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FINAL REPORT ON

INDEPENDENT ASSESSMENT OF LONG-TERM MANAGEMENT OPTIONS FOR LOW AND INTERMEDIATE LEVEL WASTES AT OPG'S WESTERN WASTE MANAGEMENT FACILITY

Submitted to:

Steering Committee
Municipality of Kincardine and Ontario Power Generation

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EXECUTIVE SUMMARY

In 2002 the Municipality of Kincardine and Ontario Power Generation (OPG) signed a Memorandum of Understanding (MOU) which set out the terms under which OPG, in consultation with the Municipality of Kincardine will develop a plan for the long-term management of low and intermediate level waste at the Western Waste Management Facility (WWMF). As part of the MOU related activities, an independent assessment of the possible long-term management options was conducted. This report provides the results of the independent assessment study.

The study examined the costs, impacts and benefits of constructing and operating each of three long-term management concepts at the WWMF, namely:

- Enhanced Processing and Storage;
- Surface Concrete Vaults; and
- Deep Rock Vaults.

In addition, the costs and benefits of the current low and intermediate level waste management operations at the WWMF, identified as the "Status Quo", are provided.

The study found that all three long-term management options are technically feasible and may be safely constructed and operated at the WWMF. There is considerable international experience with the use of each of the three options for the long-term management of low and intermediate level waste. A safety assessment showed each option is capable of meeting stringent Canadian and international safety standards with a considerable margin. An examination of the environmental protection feasibility of the options showed that all potential adverse effects could be mitigated or managed using known and proven methods.

Each of the options would have significant economic benefits to Kincardine and the neighbouring municipalities. These benefits include direct expenditures and employment as well as indirect employment and associated economic activity in the community. The benefits from all of the options would be in addition to the current benefits to the community from the WWMF. No adverse economic effects were identified in the economic analysis.

Public attitude and tourism research conducted as part of the study found that none of the options would have significant adverse effects on resident, business or farm operator feelings of personal security, community satisfaction or commitment to farming. In addition, residents did not anticipate any changes in their daily behaviour as a result of a long-term waste facility being built in their community. Tourism research found that none of the options would be expected to have any measurable effect on tourist activities or visits to Kincardine. No clear preference for any of the options was identified throughout the public attitude and tourism research.

Communication activities were conducted throughout the duration of the study to inform stakeholders and the public of the study and obtain their comments on the long-term management options. Low and intermediate waste management issues are not of high interest in the community. Few residents expressed any concerns with respect to any of the options. A draft communications protocol was developed to guide consultation with the First Nations and preliminary discussions were held with the Saugeen and Nawash First Nations.

ACRONYMS AND UNITS USED IN REPORT

Acronym	Description
AMBER	A state-of-the-art computer software tool used to model the transport and potential impact of contaminants in the environment
CNSC	Canadian Nuclear Safety Commission
FTE	Full Time Equivalents. Equivalent to one person working full time for one year
Golder	Golder Associates Limited, an independent consulting firm who conducted the Independent Assessment Study on behalf of Kincardine and OPG
IAS	Independent Assessment Study
ICRP	International Commission on Radiological Protection
ILW	Intermediate Level Waste
Kincardine	The Municipality of Kincardine
LLW	Low Level Waste
MOU	Memorandum of Understanding
OPG	Ontario Power Generation
PAR	Public Attitude Research
WWMF	Western Waste Management Facility
Units	**Description**
Sv	Sievert, a unit of measure used to describe the effective dose of ionizing radiation
mSv	MilliSieverts (1/1,000 of a Sievert)
µSv	MicroSieverts (1/1,000,000 of a Sievert)

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1.0 INTRODUCTION

1.1 Working Towards A Solution

Low and intermediate level radioactive waste is produced at all of Ontario's nuclear generating stations. For the past 30 years, this waste has been safely transported to waste management facilities located on the Bruce Power site in the Municipality of Kincardine. The waste management facility, currently known as the Western Waste Management Facility (WWMF), is owned and operated by Ontario Power Generation (OPG). The facility currently provides interim storage of the waste and OPG is seeking to find an acceptable long-term management solution.

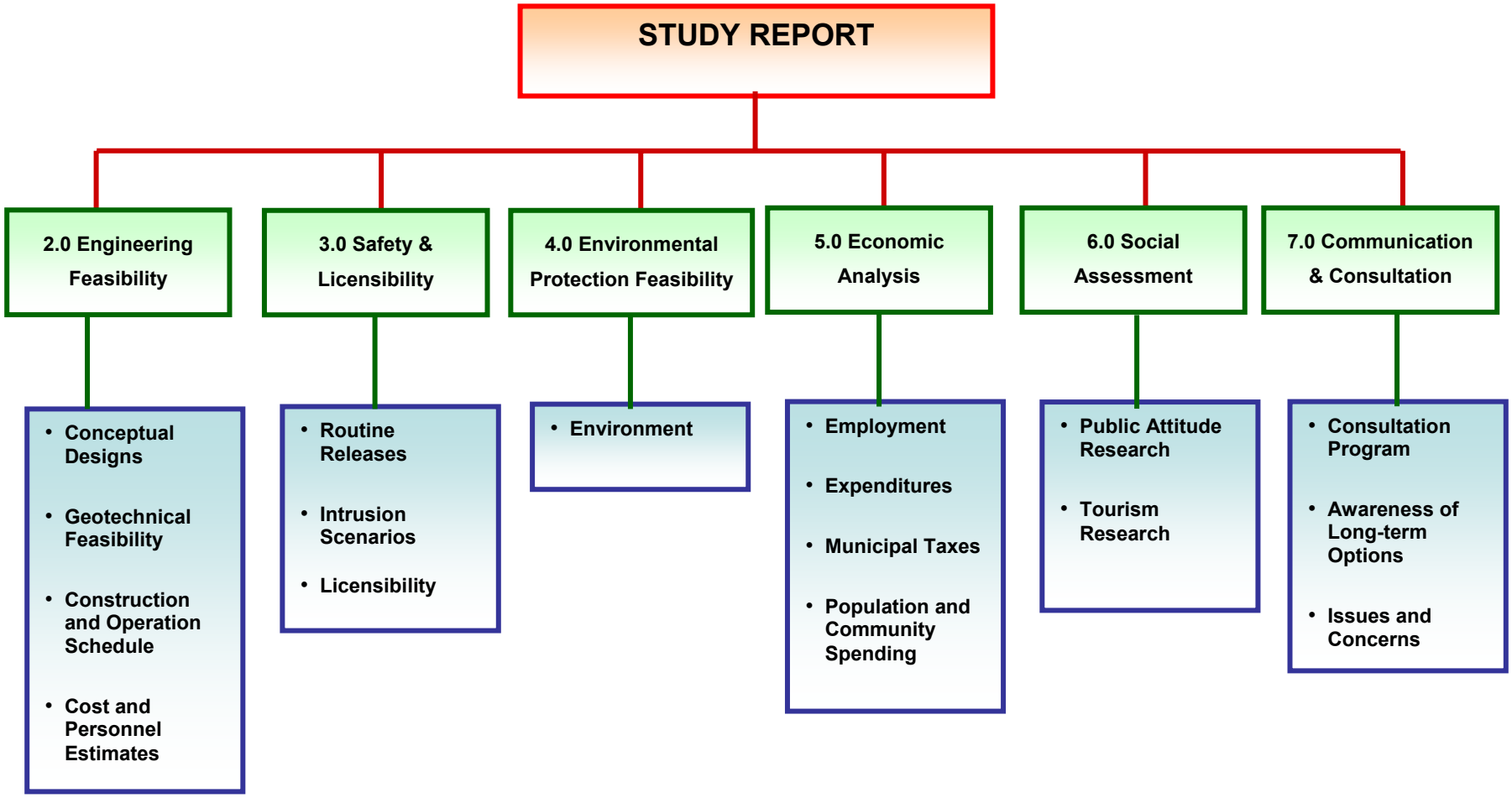
In 2002, the Municipality of Kincardine and OPG signed a Memorandum of Understanding (MOU). The purpose of the MOU is to set out terms under which OPG, in consultation with the Municipality of Kincardine, will develop a plan for the long-term management of low and intermediate level radioactive waste at the WWMF. As part of the MOU related activities, Golder Associates, on behalf of Kincardine and OPG, has conducted an independent assessment of three possible long-term management options which are presently under consideration by OPG. This report documents the results of the Independent Assessment Study.

1.2 Independent Assessment Report

The Independent Assessment Study (IAS) was carried out to develop information regarding a shortlist of possible long-term management options for the low and intermediate level waste currently stored at the WWMF and planned to be received in future. The goal of the IAS is to provide decision makers with a clear and fact-based assessment of each of the options. The IAS report describes the options, and provides a comparison of the ability of each to meet the appropriate engineering, safety, socio-economic and environmental criteria. The report also describes the results of broad consultations with stakeholders and members of the public on the possible options and the proposal to locate at the WWMF. Figure 1 outlines the framework of the IAS report and shows the primary areas considered in the study.

The information provided in the IAS report is a summary of a number of more detailed background studies relating to the long-term management of low and intermediate level wastes.

Figure 1: IAS Framework



1.3 Background of Project

The three possible options currently under consideration for the long-term management of low and intermediate level waste are:

- Enhanced Processing and Storage;
- Surface Concrete Vaults; and
- Deep Rock Vaults.

To be considered in the IAS, each of the options was demonstrated to be capable of meeting the required high level of worker, public and environmental safety. The options were also demonstrated to be capable of being constructed and operated at the Bruce Power site on or adjacent to the existing WWMF.

In addition to the three long-term waste management options, consideration of the current management of low and intermediate level waste at the WWMF, termed the "Status Quo", was included in the study to allow a comparison with the long-term options under consideration. The Status Quo provides safe and effective storage of the wastes and could be continued indefinitely.

1.4 Overview of the Western Waste Management Facility

Currently, all low and intermediate level wastes resulting from the operation of all Ontario's nuclear generating stations are stored at OPG's WWMF. An aerial view of the WWMF is shown on Figure 2. The facility consists of several buildings including administration, receiving, processing and treatment, and storage buildings for low level waste. Intermediate level waste is stored in in-ground containers (located to the right of the Low Level Storage Buildings in Figure 2). Low level waste processing occurs in the Waste Volume Reduction facility in the centre of the photo. The low level waste is stored in the eight Low Level Storage Buildings in the upper left corner.

The WWMF is also the site of the Western Used Fuel Dry Storage Facility. This facility is located in the upper centre of the photo. This facility, which began operations in 2002, receives used fuel from the Bruce Power stations that has been stored for at least 10 years in water filled pools at the station. Used fuel is received only from the Bruce Power stations and there are no plans to receive used fuel from any other nuclear generating station. The long-term management of used fuel is being studied by a federal government mandated organization known as the Nuclear Waste Management Organization.

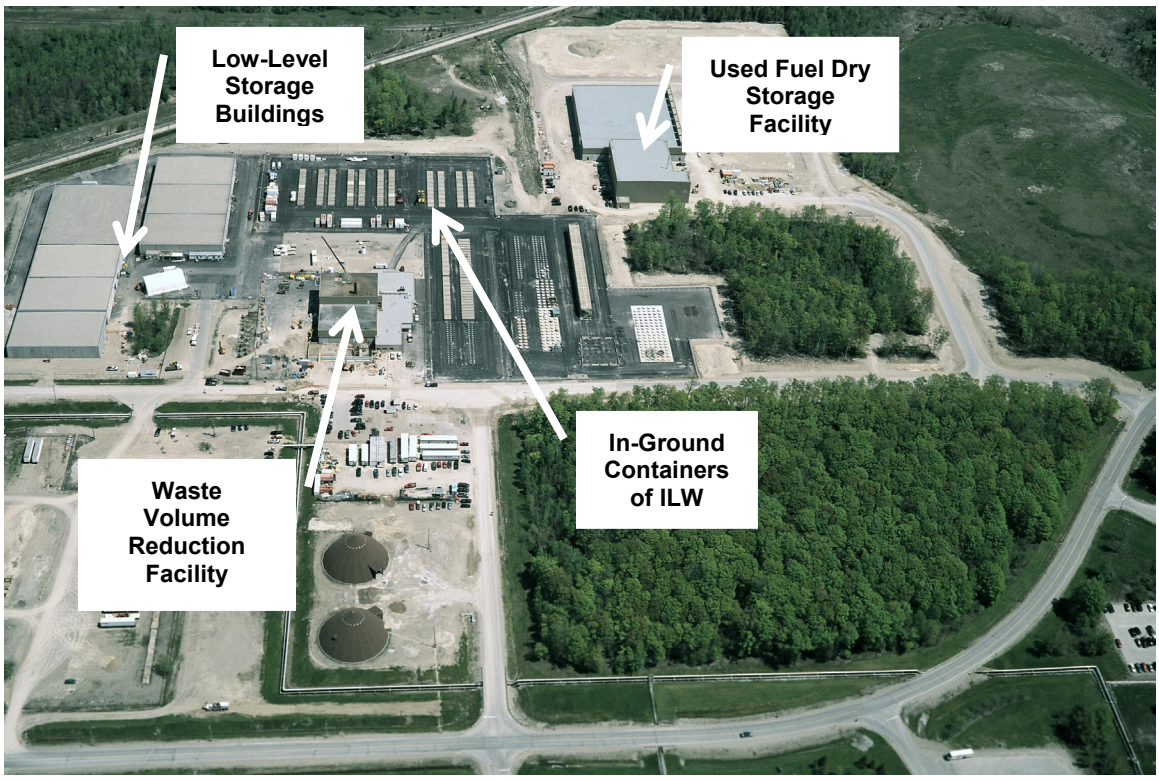


Figure 2: Aerial view of the WWMF at the Bruce Power site

1.4.1 Low and Intermediate Level Waste

Low level waste (LLW) consists of industrial items that have become slightly contaminated with radioactivity and are of no further use. The levels of radioactivity in LLW are such that it may be safely handled by workers using normal industrial practices and equipment without any special radiation protection. LLW accounts for 95 percent of the total volume of low and intermediate level radioactive waste received at the WWMF.

