Summary: Intervention & Options

Department /Agency:	Title:	
Defra	**Impact Assessment of A framework for implementing geological disposal for higher-level radioactive wastes.**	
Stage: Final	**Version:** 1	**Date: 13 May, 2008**
Related Publications: References, related publications and supporting detail are set out in the Evidence Base notes (attached).		

Available to view or download at:

http:// www.defra.gov.uk/corporate/consult/radwaste-framework/index.htm

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What is the problem under consideration? Why is government intervention necessary?

Radioactive wastes in the high and intermediate level categories have been accumulating for many decades, mainly as a consequence of nuclear power generation and nuclear weapons production. These wastes must be managed safely and securely – they need to be stored in a safe condition while preventing access by unauthorised parties. These waste management arrangements are expensive and time-consuming. Government intervention is necessary because the wastes are mainly the responsibility of Government, and only Government can implement such a major waste management programme.

What are the policy objectives and the intended effects?

To provide for safe long-term management of the United Kingdom's higher-activity radioactive waste in a sustainable and cost-effective manner.

What policy options have been considered? Please justify any preferred option.

Policy options have been considered by the Committee for Radioactive Waste Management (CoRWM). The options considered were variations on the theme of long-term storage (Options 1 - 6) and various types of permanent disposal (Options 7 - 14). The options are set out in the documents referenced in this Impact Assessment, and are summarised in the Evidence Base. CoRWM carried out an options' assessment based on a number of criteria, using a multi-attribute analysis approach, and working with a wide range of stakeholders including NGOs and members of the public. The Committee's recommendation was for permanent geological disposal (Option 7C). The full justification for CoRWM's recommended approach is set out in its final report, as summarised in the Evidence Base. This impact assessment presents the costs and benefits of the recommended option relative to the status quo (option 3 in the CoRWM report).

When will the policy be reviewed to establish the actual costs and benefits and the achievement of the desired effects?

The implementation programme is subject to continual review on three levels: by the Nuclear Decommisioning Athority (NDA); by Government (Defra); and by independent oversight (CoRWM). CoRWM is required to report annually from 2008.

Ministerial Sign-off For final proposal/implementation stage Impact Assessments:

I have read the Impact Assessment and I am satisfied that, given the available evidence, it represents a reasonable view of the likely costs, benefits and impact of the leading options.

Signed by the responsible Minister:

..... Date:

Summary: Analysis & Evidence

Policy Option: 7c	Description: Deep geological disposal

Costs

ANNUAL COSTS		Description and scale of **key monetised costs** by 'main affected groups'
One-off (Transition) **Yrs**		Government will bear all costs relating to legacy wastes - these are for design, construction, operation and closure of a repository. These costs are expressed relative to those incurred under the status quo policy, i.e "interim store" (presented as option 3 in the CoRWM
£ Nil		
Average Annual Cost (excluding one-off)		
-£2.7m to +£6.3m, best estimate +£1.6m[1]	300	**Total Cost** (PV) **-£816m to +£1,895m**

Other **key non-monetised costs** by 'main affected groups' Industry will bear some of the costs if the deep geological disposal facility is made available to current and future generators.

BENEFITS

ANNUAL BENEFITS	Description and scale of **key monetised benefits** by 'main affected groups' :
One-off **Yr**	Given the difficulties posed by decision-making in the areas of radioactive waste management (complexity, uncertain and disputed evidence, multi-dimensionality) CoRWM adopted a Multi-criteria Decision Analysis (MCDA) approach to assess benefits. The main benefits are reflected in the non-monetised benefits box below. No monetised benefits were calculated.
£ N/a	The MCDA showed that Option 7c offered the best value for money, providing a significantly higher level of benefits (see Charts 1 and 2) than cheaper options (Options 2 and 6). Option 9c is very similar to the preferred option, offering a slightly higher level of benefits at a higher cost (see Table 2), but did not perform well in the MCDA severe sensitivity test (see Chart 2).
Average Annual Benefit (excluding one-off)	
£ N/a	**Total Benefit** (PV) **£ N/a excluding non-monetised benefits [5]**

Other **key non-monetised benefits** by 'main affected groups' Enhanced public safety; reduction in uncertainty about future institutional control; reduction in technical uncertainties; reduction in risk of terrorist acts involving radioactive waste.

Key Assumptions/Sensitivities/Risks :No significant scientific developments will occur with respect to uses of radioactive waste or new waste management technology.

Price Base Year 2008	Time Period Years 300	**Net Benefit Range** (NPV) **-£1,895m to +£816m excluding non-monetised benefits**	**NET Benefit** (NPV Best estimate) **-£472m excluding non-monetised benefits**[2]

What is the geographic coverage of the policy/option?				UK (Note 1)
On what date will the policy be implemented?				2008
Which organisation(s) will enforce the policy?				NDA (Note 2)
What is the total annual cost of enforcement for these organisations?				£ 0.5m (Note 3)
Does enforcement comply with Hampton principles?				Yes
Will implementation go beyond minimum EU requirements?				No
What is the value of the proposed offsetting measure per year?				£ N/A
What is the value of changes in greenhouse gas emissions?				£ N/A
Will the proposal have a significant impact on competition?				No
Annual cost (£-£) per organisation (excluding one-off)	Micro	Small	Medium	Large
Are any of these organisations exempt?	N/A	N/A	N/A	N/A

Impact on Admin Burdens Baseline (2005 Prices) (Increase - Decrease)

Increase of £ Nil Decrease of £ Nil **Net Impact** £ Nil

Key: **Annual costs and benefits:** **(Net) Present Value**

[1] These are discounted costs averaged over 300 years.
[2] See paragraphs 60 - 63

Context

CORWM published its recommendations to Government in July 2006. In October 2006, the Government accepted the recommendations for geological disposal and confirmed its support to explore how an approach based on voluntarism (that is willingness of communities to participate) and partnership, as recommended by CoRWM, could be made to work in practice. In June 2007, the Government consulted on a proposed framework for implementing geological disposal and the White Paper sets out the Government's proposals for implementing geological disposal. CoRWM has already considered the financial implications of geological disposal in the context of legacy waste and that work has already been published. This Impact Assessment looks at the impact of implementing geological disposal drawing on CORWM's work in relation to disposal of legacy waste. The Impact Assessments for the Nuclear White Paper and the Energy Bill 2008 consider issues in relation to the impact of disposing of new build waste.

