Chapter 6
Description of Repository Facility

This chapter describes the preliminary design layout and aspects of the facility, and presents an outline of operating concepts. The detail of these aspects would be determined during the detail design stage, which would form the next stage of the project.

6.1 Facility Objectives and Design Basis

6.1.1 Objectives

The purpose of the facility is to:

- strengthen Australia's radioactive waste management arrangements by promoting the safe and environmentally sound management of its radioactive waste through the establishment of a purpose-built, near-surface repository
- provide safe containment of radioactive waste until the radioactivity has decayed to background levels.

In achieving these objectives, the facility shall comply with Australian radiation dose limits for workers and the public under normal operation, including during any foreseeable events, after closure and during and after the institutional control period.

6.1.2 Performance Specifications for the Repository

The operational requirements for the design of the repository are to:

- be suitable for the disposal of low level and short-lived intermediate level radioactive waste generated within Australia
- be a near-surface engineered facility that ensures the waste is isolated from the biosphere for a period long enough for the radioactivity to decay to acceptably low levels
- accommodate all existing waste and future arisings over a period of at least 50 years
- comply with international guidelines and accepted international practice
- comply with the following Australian regulatory requirements:
  - the National Health and Medical Research Council (NHMRC) *1992 Code of practice for the near-surface disposal of radioactive waste in Australia* (NHMRC 1992 Code), the regulatory requirements of the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) and the environmental conditions imposed by the Commonwealth Department of the Environment and Heritage (Environment Australia) (see Section 3.3)
  - the national radiation protection dose limits for workers and members of the public, for both the operational and post-closure periods (see Section 3.2.2).

The basic design requirements of the facility would be to:

- minimise water ingress
- minimise intrusion by flora and fauna
- prevent unauthorised or inadvertent human intrusion during both the operational and post-closure periods
- minimise effects of weathering/erosion
- provide sufficient structural stability to accommodate waste packages
- provide a level of monitoring sufficient to detect inadequate performance.

The facility operator would put in place a management structure and monitoring program for the facility that clearly define:

- responsibility and procedures for the operation of the facility
- compliance with contractual, statutory and licensing obligations.

6.1.3 Design Basis

A multi-barrier approach would be used including physical containment provided by some, or all, of the following:

- the trench/borehole design
- the waste form
- the conditioned waste packages
- the host rocks, arid environment, and groundwater and surface water characteristics of the site.

The disposal trenches (capped with an engineered system to minimise the potential for water infiltration) and boreholes (lined with clay or cement grout) would provide an engineered barrier for waste containment, in addition to containment provided by packaging. In some instances, for example short-lived intermediate level waste, cement overpacks would provide a containment barrier for the solid waste. The characteristics of the surrounding and underlying rock strata would provide additional containment for the waste.

The environment provides a natural barrier to isolate the waste through the rock type, the low rainfall and high evaporation rate, the deep and saline watertable, the time needed for the small amount of surface water that does not evaporate to travel to the watertable, and the time needed for the groundwater to then move to a point of discharge.

Waste would arrive at the repository in a conditioned form suitable for disposal (waste acceptance criteria (WAC) are described in Section 4.3). There would be some provision at site for concreting or emergency minor repackaging of waste, should this be required. More active sources may be placed in concrete overpacks at the site for disposal.

The design would be assessed in terms of its:

- operational safety
- environmental compliance
- post-closure performance
- cost.

The assessment would indicate the key performance and safety parameters and the design would be reviewed and revised to optimise these parameters. Figure 6.1 shows the preliminary design concept for the national repository; the groundwater depth and movement shown in the figure are based on the local conditions at Site 52a.

6.1.4 Operational Usage and Institutional Control Periods

The repository would receive the current inventory of low level and short-lived intermediate radioactive waste held at various facilities around Australia in an initial disposal campaign. Disposal campaigns would then be conducted every few years for a period of approximately 50 years, at which time a major review would be undertaken to determine the ongoing requirements for disposal space, and the ability of the facility to meet the ongoing requirements.

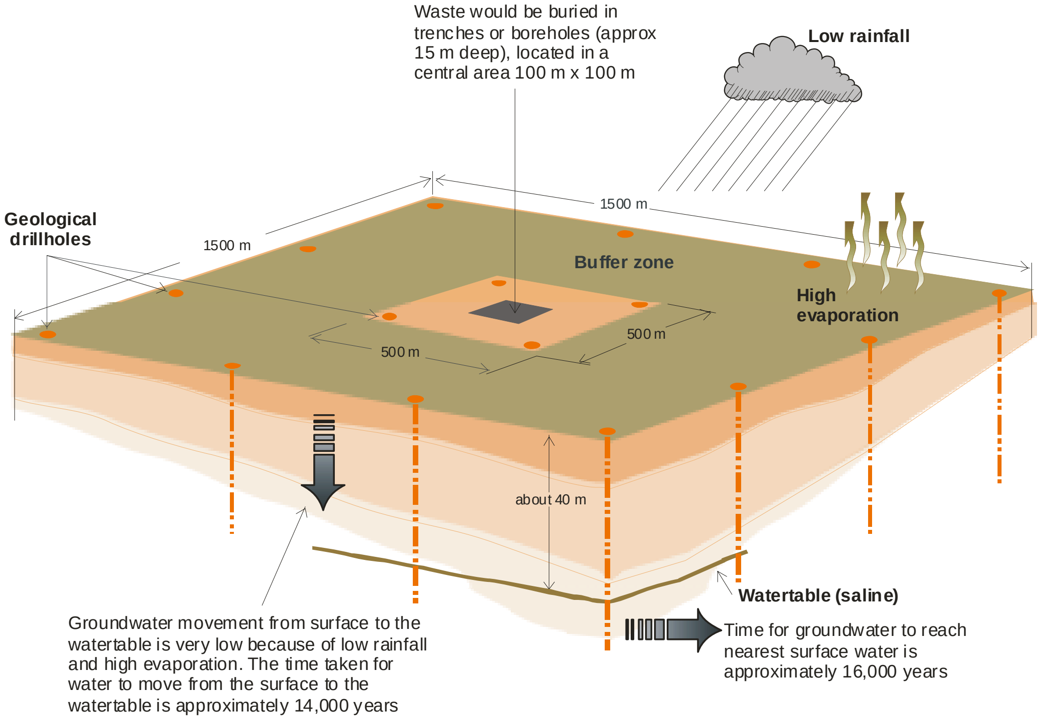

FIGURE 6.1
Graphic representation of repository site (Site 52a)

To clarify the terminology on the phases of the project in Sections 8.3 and 8.4 of the EIS Guidelines (Appendix A): surveillance would be undertaken in the periods between operational campaigns (expected to be every 2–5 years); decommissioning would take place at the end of the operational phase (nominally 50 years); and the institutional period of 200 years would follow the decommissioning and closure of the repository.