The primary radionuclides found in LLW are Cobalt-60, Cesium-137 and other radionuclides with half-lives generally equal to or less than 30 years. As shown on Figure 3a, the total amount of radioactivity associated with LLW will decay to approximately 1/10th of the original amount after 50 years. After 250 years, the amount of radioactivity will have decayed to about 1/50th of its initial amount.

Intermediate level waste (ILW) consists primarily of used nuclear reactor components and the resins and filters used to purify reactor water systems. ILW is more radioactive than low level waste. This type of waste is generally required to be shielded to protect workers during handling of the waste.

The primary radionuclides found in ILW are Carbon-14 and other radionuclides with half-lives equal to or greater than 30 years. As shown on Figure 3b, the total amount of radioactivity associated with ILW will decay to approximately 1/2 of the original amount after 50 years. After 250 years, the amount of radioactivity will have decayed to approximately 1/3 of the original amount.

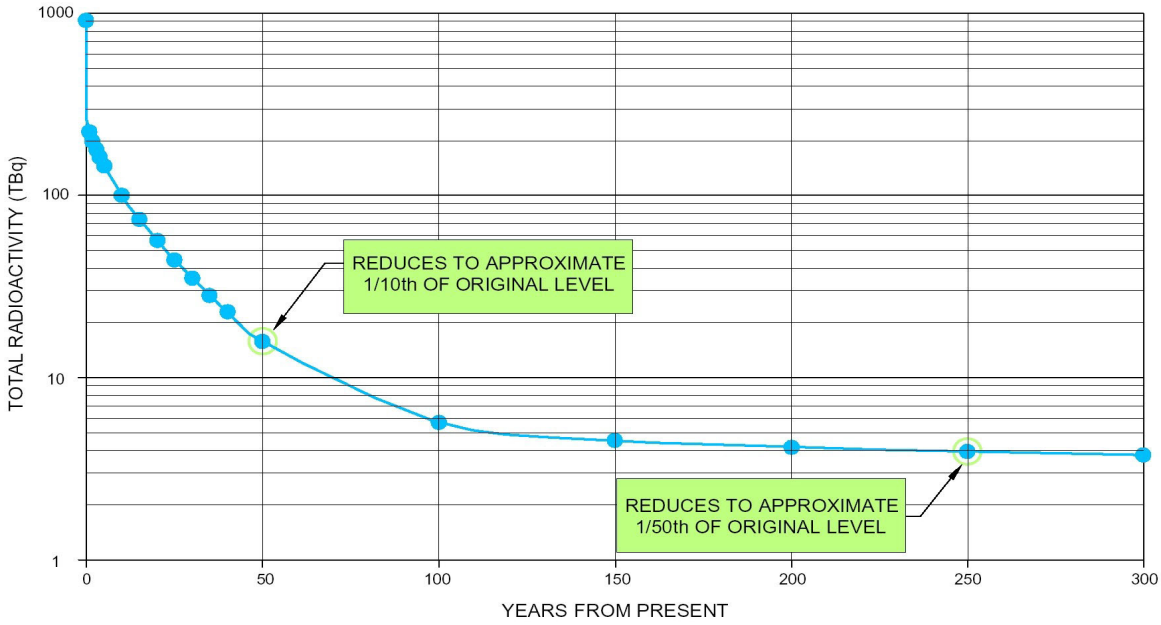


Figure 3a: Reduction in radioactivity over time for LLW

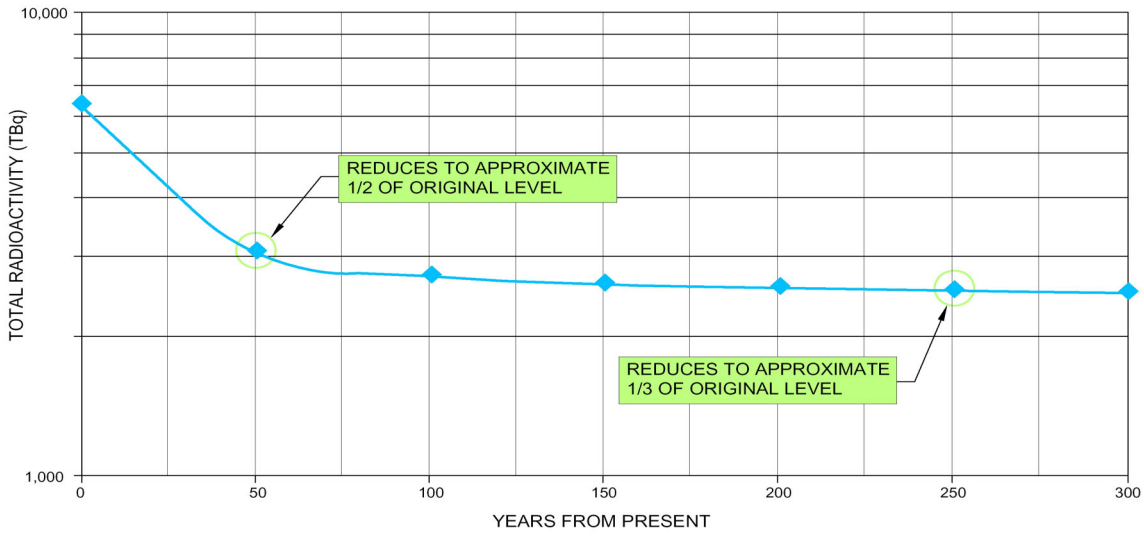


Figure 3b: Reduction in radioactivity over time for ILW

1.4.2 Current Processing, Treatment and Storage (Status Quo)

Low and intermediate level wastes are transported by road from the nuclear power stations to the WWMF. Over more than three decades, there have been over 25,000 shipments of radioactive material. During that time, there have only been five road accidents. In each case, the accident was minor and only the transport truck was damaged. There was no release of radioactive material to the environment.

The LLW received at the WWMF consists of three categories which are managed as follows:

- Compactable wastes, which make up 5 - 25 percent of the total, are reduced in volume using the current compactor prior to being placed into large steel containers and stored in the Low Level Storage Buildings. Typically, a volume reduction of up to 5:1 is achieved by the compactor.
- Incinerable wastes, which make up 50 - 70 percent of the total, are reduced in volume in the incinerator and the ashes placed in steel containers and stored in the Low Level Storage Buildings. Typically, a volume reduction of up to 60:1 is achieved by the incinerator.
- Non-processible wastes, which make up approximately 25 percent of all wastes received, are stored as received, without any processing.

All LLW processing and treatment occurs at the WWMF, which houses a low force compactor and waste incinerator. The waste incinerator was recently upgraded.

Currently a number of types of containers or packagings are used to store the waste, including open-topped steel boxes, covered boxes and large steel bins, as shown on Figure 4. Following processing, all three categories of waste are placed in interim storage in one of the eight Low Level Storage Buildings. A total of approximately 48,000 m^3 of LLW is currently stored in the eight storage buildings. New storage buildings are constructed as they are needed, generally about every four to five years.

Based on current waste generation rates, the volume of LLW in storage will increase to approximately 60,000 m^3 by early in the next decade, the earliest that a long-term management facility could become operational. The estimated volume in 2034 at the end of the facility operating life is 77,000 m^3.

Figure 4: Steel boxes used to store LLW at the WWMF

ILW is not processed for volume reduction due to its physical condition and greater levels of radioactivity. Instead, it is stored in steel containers set in concrete- and steel-lined holes that have been bored into the ground, or in concrete lined and covered trenches. Figure 5 shows sealed in-ground containers at the WWMF. Currently, there is approximately 8,500 m^3 of ILW stored in in-ground containers at the WWMF. This volume could increase to approximately 15,000 m^3 by 2034.

ILW will continue to be stored in these in-ground containers at the WWMF pending a decision to include some or all of it in one of the long-term management options at the WWMF or to relocate it to another long-term management facility.

Figure 5: In-ground containers used to store ILW at the WWMF

2.0 ENGINEERING FEASIBILITY

2.1 Goal of Engineering Feasibility Studies

The goal of the engineering feasibility assessment is to identify and describe the long-term management options. This includes identifying which of a long list of potential repository options could be constructed and operated in the geological conditions present at the WWMF. The engineering feasibility studies also seek to develop the conceptual designs for the identified feasible options along with their construction and operating schedules, cost estimates and personnel requirements.

It is common to distinguish between two approaches to the long-term management of radioactive waste. Storage options require a continuous and active presence of facility operators at the site to ensure the long-term isolation for the waste from people and the environment. The second approach involves "long-term repositories" which do not rely on active care and maintenance for their safety because they incorporate substantial geological or engineered barriers to isolate the waste from people and the environment. Both approaches include monitoring to confirm that they are operating safety as designed. The engineering feasibility studies examined options for both approaches.

2.2 Methods and Details of Engineering Feasibility Studies

Conceptual designs and cost estimates for the three long-term management options were developed based on existing studies. The designs and cost estimates were based on a number of assumptions:

- The long-term management facility would be located on or adjacent to the current facilities at the WWMF;
- The repository options consist of the repository structure plus associated direct support facilities;
- Receipt and preliminary processing of the waste would continue to take place at the WWMF;
- Administrative support services, laboratory services, security and the like would be provided from the WWMF;
- The facility would be capable of receiving wastes through 2034;
- Construction of the facility would be carried out by independent contractors and would be separate from waste management operations;
- Approximately 115,000m^3 of LLW would be managed in the facility;

- Though some of the facilities are capable of managing ILW, the current designs and cost estimates do not include ILW; and
- The facility would be closed and decommissioned following waste placement operations.

These assumptions were used in developing the designs and costs of the options in the study. However, because the facilities are modular in nature they could be readily adapted to accommodate additional wastes or to continue in operation beyond 2034 if required. This flexibility ensures that any of the options can provide for the long-term management of LLW from Ontario nuclear reactors in the event that current planning and operating assumptions change.

A geotechnical feasibility study reviewed existing geological, groundwater and geotechnical information relating to the Bruce Power site. A stratigraphic and hydrogeological model of the site was developed and the compatibility of the generic long-term repository concepts with the site conditions was assessed. The study reviewed mining and excavation experience across Ontario to determine the suitability of the rock formations underlying the site for a waste repository. The geotechnical study also developed input parameters for a concurrent Safety Assessment (see Section 3.0) of the potentially feasible concepts. The geotechnical feasibility study considered only long-term repository options; a separate study had determined that Enhanced Processing and Storage was feasible at the WWMF.

It is common engineering practice to prepare schedules and cost estimates at various stages in the development of a project, typically:

- Conceptual Design stage;
- Preliminary Design stage; and
- Detailed Design stage.

Each succeeding estimate reflects increased knowledge of the project requirements and hence increased confidence in the accuracy of the estimate. The cost estimates and schedules presented in this report have been developed at a conceptual level. Subsequent designs may be expected to result in progressively more precise cost estimates and schedules.

2.3 Geotechnical Feasibility Study

The geotechnical study assessed the feasibility of constructing any or all of a number of generic long-term repository concepts previously considered by OPG for the long-term management of LLW. In all, seven generic concepts which may be possible at the WWMF were assessed:

- Covered Above-Grade Concrete Vaults;
- Shallow Concrete Vaults;
- Deep Concrete Vaults;
- Shallow Rock Cavern Vaults in near surface dolostone (less than 100 m below surface);
- Deep Rock Cavern Vaults in thick salt bed (200 to 400m below surface) ;
- Deep Rock Cavern Vaults in "tight" shale formation (400 to 600m below surface); and
- Deep Rock Cavern Vaults in "tight" limestone formation (600 to 800m below surface).

The results of a primary screening analysis eliminated "deep concrete vaults" and "deep rock cavern vaults in thick salt bed" from further evaluation. A secondary geotechnical feasibility screening showed that the "shallow concrete vaults" and "shallow rock cavern vaults" were not technically feasible at the WWMF site.

The geotechnical feasibility study confirmed the deep rock cavern vaults are feasible in the tight shale and limestone formations underlying the WWMF. The study also determined that access to this deep rock formation is feasible by a vertical shaft using conventional mining technology. Because these concepts differ only in the depth of the host rock formation, they are identified as a single concept, named the "**Deep Rock Vaults**" option in the IAS.

The study also found that the "covered above-grade concrete vaults" concept is feasible for the surficial soils adjacent to the WWMF. This is named the "**Surface Concrete Vaults**" option in the IAS.

2.4 Description of the Long-Term Management Options

2.4.1 Status Quo

The Status Quo consists of the continuation of the current LLW and ILW management operations at the WWMF. A description of current operations is provided in Section 1.4.