Introduction

1. Higher-activity radioactive wastes comprise the following categories.

    - **High Level Radioactive Waste (HLW)** is very radioactive comprising mainly fission products, and generates a great deal of heat. This heat generation has to be taken into account when storing HLW and designing facilities for its management in the long term.

    - **Intermediate Level Radioactive Waste (ILW)** is less radioactive than HLW, and does not generate sufficient heat for this to be taken into account in the design of the facilities for management, but can require significant shielding.

    - **Spent Nuclear Fuel (SNF)** is fuel which has been removed from a nuclear reactor post-irradiation at the end of its useful life.

    - **Plutonium** and **Uranium** - Current owners place a zero asset value on these materials meaning that they are neither classed as waste nor a commercial asset. If they are declared as wastes in the future, then they will be considered as higher-activity wastes.

2. All such wastes are currently stored on one of a number of nuclear licensed sites in the UK. A store is a robust engineered facility (building) with a design life of typically 50-100 years. This interim storage allows wastes to be monitored and relatively easily retrieved. However, if the storage option is to address the need to protect humans and the environment for hundreds of thousands of years, whilst long-lived radionuclides decay to safe levels, then stores will have to be actively managed over these long times scales.

3. Storage for 50-100 years is already in place. However, many stores were only designed for lifetimes of 50 years and will need refurbishment. If stores are to operate for longer periods, periodic maintenance and refurbishment will be required to avoid structural deterioration of the facility.

4. Indefinite storage passes on waste management responsibilities to future generations. It places burdens on future generations, in terms of store management, provision of funding levels, capacity to monitor and inspect the waste, repair and refurbish buildings, equipment, waste packages and maintaining security.

5. The Managing Radioactive Waste Safely (MRWS) White Paper sets out Government Policy with respect to the permanent (geological) disposal of higher activity radioactive wastes, meaning wastes in the High Level Waste (HLW) and Intermediate Level Waste (ILW) categories, with some possible contributions to the waste inventory comprising Spent Nuclear Fuel (SNF) and Plutonium. The policy as set out in the White Paper states:

- Geological disposal is the way forward for the management of higher activity radioactive waste in the long-term.

- Implementation will be undertaken on a staged basis, with clear decision points allowing progress to be reviewed and costs, affordability, value for money, safety, and environmental and sustainability impacts to be assessed before decisions are taken on how to move to the next stage.

- This will be preceded by safe and secure interim storage until a geological disposal facility can receive waste. This period will include contingency planning to cover any uncertainties associated with implementation.

- Government will explore an approach to geological disposal site selection based on voluntarism and partnership. (This means that communities will be invited to express an interest in opening up without commitment discussions on the possibility of hosting a geological disposal facility at some point in the future.).

- The Nuclear Decommissioning Authority (NDA) has statutory functions under the Energy Act 2004, one of which is for the disposal and safe and secure interim storage of its waste in designated circumstances, and this is being provided for in its Strategy and Business Plan. The NDA is therefore the body responsible for planning and implementing geological disposal, in addition to its role for the safe, cost-effective decommissioning and clean up of government-owned nuclear facilities.

- The arrangements will be subject to strong independent regulation by the statutory regulators.

- The implementation programme will be subject to the relevant planning processes.

- Scrutiny and advice to Government on the implementation programme will be provided by the independent Committee on Radioactive Waste Management (CoRWM).

- An open and transparent approach which enables stakeholders to be involved throughout the implementation process.

6. Geological disposal as set out in Command 2919 (1995) - Review of Radioactive Waste Management Policy; Final Conclusions - was Government policy up to 1997 when an earlier UK Nirex Ltd disposal programme collapsed at the planning stage. From 1998 to 2006, the policy was temporarily in abeyance pending the establishment and deliberations of CoRWM.

7. The UK Government and the devolved administrations set up CoRWM in November 2003. The committee's remit was to oversee a review of options for the long term management of high and intermediate level radioactive wastes in the UK and to recommend the option or combination of options that can provide a long term solution. The policy cycle is set out in Table1 below :

Table 1: Policy timeline

Timing	Work	Stage
2001-02	• MRWS consultation on the process. • Consideration of responses and planning for stage 2	1
2002-06	• Establishment of Committee on Radioactive Waste Management (CoRWM). • CoRWM lead research and public engagement to recommend the option or combination of options on the long-term management of the UK's higher activity radioactive waste that would be both practicable, provide long-term protection of people and the environment and inspire public confidence. • Government decision on the option(s) to implement	2
2007	• Consultation on the Government's framework for implementing its preferred option(s)	3
2008	• Implementation of preferred option(s)	4

8. In 2006, following CoRWM's work, the geological disposal policy was re-affirmed, albeit with significantly more detail and some changes of emphasis. For instance:

- In 1995, Government envisaged two programmes: one for high level radioactive waste (HLW) and one for intermediate level radioactive waste (ILW). Not only does Government now envisage one programme for both waste categories, but the additional categories of spent nuclear fuel (SNF), Plutonium and Uranium wastes may also need to be accommodated within the same programme if they are declared as wastes.

- The NDA was set up under the Energy Act 2004, and will be the implementing body. The old UK Nirex Ltd organisation, with its skills and resources, has been subsumed into the NDA.

- Approaches to partnership and voluntarism are a development arising from the CoRWM process, and were not envisaged in 1995.

9. From this perspective, the proposed new policy does not represent a significant departure from previous policy. This Impact Assessment is based on a move from a current position of storage of higher activity radioactive wastes, which was, of necessity, maintained as an interim measure. The cost comparisons provided in this Impact Assessment have been derived on this basis.