The low generation rate of low level and short-lived intermediate level radioactive waste in Australia means that once the current inventory has been disposed of, disposal campaigns at the repository may be separated by extended periods of two to five years where no disposal may occur. The quantities to be disposed of in the existing inventory, and expected future arisings, are discussed in Sections 4.1 and 4.2.

At the end of each campaign the disposal structure (trench or borehole) would be closed and securely contained to prevent intrusion by people or animals, and to minimise the ingress of rainwater. Most or all buildings would be removed from the site between campaigns.

Periodic monitoring and surveillance would be undertaken in the periods between campaigns to ensure the facility remains secure, and the waste contained. At the end of the operational period, the facility would enter the institutional control period. This is the length of time following closure for which land use restrictions are applied. Over this time, the facility would be monitored and access restricted.

The institutional control period for the facility would be 200 years. At the end of this period the radioactivity in the disposed waste would have decayed to low enough levels to allow unrestricted land use. Long-lived radionuclides would be buried at an acceptably low level of activity concentration to ensure this requirement.

Arrangements for the timing of campaigns would be determined in consultation with waste producers, and would take into consideration the amount of waste requiring disposal.

6.1.5 Repository Layout

The repository would be located on a site measuring 1.5 x 1.5 km, with the waste buried in the central part of the site in a series of trenches about 15–20 m deep (depending on the final site) and also in boreholes. These would be placed within an area of approximately 100 x 100 m, about the size of a soccer or rugby field. Support buildings and other infrastructure would be located on the site adjacent to the trenches. An indicative site plan is provided in Figure 6.2.

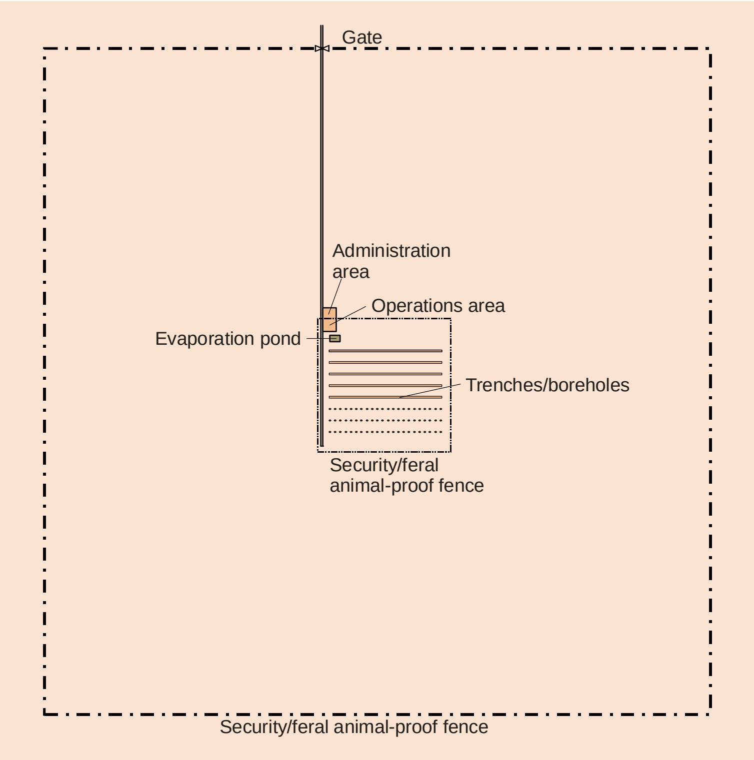

FIGURE 6.2
Indicative site plan

A security fence would be constructed around the 1.5 x 1.5 km margin of the buffer zone to prevent human intrusion and exclude grazing animals. It would also be designed to exclude key feral animal species (rabbits, cats and foxes, which would be eradicated from the site) and allow the regeneration of native species within the buffer zone. Similarly, a fence would be provided around the 100 x 100 m disposal area, to exclude animals.

6.2 Disposal Facility Design

A preliminary design concept has been prepared, which would be further defined during the detailed design phase of this project. A summary of the preliminary design is presented in the following section.

The regulator would provide formal assessment of the performance and safety of the facility during the licensing process.

6.2.1 Key Features

The repository would be designed to meet the overall performance criteria and safety requirements of the NHMRC 1992 Code. The facility would contain a number of disposal trenches and boreholes to best meet operational requirements, and would be designed and sized to account for the different waste types and quantities. The trenches and boreholes would be constructed, and disposal operations conducted, in such a manner as to minimise the time the structures were open.

As noted in Section 6.1.3, the trenches would be capped with an engineered system to minimise the potential for water infiltration, and the boreholes would be backfilled with clay or cement grout. In some instances, based on safety assessment, concrete overpacks or modular canisters would provide the containment barrier, rather than engineered barriers in the disposal structure (see Section 6.5.5).

The characteristics of the surrounding and underlying rock strata would provide further containment to prevent contaminants leaching into the environment.

To allow waste to be securely contained between campaigns, new excavation(s) would be prepared for each campaign.

Figure 6.3 provides an indicative trench design, and Figure 6.4 provides an indicative borehole design based on the methodology previously used at the Mount Walton East facility in Western Australia. The trench and borehole designs would be finalised during the detail design phase as part of the ARPANSA regulatory approval process (see Section 3.3).