2.4.2 Enhanced Processing and Storage

Enhanced Processing and Storage is an adaptation and enhancement of the current LLW and ILW management operations at the WWMF. Specifically it involves:

- Improved waste processing through super-compaction and conditioning via cementation; and
- Improved waste storage in controlled access storage buildings.

A 5000 tonne box super-compactor would be used to compact one cubic metre sacrificial containers filled with "compactable" waste. Several of these compacted sacrificial containers would then be placed into a larger steel container, known as an "overpack", and the remaining air space in the container filled with special purpose cement. The overpack containing the compacted and cemented waste would be suitable for long-tem storage. These waste processing operations would take place in a new processing and treatment building to be constructed immediately adjacent to the current buildings at the WWMF.

The filled overpacks would be transferred by forklift to modified Low Level Storage Buildings. The building enhancements involve the installation of airlocks and a climate control system.

Administrative support services, waste receiving operations, laboratory services, security and the like would continue to be provided from the WWMF. However, the processing and treatment facilities would be new construction.

A number of countries use the Enhanced Processing and Storage technology for the management of LLW. For example, prior to being place into long-term storage in the Netherlands and Belgium, the volume of LLW is minimized through the use of super-compaction technology. Super-compaction technology is also used in the US and the UK, and is capable of reducing the waste volume to typically less than one tenth of its original volume. In addition, compacting the waste enhances the long-term stability of the waste. The compacted drums are placed in specially designed metal containers or "overpacks" and filled with concrete grout to ensure their long-term safety and isolation from the environment. The overpacks are stored in a controlled environment inside a storage building.

2.4.3 Surface Concrete Vaults

This is a long-term repository option which would be constructed adjacent to the WWMF. This would allow the use of current WWMF infrastructure and services. Further, water, sewer, electrical power and other services would be provided to the repository facility from the WWMF. The facility would consist of two parallel bays of 24 vaults each (see Figure 6). The total area of the new facility would be approximately 367 m by 260 m or about 9.6 hectares.

Processing of LLW would continue to take place at the WWMF prior to and during the operating phase of the repository. Additional contractor support facilities would be constructed including a security kiosk, warehouse, equipment storage and maintenance building, roads, parking areas, laydown/stockpile areas and a concrete batch plant.

The vaults would have a total capacity of 130,000 m^3 and are expected to handle 115,000 m^3 of LLW comprising of 33,000 waste packages retrieved from the WWMF. While the option could accommodate some ILW, the current design and cost estimate do not include this waste.

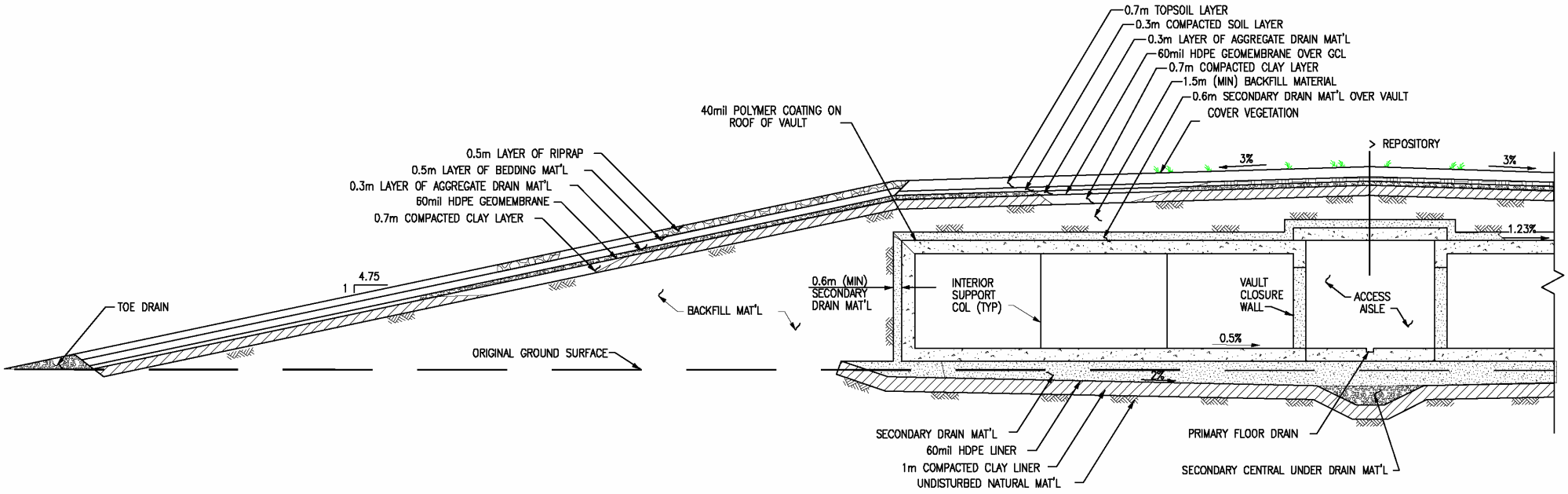


Figure 6a: Cross-section of a typical Surface Concrete Vault

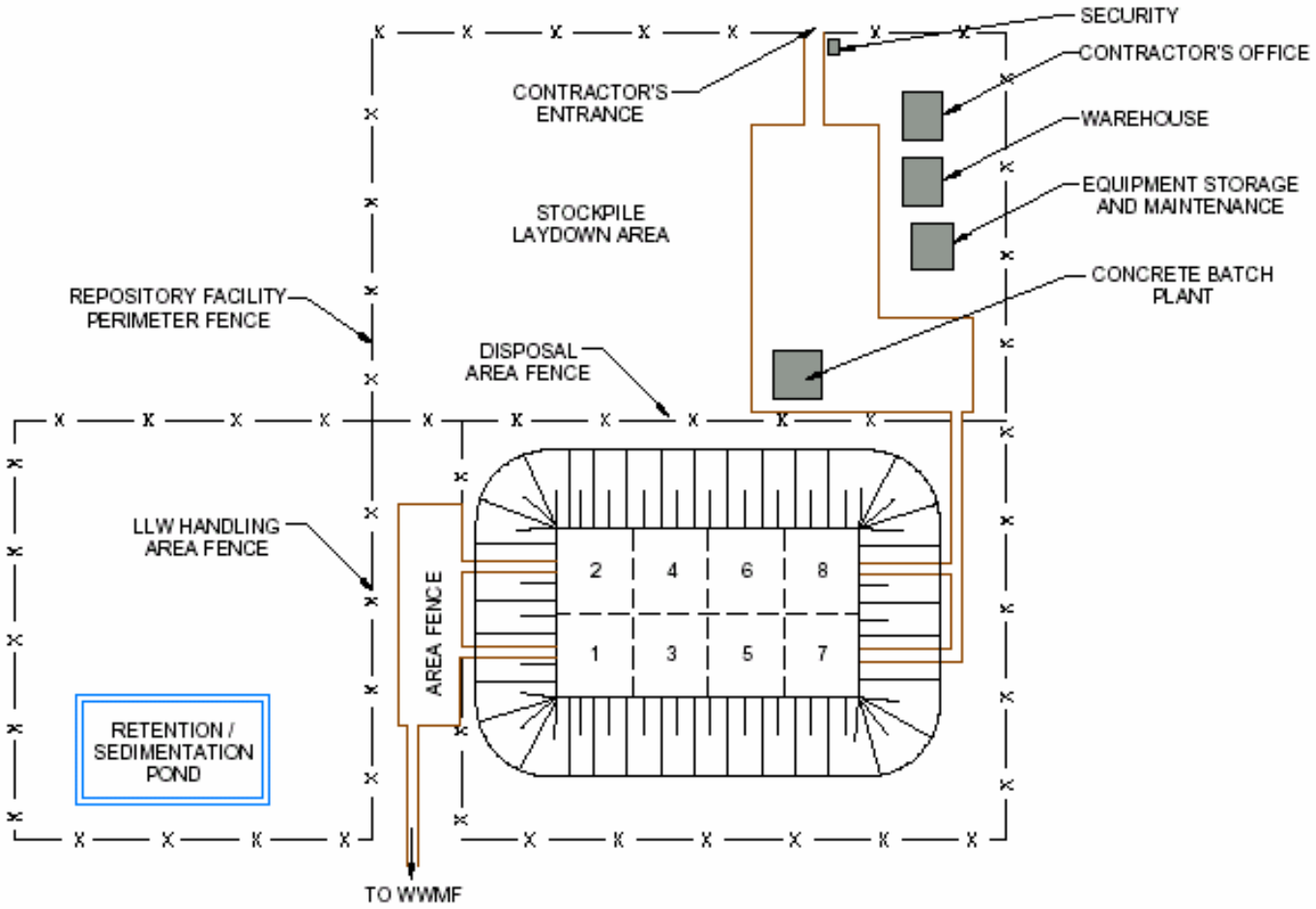


Figure 6b: Overview layout of a typical Surface Concrete Vault

There are several international examples of the use of Surface Concrete Vaults including facilities in France and Spain. The facility located at Centre de l'Aube in France, which began operations in 1992, has been designed to be Europe's largest repository for low and intermediate level waste. This site was chosen based on its geology, consisting of an unsaturated layer of sand covering thick deposits of clay. Wastes are placed in concrete vaults constructed on the surface under a movable shelter that protects the wastes from the weather during transfer. Once a vault is full, a concrete cover is poured to completely isolate the waste from the environment. When the site is full, an earth cover will be placed over all of the concrete vaults.

2.4.4 Deep Rock Vaults

As noted in Section 2.3, two geotechnically feasible deep mined cavern vault concepts were developed:

- Vaults constructed (excavated) in the Ordovician age, Queenston Formation shale at an assumed depth of 460 m below ground surface; and
- Vaults constructed (excavated) in the Ordovician age, Lindsay Formation limestone at an assumed depth of 660 m below ground surface.

For the purpose of the IAS, these two concepts have been combined as a single Deep Rock Vaults option. The Deep Rock Vaults option is a long-term repository option which would be constructed in the bedrock underlying the WWMF.

The repository would consist of 20 individual excavated vaults, each of which is typically 10 m wide by 7 m high by 120 m long arranged in two parallel rows of 10 caverns each (see Figure 7). The vaults would have concrete floors and the roofs would be spot-bolted and meshed as required to protect workers.

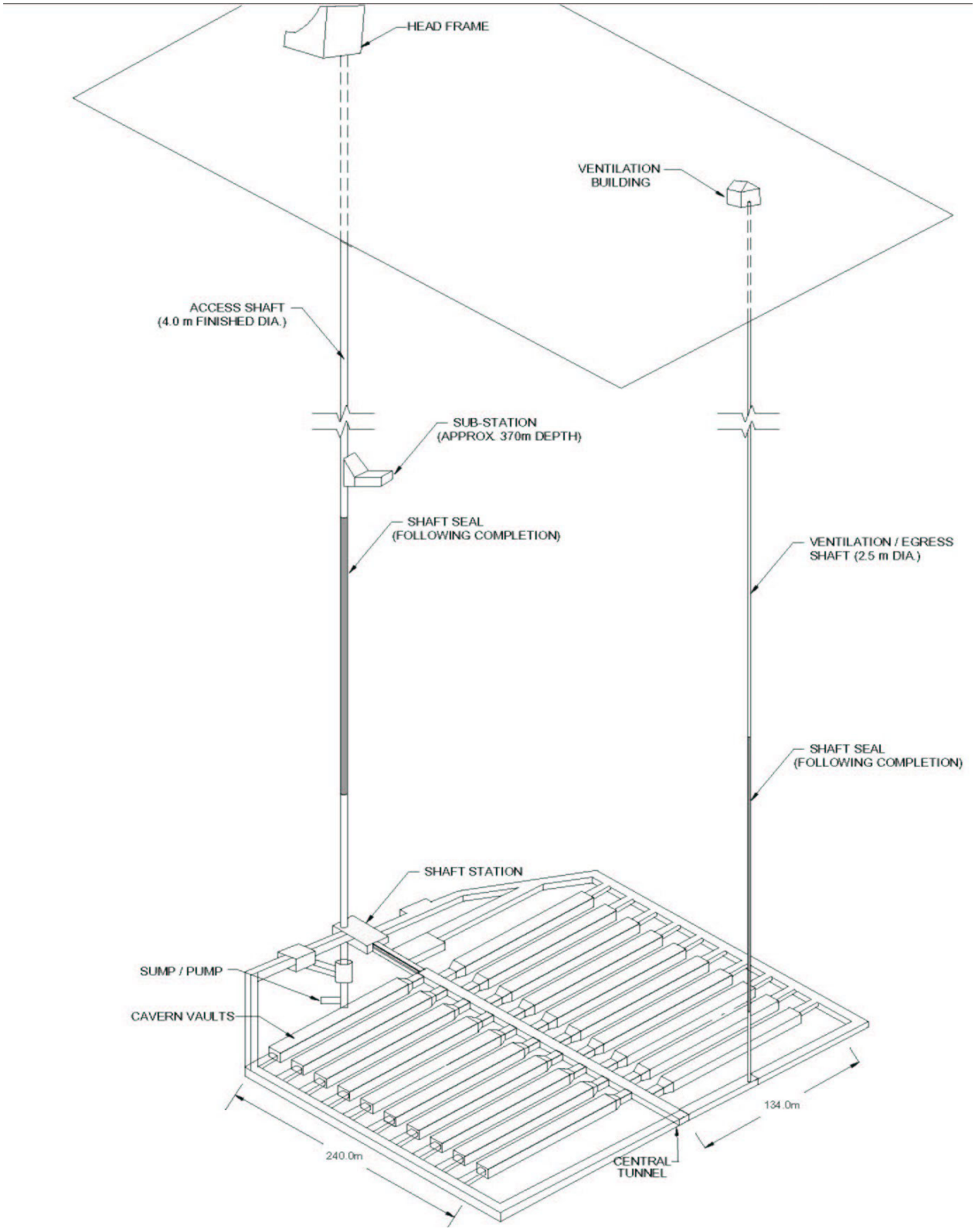


Figure 7: A schematic of a typical underground structure of a Deep Rock Vault showing the vaults that would hold the LLW

The typical repository would be accessed by two vertical shafts: a 4 m finished diameter, lined main shaft for excavation and waste placement operations; and a 2.5 m diameter, lined ventilation/emergency egress shaft. To facilitate positive ventilation of the vaults during mining and waste emplacement operations, it is assumed that a 5 m wide by 5 m high ventilation exhaust gallery is constructed around the perimeter of the cavern area as part of the initial development work.

