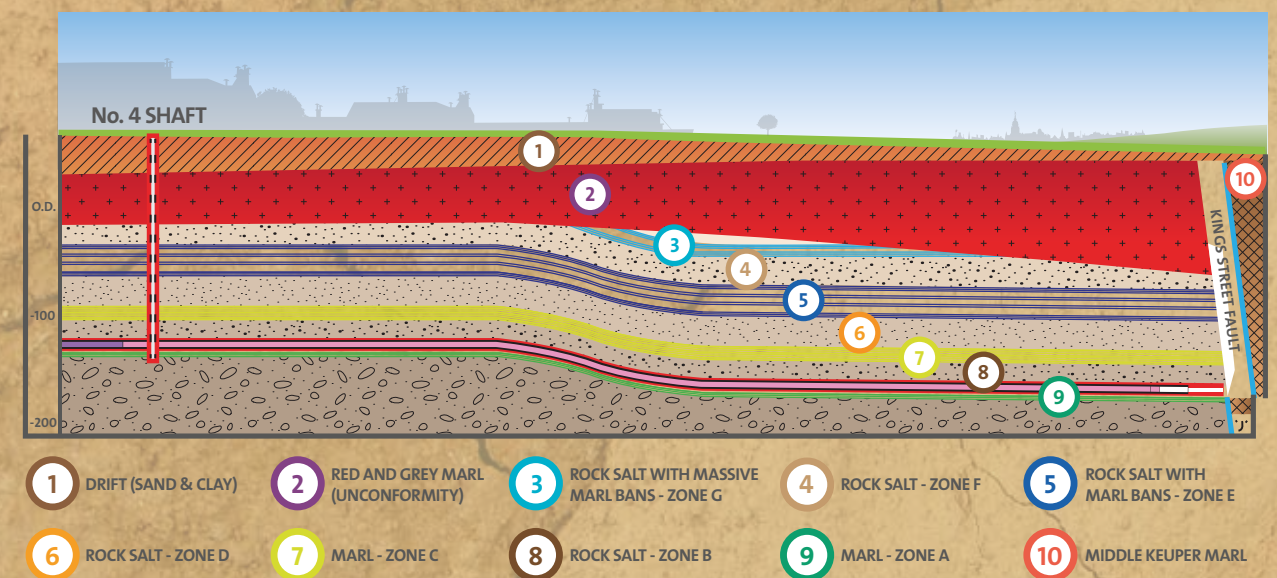
not cause harm to groundwater or to the atmosphere. This is not an easy task. Particularly considering the interaction with other waste streams, production of leachates/gases and the general environment in above ground landfills. One of the main concerns surrounding the deposit of hazardous wastes in above ground landfill sites relates to the potential for the production of harmful leachates and gases and their management.

Since the Minosus mine is a dry environment, and therefore no leachate is produced, the original IPPC (now EPR) permit recognises this with no insistence on a leachate management system which is a

requirement for all above ground landfill. There is no concern relating to the production of harmful leachates and gases and their impact on the surrounding environment.

In addition to the containment provided by the surrounding rock formations, the Minosus acceptance criteria goes one step further to require that all waste streams are deposited in approved packaging. This together with the construction of individual rooms underground also means that waste streams can be easily segregated and there is the additional benefit of complete traceability of all waste deposited.

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Waste Acceptance Criteria

The Minosus waste acceptance criteria differs from that of above ground hazardous landfill.

The criteria (specific to Minosus) is designed to consider how the waste will behave when placed in the mine environment and ensures that there will be no chemical or biological reactions. As there will never be any leachate produced, the main difference between the acceptance criteria at Minosus and above ground hazardous landfills is that there is no test required to determine what contaminants would be released into water passing through the waste.

The permitted waste list coupled with the robust site specific testing criteria ensure that no biodegradable waste is deposited in the facility, therefore there is no potential for greenhouse gas evolution. Minosus is limited to a 3% Total Organic Carbon (TOC) on input streams (the same limit as is set for inert landfills). In addition to the TOC test, the Acceptance Criteria also includes biodegradability testing.