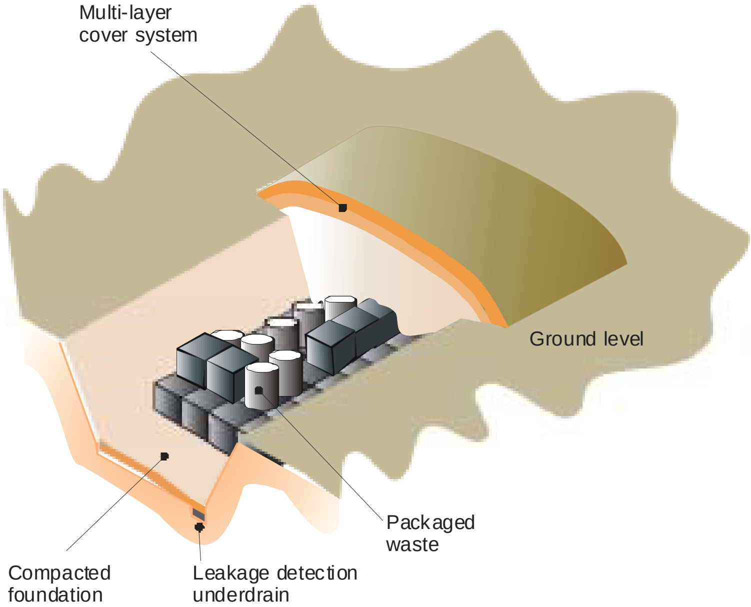

FIGURE 6.3
Indicative trench design

6.2.2 Surface Drainage

The trench sites would have low, natural vertical relief. Existing surface water flow paths or engineered drainage systems would ensure that there is no likelihood of flooding or surface flow to the trench (or boreholes), even in the event of a 1-in-100-year storm event. The completed slope of the repository would be designed to minimise the potential for ponding and ensure erosion is not significant over the life of the repository (including the institutional period).

Predicted rainfall intensities for a 1-in-100-year storm in the region are 59.6 mm/hr for a 1-hour duration storm, 9.7 mm/hr for a 12-hour duration storm, 5.5 mm/hr for a 24-hour duration storm and 2.1 mm/hr for a 72-hour duration storm (see Table 8.12).

The design would ensure that surface water from rainfall events does not accumulate in the vicinity of the buried wastes, or enter trenches or boreholes, both during operations and after closure. Surface drains from operational areas where radioactivity is handled would be led to an evaporation pond within the repository compound to collect runoff and contain potentially contaminated surface water on site.

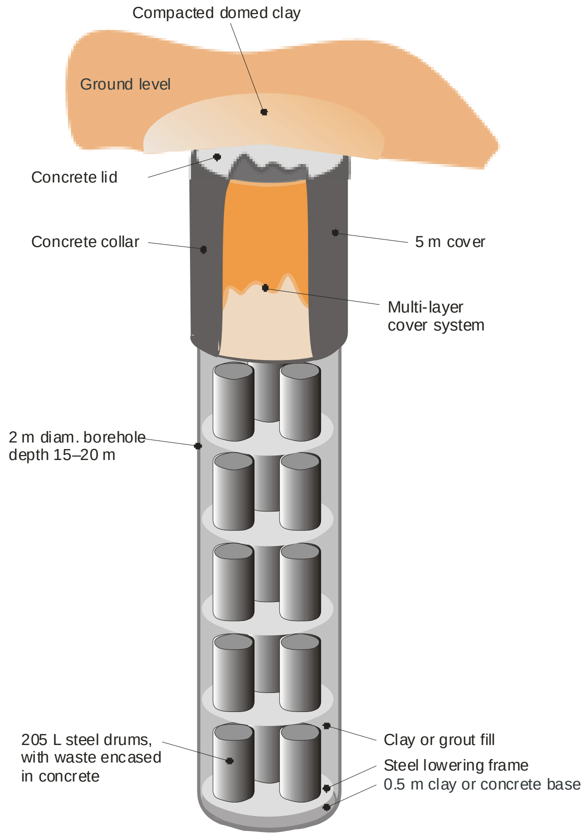

FIGURE 6.4
Indicative borehole design

During operations, while trenches or boreholes were open, facilities would be available to collect any rainwater that accumulates in the bottom of a trench. Modelling undertaken as part of the project assessment indicates that rainwater infiltration would be insignificant with an engineered cover. This is discussed further in Section 8.10.3. It is also proposed to compact the base of the repository and grade the finished surface to a sump to collect any free water and direct it to a sampling well.

6.2.3 Trench and Borehole Design

The disposal facility (trench and/or borehole) would be designed to hold the total volume of waste proposed for each disposal campaign. The trenches and boreholes would be designed to ensure adequate containment of the emplaced waste such that the safety criteria are met.

Trench Design

The trenches are expected to be about 12 m wide at the base to enable adequate construction equipment access, and crane reach during unloading operations. The base would vary depending on the final site, but would be expected to be about 15–20 m below ground level. The sides of the trench would be battered to prevent collapse (Figure 6.3). The trenches would be ramped at one end to allow access by heavy machinery.

Excavated topsoil would be separately stored for use in the final cover. The zone adjacent to the top of the trench would have an earth berm to exclude rainfall runoff and to keep heavy trucks or other vehicles away from the edge of the trench to lessen the risk of the batters collapsing.

Borehole Design

Boreholes would comprise holes approximately 2 m in diameter and of similar depth (15–20 m) to the trench design described above. The indicative design shown in Figure 6.4, which is based on the methodology used at the Mount Walton East facility in Western Australia, would be finalised during the design stage.

Construction at the Mount Walton East facility (see Section 2.4.1) used a manual method of pneumatic jackhammers with spade bit drills and a vacuum ore-lifter to raise the spoil to the surface (provided the ground was not too hard). A concrete collar was poured at the top of the shaft to ensure stability of the shaft at the surface.

An alternative method would be to use large diameter augers for borehole drilling. The actual method to be used would be determined during the design phase.

At Mount Walton East waste was prepared for disposal in 205 L drums, using steel frames lowered into the borehole, with three 205 L drums placed on each frame. Waste was placed on a concrete block inside the 205 L drums, and the drums filled with concrete. After being lowered into the borehole, the drums and complete frame were covered with cement grout, and the next frame was lowered into place before the grout had set. The actual method to be used for the national repository would be determined during the design phase.

Upon completion of the placement of waste packages into the borehole, the top 5 m would be backfilled with a compacted multi-layer system similar to that used for trench backfill, to minimise water ingress into the borehole. Depending on the depth of the borehole (15–20 m), it is expected that 15–27 drums would be disposed of in each borehole.

6.2.4 Backfill

In view of the long institutional control period of the repository and the requirement of structural stability for the stored wastes, it would be important to minimise settlement arising from consolidation over time of the backfill material used to cover the waste. This would involve voids being filled, and adequate compaction of backfill and cover materials.

Criteria for the backfill material, its placement and compaction and testing requirements would be determined in the detail design phase for the facility. Materials recovered during excavation would be investigated for suitability as a backfill material. There may be a need to process the material excavated from the lower portion of the repository to produce a well-graded backfill.