10. Government consulted on its approach to implementing CoRWM's recommendations by way of '*Defra. Managing Radioactive Waste Safely – a framework for implementing geological disposal. A public consultation. 2007'.* The results of the consultation were broadly in agreement with the Government's proposed approach.

11. There are a number of significant benefits associated with the proposed option. These are not set out in full here, but derivation of these benefits was a major feature of CoRWM's work, and they are presented in the final report of that Committee – '*CoRWM: Managing radioactive waste safely – CoRWM's recommendations to Government. 2006'.* A summary of these benefits appears in the following sections.

12. It should be noted that, at this stage, there is no proposed location for a geological disposal facility. Identification of a facility site forms part of the process described in the White Paper. The White Paper itself describes the site selection process in outline.

CoRWM's options list

13. CoRWM considered 14 short-listed options (from a much longer initial list) as follows:

- Options 1 – 6 are variations on the theme of long-term storage.

- Option 7 is for geological disposal, entailing the construction of a deep cavern. Costs have been estimated for three situations, these being useful extremes for the purposes of the options' assessment process, chosen from a matrix of all wastes which might require disposal.

  A – Intermediate Level Waste (ILW) + Low Level Waste (LLW)
  B – High Level Waste (HLW) + Spent Nuclear Fuel (SNF)
  C – All wastes

- Option 8 is for a variation on deep geological disposal, in this case in boreholes (narrow vertical channels down which the waste is lowered).

- Option 9 is for deep geological disposal, but with the facility for retrieval of the wastes ('phased deep disposal'). The same three situations as in 7 above have been considered.

- Options 10 – 14 deal with management options for reactor decommissioning wastes, and represent a limited solution for wastes from one source only. The options consider dealing will all wastes, in all categories, from redundant nuclear power stations as one entity, by leaving the reactors in-situ.

14. For Options 1-6, the variations relate to a central (one) or dispersed (several) stores, and to the degrees of protection required for the stores. (It should be noted that in the cost information,

CoRWM have not elicited costs for a permanent solution under this option; that is, storage costs should be seen as necessary costs *in addition to* permanent disposal costs). For long-term storage, Government would only consider one of the options – Option 3 – this representing the option which matches the current situation. The other storage options (1, 2, and 4-6 inclusive) would represent either a significant technical departure (storing wastes underground, or constructing one centralised store), or an unacceptable reduction in protection standards.

15. For these reasons, **CoRWM's description of Option 3 is used in this Impact Assessment to represent the baseline, or 'do nothing' option.**

16. Option 8 was rejected by CoRWM on technical grounds, considering that the technical aspects were not sufficiently well understood at this time.

17. **Option 7 – representing CoRWM's favoured option - must accommodate all wastes, the other variations representing only a partial solution to the problem. This is Option 7 (C), and is the Government's way forward.**

18. Option 9 – phased disposal - was considered by CoRWM, the conclusion being that over the timescales for the assessment, there was little difference in practice between this option and Option 7. Option 7 represents a better basis for comparison in this regard.

19. Options 10 – 14, dealing with limited amounts of waste in specific categories, are not directly comparable, in cost terms, with the other options. A consideration of these options and associated costs, is not directly relevant to the current needs of the MRWS White Paper in that Government wishes to implement a solution which deals will all higher-activity wastes in all situations.

CoRWM's options analysis

20. CoRWM used Multi-Criteria Decision Analysis to conduct a thorough performance assessment of its short-listed options for the entire waste inventory, against a number of criteria. The criteria were applied over a period of 300 years. The criteria (see annex III), weighted to give a total of 100 were (with criteria weightings shown in brackets):

- Public Safety – radiation and non-radiation effects (23.3%). This criterion involved consideration of
    - individual exposure to radiation
    - number of deaths and serious accidents among the public
- Security – vulnerability of waste to terrorist and other attack; prevention of misappropriation of hazardous materials (23.3%). This criterion involved consideration of
    - withstanding reasonably foreseeable malicious and purposeful attacks
    - prevention of unauthorised removal of hazardous material
- Burden on future generations – financial liabilities; managerial effort; exposure of a workforce to radiation; environmental impacts (16%).
- Flexibility – allowance for future choices and unforeseen circumstances (16%).
- Worker safety – radiation and non-radiation effects (7.7%). This criterion involved consideration of
    - individual exposure to radiation
    - number of deaths and serious accidents among the public
- Environment – radiological and non-radiological pollution; physical disturbance (noise, light pollution, disruption of flora and fauna etc.); use of natural resources (7.1%).
- Implementability – technical aspects; regulatory compliance (4.0%). In consideration of this criterion, it was asked whether the option could be implemented using currently-available technology.

- Amenity – visual and audible impacts; transport effects; land take (1.7%).

- Socio-economic - employment; spin-offs to technology and business (0.9%)