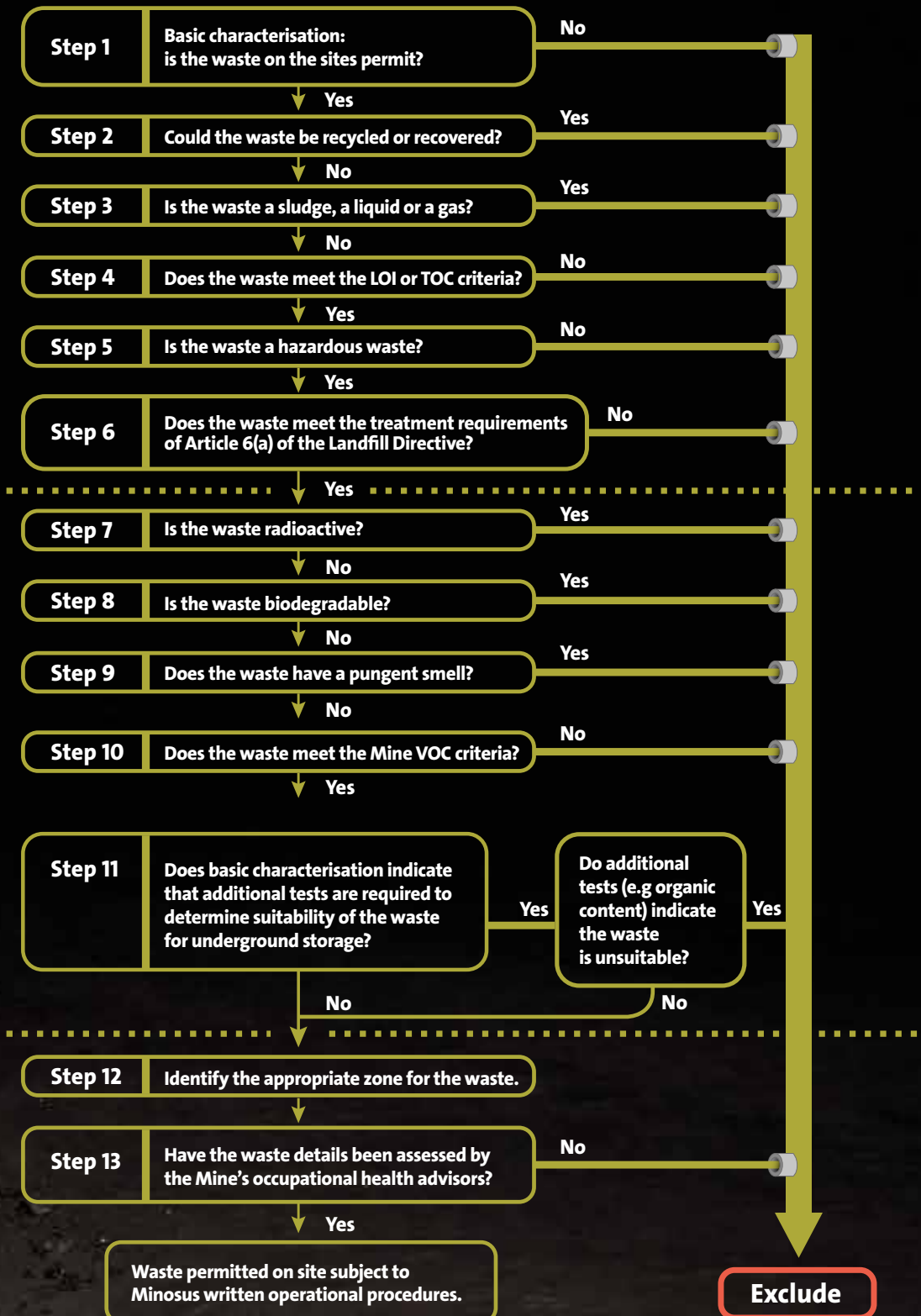
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Suitability for Hazardous Waste Landfill

Suitability for Underground Storage



What makes Minosus so unique?