Similar to the Surface Concrete Vaults option, the Deep Rock Vaults option would be located within the Bruce Power site adjacent to the WWMF. This would allow the use of current WWMF infrastructure and services. Additional support facilities would be constructed at the surface, including a security kiosk, warehouse, equipment storage and maintenance building, roads, parking areas, and a temporary waste rock storage area.

The vaults would have a total capacity of 130,000 m^3 and are expected to handle 115,000 m^3 of LLW comprising of 33,000 waste packages retrieved from the WWMF. While the option would be intended to accommodate ILW the current design and cost estimate do not include this waste.

Facilities at Loviisa in Finland and Forsmark in Sweden are examples of the use of the Deep Rock Vaults technology for the disposal of LLW and ILW. The Forsmark facility was commissioned in 1988 and is located adjacent to the Forsmark nuclear power station. The repository was excavated in rock situated one kilometre offshore below the bottom of the Baltic Sea. The Loviisa facility began operations in early 1997 and is located on the Hästholmen Island near the Loviisa nuclear power station. That repository is excavated in rock at a depth of 110 m below ground.

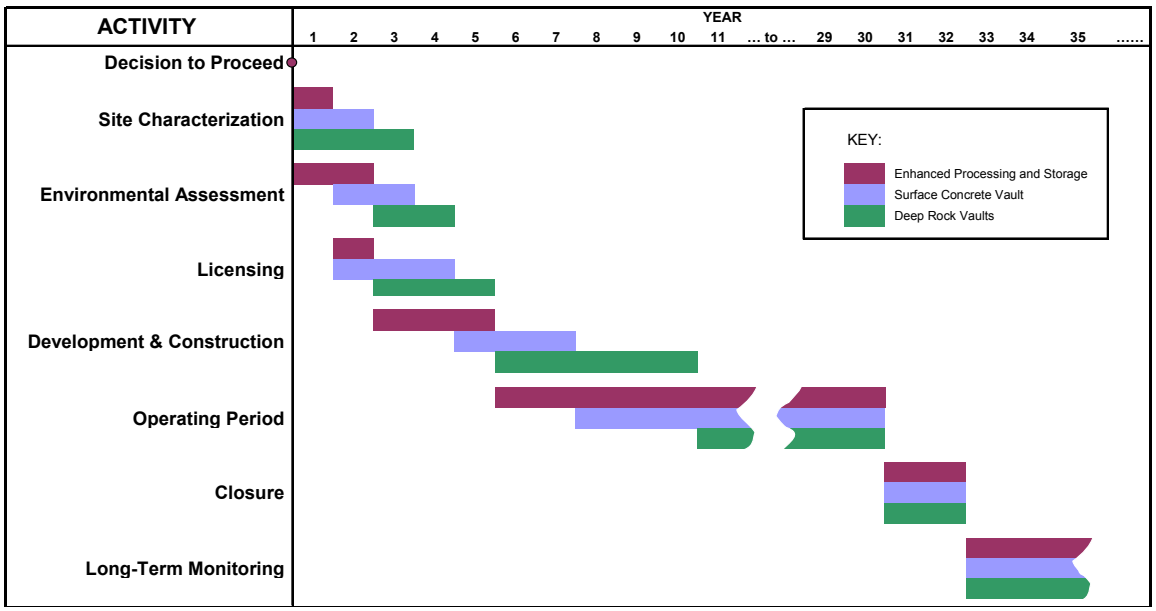
2.5 Construction and Operating Schedule

A conceptual schedule for the design, construction, operation and closure of the long-term management options was developed for the purposes of the IAS. The key activities leading to the establishment and operation of a facility are summarized in Figure 8 for each of the long-term management options. The schedule shows the duration of each of the activities following a decision to proceed assumed to occur in 2004. The schedule is based on a preliminary estimate of the duration of each of the activities and may be expected to change as more specific and detailed information on the options is developed. It was also assumed that the continued management of ILW and LLW at the WWMF (the Status Quo) could safely continue over the same period.

Figure 8 shows that the options could be planned and constructed on slightly different schedules due to the different level of effort required in their design, approval and construction. For example, it is assumed that a longer time is required for site characterization for the Deep Rock Cavern Vault option compared with the Enhanced Processing and Storage option because of the need to conduct an underground drilling and testing program. In addition, construction would

occur on an incremental basis with the development of waste management storage capacity as it is required.

Figure 8: Schedule for establishment and operation of long-term waste management options



The schedule for the Enhanced Processing and Storage option assumed that construction of buildings and installation of equipment for the would begin in 2006, with receipt of wastes beginning in 2010. The facility would receive waste through December 2034. This option has a design life of 100 years. At the end the 100 years, a decision would be required to continue storage or to transfer the wastes to a disposal facility.

Construction of the Surface Concrete Vaults option is assumed to begin in early 2009. The vaults would be constructed in eight blocks of six vaults each; operation of the first block would start in 2012. Operations would end in December 2034 following which the long-term repository would be closed. Following closure there would be an institutional control period of up to 300 years during which time the site would be controlled by a legally designated institution.

Construction of the Deep Rock Vaults option is assumed to begin in January 2010, with the excavation of the main shaft, central access gallery, perimeter ventilation exhaust gallery and ventilation shaft being completed by 2013. Construction of the first three vaults would occur through 2014, and waste placement would start in 2015. Mining of subsequent vaults and waste placement would occur alternately until 2034; at this point closure would begin.

2.6 Cost and Personnel Estimates

The following conceptual cost and personnel estimates are limited to the design, construction and operation of the long-term management facilities and directly associated infrastructure. Costs are provided for the Construction Phase and the Operating Phase. The costs include the management of LLW only. The long-term options could accommodate different proportions of the ILW. For example, the Deep Rock Vaults could accommodate all the ILW while the Surface Concrete Vaults could safely accommodate only a portion of the ILW. Inclusion of ILW would involve additional costs, depending upon the volume of ILW requiring disposal. The estimates do not include pre-construction costs associated with site characterization, licensing, environmental assessment and the like, or the on-going costs of operating the WWMF.

Cost estimates for the long-term repository options were developed by Golder. Cost estimates for the Enhanced Processing and Storage option were developed by SGN, an engineering consulting company. These conceptual cost estimates were used as one input to the economic model to determine the economic benefits of each of the options, as reported in Section 5.0.

The costs in the following sub-sections provide an initial conceptual cost estimate for constructing, operating and decommissioning the long-term management options. As noted previously, subsequent designs and cost estimating efforts may be expected to result in progressively more precise cost estimates.

2.6.1 Status Quo

The annual operating costs for the Status Quo were provided by OPG and include the cost of all payroll, purchasing and municipal taxes associated with the current LLW and ILW management operations at the WWMF. OPG's current average annual payroll expenditures were determined from the salary costs associated with all employees currently engaged in ILW and LLW management operations. The estimated expenditures are based on the average of projected future expenditures and include the construction of new low level storage buildings and other on-going improvements at the WWMF. Finally, municipal taxes related to ILW and LLW operations at the WWMF payable to Kincardine for the current taxation year are $305,000.

The assumed current annual operating costs for the Status Quo are $21.2 million as shown below.

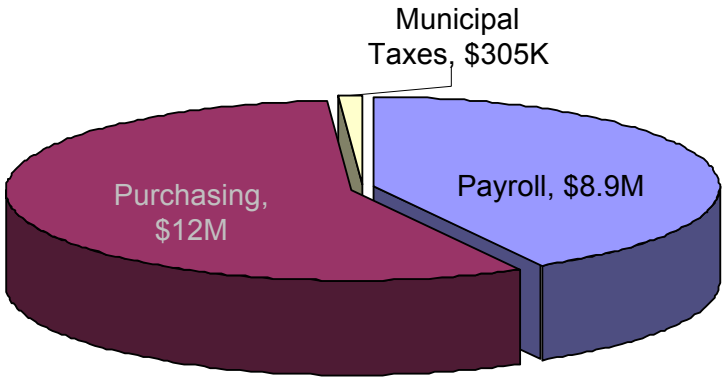


Figure 9: Current annual operating costs for the Status Quo

The cost of implementing any of the long-term management options at the WWMF will be in addition to these annual operating costs.

2.6.2 Enhanced Processing and Storage

The total incremental post Construction Licence cost of Enhanced Processing and Storage is expected to be $128 million, over a period of 28 years. As noted above, this cost is in addition to the annual operating cost for current LLW and ILW management operations at the WWMF (the Status Quo). The incremental costs comprise approximately $40 million for the construction phase and $88 million for the operating phase. These costs are summarized in Table 1 and represent the total construction and operating costs.

TABLE 1
Conceptual Cost Estimate for Enhanced Processing and Storage

ITEM	$kCAD (2002)
Construction Phase	
Engineering	9,689
Equipment and Materials	20,566
Construction and Installation	9,688
Operating Phase	
Labour	21,476
Consumables and Utilities	66,348
Total	**127,767**

2.6.3 Surface Concrete Vaults

The total incremental post Construction Licence cost for the Surface Concrete Vaults is estimated to be $275 million, over a period of 26 years. The incremental costs comprise approximately $40 million for the construction phase, $231 million for the operations phase and $4 million for the decommissioning phase. The total construction and operating costs for this option are summarized in Table 2.

The costs shown in Table 2 are for LLW only. The Surface Concrete Vaults could also be suitable for some ILW. However, additional costs would be involved with the placement of ILW and an alternative disposal facility would be required for the ILW that could not be safely placed in the vaults.

TABLE 2
Conceptual Cost Estimate for Surface Concrete Vaults

ITEM	$kCAD (2002)
Construction Phase	
Engineering	5,492
Equipment and Materials	8,787
Construction and Installation	25,282
Operating Phase	
Facility Operations – Labour	96,359
Facility Operations – Materials and Equipment	45,533
Construct Vaults and Cover	89,261
Decommissioning Phase	
Labour	1,801
Materials and Equipment	2,070
Total	**274,585**

2.6.4 Deep Rock Vault

The total incremental post Construction Licence cost for the Deep Rock Vaults is estimated to be $279 million for LLW only, over a period of 25 years. The incremental costs comprise approximately $92 million for the construction phase, $179 million for the operations phase and

$8 million for the decommissioning phase. The total construction and operating costs are summarized in Table 3.

The Deep Rock Vaults option has the capability to accept the full range of ILW. Although the volume of ILW is smaller than the volume of LLW, the greater radioactivity level and the shape and size of the containers to be placed underground likely requires a similar volume to that required for the LLW. The additional incremental post Construction Licence costs for ILW could potentially be up to an additional $200 million.

TABLE 3
Conceptual Cost Estimate for Deep Rock Vaults

ITEM	$kCAD (2002)
Construction Phase	
Engineering	6,671
Equipment and Materials	6,081
Construction and Installation	79,182
Operating Phase	
Facility Operations – Labour	100,709
Facility Operations – Materials and Equipment	51,290
Construct Caverns	26,717
Decommissioning Phase	
Labour	4,820
Materials and Equipment	3,006
Total	**278,476**

2.7 Conclusions of Engineering Feasibility

The engineering feasibility studies found that all the long-term management options are feasible at the WWMF, The options use internationally proven technology and are capable of accommodating all of the LLW currently stored and likely to be received in future. The results of the feasibility assessment are summarized on Tables 4a and 4b.