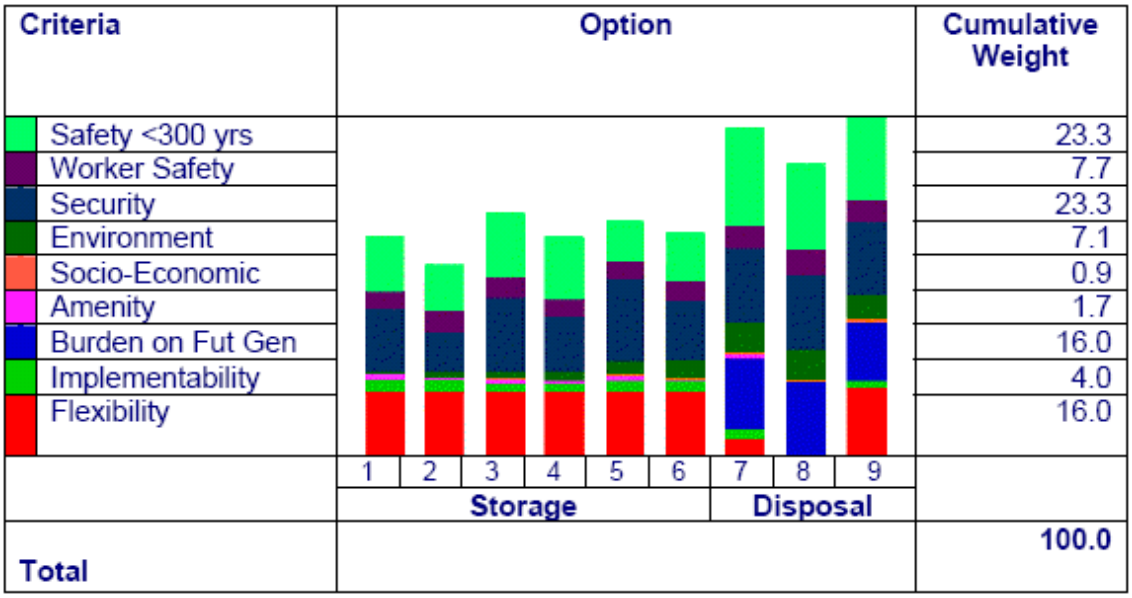
21. The weightings are based on CoRWM's public and stakeholder engagement work, in which different groups of people were asked to indicate the relative importance of the various criteria.

22. The criteria listed above are, in the main, non-monetised, and represent a measure of the non-monetised benefits used in this Impact Assessment. Costs (to include the costs for development, implementation, operation, closure and monitoring) were not used independently as a criterion in the options' assessment process. (*'CoRWM decided to …….assess the impact of cost through a form of sensitivity analysis'*; and '*There was also less difference between the options than expected'*). The conclusion from the sensitivity analysis was *' …the highest cost estimates for disposal and the lowest cost estimates for storage were fed into the model. The storage options, despite their lower costs, continued to perform less well than disposal'* [overall – that is, taking into account all of the criteria].

Outcomes of MCDA analysis

23. The outcomes of the MCDA analysis are shown graphically as follows.

Chart 1: HLW baseline case with specialist scores and CoRWM swing weights[3]



24. The coloured portions of the bar chart above show the relative contributions of the headline criteria to the totals. Geological disposal options scored higher than the storage options because of the lower burden they would place on future generations as indicated by the large blue sections and the short-term safety criterion is also an important discriminator because of the vulnerability of storage options if there was a loss of institutional control. Phased geological disposal achieves the highest weighted score, though geological disposal is similar.[4]

25. *'The sensitivity analysis was used on the weightings to enable participants to see the effects of differences in opinion about scores and weights, the effects of imprecision in the scores and weights, and to simulate alternative perspectives, which involve combinations of different scores and weights from the base case (e.g., a 'green' perspective)'.*[5]

26. *'For the sensitivity testing of the cost criterion, the highest cost estimates for disposal and the lowest cost estimates for storage were fed into the model. The storage options, despite their lower costs, continued to perform less well than disposal.*[6] *See [Table 2] below for a sensitivity*

[3] Taken from CoRWM report (Table 11.4)
[4] CoRWM Report
[5] CoRWM Document Number: 1666: Completing and exploring the MCDA models, 28-30 March 2006, Catalyze
[6] CoRWM Report

analysis of the cost calculations that show the upper and lower cost estimates for the different options.

Table2 Showing overall undiscounted costs for each option and uncertainty ranges, and confidence in cost estimates[7]

option 7c in this impact assessment is equivalent to option "7 All" below.[8]

Summary of costs in £ millions. Note assumptions, uncertainties, and omissions for each option when using these costs.

Option	Develop-ment (£ M)	Design & Construction (£ M)	Operation (£ M)	Completion (£ M)	Total Best Estimate (£ M)	Lower Estimate (£ M)	Upper Estimate (£ M)	Confid-ence
1	950	2,050	10,065	1,335	**14,400**	8,500	18,800	**M**
2	195	1,760	5,160	1,215	**8,330**	6,900	9,700	**M**
3	950	4,105	10,530	1,610	**17,195**	10,000	21,600	**M**
4	195	3,625	5,625	1,560	**11,005**	8,700	12,400	**M**
5	1,065	4,700	8,290	1,850	**15,905**	11,200	21,000	**L/M**
6	280	2,785	2,600	1,215	**6,880**	5,900	8,200	**L/M**
7 ILW/LLW/U	960	3,175	3,070	275	**7,480**	-	8,680	**M/H**
7 HLW/SF/Pu	920	1,600	3,990	340	**6,850**	2,800	8,050	**M/H**
7 All	1,100	3,705	6,160	355	**11,320**	-	13,120	**M/H**
8 *	1,500	1,150	1,880	55	**4,585**	2,870	18,450	**L**
9 ILW/LLW/U	960	3,175	4,745	275	**9,155**	-	10,355	**M/H**
9 HLW/SF/Pu	920	1,600	4,490	340	**7,350**	3,300	8,550	**M/H**
9 All	1,100	3,705	8,085	355	**13,245**	-	15,045	**M/H**
10 *	100	260	400	160	**920**	240	1550	**M/H**
11 *	10	130	375	40	**555**	240	1550	**H**
12 *	375	1,875	in construction	250	**2,500**	1,500	3,125	**L**
13 *	10	190	410	35	**645**	525	-	**M/H**
14 *	210	300	150	320	**980**	350	1,230	**M/H**

Confidence = degree of confidence in cost estimates: L = low; M = medium; H = high – see Section 2.2 for discussion. Upper and lower estimates are based on cost ranges identified when developing cost estimates. Basis for confidence ratings and upper and lower estimates is provided under the uncertainty section for each option in Section 4.

Cost on ongoing R&D to develop long-term management strategy is not included in costs of storage options.

* Does not manage all CoRWM wastes.