6.2.5 Cover

A suitable cover would be placed over the buried waste to limit infiltration of rainwater; discourage entry of animals, plant roots and humans; and inhibit erosion. The cover would be designed to ensure that the layer properties and thicknesses were adequate to comply with requirements on water ingress and intrusion over the long term. Likely settlement or adjustment would be assessed to ensure that the cover would maintain its integrity during any consolidation.

The NHMRC 1992 Code requires a 2 m cover for Category A waste and a 5 m cover for Category B and C waste. For this repository it is proposed to use a 5 m cover for all waste to limit the potential of radon release from the waste.

A possible cover design may consist of the following layers (from the top):

- **The surface profile**, which would direct any rain or storm surface water away from the burial trenches and be constructed of material with low susceptibility to erosion (such as gibbers, cobbles or rock). Plant growth on the cover would increase evapotranspiration and decrease erosion. The final cover would be of sufficient height above ground level to shed surface water and allow for possible consolidation. All slopes would be shallow enough and covered with material to prevent sheet erosion

- **A soil layer** that supports vegetation similar to that in the surrounding landscape
- **A cobble layer** to discourage digging animals
- **An impermeable layer,** possibly an impermeable geomembrane
- Possibly **a clay layer** at sufficient depth to maintain adequate water content extending from one side of the trench to the other
- Possibly **a layer of site spoil** (or other material), an extension of the material used to backfill the spaces between placed wastes.

There would be an access road to transport waste materials to the site and the trenches. The transport routes are described in detail in Chapter 7.

6.3 Site Support Facilities

The extent of facilities at the site would largely be determined by the facility operator and would depend on such issues as the agreed nature of the packaging of arriving waste and the frequency of disposal operations.

6.3.1 Key Facilities

The key features of the facilities to be constructed are expected to include (Figure 6.5):

- an operations building
- a decontamination/washdown area
- office and ancillary facilities
- a health physics facility
- services Infrastructure.

These facilities are described below. As noted in Figure 6.5, the operations building and associated facilities would be located within the health physics supervised area, with personnel access through the health physics facility. The office and associated facilities would be outside of this area.

6.3.2 Operations Building

The operations building would include facilities for waste receipt, holding, conditioning and packaging and a small laboratory for monitoring waste. It would be about 20 x 12 m in size.

Waste Receipt and Holding

After the waste packages have been received at the repository, and are confirmed as acceptable for disposal, they may require a short period of storage, probably a period of days or a few weeks at most, prior to disposal while quality assurance and assay activities are undertaken. Depending on the type of package design required, additional stillages (support structures) might be provided in the waste store to add structural stability to the stacked packages.

Prior to disposal at the repository, the radionuclide inventory of a waste package would be recorded. This would enable safety assessments to be carried out during handling operations and post-closure repository conditions.

The recording system would also identify what packages have been accepted and where they are located. A document quality assurance trail would be used to establish the contents of any package, using records from the origin of the package, the conditioning undertaken before transport to the repository, any additional conditioning undertaken on site and storage prior to disposal.

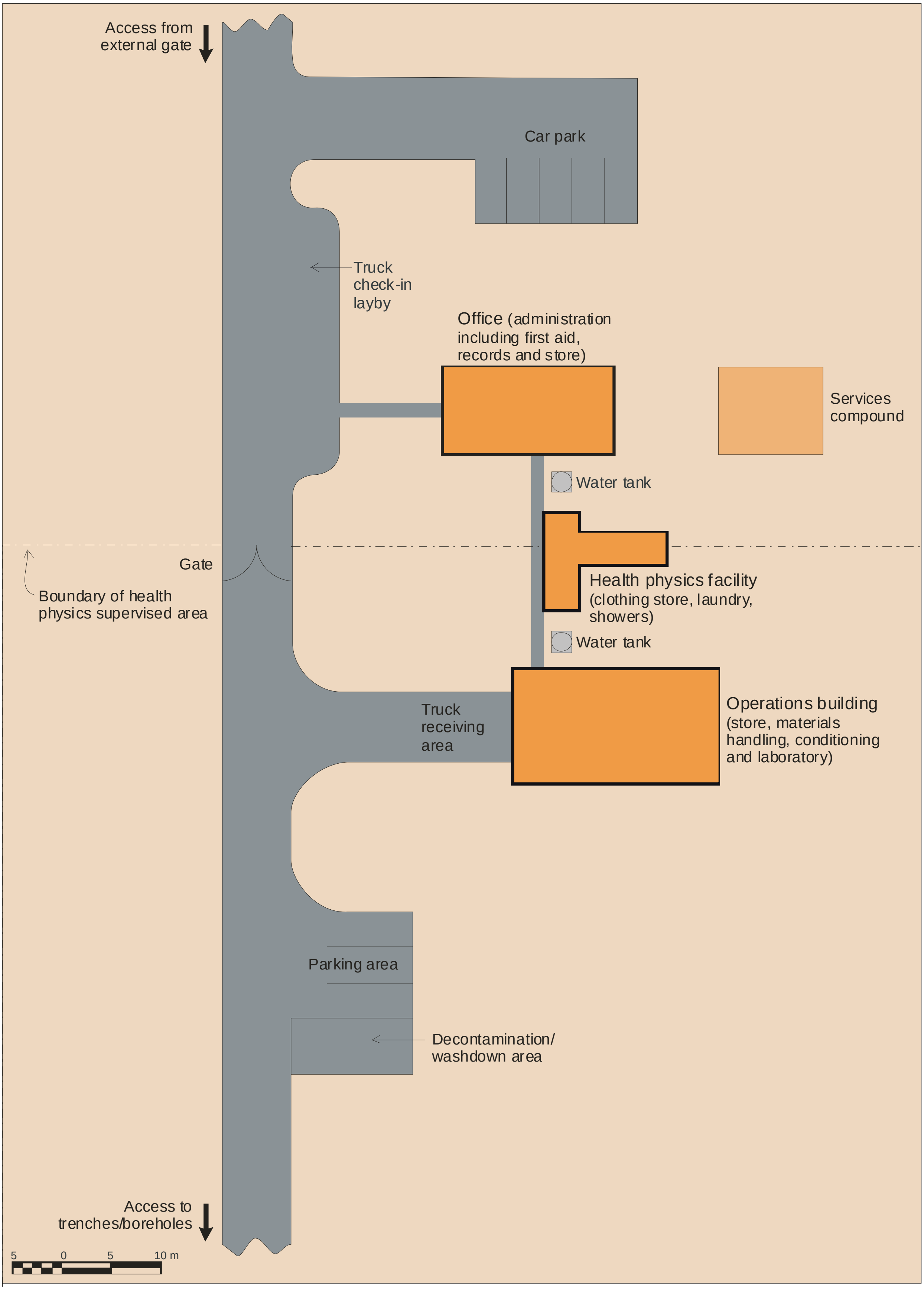

FIGURE 6.5
Indicative plan layout — administrative and operations area

Packaging/Waste Conditioning

Waste would only be accepted for disposal if all relevant WAC had been met. However, in the unlikely situation of in-transit damage, it is possible that some waste packages arriving at the repository may need repackaging prior to disposal. Provision would be made for some simple repackaging of waste as required. Facilities would be provided for the handling of such materials, with appropriate radiation protection and waste management handling facilities for the resulting waste. Some additional packaging of waste could occur at the repository, that is placing of waste in concrete overpacks.