TABLE 4a
Feasibility of Long-Term Management Options

	Feasible at Bruce Power site?	**International experience with technology**	**Design life**	**Management strategy**	**Total Incremental Cost* ($CAN Million)**
Enhanced Processing and Storage	Yes – can be constructed on existing WWMF	Netherlands Belgium	100 years	Storage	128
Surface Concrete Vaults	Yes – suitable soils occur adjacent to WWMF Requires area of approximately 10 hectares	France Spain	300 years	Long-term repository	275
Deep Rock Vaults	Yes – suitable bedrock occurs beneath WWMF: - Shale - Limestone	Sweden Finland	>>500 years	Long-term repository	279

***** Post Construction Licence costs only

TABLE 4b
Capacity of Long-Term Management Options

	Waste Capacity	Ability to accommodate increase in volume	Ability to accommodate other waste types
Enhanced Processing and Storage	All existing and planned LLW in up to 8 storage buildings	Additional storage buildings could be constructed as required	Suitable for all LLW
Surface Concrete Vaults	All existing and planned LLW in 24 concrete vaults	Additional vaults could be constructed as required	Suitable for all LLW and some ILW
Deep Rock Vaults	All existing and planned LLW in 20 underground mined vaults	Additional vaults could be constructed as required	Suitable for all LLW and ILW

3.0 SAFETY AND LICENSIBILITY

3.1 Goals of Safety and Licensibility Assessment

The goals of the safety analysis were to:

- Assess the safety of the Status Quo and Enhanced Processing and Storage options based on current experience at the WWMF; and

- Assess the long-term safety of the Surface Concrete Vaults and Deep Rock Vaults using internationally-accepted safety assessment methods.

The safety of the Surface Concrete Vaults and Deep Rock Vaults was assessed for two types of scenarios, Reference Scenarios and Intrusion Scenarios, and the results of the model were compared to both Canadian and international safety criteria to determine if the options can be safely constructed and operated over their lifetimes.

There are a number of aspects to the safety of long-term waste management options, including the potential radiation exposures and safety of workers and members of the public. For assessing the licensibility of a long-term waste management option, the most important facet of safety is protection of members of the public from exposure to radioactivity during operations and after the facility has been closed. Long-term public safety is determined from a safety assessment which estimates the potential radiation exposures to people for a variety of scenarios long into the future. It is assumed that any long-term management option that can be shown to meet Canadian and international safety criteria for the protection of members of the public is capable of being licensed.

The safety of workers during construction and operation of any of the options would be managed and monitored through well-established radiation protection and occupational health and safety programs. The WWMF has an excellent record of worker safety with over 8 years of operation without a lost-time accident. The IAS assumed that the safety of workers can be assured for all of the options.

3.2 Methods and Details of Safety Studies

The safety of the Status Quo and Enhanced Processing and Storage options was assessed using the currently reported maximum radiation dose received by members of the public due to the WWMF. Because both options include generally similar activities that would occur within the same area of the Bruce Power site, it is assumed that the dose to members of the public from either option would be similar. Bruce Power reports the annual dose to a hypothetical member of the public as a result of all activities on the Bruce Power site, including operation of the WWMF.

For the purposes of the IAS, it is assumed that this dose is representative of the dose that might be received over the 100-year life of the Enhanced Processing and Storage option.

The safety assessment of the long-term repository options was conducted by Quintessa Limited, a firm with international experience in determining the safety of waste management facilities.

To assess the safety of the Surface Concrete Vaults and the Deep Rock Vaults, potential dose rates to members of the public over the long-term were predicted using computer model simulations. A set of key scenarios were devised to identify pathways for potential release of radionuclides from the repositories into the environment, along with the potential exposure to humans. In addition, inadvertent human intrusion into the facility was considered.

The Reference Scenarios consider the gradual release of radionuclides from the repositories in the very long term and subsequent migration in the environment and the resulting potential dose rate to humans. The potential releases were assumed to occur as a result of natural degradation and weathering of the facility, including the breakdown of concrete or corrosion of the waste containers in the long-term.

The Intrusion Scenarios consider the possible inadvertent disruption of the wastes in the future. A small human intrusion is considered to be a disturbance such as drilling of boreholes into the repository resulting in the potential direct exposure of individuals to essentially undiluted wastes. A large human intrusion is applicable to the surface concrete vault option and is representative of large-scale excavations resulting in the potential exposure of both the intruder and individuals with no direct connection to the intrusion event, but who may nevertheless encounter waste materials incorporated into local surface environmental media. For both small and large events, possible intrusion was assumed to occur 300 years after closure of the long-term repository.

The site-specific data for the safety assessment was taken from the geotechnical feasibility study (see Section 2.3). The repository concepts were modelled using the AMBER safety assessment code (software tool used to model transport and potential impact of contaminants in the environment).

3.3 Results of the Safety and Licensibility

3.3.1 Current LLW and ILW Storage Practice (Status Quo)

The safety performance of all facilities located on the Bruce Power site, including the WWMF, is measured by estimating the annual dose that would be received by hypothetical members of the public, described as “critical group”, who live, work and carry out recreational activities in the immediate vicinity of the site. The estimated annual radiation dose to the critical group in 2001 was 2 μSv from all facilities on the Bruce Power site, including the WWMF. This is a very small

fraction (0.2 percent) of the Canadian Nuclear Safety Commission's regulatory standard of 1,000 μSv/year for the protection of members of the public.

The WWMF makes a small contribution to the overall dose to the critical group compared with other facilities on the Bruce Power site. For example, in 2001, the WWMF was responsible for 0.03 percent of the total Carbon-14 emissions from the site to the atmosphere and 0.04 percent of the tritium releases to surface watercourses.

Based on the above analysis the annual dose to members of the public from the Status Quo is a small portion of the overall Bruce Power site dose of 2 μSv per year. While the specific value is not known, it is certainly less than 1 μSv per year, the value assumed for the purpose of this assessment.

The likelihood of inadvertent intrusion into the facility and resulting radiation exposure to members of the public is negligible since the WWMF is a secure facility located entirely within the fenced and controlled access Bruce Power site. In addition, operations at the WWMF include on-going maintenance and inspection to minimize any potential release of radiation to the environment as well as avoiding potential intrusion by trespassers.

3.3.2 Enhanced Processing and Storage

The Enhanced Processing and Storage option is an enhancement and improvement of the Status Quo. The enhancements include a box super-compactor and enhanced storage buildings which would further minimize the potential for radiation to migrate into the environment and reach workers or members of the public. Thus, the radiation dose estimates for members of the public for the Status Quo may be used to provide a conservative estimate of the doses that would be received by members of the public as a result of Enhanced Processing and Storage.

The Enhanced Processing and Storage option also includes on-going maintenance and inspection to minimize any potential release of radiation to the environment or public as well as avoiding potential intrusion by trespassers.

Based on the records of safety at the existing WWMF and the design enhancements to be included in the construction of the waste management facility, the Enhanced Processing and Storage option could be safely constructed and operated at the WWMF.

3.3.3 Surface Concrete Vaults

The base case scenario for the Surface Concrete Vaults assumed that only LLW was placed into the vaults. The pathway for gradual potential exposure of radiation to the public for the Surface Concrete Vaults was identified for the reference scenario. This involved the discharge of

radioactivity to the shallow groundwater system and consequential use of the contaminated well water by a farmer. The model estimated a maximum dose rate of 2.3 percent of the ICRP 81 dose constraint of 300 μSv per year at 7,500 years after the closure of the long-term repository.

One pathway for potential exposure of radiation to the public for the Surface Concrete Vaults was identified for the human intrusion scenario. Specifically, future excavation and spreading of contaminated soil to be used to grow crops. Assuming only LLW is placed in the vaults, the model showed a maximum dose rate of 3 percent of ICRP intrusion dose constraint of 1000 μSv per year at 300 years after the closure of the long-term repository.

Supplementary analyses by Quintessa indicate that some types of ILW can also be safely placed into the Surface Concrete Vaults but that some long-lived ILW should be excluded from the surface facility. An alternative disposal facility would be required for this long-lived ILW, which includes waste ion exchange resins produced in liquid treatment systems.

In summary, provided some long-lived ILW is excluded from the facility, the results of the safety analysis for both the reference and intrusion scenarios showed that the potential exposure to members of the public far into the future is below the dose constraints.

3.3.4 Deep Rock Vaults

The base case scenario for the Deep Rock Vaults option assumed that only LLW was placed in the vaults. One pathway for potential exposure for the Deep Rock Vaults option was identified for the reference scenario. Specifically, the potential for discharge of radioactivity to the deep and intermediate groundwater systems and transport of contaminants to off-shore lake sediments. The model showed a maximum dose rate of much less than 0.001 percent of the ICRP dose constraint of 300 μSv per year at about 50,000 years after the closure of the long-term repository.

One pathway for potential exposure for the Deep Rock Vaults was identified for the human intrusion scenario. Specifically, direct exposure to LLW that is brought to the surface by future drilling. The model showed a maximum dose rate of 0.003 percent of the ICRP intrusion dose constraint of 1000 μSv per year at 300 years after the closure of the long-term repository.

Supplementary assessment by Quintessa indicated that all of the expected ILW can also be safely placed into the Deep Rock Vaults. In summary, the results of the safety analysis for both the reference and intrusion scenarios showed that the potential exposure to members of the public far into the future is well below the dose constraint.

3.4 Conclusions of Safety and Licensibility Assessment

A summary of the safety assessment and licensibility of the long-term management options is presented in the following table. The performance of the Status Quo is provided for comparison.

TABLE 5
Overview of Safety Assessment

	Percent of Dose Constraint – Reference Scenario	Time Maximum Dose Occurs – Reference Scenario	Percent of Dose Constraint – Intrusion Scenario
Status Quo	<1 %	Throughout the life of facility	Inadvertent intrusion is precluded by access control
Enhanced Processing and Storage	<1 %	Throughout 100 year life of facility	Inadvertent intrusion is precluded by access control
Surface Concrete Vaults	2.3 %*	7,500 years after closure	3 %*
Deep Rock Vaults	<< 0.001 %*	> 10,000 years after closure	0.003 %*

* Assumes only LLW placed into vaults.

All three options for the long-term waste management facility can be safely constructed and operated. All of the options have potential dose rates well below the target limits associated with long-term management facilities. Since all of the options meet international and Canadian safety criteria with a considerable cushion of safety, it may be assumed that each is capable of being licensed by the Canadian Nuclear Safety Commission. Obtaining Site Construction and Operating Licenses from the Canadian Nuclear Safety Commission would be required for any project.

4.0 ENVIRONMENTAL PROTECTION FEASIBILITY

4.1 Goals of the Environmental Protection Feasibility

The goals of the environmental screening are to:

- Examine the potential effects of the three options on the environment and identify all potential adverse effects during the construction and operation phases; and
- Review the three options to determine if feasible management and mitigation measure exist to allow potential adverse effects to be avoided.

4.2 Methods and Details of Environmental Studies

The principal components of the environment that were considered during the environmental protection screening include:

- Surface and Ground Water;
- Land;
- Air and Noise;
- Natural Environment;
- Resources;
- Socio-economic;
- Heritage and Culture;
- Aboriginal; and
- Radiation.

These environmental components are further subdivided as necessary to determine if there might be an effect of the long-term management facility option on the sub-component. A judgement was made whether or not any potential effects are likely to be adverse.

The three options were examined for the construction and operation phases and individually assessed. The environmental effects of the post-closure period were not assessed. However, the Safety Assessment considers the long-term performance of the two long-term management facilities during the post-closure period.

During the construction phase no LLW and ILW waste is placed in the facility. Potential adverse effects include dust, noise, increase in traffic, potential disturbance of wildlife habitat, perception in the community, and decrease in tourism.

The operating phase includes the period during which that waste would be placed in the facility. This would include construction on an on-going basis of additional waste capacity to accommodate the total amount of waste. The potential adverse project-related effects include those identified for the construction phase as well as potential radioactive releases to the environment, and radiation exposures to workers and members of the public.

4.3 Results of the Environmental Protection Feasibility

The environmental protection feasibility of the Status Quo was not undertaken. The WWMF is an operating facility which has undergone several environmental assessments that show that although there are some potential adverse effects associated with the LLW and ILW operations, mitigation measures have successfully managed them such that they do not cause significant adverse effects on the environment.

Potential adverse effects were identified in five environmental components during the construction phase of the Enhanced Processing and Storage option. These effects, which may include effects on groundwater, the atmosphere, the natural environment, socio-economics and aboriginals, are similar to those associated with past construction projects at the WWMF. All the potential effects on groundwater (decrease in ground and surface water quality or quantity), air (noise and dust) and the terrestrial environment (potential disturbance of wildlife habitat) were capable of being managed using known and proven methods. A positive effect was identified for the socio-economic environment with an increase in local expenditures and employment. Potential disturbance of sacred burial grounds can be managed through archaeological assessments prior to construction and working cooperatively with First Nations.

Potential adverse effects were identified in six environmental components during the operating phase. These include potential effects on groundwater, the atmosphere, the natural environment, socio-economics, aboriginals and radioactivity releases to the environment, radiation exposure to workers and members of the public. All the potential effects on groundwater (decrease in ground and surface water quality or quantity), air (noise and dust) and the terrestrial environment (potential disturbance of wildlife habitat) could be managed using known and proven methods. A positive effect was identified for the socio-economic environment with an increase in municipal tax and employment in the area. The safety assessment (see Section 3.0) shows that the Enhanced Processing and Storage option can be safely constructed and operated.

With proven management and mitigation methods and an on-going consultation process, no likely significant adverse effects are expected for the Enhanced Processing and Storage during the construction or operation phase.

The environmental protection feasibility of the two long-term repository options was similar to the Enhanced Processing and Storage. All three options may have an effect on groundwater

quality and quantity. Design and mitigation measures would prevent any contamination of near surface groundwater in the case of the Enhanced Processing and Storage and Surface Concrete Vaults options. No adverse effect on groundwater, drinking water supplies or Lake Huron are expected due to the depth of the Deep Rock Vaults, the low permeability of the rock and slow rate of groundwater flow.