27. CoRWM applied a more severe test[9] of the robustness of the conclusions. *'This involved much more weight being placed on environment, amenity, flexibility and implement-ability criteria. These weights, combined with reduced scores for geological disposal options against burden on future generations to the same levels as for storage options, reflected concerns that disposal options could impose substantial burdens on future generations if poor repository performance resulted in substantial negative environmental impacts and clean-up effort in addition to a negative impact on human health. The score for flexibility for phased geological disposal was reduced to the same as that for geological disposal to reflect a view that social and political hurdles could prevent retrieval of wastes during the open phase of a repository. Even in this case, geological disposal still ranked highest'.*[10]

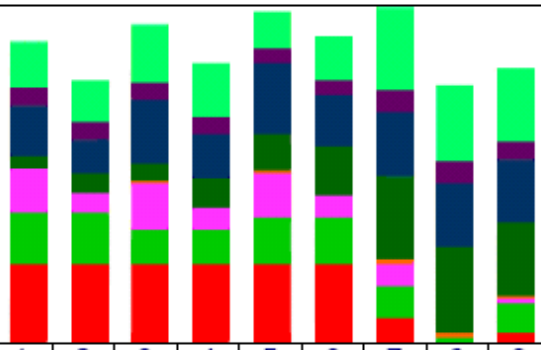
[7] Table taken from: '*Galson Sciences Ltd. CoRWM criteria discussion paper: cost. 2005'*

[8] The Total best estimate for option 7c is £11,320m above, the equivalent figure in this IA and table 1 in annex I is £9,470. The difference between the two (£1,850m) is the exclusion of Pu (Plutonium) and HEU (Highly Enriched Uranium) from option 7c in this IA, as these are not classified as waste at present.

[9] CoRWM Report

[10] Ibid

Chart 2: HLW NGO Limiting Case[11]

Criteria	Option	Cumulative Weight
Safety <300 yrs		15.6
Worker Safety		5.2
Security		15.6
Environment		15.6
Socio-Economic		0.6
Amenity		10.7
Burden on Fut Gen		10.7
Implementability		10.7
Flexibility		15.6
	1 2 3 4 5 6 7 8 9	
	Storage / Disposal	
Total		**100.0**

28. It has been noted by CoRWM that the MCDA models are not intended to provide the 'right' answers owing to the considerable uncertainty and conflicting objectives involved in dealing with the future. However, CoRWM stated that *'despite the inherent limitations and some implementation issues raised by ourselves and others, our conclusion is that the MCDA was valid, had value, and can make a significant contribution to the decision-making'.*[12]

29. Taking into account the outcomes of the MCDA analysis and the costs presented in Table 2, we find that, overall, Option 7c performs better than the other options. We can see that Options 2 and 6, those directly comparable to Option 7c[13], have lower undiscounted costs but do not perform as well in the MCDA analysis shown above (see Charts 1 and 2). In particular Chart 1 shows that Option 7 performs significantly better than Options 2 and 6, mainly owing to the reduced burdens on future generations and greater safety within the 300 year period. Option 9, which performed slightly better than Option 7 in the baseline MCDA (see Chart 1), but not in the Severe Sensitivity Test (see Chart 2), is more expensive than Option 7 (see Table 2).

Conclusions from MCDA analysis[14]

30. 'The MCDA analysis led to three conclusions:

- *Overall, geological disposal options ranked higher than storage options.*
- *The difference in ranking between geological disposal and storage is substantial for most waste streams and for most of the limiting case sector scenarios.*
- *Generally, the borehole option is the lowest ranked geological disposal option.'*

31. CoRWM complemented the MCDA analysis with an holistic assessment of the options, and compared the outcomes of the two assessments. '*The Holistic assessments involved a number of discussions over a period of several months on specific aspects of the problem, at workshops, in plenary discussions, and using panels of specialists. Each discussion was supported by briefing papers, and conclusions reached were recorded'.* This was used as it 'enabled a more discursive and intuitive approach where ethical, scientific and public forms of knowledge could be brought together in reaching conclusions'[15].

32. Through the MCDA analysis with the holistic assessment and a number of deliberations and Public Sector Engagements CoRWM first recommendation was: Within the present state of knowledge, CoRWM considers geological disposal to be the best available approach for the long-term management of all the material categorised as waste in the CoRWM inventory when

[11] Table taken from CoRWM report (Table 11.5)
Higher level waste Non-governmental organisation limiting case
[12] Ibid
[13] Options that cover all recognised waste streams.
[14] Ibid
[15] Ibid

compared with the risks associated with other methods of management. The aim should be to progress to disposal as soon as practicable, consistent with developing and maintaining public and stakeholder confidence.[16]

33. For the purposes of this Impact Assessment, the view has been taken that CoRWM's options analysis, as reported in the references, is fit-for-purpose; that is, no further options assessment will be undertaken.

Cost comparisons for the recommended option and the 'do nothing' option

34. This Impact Assessment compares the costs for two options. These are:

- Option 3 – Interim store, at location of waste arisings, protected. This option is the one which matches the current situation, and can be taken as the 'do nothing' option. Higher-level wastes are currently stored at the sites of origin in secure stores. These stores will require maintenance and surveillance for an indefinite period, and replacement or significant refurbishment over a period of 250,000 years until radioactive decay has rendered the wastes almost harmless.

- Option 7(C) – Deep repository for all wastes. This option represents the closest option to the proposals outlined by Government in the White Paper and described in the above sections. It was selected by CoRWM in preference to long-term storage (Options 1 – 6) because storage was not regarded as a long-term sustainable and permanent solution to the problem. The additional cost over of option 7c relative to the baseline is in a range of -£816m to +£1,895m in present value terms, with a best estimate of -£472m.

35. Derivation of these costs is summarised below, with more details presented in Annex I Table 2 to this Impact Assessment.

- CoRWM commissioned a discussion paper on costs to inform its options' assessment process. This was published as '*Galson Sciences Ltd. CoRWM criteria discussion paper: cost. 2005'.* CoRWM's contractors used information to support their cost estimates from a variety of sources, including:

  - NDA/Nirex estimates for design, construction and operation of facilities - these estimates were built up over many years of research by Nirex;
  - actual costs incurred in development programmes overseas; and
  - actual costs of storage of radioactive wastes.