Noise, odour and dust

Independent assessments found noise sources on the site to be 'insignificant' or 'inaudible' with all above ground activities (unloading of waste, packaging and storage) taking place within a dedicated building.

Waste is delivered either already contained within bags or in tankers which are discharged directly into on-site silos within the designated building. The building is also equipped with filtered mechanical extraction and all waste is packaged for movement into the mine. Therefore there is no potential for dust release to the environment.

Visual impact

The facility could be likened to an iceberg. With a surface footprint for waste reception of only 0.7 hectares the majority of the operation is underground and not visible to the public.

Land use and aftercare requirements

Minosus does not have the same issues associated to reuse of the land post closure as above ground landfills since the land is already in use for a variety of activities including agricultural use. A dairy farm is the nearest neighbour at 150 metres from the above ground operation. There is no impact on productive uses now or will there be in the future.

Since Minosus does not produce leachate or landfill gas, there are no aftercare requirements associated to leachate or gas management as is necessary for above ground landfill. The closure plan consists of a series of mechanical barriers to isolate the waste disposal area from the rest of the mine.

Health and Safety

There are several advantages to the Minosus operation in terms of reduced risks associated to health and safety when comparing to above ground landfill. For example:

- No vermin
- It does not have the same risks associated to uneven ground (at above ground landfills)
- There are limited vehicle movements and personnel on foot in the waste deposit area
- There is low risk of contact with the waste stream since the material is either delivered already in sealed bags or in tankers which is discharged through pipes into a storage silo then placed into bags using a mechanical bagging unit.

Landfill



Waste reception



Tipping



Closure (on-going sampling & monitoring)

Minosus



Waste reception



Bag placement



Closure

IPPC (now EPR) permit: Leachate Management

'The waste acceptance procedures are designed to ensure that no leachate is generated in the underground disposal facility. Therefore no leachate collection system is required.'

Groundwater Monitoring

'The regulation 15 assessment highlights that, due to the unique nature and location of the facility, the pathway for migration of the deposited material to useable groundwater resource is not considered credible. Therefore it is considered that there is little practical benefit in monitoring groundwater quality.'

All testing is focused to ensure that no chemical or biological reactions can take place within the mine.

Taking a lead in quality, health, safety and the environment

As a responsible business we take health and safety very seriously. We emphasise the importance of a safe working environment at every level of the company. This proactive approach has seen a reduction in Lost Time Incident (LTI) accidents.

One of the ways in which we are successfully reducing the number of accidents is to identify situations that have a potential to cause harm or injury. This is called a near miss report and we actively encourage all employees to take part in this process. The lessons we learn from near miss reports enable us to improve our workplace health and safety controls and prevent future accidents.

Our sites are certified to BS EN ISO 9001:2008 – the internationally recognised standard for quality management systems.

This enables us to provide an assurance that we will fulfil agreed customer requirements.

All of our sites are also certified to BS EN ISO 14001:2004 Environmental Management Standards, demonstrating our compliance to the guidelines for the development of environmental performance control.

In addition, all of our sites are certified to OHSAS 18001 (Health and Safety Management System). Our external audits are conducted through a third party certification body, Lloyd's Register Quality Assurance (LRQA).

All staff regularly receive training in health, safety and compliance issues relating to the site.



ISO9001



ISO14001



OHSAS 18001

ISO 20000 (work towards 27000 - Information Security Management System)