It is intended that waste would arrive at the site in a conditioned form ready for disposal. In-drum compaction facilities and mobile concrete mixing equipment would be available at site if required.

Waste Retrieval

It is possible that waste may require retrieval after disposal. Key features to be provided to retrieve a waste package include:

- use of package identification markings and records of location to identify an individual waste package in the repository
- excavation equipment and a mobile crane to recover the identified package
- a container in which to place the subject package, to provide containment and shielding
- radiation protection and decontamination facilities for the lifting gear and personnel, and for the potential contaminated part of the repository and its surroundings
- a transport and storage facility with appropriate containment, radiation protection and security.

Waste retrieval is described in greater detail in Section 6.7.2.

Laboratory

The laboratory would house monitoring equipment used for checking radiation levels of incoming waste and of equipment during operations.

6.3.3 Decontamination/Washdown Area

The decontamination and washdown area would be designed to decontaminate plant and equipment after use. All waste handling areas and the decontamination facility would be bunded, and washwater from these areas would be passed to an evaporation pond. The pond would be monitored periodically and, if necessary, material from the pond would be disposed of in the repository. Provision would be made for the washing of vehicles or personnel as required.

6.3.4 Office and Ancillary Facilities

The office and ancillary facilities would include:

- administration
- emergency services (first aid, health physics, fire)
- truck lay-by / check-in area
- car park
- change facilities (including showers)
- a separate services compound including portable power generators and a small workshop.

6.3.5 Health Physics Facility

The health physics facility would be located at the boundary of the health physics supervised area, which would include the repository itself, the operations building and the decontamination/washdown area. The facility would include:

- radiation monitoring equipment used to monitor workers, and for radiological surveillance of groundwater and other environmental monitoring
- used protective clothing store and laundry
- male and female change rooms and showers
- clean protective clothing store.

6.3.6 Services Infrastructure

The main infrastructure items to be provided comprise access roads, water supply, electricity supply, telecommunications and sewage disposal.

The requirements for construction of access roads to the preferred and alternative sites are discussed in Section 7.4. In summary, the preferred (Site 52a), which is 55.5 km by road northwest of Woomera township, has good existing access and would require no significant construction works. Site 40a, which is approximately 42 km by road east of Woomera, would require about 35.5 km of significant road upgrading, including 13 km of reconstruction along the old Woomera–Port Augusta road route. Site 45a, which is 91 km northeast of Woomera via the current access route, would require 12.5 km of road upgrading in gibber terrain along the old Woomera–Andamooka Road.

Water would be transported into the site by truck, and pumped to tanks located near the office facilities and in the health physics supervised area, from where it would be reticulated.

Temporary generators would be provided for site power generation, and would be located within the services compound. Fuel would be stored in drums or above-ground tanks in a bunded area within the services compound. Telecommunications would be by satellite phone or UHF radio.

Sewage would be disposed of in septic tanks and associated soakage trenches. The design would conform to South Australian Department of Human Services design guidelines.

Any other wastes arising during operational periods would be appropriately conditioned, packaged and disposed of on site in a small landfill in the trench area. The landfill design and operation would conform to South Australian Environmental Protection Agency guidelines.

6.4 Description of Construction Works

6.4.1 Construction Program

The construction works program and first disposal campaign would commence after satisfactory completion of the environmental assessment and ARPANSA licensing processes as described in Section 3.3 and land acquisition by the Commonwealth, Section 3.3.1. If the Minister for Environment and Heritage made a positive assessment of the proposal in the second half of 2002 or early in 2003, application to ARPANSA for the relevant licences would follow shortly afterwards. A Commonwealth tender selection process would be used to let the construction works and the operation of the repository.

The ARPANSA licensing process also requires an assessment of risk to the environment or at least referral to the assessment of the environment undertaken by Environment Australia, which must be satisfied that no risk is posed to 'people or the environment from a radiological safety perspective'.

Land acquisition would commence after a decision is made on a final site by the Minister for the Environment and Heritage.

The initial construction would be expected to take a period of two months, not including any access road construction (discussed in Section 6.4.3).

6.4.2 Construction Works

Construction work for the repository would involve two main aspects:

- construction of buildings and infrastructure
- excavation of the trench and boreholes.

The first disposal campaign would occur directly after the construction of the disposal structure to ensure that the trenches and/or boreholes are open for a minimum amount of time. This would minimise the chance of rain water collecting in the structures.

The specific design of the buildings including preferred materials and colours, would be undertaken during the detailed design phase. However, it is expected that they may be portable buildings for the office and similar facilities, and simple steel and corrugated iron buildings for operational purposes. It is intended that most of the buildings and other on-site infrastructure, apart from the security fencing, concrete slabs or roads, would be removed from the site between disposal operations.

A portable site office would be established during the construction phase and removed following completion of construction works. The bunded fuel storage area would be built during the initial construction works.

The excavation of the trench or trenches would involve earthmoving equipment including bulldozers, excavators and trucks. The sides of the trenches would be battered to prevent collapse. The boreholes would be dug using either augers or pneumatic jackhammers with spade bits, and a vacuum ore-lifter designed to suck the spoil to the surface (see Section 6.2.3).

The site preparation works would involve clearance of the central 100 x 100 m area, as well as the access road and any area required for other infrastructure. Only the minimum area necessary for the construction of the repository and ancillary activities would be disturbed.

All buildings, structures and infrastructure would be designed in accordance with Australian Standards, including provisions for stability under seismic conditions.