36. The process is obviously not at the cost-engineering stage, and so the costs estimated to support the CoRWM deliberations are, of necessity, uncertain. The main uncertainties concern the following assumptions, that:

  - NIREX research into repository and other costs was robust;
  - the costs of overseas programmes are comparable, to some degree, with the UK position;
  - costs for storage will not increase substantially due to any new legislation or political direction; and
  - new technical developments will not substantially reduce costs of construction or operation of a facility.

37. The figures in the above paper were used in a paper commissioned by the MRWS Implementation Planning Group as '*Atkins. MRWS financial provisions. MRWSPG906)8. 2006'.* A spreadsheet was developed to support the cost analysis in the paper. This spreadsheet is the principal source of the information in Annex 1 to this Impact Assessment.

38. The figures in the above two papers and associated spreadsheet were not discounted. Discounting has now been done to support this Impact Assessment for the two options listed above, and a modified spreadsheet developed. Two discount rates ('standard' and 'reduced') on a sliding scale have been applied over a period of 300 years, based on the recommendations in the current version of the Treasury Green Book and a sensitivity that eliminates the *pure* rate of social time preference (see discounting section below).

[16] Ibid

Methodology of cost calculations from CoRWM[17]

39. A summary of the suggested costs that comprise Table A1 in Annex I, for each CoRWM short-listed option is provided in terms of the following major cost components for radioactive waste management:

40.

'• Development, including planning and licensing: these costs include application costs for facility construction, the cost of stakeholder consultation and public relations, the cost of a public inquiry, R&D costs for concept development and site selection, and regulatory costs.

• Design and Construction: these costs include the cost of the design and construction of the waste management facilities, and of any necessary supporting facilities specific to an option.

• Operation: these costs include the cost of operation of the waste management and supporting facilities, facility refurbishment, security, and transport costs.

• Decommissioning and Completion: these costs include the cost of decommissioning facilities, and of repository closure in the case of the disposal options. The cost of post-closure monitoring and institutional control for disposal options is also included in this component.

41. *A top-down approach to estimating costs has been taken, using data from existing studies and facilities worldwide. Costs are provided at present day values. Approximate profiles of spend over time are provided assuming a linear spend over the timescale of each cost component. [18]'*

Key Assumptions

1. CoRWM attempted to achieve a sufficient measure of public acceptability for their recommendations. It is assumed that this acceptability will not change.

2. There will be no significant technical developments which change the technical arguments underpinning the options assessment.

3. No new international treaty agreements will affect the options assessment by ruling out any of the options under consideration.

4. Voluntarism/partnership will result in a suitable site being identified.

5. It will be possible to develop a robust safety case.

6. Costs were based on 2003 - 5 values. They are estimates which were considered sufficiently robust for the purposes of options assessment (costs have been adjusted to 2008 prices in this IA – see below).

Key Uncertainties

1. The very long timescales involved mean that all assumptions are open to some level of uncertainty.

2. Plutonium and Uranium are not currently classified as waste. This may change.

3. The radioactive waste inventory has inherent uncertainties, particularly with respect to future waste arisings.

4. Improved minimisation techniques may reduce the amount of waste requiring disposal.

Cost comparisons and discounting in this Impact Assessment

42. The costs presented in Table A1 in Annex I are taken from '*Galson Sciences Ltd. CoRWM criteria discussion paper: cost. 2005',* which looked at the overall costs of the baseline (option 3) and the overall costs of the recommended option (7c). For the purposes of this Impact Assessment we have subtracted the costs of the recommended option annually over 300 years to work out the additional cost of the recommended option relative to the baseline (the net figure). Table A4 in Annex I presents these net figures. The net figures (non-discounted) have then been

[17] Section taken from '*Galson Sciences Ltd. CoRWM criteria discussion paper: cost. 2005'*
[18] *Galson Sciences Ltd. CoRWM criteria discussion paper: cost. 2005'*

discounted over a period of 300 years, which results in the discounted costs of the recommended option using the declining standard discount rate schedule (see Table 3 below). The best cost estimates are £472m whereas, using the reduced rate, they are £474m, making very little difference over such a long time period.

43. The cost comparisons in this Impact Assessment have been carried out over a timescale of 300 years. (CoRWM elicited radioactive waste management costs over this period, but the Committee chose not to use discounting methods in its options' assessment process – see the discounting section below for a discussion on different approaches to accounting for future costs and benefits).

44. The comparisons show that the discounted costs of long-term storage are marginally lower than the costs for the proposed option – geological disposal. But after 210 years, there are no subsequent disposal costs (it is assumed that post-closure, any disposal facility will be left in such a condition that no further monitoring will be necessary, whereas storage costs would continue indefinitely).

Discounting issue

45. Discounting allows us to compare costs and benefits that occur in different time periods. The discount rate is used to convert all costs and benefits to 'present values', so that they can be compared[19]. The discounted monetised costs (in present value terms) is £472m - £474m. It should also be borne in mind that what is being compared here are only those costs that have been monetised; the benefits associated with the preferred option, principally the reduced risk of environmental costs associated with permanent disposal have not been monetised.

46. Arguments can be made for different approaches to discounting. The main argument for using a zero discount rate is ethical - that the weight placed upon a person should not be reduced simply because they live in the future[20]. However a zero discount rate would mean that the allocation through time would be biased against the current generation in favour of the future generations, since, with economic growth, future generations will enjoy a higher average consumptions levels than the current ones. A positive discount rate is necessary in order to maintain a constant consumption over time.[21]

47. The Green Book recommends a declining schedule of discount rates (see table below: standard rate), rather than a set discount rate (3.5%) for cost-benefit comparisons over 30 years. This incorporates uncertainty into social cost benefit analysis about the future rate of time preference. However there is still uncertainty in regards to one of the components in the discount rate, that is the pure rate of time preference.