4.4 Conclusions of the Environmental Protection Feasibility

A summary of the results of the environmental screening is presented in Table 6 following. The environmental protection feasibility assessment is similar for all three options and represents both the construction and operation phase except where noted.

While all three options for the long-term waste management facility have the potential to cause effects on the environment, all the identified potential effects can be appropriately managed using proven mitigation and management methods. As such, no residual environmental effects are anticipated for any of the options.

A full environmental assessment would be completed in accordance with the Canadian Environmental Assessment Act as part of the approvals process for any of the three options.

TABLE 6
Summary of Environmental Protection Feasibility

Environmental Component	Criterion	Is Effect Anticipated?	Is Management and Mitigation Possible?	Are Significant Residual Effects Anticipated?
Surface and Groundwater	Surface and groundwater flow impact	Yes	Yes	No
Land	Land uses, policy	No	-	No
Air and Noise	Vehicle emissions, dust, noise	Yes	Yes	No
Natural Environment	Disturbance of vegetation, bird, mammal and fish habitat	Yes	Yes	No
Resources	Non-renewable resource use, agriculture, forestry	No	-	No
Socio-Economic	Tourism, community services, local employment, traffic, economic base	Yes	Yes	No
Heritage and Culture	Heritage buildings, landscaping	No	-	No
Aboriginal	Burial of wastes in ground, disturbance of burial grounds, consultation process	Yes	Yes	No
Radiation	Potential radionuclide releases to workers and public	Yes (Operation Phase Only)	-	No

5.0 ECONOMIC ANALYSIS

5.1 Goals of Economic Analysis

The goals of the economic analysis are to identify the potential costs and associated economic benefits to the community as a result of implementing the long-term management options. The costs and economic benefits of current ILW and LLW management operations at the WWMF (the Status Quo) are also provided for comparison.

Costs related to the options include the capital and operating costs of the facilities (including payroll costs), and spending on purchases of services and materials. Economic benefits experienced by the Kincardine and the neighbouring municipalities include direct and indirect jobs associated with the facility and the direct and indirect expenditures in their communities. In addition, taxes for the facility are paid to Kincardine as the host municipality.

5.2 Methods and Details of Economic Modelling

The relationship between OPG's costs for construction and operating the facilities and the associated economic benefits in Kincardine and the neighbouring municipalities was determined using an economic model developed by Gartner Lee Limited.

The key inputs to the economic model were employment, payroll, and goods and services expenditures reported by OPG for the WWMF. Similar information for each of the long-term management options was provided by Golder based on the cost information in Section 2.6. Municipal projections for employment, population and housing were obtained from Official Plans, Ontario Population Projections and projected annual growth rates from the Statistics Canada 2001 census. For modeling purposes, a medium projection was used that combined the high (i.e., Bruce County Official Plan) and low (i.e., Ontario Population Projections) population, employment and housing forecasts. Financial data and municipal projections were for the period 2005 to 2035.

The economic model estimates the total number of jobs and the total income spending by persons associated with the current LLW and ILW operations at the WWMF and the future long-term management options through direct, other direct, indirect and induced means. The employment and economic activity was determined within and outside of Kincardine and the neighbouring municipalities.

The output from the economic model provides the estimated economic effects of constructing and operating the long-term management options on:

- Project expenditures (payroll, goods and services, municipal taxes);
- Project–related employment (direct, indirect and induced);
- Population associated with ILW and LLW management; and
- Employment-related economic activity in the community.

Effects on employment, population and housing are considered to be key indicators of potential effects on overall community stability. Total income spending was considered to be a key indicator of total economic activity.

5.3 Project Expenditures

OPG's expenditures associated with the long-term management options include payroll, purchases of goods and services, and municipal taxes. These expenditures, which are incurred directly by OPG, are the source of all economic activity related to the options in Kincardine and the neighbouring municipalities. All cost information is reported as $CAN (2002) and does not include any escalation.

Current expenditures on LLW and ILW management operations at the WWMF are provided in Section 2.6. These expenditures were used to predict total project expenditures for the Status Quo. Expenditures on each of the long-term management options include these expenditures for the Status Quo since the long-term management options are in addition to the current operations and facilities at the WWMF. Projected annual spending on payroll, purchasing and municipal taxes was estimated for each of the options. In addition, the projected total spending on payroll, purchasing and municipal taxes over the period 2005 through 2035 was estimated to provide the magnitude of the total expenditures associated with the options.

There will be some variation in expenditures from one year to the next over the life of the options. However, unlike many other projects, the long-term management options do not involve constructing the facility in a short initial period followed by a longer operating period. Rather, the waste management facility is constructed in stages as the need for additional waste management space is required. The estimated variation in the annual expenditures over the period 2005 through 2035 generally varies by less than 20 percent from one year to the next.

Projected payroll costs, expenditures on goods and services and municipal taxes were developed for each of the options using the above information on the current operations at WWMF and cost information from the engineering feasibility study. Estimated annual expenditures are provided in Table 7 and the total life-time expenditures are provided in Table 8, following. As noted previously, the Deep Rock Vaults option, with its capacity to handle all ILW, could be expected to have additional post Construction Licence costs of up to $200 million.

TABLE 7
Estimated Average Annual Expenditures Associated with Options

	Payroll Costs ($CAN Million)	Purchases of Goods and Services ($CAN Million)	Municipal Taxes* ($CAN Million)
Status Quo	8.9	12	0.25
*Enhanced Processing and Storage***	10.2	14.8	0.305
*Surface Concrete Vaults***	13.0	16.7	0.305+
*Deep Rock Vaults***	13.4	16.4	0.305+

TABLE 8
Estimated Total Expenditures Associated with Options (2005-2035)

	Payroll Costs ($CAN Million)	Purchases of Goods and Services ($CAN Million)	Total ** ($CAN Million)	Total Incremental Cost** ($CAN Million)
Status Quo	276	372	648	0
*Enhanced Processing and Storage**	318	458	776	128
*Surface Concrete Vaults**	404	519	923	275
*Deep Rock Vaults**	417	510	927	279

* Costs include Status Quo expenditures.
** Costs do not include Municipal Taxes

5.4 Project-Related Employment

Employment associated with the options includes direct, indirect and induced employment. All employment information is expressed as full time equivalents (FTE). One FTE is equal to one person working full time for one year.

The projected average annual direct, indirect and induced employment was estimated for each of the options. In addition, the total employment over the period 2005 through 2035 was estimated to provide the magnitude of the total employment associated with implementing the options in Kincardine.

Direct employment is the number of OPG employees working directly at the facility. It is assumed that currently there are 81 FTEs engaged in activities related to ILW and LLW management at the WWMF. Indirect employment is the number of employees of other businesses or contractors involved in activities directly related to the construction and operation of the facility. This includes, for example, contractors engaged in the maintenance or modification to existing facilities at the WWMF. The estimated indirect employment related to ILW and LLW at the WWMF is 118 FTEs. Induced employment is the jobs generated in the community as a result of OPG and employee spending the community, including, for example, jobs in local stores and restaurants. Induced employment was estimated using standard Statistics Canada multipliers. It is estimated that the induced employment related to current ILW and LLW management operations at the WWMF is 80 FTEs. This annual employment information is used to project the total project employment for the Status Quo over the period 2005 through 2035.

There will be some variation in employment levels from one year to the next over the life of the options. However, unlike many projects, the long-term management options do not involve a large short-term construction workforce. Because a waste management facility is constructed in stages as the need for additional waste management space is required, construction activities occur over the life of the facility and construction-related jobs are generated over the life of the option. Consequently, the estimated variation in the number of employees associated with the facility from year to year is expected to be small.

Direct, indirect and induced employment was estimated for the three long-term management options using the above information on the current operations at WWMF and cost information from the engineering feasibility study. Estimated average annual employment is provided in Table 9 and the total project employment is provided in Table 10.

TABLE 9
Estimated Average Annual Employment (FTEs) Associated with Options

	Direct Project Employment	Indirect Project Employment	Induced Employment	Total Employment
Status Quo	81	118	80	279
*Enhanced Processing and Storage**	93	136	92	321
*Surface Concrete Vaults**	118	173	116	407
*Deep Rock Vaults**	122	179	120	421

*Includes Status Quo employment.

TABLE 10
Estimated Total Employment (FTEs) Associated with Options (2005-2035)

	Direct Employment	Indirect Project Employment	Induced Employment	Total Employment
Status Quo	2511	3671	2480	8654
*Enhanced Processing and Storage**	2888	4222	2842	9952
*Surface Concrete Vaults**	3666	5359	3608	12,633
*Deep Rock Vaults**	3787	5537	3727	13,051

*Includes Status Quo employment.

5.5 Associated Population

Workers associated with the long-term management options may reside in Kincardine, the neighbouring municipalities or elsewhere in Ontario. One measure of the significance of the long-term management to the community is the percentage of the municipal population that is

associated with the option, through direct, indirect or induced employment. This measure, termed "associated population", provides an estimate of where people associated with the long-term management options might live. The associated population was determined where workers might reside and applying population to employment ratios.

The previous sub-section determined that the direct, indirect and induced employment associated with the current ILW and LLW management operations at the WWMF is 279 FTEs. The associated population was determined by estimating where these workers might reside. This was estimated from three sources:

- The place of residence of direct employees was determined from the postal codes of OPG's current employees at the WWMF;
- The place of residence of indirect employees was estimated by identifying the location of OPG's expenditures, including how much of that spending occurs in the local community; and
- The place of residence of induced employment was determined from household spending patterns of community residents determined by public attitude research.

The economic model was used to predict the place of residence of direct, indirect and induced employees for each of the options. The estimates are provided in Table 12 for the period 2005 through 2035 and show the percentage of the municipal population associated with each of the options. During this time the population of Kincardine and the other neighbouring municipalities is expected to increase through normal growth. The estimates of the average population associated with each of the options in Table 11 include the increase in the population through growth.

TABLE 11
Current and Estimated Associated Population (Avg. % of Municipal Population) 2005-2035

	Kincardine	Saugeen Shores	Other Neighbouring Communities
Status Quo	0.8	0.7	0.2
*Enhanced Processing and Storage**	1.0	0.9	0.2
*Surface Concrete Vaults**	1.2	1.1	0.3
*Deep Rock Vaults**	1.3	1.1	0.3

*Includes Status Quo population.

5.6 Income-Related Spending

A portion of the income earned by those employed through direct and indirect means at the WWMF will be spent on goods and services. This spending will occur within and outside of Kincardine and the neighbouring municipalities and will generate induced employment. The geographic distribution of the induced jobs was determined from the results of Public Attitude Research undertaken as part of the IAS, which determined where residents tend to go shopping or spend their incomes.

The estimated current income spending related to LLW and ILW management operations at the WWMF is $12.2 million. It is estimated that 21 percent of this spending occurs within Kincardine, 14 percent in the neighbouring municipalities and 65 percent occurs outside of Bruce County.

Projected income-related spending on goods and services and municipal taxes was developed for each of the options using the above information on the current operations at WWMF and cost information from the engineering feasibility study. Estimated annual spending is provided in Table 12 and the projected total life-time spending is provided in Table 13. The spending identified in Table 14 is based on current spending patterns. Any of the long-term management options could result in opportunities for new businesses which could lead to additional economic activity in the community.

TABLE 12
Projected Annual Income-Related Spending for Options (2005-2035)

	Total Spending ($CAN Million)	Kincardine ($CAN Million)	Neighbouring Municipalities ($CAN Million)	Outside Bruce County ($CAN Million)
Status Quo	12.2	2.6	1.7	7.9
Enhanced Processing and Storage	14.0	3.0	1.8	9.2
Surface Concrete Vaults	17.8	3.8	2.3	11.7
Deep Rock Vaults	18.4	3.8	2.4	12.1

TABLE 13
Projected Total Income-Related Spending for Options (2005-2035)

	Total Spending ($CAN Million)	Spending in Kincardine ($CAN Million)	Spending in Neighbouring Municipalities ($CAN Million)	Spending Outside Bruce County ($CAN Million)
Status Quo	378	81	53	245
*Enhanced Processing and Storage**	434	93	56	285
*Surface Concrete Vaults**	552	118	71	363
*Deep Rock Vaults**	570	120	74	376

* Includes Status Quo spending.

5.7 Conclusions of the Economic Analysis

There are significant economic benefits to Kincardine and the neighbouring municipalities associated with all of the options. These benefits are greater than those currently occurring as a result of the operation of the WWMF. The economic analysis did not identify any negative economic effects associated with the options. Figure 10 provides a summary of the direct, indirect and induced employment associated with each of the options. The incremental employment above that for the Status Quo is generally similar for all the options although it is larger for the two repository options. Figure 11 provides a summary of the expenditures and income-related spending in Kincardine for each of the options. The incremental dollar value above that of the Status Quo is generally similar for all the options although the repository options are somewhat larger.