6.4.3 Construction Access

The requirements for construction of access roads to the preferred and alternative sites are discussed briefly in Section 6.3.6, and in more detail in Section 7.4. For Sites 40a and 45a, road construction work would need to precede any site works, and would add approximately one to two months to the overall construction time. Site 52a would not need any immediate roadworks, although 1.5 km of the mainly unsealed road has a narrow seal (4 m wide) that is in poor condition and could be removed.

Any road construction works for Sites 40a and 45a would comprise upgrading of the existing roads and tracks, and would involve minimal disturbance to the existing road verges. Any previously identified sensitive environmental or heritage area would be identified using bunting, with appropriate signage advising people to keep clear of the area.

6.4.4 Construction Workforce

Owing to the relatively modest extent of the construction work required for the repository, the construction workforce would also be modest in size, numbering up to about 15 persons at any one time. The actual numbers would vary during the construction phase, and would be determined more precisely during the design and project planning phase.

The initial works would involve construction and fitout of buildings and provision of infrastructure. The later works would involve construction of the trenches and boreholes ready for waste disposal.

6.4.5 Accommodation

Adequate motel and caravan park accommodation for the projected workforce for Sites 40a and 52a is available at Woomera. For Site 45a, alternative motel and caravan park accommodation is available at Roxby Downs, which is a similar distance from the site as Woomera.

6.4.6 Construction Waste Disposal

All construction wastes other than spoil would be required by construction contracts to be removed from the site. Spoil would be retained as backfill and for use in construction activities on site.

6.5 Description of Operations at the Repository

6.5.1 Main Activities

The main activities associated with operations at the repository would include:

- implementing criteria for acceptance of radioactive waste for disposal at the facility
- implementing a waste recording, documentation and quality assurance system
- planning and preparation of waste for disposal
- trench and borehole design and excavation
- transport of radioactive waste to disposal site
- receipt and checking of consignment quantities on arrival
- acceptance of radioactive waste for disposal
- short-term storage on site pending disposal
- response to contamination or damaged packages
- implementing a site security system
- administering procedures for arrival of personnel and visitors on site and for movement around the site, and associated record-keeping
- response to incidents or accidents
- closure of facility between campaigns
- managing work methods for waste disposal operations, including safety procedures
- monitoring of environmental radiation
- capping trenches and boreholes
- rehabilitation of trench surrounds
- close-out reporting.

6.5.2 Workforce and Accommodation

During the initial and subsequent disposal campaigns a small workforce would carry out the activities at the repository. In between campaigns the repository would have no permanent staff; however, a security presence (visits to the site on a regular basis by security personnel) would be maintained.

The workforce during campaigns would number up to 10 personnel, including an operations manager, radiation protection officer and operational and security personnel, depending on the volume of waste to be disposed of during the campaign. The actual numbers would be determined in greater detail during the design and project planning phase.

Adequate temporary accommodation for the projected workforce for Sites 40a and 52a is available at Woomera. For Site 45a, alternative accommodation is available at Roxby Downs, which is similar distance from the site as Woomera.

6.5.3 Interface with Department of Defence Activities (Site 52a)

The timing of construction and disposal operations at Site 52a would be scheduled so as not to conflict with other uses of the Woomera Prohibited Area (WPA). It would be possible, during construction and operations, to suspend activities to allow for other uses on the WPA and within the Woomera Instrumented Range (WIR), as described in greater detail in Section 10.4.4.

6.5.4 Planning and Preparation of Waste for Disposal

Waste holders would be required to arrange disposal of waste at the repository with the facility operator, and to provide details of the waste to be disposed of to ensure it is suitable for disposal at the repository and that the WAC are met (see Section 4.3).

All aspects of health and safety requirements would be examined and documented and approved before waste is dispatched to the repository. In addition, the operator would ensure that the correct equipment and facilities are ready before approval is given to transport the waste.

Where practicable, packages would be used that are suitable for direct disposal. Quality checks would be undertaken to ensure compliance with packaging requirements and the WAC.

All waste would comply with the packaging requirement of the ARPANSA 2001 (ARPANSA 2001 Code) *Code of practice for the safe transport of radioactive material* (ARPANSA 2001 Code) (see Section 3.2.3). In addition, any waste classified as dangerous goods would comply with the requirements of the National Road Transport Commission and Federal office of Road Safety *Australian dangerous goods code 1998* (ADG Code).

6.5.5 Packaging and Placement in the Repository

The packaging, placement and disposal methodology would conform to the NHMRC 1992 Code. The repository would accept Category A, B and C wastes as defined by the code.

Packaging and placement would also comply with other documents reflecting accepted international practice, such as relevant International Atomic Energy Agency documents.

Packaging

The types of packaging able to be used for the waste are described in the various codes by parameters covering strength and durability. Packaging could be constructed out of different materials to meet these parameters, and the final choice of packaging used would be determined by reference to the requirements of the various applicable codes and regulations, and also practicality and availability. Acceptable types of packaging include polyethylene high integrity containers, steel or concrete-lined steel drums, large steel boxes or prefabricated concrete containers.

Waste packages made of concrete, steel or other suitable material would be placed in layers in the trench by either a crane or a forklift. For borehole disposal a light mobile crane would be used. The location of all packages would be recorded. The waste packages would be designed with adequate strength to enable stacking.

The packages would be packed tightly to minimise voids. For trench disposal the voids between the packages would be filled with spoil material from the excavation of the trench, or other suitable and approved material, once each layer is in position. Boreholes would be backfilled with clay or cement grout.

The common types of packages that are likely to be used include:

Steel Drums

Direct disposal in 205 L steel drums would be appropriate for very low level (Category A) waste. Where the container is being used to provide structural stability, steel drums may be suitable as containers for transport and short-term storage only, not for long-term containment after disposal.

Modular Canisters

Modular canisters or overpacks would be appropriate for some waste. The canisters would be required to comply with structural and containment criteria, could be designed to meet long-term containment criteria, where the degree of containment required would depend on the radiotoxicity of the waste.

Canisters can be constructed of a variety of materials including concrete special, high-strength concrete, fibre reinforced concrete, polyethylene or steel, but concrete is the most probable material for storage canisters.

Canisters can be constructed of a variety of materials including concrete, special high-strength concrete, fibre reinforced concrete, polyethylene or steel, but concrete is the most probable material for storage canisters.

6.5.6 Transport of Radioactive Waste to Site

Transport of the waste would conform to the ADG Code, Australian Dangerous Goods Regulations (as applicable), the ARPANSA 2001 Code and any conditions required under ARPANSA licensing.