Licensed operation under IPPC



The future of Minosus

Innovation

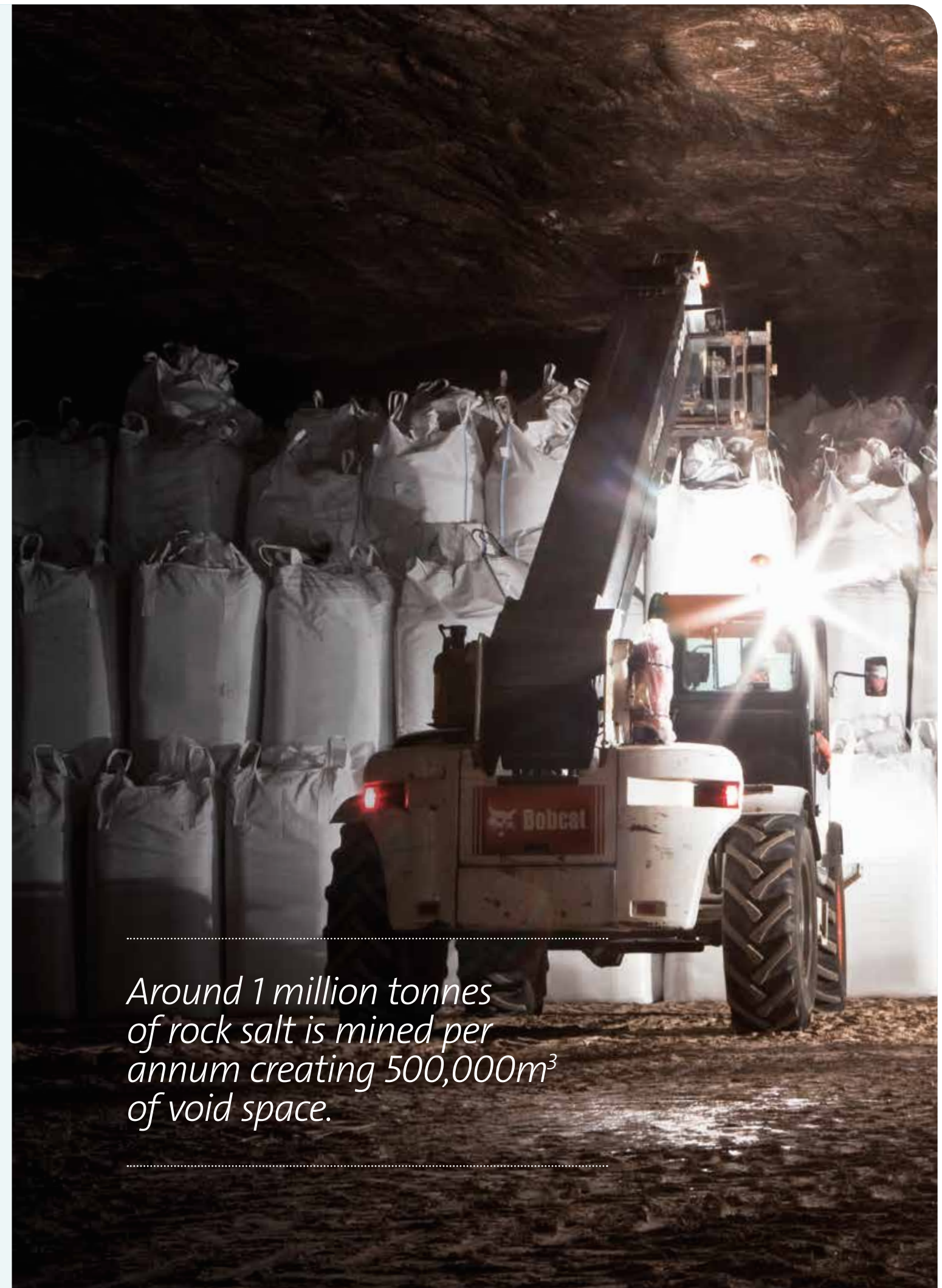
We are continuously working to further improve our offer at Minosus. The mature facilities in Europe have developed alternative methods of waste handling and placement to increase deposit efficiencies. These are currently being evaluated for potential implementation at the Minosus facility to ensure ongoing improvement and maintain best practice.

Veolia continues to provide an outlet for some waste streams which would otherwise only be handled under a special exemption as they would have no treatment or disposal route.

However, at group level, Veolia researches alternative treatments to find environmentally sustainable ways to reuse, recycle or recover different waste streams.

Sustainability

The potential waste deposit capacity at the mine is continuing to grow as the rock salt is extracted. The remaining rock salt reserves are extensive and active production is anticipated to continue for a further 50 to 70 years at present production rates. Around 1 million tonnes of rock salt is mined per annum creating 500,000m³ of void space. The area currently permitted for waste represents less than 10% of the existing void.



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Resourcing the world

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