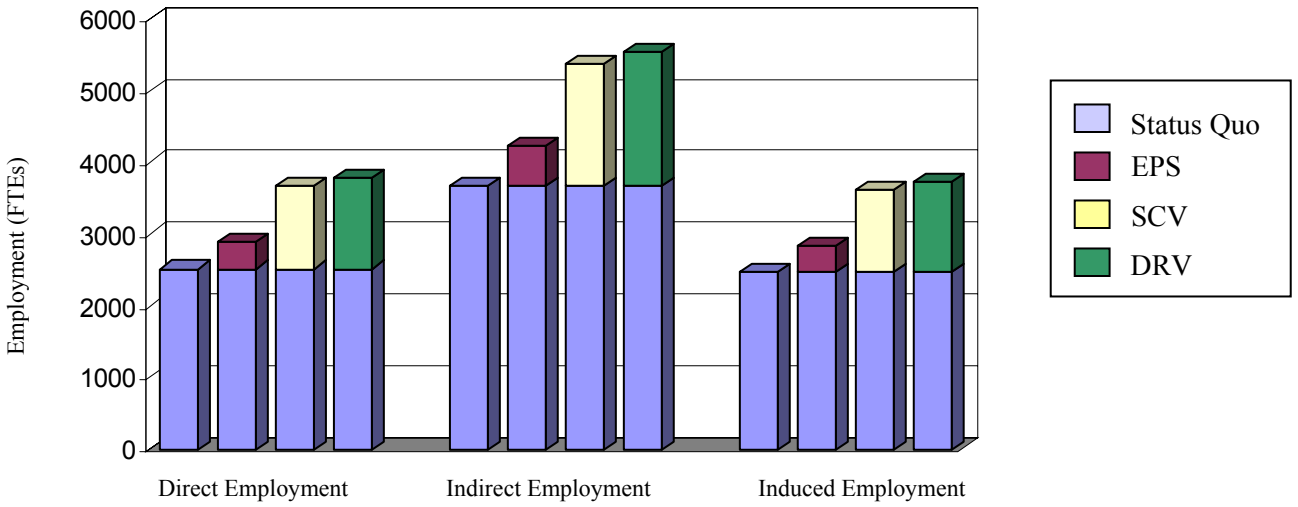


Figure 10: Summary of total employment associated with options

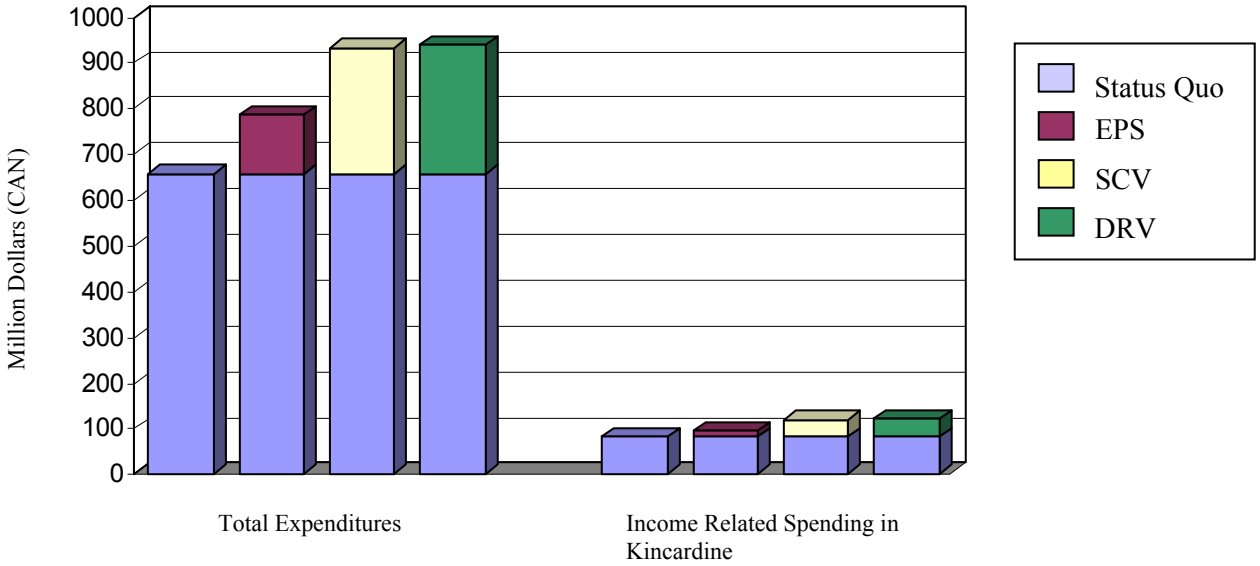


Figure 11: Summary of spending associated with options

6.0 SOCIAL ASSESSMENT

6.1 Goals of the Social Assessment

The social assessment conducted for the IAS included Public Attitude Research aimed at determining residents' knowledge of and attitudes towards LLW and ILW management at the WWMF as a result of implementing any of the long-term waste management options. In addition, research was carried out to determine how the long-term management options might affect the perceptions and attitudes of tourist businesses and tourists visiting Kincardine.

The goals of Public Attitude Research were to:

- Identify people's attitudes towards, and perceptions of, their community;
- Identify the activities and behaviours of the local residents;
- Gauge awareness of the existing WWMF and the proposed long-term waste management facility options; and
- Examine the potential for effects on people's daily life and any likely changes in attitudes towards the community.

The goals of the tourism research were to:

- Determine the number of tourists who visit the area and gain their perspective of the community;
- Identify the key attributes of the community that contribute to its unique character among visitors to the community;
- Gauge tourists' level of awareness of the current WWMF operations and its current influence on the attractiveness of the community as a place to visit; and
- Assess any potential change a long-term management facility may have on tourists visiting the community and tourist-based businesses.

6.2 Methods and Details of Social Studies

6.2.1 Public Attitude Research

The Public Attitude Research (PAR) took place within Bruce County, excepting the North and South Peninsulas. A total of 751 telephone surveys were conducted, 400 in the Municipality of Kincardine and the remaining 351 in the neighbouring communities.

The surveys contained 55 questions that examined the issues currently affecting the community and explored the potential for the long-term management facility options to affect any of the attitudes or activities in the community. The PAR included both men and women over the age of 18 and included both permanent residents and cottagers. A survey of this size is accurate to within 95 % nineteen times out of twenty.

6.2.2 Tourism Research

The tourism research included briefing interviews with local businesses, surveys conducted with visiting tourists and a round table discussion conducted with local tourist business operators.

The briefing interviews, conducted during the Summer of 2003, involved 32 participants who have business related to the tourist industry.

The tourist surveys were completed between July 3 – 6 and July 18 – 19, 2003 with 54 tourists. The surveys were conducted at Inverhuron Provincial Park, Inverhuron Beach, Station Beach and Tiny Tots Park in Kincardine.

The tourism round table was conducted on October 7, 2003 at the Governor's Inn, Kincardine. Three local tourist business operators took part in the discussion. The round table was conducted to identify issues, character and activities in the community and local area that most effect tourism. The participants were asked to identify the current awareness and concerns that tourism operators and tourists may have regarding the operation of a nuclear generating station, radioactive waste management and the WWMF. The round table also included a discussion on potential effects on the tourist trade that may be attributable to the long-term management facility options.

6.3 Results of the Social Assessment

6.3.1 Public Attitude Research

The PAR identified what people in Kincardine and the neighbouring communities felt about the long-term waste management facility options and how a facility might affect their level of concern and satisfaction with their community. In addition, the PAR identified how long-term management options may affect people's recreational activities, satisfaction with their community as a place to live, operate a business or visit. Farmers were surveyed to determine how the long-term management options may affect their commitment to farming.

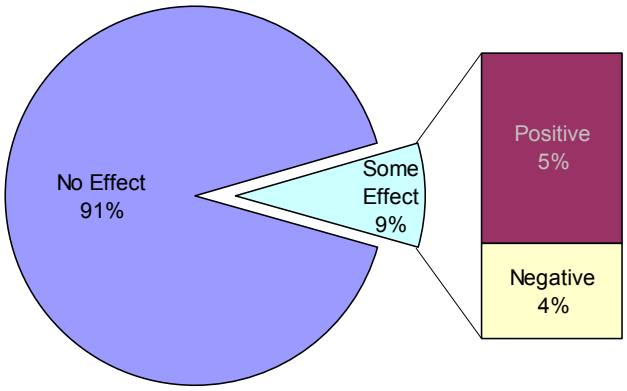
Current Issues of Concern and Activity Level in the Community

The PAR suggests that major current issues of concern in Kincardine and the neighbouring municipalities relate to the level of healthcare and drinking water. Bruce Power and nuclear waste were identified as a concern by a small minority (approximately 5 percent) of the respondents in Kincardine, and by even fewer respondents in the neighbouring municipalities.

The PAR also examined people's activities within the community, such as their use of beaches, trails and parks as well as fishing and boating. A majority (approximately 55 percent) of local residents indicated that they regularly use the beaches, trails and parks but very rarely fish or boat in the local area.

Current Knowledge and Attitudes of the Western Waste Management Facility

Nearly half of the survey respondents indicated that they are very or somewhat aware of the WWMF. However, the following figure shows only a few of the Kincardine respondents (approximately 9 percent) indicated that the presence of the WWMF has had any effect on their daily lives. Those that identified the facility as having an effect indicated that the effect was more often positive than negative.



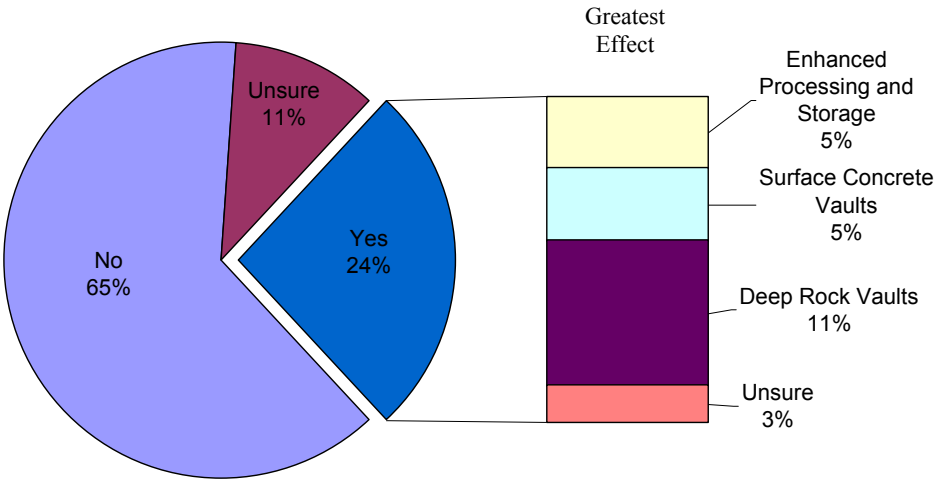
Does the WWMF have an effect on your daily life?

In addition, over 75 percent of the Kincardine respondents were very or somewhat confident in the existing technologies for processing and treatment of low and intermediate level waste.

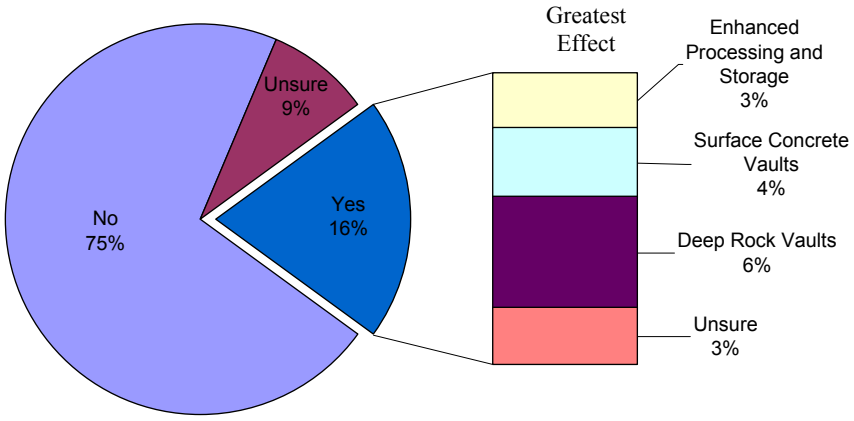
The PAR results of the neighbouring municipalities are very similar to those from Kincardine.

Effects of the long-term management Options on Attitudes in the Community

The majority of both Kincardine and neighbouring municipality respondents indicated that none of the management options would have an adverse effect on their feelings of personal security or satisfaction with the community. The figure below shows that 65 percent of Kincardine respondents indicated that there would be no effect on their personal security. A further 11 percent were unsure of whether or not there would be an effect. Of the remaining 24 percent who believed there would be an effect, approximately one third thought the effect would be positive and two thirds thought it would be negative. These latter respondents indicated that the Deep Rock Vaults option would have the greatest negative effect of the three long-term management options.