48. Sensitivity analysis has been performed on the discount rate schedule (see Table 3 below) with the reduced rate which excludes the pure rate of social time preference from the calculations[22]. This allows us to consider the impact on the cost benefit analysis of taking a particular ethical perspective on irreversible and long-term intergenerational wealth transfers, which is particularly relevant with a timeframe of 300 years[23]. It is this sensitivity that provides us with the upper ranges of our discounted cost estimates.

Table 3: Standard and reduced discount rate

Period of years	0–30	31–75	76–125	126–200	201–300	301+
Standard rate[24]	3.5%	3.0%	2.5%	2.0%	1.5%	1.0%
Reduced rate (STP=0)	3.0	2.6	2.1	1.7	1.3	0.9

[19] The Green Book, HMT
[20] Valuing the far-off future: discounting and its alternatives, Hepburn, Cameron, 2006
[21] Social Time Preference, Journal of population economics 13:639-645, Marini, Giancarlo and Scaramozzino, Pasquale, 2000
[22] The rate of social time preference reflects individuals' preference for consumption now, rather than later. It is comprised of three elements: the assumption of rising income over time; a coefficient representing diminishing marginal utility of money, which reflects the assumption that, as income rises, less utility will be gained from the consumption gained from an extra unit of money - when combined with the first element (rising incomes) this suggests a positive element to the discount rate; and the *pure* rate of social time preference which represents human impatience. It is this latter element that has been set to zero in the sensitivity analysis.
[23] After 300 years, the discounted costs of managing radioactive waste, whether existing, or newly arising, are negligible.
[24] This is the recommended declining rate for project impacts over 30 years, Green Book, HMT

49. The net cost of the recommended option (7C) - geological disposal - using the declining standard discount rate schedule (see table 1 above) is £472m, whereas the cost faced using the reduced rate is £474m over 300 years.

50. The present value cost figures are not that significant as, given the time period and the annual average cost, they are £1.6m in both cases. A significant difference is apparent if undiscounted costs and benefits are used (£18,241m overall cost for storage versus £10,546m overall cost for disposal over three hundred years, in 2008 prices, see Table A1 in Annex 1) and this is, in fact, the cost difference which CoRWM used in its deliberations (although CoRWM decided that the cost factor was not of major importance in deciding between options). The undiscounted costs over the period show that disposal is cheaper than storage, however as the costs of disposal are higher in the early period relative to storage, the discounted cost of disposal is higher than storage.

51. However, the actual cost-benefit balance, even with discounted values, is in practice expected to be more firmly on the benefit side than is shown in this Impact Assessment. This is because ultimate disposal costs need to be added to the storage costs for a more accurate comparison; that is, disposal will ultimately be required provided that no alternative technical solution is developed in the future.

52. In practice, it will be some 250,000 years before the higher activity radioactive wastes in question have decayed to safe levels. Over this timescale, (assuming an operational life of some 100-200 years), any waste store will have to be replaced or refurbished more than 1,000 times after the 300 year cut off period of this assessment, before a lasting and sustainable solution to the higher-activity waste problem is achieved.

Sensitivity analysis of costs

53. A sensitivity analysis has been performed on the costs of each option using the upper and lower limits, where available, as used by CoRWM (see Table 2 above). This analysis provides us with the range of discounted costs that are presented on the front page of this document. Table 4 shows the central estimates and Table 5 shows the upper and lower ranges.

Table 4: Discounted Net Costs and Savings

£m (2008 prices)	Standard Discount	Reduced Discount
Present Value of Net Costs	735	739
Present Value of Net Savings	263	264
Present value and Net Present Value[25]	-472	-474

Table 5: Sensitivity analysis on discounted net costs and savings

£m (2008 prices)	Standard Discount	Reduced Discount
PV of net cost Upper limit	1,936	1,945
PV of net cost Lower limit	201	202
PV of net savings Upper limit	1,018	1,022
PV of net savings Lower limit	41	41
PV and NPV Upper limit	816	820
PV and NPV lower limit	-1,895	-1,904

Assumptions underlying the above sensitivity analysis[26]:

54. Sensitivity tests for the costs of the Policy Option (7c) were suggested by CoRWM. The upper limit is 16% higher than the best estimate; no lower limit was provided.

[25] This is the present value of the additional costs of the recommended option relative to the baseline option 3. It is also the net present value (discounted figure) of the recommended option (option 7c) as there are no monetised benefits

[26] The upper and lower ranges have been worked out from the table of sensitivity costs in the IA: see Table 2.

55. CoRWM's sensitivity tests for Option 3 (the baseline) included an upper limit 26% higher than the best estimate and a lower limit 42% below the best estimate of costs.

56. In this IA we have discounted the additional costs from the higher limit of disposal (option 7c) relative to the lower limit of the baseline costs (option 3) to get an upper limit for our PV and NPV. To get a lower limit we have also separately discounted the additional cost from the central estimate of disposal (option 7c) relative to the higher limit of the baseline costs (option 3).

57. The analysis provides us with a central estimate of NPV of minus £472m, sitting within a range of minus £1,895m and plus £816m over 300 years using the standard Green Book approach to discounting.

Non-monetised benefits

58. CoRWM set out non-monetised benefits of their recommendation for geological disposal (as opposed to long-term storage) in their final report. These benefits were derived by way of a multi-attribute analysis approach involving the use of panels of UK and international experts as well as members of the public (see annex III for MCDA process). The relative benefits were compared between the various options under consideration. The benefits relate to reduction in risk and uncertainty. In summary these benefits were stated to be:

- '*…..most members considered that there is a case for implementing some form of geological disposal as soon as practicable because this would reduce the burdens handed on to future generations. These burdens included the need for refurbishing stores and repackaging the waste as both deteriorate with time'.*

- *'…..vulnerability of storage to external risks means that containment could not be guaranteed ….the primary intention of geological disposal is to provide geological isolation on timescales sufficient to exploit radioactive decay'.*