Waste would only be accepted at the repository within limited time frames during disposal campaigns.

Transport operations, including methodology, controls, routes, emergency response, communication arrangements and timing would be described in specific transport procedure documents to be produced by the facility operator. These would cover provisions for emergency response during loading and transportation of the waste, as well as health and safety issues relating to the loading and transport of the waste to the repository, and any conditions required under ARPANSA licensing.

All personnel involved in transport and loading operations would undergo formal training, including as appropriate:

- health and safety issues related to the waste
- relevant provisions of the transport documentation including emergency response procedures

- communication arrangements
- general environmental awareness training in relation to the waste
- the use and significance of ‘chain of custody’ documentation.

The facility operator would prepare and put in place operating procedures addressing:

- assessment of the radiation dose to workers and to the public during the transport of radioactive material
- emergency provisions in the case of accidents during transport
- assessment of waste being transported to the repository, to determine:
  - its labelling category
  - the class of packaging required
- packaging and conditioning requirements for transport.

Further detail on the transport of waste to the repository is provided in Chapter 7.

6.6 Security, Health, Safety and Environment

6.6.1 Security and Surveillance

A security fence would be constructed around the 1.5 x 1.5 km buffer zone to prevent unauthorised human intrusion and to exclude grazing animals. The fence would be designed to exclude key feral animal species (rabbits, cats and foxes) and would allow the regeneration of native species within the buffer zone once feral species had been eradicated from the site.

A fence would be constructed around the central 100 x 100 m area, to exclude native animals within the buffer zone from the repository itself.

Appropriate security monitoring measures would be adopted to ensure the safety of the site. A security presence would be in place during the initial and subsequent campaigns to ensure the safety of personnel. The site would be monitored for any potential breaches in security between campaigns.

In addition, the waste would be protected by burial at depth and would be covered between disposal campaigns.

6.6.2 Health Physics Requirements

The repository would have a health physics framework that reflects the facility’s radioactivity parameters and the nature of work undertaken. This framework would include procedures governing all work at the site that involves radioactive materials, as well as such matters as conditions for entry to areas where there are radioactive substances, precautions to be taken when working in those areas, and procedures for decontamination of personnel and equipment.

The facility operator would be responsible for implementing procedures complying with the health physics framework and occupational health and safety requirements as approved by the regulator (ARPANSA) including:

- statutory record keeping and maintenance of health physics documentation
- the system for keeping records of health and safety issues
- precautions for personal protection to be taken by personnel working with contaminated materials
- procedures for monitoring and recording the health and especially the exposure of site personnel

- procedures for leaving the contaminated areas, including procedures for the decontamination of personnel
- procedures for monitoring dose uptake by workers, including as appropriate:
  - whole body monitoring for each campaign
  - personal and fixed air sampling
  - urine analysis
- training for workers on the hazards involved with ionising radiation, and on appropriate precautionary measures for personal protection
- any modifications to plant and machinery for use with contaminated materials, to give radiological protection to the plant operators
- procedures for the decontamination of plant and equipment, including monitoring.

6.6.3 General Health and Safety Requirements

There would be a variety of general hazards potentially associated with operations at the facility. These can be divided into operational hazards and environmental hazards.

Operational Hazards

- excavation activities and working in and around an excavation
- heavy machinery and heavy vehicle movement:
  - general activities and traffic control
  - overhead activities
  - vibrations
- slip/trip/fall hazards
- manual handling
- electrical hazards
- waste unloading and placement operations and exposure to radionuclides.

General/Environmental Hazards

- lightning
- bushfire
- environmental hazards:
  - heat stress
  - noise
  - snake bites
  - allergies such as bee stings
  - dust
- remote location — access and communications
- domestic hazards.

Procedures would be developed to address the occupational health and safety management required for general site operations such as excavation, traffic movements, waste conditioning and burial. These procedures would include the identification of potential hazards and their management, as well as emergency response procedures and incident management planning.

The facility operator would be responsible for implementing procedures and complying with occupational health and safety requirements including:

- providing correct personal protective equipment
- providing washdown facilities for general hygiene and decontamination purposes
- maintaining safety records
- undertaking health surveillance and maintaining associated records
- providing communications and managing traffic
- providing first aid facilities (including personnel)
- monitoring personnel for heat stress
- developing protocols for safe disposal operations when using heavy machinery and cranes, including creating exclusion zones

- conducting appropriate training, inspections and safety audits
- making provision for dust suppression if necessary
- providing appropriate firefighting equipment.

Other requirements would be identified and described during the development of site-specific health and safety and emergency response plans.

6.6.4 Environmental Monitoring

A comprehensive monitoring program would be undertaken to ensure that the repository is performing as designed and that any radioactivity is effectively contained.

Data baseline surveys have been undertaken as part of the previous study phases (see Section 1.5) and as part of this environmental impact study process. The need for any additional baseline surveys would be determined during the design and licensing processes (see Section 3.3). These surveys, together with previous data, would provide a basis for assessing the results of subsequent monitoring surveys conducted through the operational and the institutional control periods.

The operational and institutional monitoring program would also be developed during the design and licensing process. The following may be monitored in the program:

- vegetation samples from the site, buffer zone and restricted occupancy zone, for gross alpha, gross beta and gamma emitters
- fauna on the site, buffer zone and restricted occupancy zone, for uptake of radioactivity
- soil, for gross alpha, gross beta and gamma emitters
- air (upwind and downwind), for gross alpha, gross beta and gamma emitters
- surface gamma radiation
- groundwater from bores on the site and in the buffer zone
- surface water, for radionuclides after major rains
- trench cover material, using neutron moisture meters and gamma probes installed in boreholes
- gas samples collected from within and beneath the cover material, for tritium, carbon-14 and radon
- the Vadose zone (the zone below the surface and above the watertable) around and below the disposal zones, using neutron moisture meter and gamma spectra probes. These would be installed in vertical and/or slant sampling boreholes alongside the trenches, with casing fitted with gas sampling ports; soil sampling holes may also be installed
- presence of water in floor drains beneath the waste, for gross alpha, gross beta and gamma emitters.

Water from operational areas of the site would be collected and monitored to check for contamination. An evaporation pond would be constructed to collect runoff from operational areas, thereby avoiding any off-site release of surface water.

Additional information on monitoring is provided in Chapter 13.