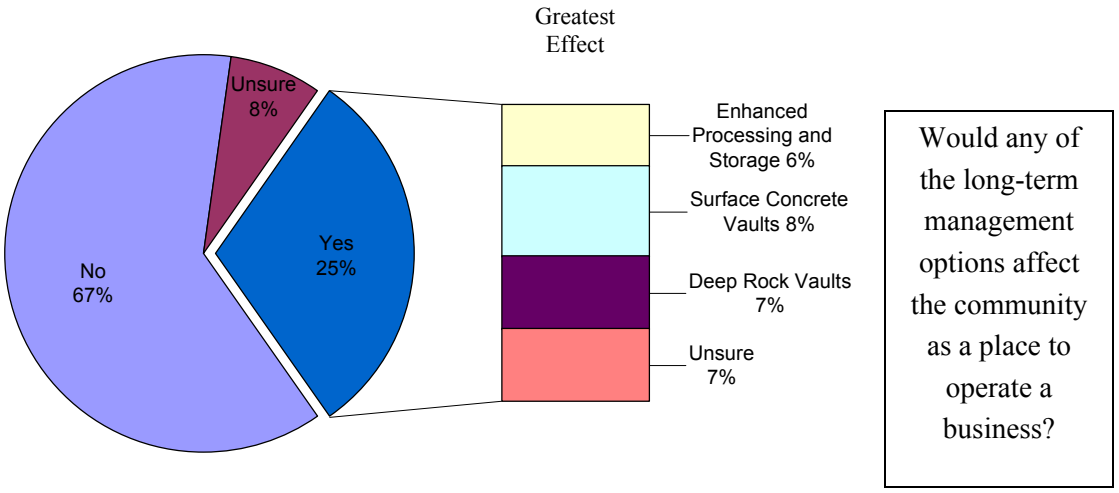
Over 74 percent of Kincardine respondents indicated that a long-term management facility would not have any effect on their satisfaction with their community. The figure below shows that the 17 percent of respondents who believes that a facility may have an effect felt the Deep Rock Vaults option would have the overall largest effect. However, over half of the respondents felt that the effect would be a positive one. The responses provided by residents of the neighbouring municipalities were similar to those of the Kincardine respondents.



Would any of the long-term management options have an effect on your satisfaction with your community?

A majority of respondents also indicated that a long-term management facility would not have any effects on the community as a place to visit, operate a business or live. For those who believed there may be an effect, it was generally felt that the Deep Rock Vaults would have the largest effect on the community as a place to visit as a tourist but the Surface Concrete Vaults would have the largest effect on the community as a place to live and operate a business.

The following figure shows that the majority of Kincardine respondents, approximately 67 percent, did not believe there would be an effect on their community as a place to operate a business. Approximately one quarter of respondents indicated that a long-term management facility may have an effect on the community as a place to operate a business, in particular the Surface Concrete Vaults option. Four out of every ten of the respondents anticipating a change believed that the effect on business would be positive.



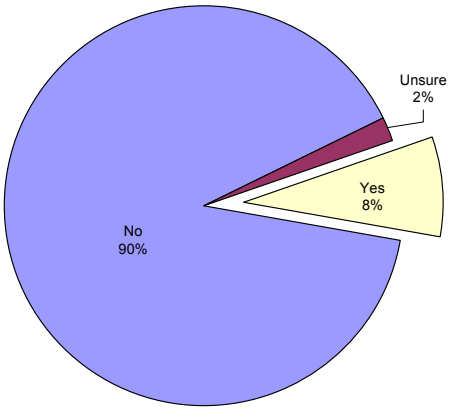
NOTE: Totals do not add up to 100 percent because of multiple responses.

The results for the neighbouring municipalities were very similar although there was a larger percentage of respondents who were unsure whether or not a long-term management facility would have any effect.

Over 85 percent of respondents for both Kincardine and neighbouring municipalities indicated that a long-term management facility would not cause them to move from the community or change their behaviours with respect to their use of beaches, trails or parks or reduce fishing or boating activities.

Farmers

Sixty respondents in Kincardine identified themselves as farmers. The figure below shows that 90 percent of the farm respondents indicated that a long-term management facility would not have any effect on their commitment to farming. For the 5 respondents (8 percent) that indicated there may be an effect, 4 believed that effect would be negative. Because of the small number of respondents, there was no clear indication of which of the long-term management options was least likely to cause an effect.



Would any of the long-term management options affect your commitment to farming?

Seventy-six of the 351 respondents in the neighbouring municipalities identified themselves as farmers. Over 88 percent of these farm respondents indicated that a long-term management facility would not have an effect on their commitment to farming. Only four respondents (5 percent) indicated that there may be an effect on their commitment to farming, the majority believing the effect could be positive.

6.3.2 Tourism Research

Briefing Interviews

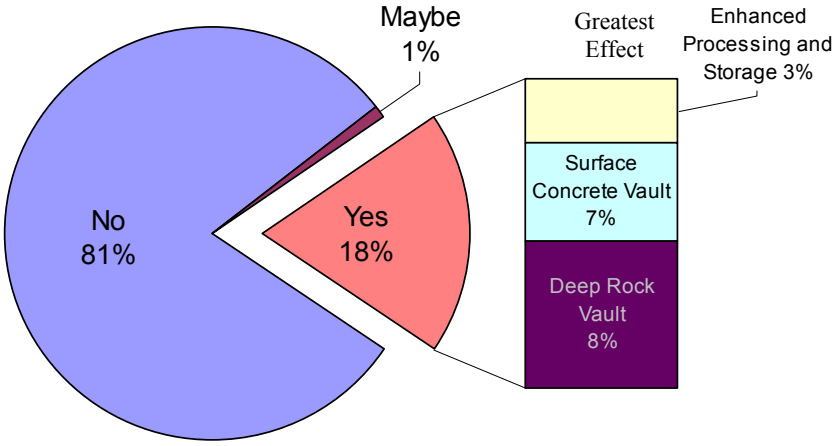
The participants generally felt that they are not affected by WWMF. Most tourist-business operators believe that any long-term management facility will neither have a negative effect on the current community image nor generate more revenues. The realtors felt that in the event that a stigma is placed on the community by a long-term management facility, that could indirectly lead to a potential decrease in property value.

Tourist Surveys

The majority of the tourists find the area to be very attractive with a positive community image. Although the tourists to the area are aware of Bruce Power, very few knew about or felt they were affected in any way by the WWMF.

The surveys indicated that if a long-term management facility was implemented in the area, very few, if any, tourists would change their behaviour towards their use of beaches, trails, parks,

boating or fishing. As shown the figure below, the overwhelming majority of tourists identified no change in their behaviour as a result of implementing any of the options at the WWMF. The respondents who indicated there may be an effect felt that the Deep Rock Vaults option is most likely to have the largest effect.



Would the implementation of any of the long-term management options change your behaviour as a tourist?

Tourism Round Table

The participants of the round table felt that Bruce Power and the WWMF have a low profile among tourists because the site is not readily visible. There was a concern that if there was ever any problem or incident at the long-term management facility, it could affect the tourist industry in Kincardine and the neighbouring municipalities through a stigma becoming attached to the area as well. However, it was noted that the majority of business is generated from commercial travelers associated with Bruce Power and the WWMF. Overall it was felt that as long as the long-term management facility and related transportation of wastes can maintain a low profile, any potential adverse effects on the tourist industry will be minimized.

6.4 Conclusions of the Social Assessment

The Public Attitude Research indicates that nuclear power and radioactive waste are not major issues of concern in Kincardine and the neighbouring municipalities. Although residents are generally aware of the WWMF, it has little to no negative effect on community attitudes, attractiveness or activities such as use of beaches, trails or parks.

Most of the respondents indicated that they are aware of the initiative for a long-term management facility but there was little concern about it within the community. The Public

Attitude Research suggests that the long-term management facility options are not likely to adversely affect the attitudes of the respondents towards the community or the attractiveness of the community. None of the options will likely cause residents to move from the community or reduce the use of beaches, parks, trails, fishing or boating.

Similarly, the majority of farm respondents in both Kincardine and the neighbouring municipalities indicated that a long-term management facility would not affect their commitment to farming. However, because of the small number of respondents, there was no clear indication of which of the long-term management options was least likely to cause an effect.

The tourism research indicates that there will not be a change in attitudes or activities by tourists in the community. Indeed, few tourists were aware of the WWMF or any plans for long-term management of the wastes. The briefing interviews show that the majority of business operators do not believe that a long-term management facility will have an effect on the commercial trade in the community.

Most of the tourists interviewed felt that the community presents a very positive image and is an attractive place to visit. The surveys also indicated that a long-term management facility will not have a negative effect on tourism.

The tourist round table further suggests that there is likely to be little to no effect on tourism and tourist-based businesses providing a low profile surrounding the long-term management facility is maintained.

7.0 COMMUNICATION AND CONSULTATION

7.1 Goals of Communication and Consultation

The goals of this consultation plan were to:

- Include all interested stakeholders and members of the community at a level of involvement suitable to their needs and interests;
- Ensure all interested stakeholders and the community are provided with sufficient information on the LLW and ILW management options; and
- Provide stakeholders with an opportunity to comment on the options under consideration.

7.2 Methods and Details of Communication and Consultation

A detailed communication and community consultation plan was developed for the community consultation relating to the IAS.

Community consultation began in the Spring of 2003. The consultation program included five main components; namely, stakeholder briefings, a newsletter, a website, five Open Houses and First Nations consultation. The consultation was undertaken in Kincardine, the four neighbouring municipalities (Saugeen Shores, Arran-Elderslie, Huron-Kinloss and Brockton). In addition, preliminary discussions were held with the two First Nation bands (Saugeen First Nation and Chippewas of Nawash).

7.2.1 Stakeholder Briefings

A briefing package was prepared to describe the IAS and outline the long-term management options. The briefings took place in late Spring, 2003 and were presented to the following:

- First Nations;
- Members of Federal and Provincial Parliament;
- Atomic Energy of Canada Limited;
- CNSC;
- Natural Resources Canada;
- Ministry of Environment;
- Ministry of Energy;
- Municipal Councils;

- Medial Health Unit, Chief Medical Officer;
- Power Worker's Union; and
- Society of Energy Professionals.

In general, the parties expressed interest in the IAS, acknowledged the effort being made to inform them, and provided useful input into the consultation process.

7.2.2 Newsletter

A newsletter was distributed in May, 2003 that provided the public with an overview of the IAS and the long-term management options. The newsletter also included a summary of the work undertaken on the study to that date and the next steps to be taken in the IAS. A description of the decision process leading to the implementation of any of the options at the WWMF was included.

The newsletter was delivered by post to 22,000 households in Kincardine and the neighbouring municipalities. This included all cottages as well as businesses and residences.

7.2.3 Website

An IAS website was established to provide information to the general public and to receive comments and questions. It is located at http://ias.golder.com and was launched in May 2003. The website has clearly identified links to the Kincardine and OPG web pages. The website includes information such as:

- Study objectives;
- Study overview;
- Organizations involved with the study;
- Schedule of public briefings and open houses;
- Frequently asked questions; and
- Contact information.

7.2.4 Open Houses

A round of public Open Houses was held in June, 2003 to inform the community about the purpose and process of the IAS and to receive input and comment on the study and the long-term management options. The dates and locations of Open Houses were:

- June 5 – Kincardine, Legion Hall, 219 Lambton Street;
- June 10 – Lucknow, Legion Hall, 477 Inglis Street;
- June 13 – Port Elgin, Legion Hall, 630 Green Street;
- June 14 – Underwood, Community Hall, Concession 7; and
- June 16 – Chesley, Fire Hall, Bruce Road 10.

The Open Houses were from 3:00 p.m. to 8:00 p.m. on weekdays and from 11:00 a.m. to 4:00 p.m. on the Saturday (June 14). The Open Houses were advertised in the newsletter and local newspapers as well as invitation post cards delivered to all the businesses and residents in Kincardine.

A total of 77 people visited one or more of the Open Houses; of these, 37 filled out and returned comment sheets.

The majority of participants at the Open Houses live in the local area where the Open Houses were held. The majority of attendees felt the Open Houses were informative and helpful.

7.2.5 First Nations Consultation

Stakeholder contact with Chippewas of Nawash First Nation and the Saugeen First Nation was conducted as part of the consultation plan. A draft communications protocol was developed and provided to the First Nations to facilitate a productive exchange of information between First Nations, Kincardine and OPG.

The goals of this protocol are:

- Acknowledging that the Saugeen and Nawash Bands have a demonstrated interest in the operations at the Bruce Power site;
- Incorporating issue identification, tracking and management capability in recognition of the reality that issues frequently arise through increased community awareness resulting from the consultation process and the related enhanced profile of the WWMF; and
- Maintaining flexibility to respond to newly identified issues as well as Nawash and Saugeen input throughout the study period.

The protocol was submitted in June, 2003 to the two First Nation bands and initial briefings were held with both First Nations. A meeting with the Joint Council for both bands is scheduled for early 2004.

7.3 Preliminary Comments from First Nations' Leadership

Representatives from Golder met with Chief Randy Roote and Dwayne Nashkewa, Band Administrator from the Saugeen First Nations on June 27, 2003 and with Chief Ralph Akiwenzie of Nawash First Nations on July 4, 2003. Some of the main points raised at these briefings were:

- Both Chief Roote and Dwayne Nashkewa noted that the First Nations have not experienced many benefits from the Bruce Power site;
- They indicated a major concern relating to the presence of sacred sites - how do we protect them and ancestors?
- Chief Akiwenzie noted his distrust of burial of radioactive waste in the underlying bedrock;
- Chief Akiwenzie identified two primary areas of interest to the Nawash: (1) the Lake Huron Whitefish fishery, and (2) potential disturbance of burial sites.

7.4 Overview of Communication and Consultation

Based on feedback received from the stakeholder briefings, Open Houses and First Nation briefings, the majority of stakeholders are supportive of the IAS and appreciate the consultation efforts to date. There was very little opposition to any of the long-term management facility options.