6.7 Receipt, Recording and Retrieval of Disposed Wastes

6.7.1 Receipt and Documentation

Arrangements would be made for the appropriate receipt and documentation of waste when it arrives at site, and for its safe storage prior to disposal. As disposal campaigns (including the receipt of waste at the repository) would be conducted during a limited time frame, storage would only be required for a short period.

A quality assurance system would be established to ensure that waste has been appropriately conditioned for final disposal either prior to transport to site or at the repository.

All waste requiring acceptance for transport to the repository would first be checked against the WAC. Non-conforming waste would not be accepted for transport. On arrival at the facility, waste would be stored for an interim period of a few days to weeks. This storage period would be kept as short as possible.

6.7.2 Recording and Retrieval

As noted in Section 4.3.2, all waste packages prepared for disposal would have a unique engraved or raised marking to indicate the batch of waste to which they belong and to allow a detailed inventory to be kept of all waste disposed of at the site. Any markings on the package would be designed for longevity and would provide sufficient information to allow identification of the complete contents of the package, on reference to the inventory. This would be important for transport and disposal, and also for the potential retrieval of any package.

During burial operations, a record would be kept of the location of each package in the excavation. This information would be incorporated into the permanent inventory of waste disposed of at the site. The boundaries of the operational area and locations of boreholes would be accurately surveyed, and a grid system and level designation used for recording the location of a particular package.

Once a package had been accurately inventoried and its location in the excavation recorded, the process of retrieval would be a matter of assembling the required equipment and exhuming the waste package. Since any requirement to retrieve the package would not arise for many years, if at all, the methodology used to retrieve the package would be more fully developed at that time. A specific retrieval plan would be developed that described the requirements of excavation retrieval and reinstatement of the capping structure.

It is possible, however, that boring techniques such as those used to sink the boreholes (see Section 6.2.3) would be used to access the appropriate area in the excavation (whether a trench or shaft), as this would cause the least disruption to the remainder of the backfill and capping structure. Where necessary, hand-held or machine directed pneumatic hammers, spades or cutting techniques would be used to retrieve a particular package.

The final phase of the retrieval process, once the required package had been accessed and removed, would be the reinstatement of the capping and backfill structure. This would only happen after the void generated by removal of the package had been satisfactorily filled.

6.8 Description of Surveillance Period

Arrangements would be put into place for periodic monitoring and surveillance during the closed periods between campaigns to ensure protection of people and the environment. Further details on surveillance and monitoring are given in Chapter 13.

In the periods between disposal campaigns, the facility would be closed and no personnel would remain on site. As noted in Section 6.4.2, it is intended that most of the buildings and other on-site infrastructure, apart from the security fencing, concrete slabs and roads, would be removed from the site between disposal operations. The period between campaigns would possibly be about two to five years. The site would be routinely inspected and monitored between campaigns, and a security presence maintained.

6.9 Description of Institutional Control, Decommissioning and Closure

At the end of the operational period the facility would enter the institutional control period, which is the length of time, following closure, for which land use restrictions apply. Over this time the facility would be monitored and access restricted. An institutional control period of 200 years has been adopted for the repository.

The NHMRC 1992 Code contains detailed guidelines for the closure of the disposal facility. Disposal operations at the facility would cease when the authorised disposal space had been filled or the limit on total site radioactivity reached. The estimated initial operational life of the national repository is 50 years, following which a review would be conducted.

In accordance with the NHMRC 1992 Code, conceptual or draft plans for decommissioning the facility and rehabilitating the site would be prepared and submitted to ARPANSA for approval before operations began. These plans would be reviewed every five years and resubmitted for approval. Detailed decommissioning plans would be submitted at least three years prior to closure.

Upon closure of the site, all visible structures would be removed (apart from fences, signs and drains around the disposal structures).

The decommissioning plans would also address aspects of any remaining revegetation requirements. This would only be required for areas where infrastructure had been finally removed, since revegetation activities would have been undertaken where necessary during the operational life of the site.

At the end of the institutional control period, no further control of the repository site would be necessary as the radioactive materials would have decayed to levels safe enough to enable unrestricted access. Further details on radiation doses and risks for a number of potential exposure scenarios are provided in Chapter 12.

6.10 Ownership and Operation

The national repository would be owned by the Commonwealth and regulated by the Commonwealth's independent regulator, ARPANSA. Operations at the national repository would be undertaken by private contractors, whose performance would be overseen by the Commonwealth department responsible for radioactive waste management policy (currently the Department of Education, Science and Training) and by ARPANSA.

In its oversight of the facility, the Commonwealth would ensure that the repository:

- satisfies all licence requirements
- maintains appropriate safety
- maintains appropriate security
- maintains appropriate records
- satisfies the needs of waste producers, and encourages waste minimisation.

The Commonwealth would ensure that disposal campaigns are effectively conducted, and that the facility is efficiently monitored and the waste secured between campaigns.

Details of arrangements for the operation of the facility would be fully outlined when application is made to ARPANSA for an operating licence for the facility (see Section 3.3).

6.11 Financial Arrangements

Commonwealth policy requires that there would be a charge for disposal of waste in the national repository.

Charges would be set in such a way that waste minimisation is encouraged, and that disposal is chosen when no other option, for example recycling, exists. Disposal charges would also be set in such a manner as to encourage use of the facility, rather than have waste producers continuing to store waste in non-purpose-built accommodation, or disposing of waste in an inappropriate manner.

The Mount Walton East repository in Western Australia (see Section 2.4.1) sets charges to cover the cost of disposal operations. This model may provide a practical basis for the Commonwealth to determine disposal costs for waste in the national repository.

Factors that could be considered in setting charging rates for disposal of waste in the national repository may include:

- the physical size and volume of the waste (i.e. a per cubic metre charge)
- the activity of the waste and amount of various radionuclides (i.e. whether the waste is Category A, B or C according to the NHMRC 1992 Code)
- transport costs associated with delivering waste to the repository
- costs associated with packaging the waste for disposal, if additional packaging is required at the repository (e.g. placing short-lived intermediate level waste into concrete overpacks).

The cost of each disposal campaign would depend on the volume of waste to be disposed of and the type of disposal structure (trench or borehole). Waste disposal is likely to be most cost-effective during the first disposal campaign, which would dispose of the largest volume of waste.

Various strategies could be used in subsequent campaigns to improve cost-effectiveness (while not compromising safe disposal):

- An extended period of time could be allowed between campaigns.
- The design of the disposal structures could be varied to suit the amount and type of waste; for example, a borehole may be more appropriate for a small volume of waste than a disposal trench.