- *' ….. it was difficult to argue that institutional control* [meaning the continued and unchanging presence of national infrastructures and regulatory bodies which are capable of managing radioactive wastes] *could definitely be maintained, even over periods measured in decades, and that both storage and phased geological disposal depended on institutional control being maintained'.*

- *'Research into longer life stores is ongoing but there was general doubt about stores having a lifetime beyond 300 years due to concerns including potential loss of institutional control* [in this case meaning the availability of industrial and technological capacity long into the future]*'.*

- *'There was a firm view from the regulators that* (waste) *package lifetimes* [meaning the time period over which waste packages – containers – can maintain their integrity without deteriorating to the point where the contents will escape into the environment] *are currently about 150 years, and that further research and development would be required if there was a need to extend this'.*

59. To the above can be added a more general and summary view regarding non-monetised benefits of geological disposal, inferred from CoRWM's report and strongly supported by Government. Geological disposal represents a one-off and permanent solution to the problem, whereas long-term and indefinite storage does not. After a period of decades of storage, it is incumbent on the present generation to solve this issue on a permanent basis. CoRWM itself summarised the non-monetised benefits in support of its recommendation as follows:

    - *'A large majority of CoRWM members have sufficient confidence in the long-term safety of geological disposal, and its ability to reduce the burden on future generations, to recommend it as the preferred end-point. This view took into account various factors, including specialist judgements during Multi-Criteria Decision Analysis, the strong consensus that exists in the earth sciences community, and estimates of public exposure to radiation in the far future after repository closure. Most members considered that the risks from geological disposal were substantially smaller than those from long-term storage, which they considered to be vulnerable to terrorist actions, war, loss of institutional control, and severe environmental change'.*

Cost-benefit balance – conclusions

60. Using the discounted values for long-term storage and permanent geological disposal, in monetary terms, this Impact Assessment shows that the additional cost of the recommended option (7c – geological disposal) relative to the baseline is £**472m-£474m**. However the non-monetised benefits far outweigh this cost. In summary, the main non-monetised benefits are:

- Public Safety – reduction in radiation and non-radiation effects over all time.
- Security - reduced vulnerability of waste to terrorist and other attack and prevention of misappropriation of hazardous materials.
- Reduction in the non-monetary burden on future generations – managerial effort; exposure of a workforce to radiation; environmental impacts.

61. Option 7c performs better than the other options when considering Table 2 (undiscounted costs of each option) and the MCDA. The directly comparable options (options covering all recognised waste streams) that have lower undiscounted costs than Option 7c perform significantly worse in the MCDA (see Charts 1 and 2). Option 9c, which performs slightly better than Option 7c in the MCDA, but not in the Severe Sensitivity Test, is very similar, but has higher discounted costs over the 300 year period (Table 2).

62. In addition it is worth noting that the annual discounted costs of the recommended option over 300 years is about £1.6m; this is a relatively small price to pay for assurance of greater public safety, security and a reduction of the burdens on future generations.

63. However it is worth reiterating that the MCDA approach is not intended to provide the 'right' answer, owing to the considerable uncertainty of analysing the different options over such a long time frame (300 years). The MCDA helped to aid CoRWM's final recommendations, along with widespread public, and expert community engagement.

Government's position on the CoRWM recommendations

64. Government accepted the majority of CoRWM's views and recommendations, using them as the basis for this White Paper after careful consideration and a further Government-sponsored consultation on the geological disposal facility implementation process.

Review

65. The process described in the White paper will be subject to on-going review by the implementing organisation (NDA) and by Government. These reviews, particularly by the NDA, are expected to contribute towards reductions in cost uncertainties, as the project moves into its cost-engineering stage. It is also expected that the non-monetised benefits described in this Impact Assessment will, in part, be evaluated and, where possible, monetary values researched and published.

66. An independent oversight will be provided by CoRWM, whose terms of reference require the publication of a publicly available annual report.

Additional notes

(1) Scotland is not included in these provisions. The Welsh Assembly has currently reserved its position.

(2) NDA is the *implementing* organisation, not strictly the *enforcing* organisation. The costs presented in this Impact Assessment are the overall costs to Government, as the direct provider of funds to the NDA.

(3) Regulatory costs are included in the costs set out in the Impact Assessment, and represent approximately 1-2% of the costs shown in annex I table A1. Regulatory costs will be recovered from the NDA.

Specific Impact Tests: Checklist

Use the table below to demonstrate how broadly you have considered the potential impacts of your policy options.

Ensure that the results of any tests that impact on the cost-benefit analysis are contained within the main evidence base; other results may be annexed.

Type of testing undertaken	*Results in Evidence Base?*	*Results annexed?*
Competition Assessment	No	Yes
Small Firms Impact Test	No	Yes
Legal Aid	No	Yes
Sustainable Development	No	Yes
Carbon Assessment	No	Yes
Other Environment	No	Yes
Health Impact Assessment	No	Yes
Race Equality	No	Yes
Disability Equality	No	Yes
Gender Equality	No	Yes
Human Rights	No	Yes
Rural Proofing	No	Yes

Annexes

Annex I: Cost tables

The costs in the table below are taken from 'Galson Sciences Ltd. CoRWM criteria discussion paper: cost. 2005'. CoRWM calculated costs for option 3 and the recommended option 7c. The costs for disposal are not additional cost relative to the baseline but the overall cost of disposal.

Table A1: Breakdown of overall costs of baseline and recommended option[27]

Option 3 (Baseline)			**Option 7c Recommended option**		
Cost for	**Total** (2005 cash values, £m)	Adjusted to 2008 prices[28], £m	**Cost for**	**Total** (2003 cash values, £m)	Adjusted to 2008 prices, £m
Development [*Covers application, consultation, planning (£152M),R&D (£76M), regulation (£722M)]*	950	1,008	Development [*Covers site characterisation (£1050) and MWRS consultation (£50M). Excludes £700M spent to-date.*]	1,100	1,225
Design/construction [*Design for one store of each type at each site only/*	4,105	4,355	Design/construction [*Only construction to first waste emplacement included. Also covers underground research and interim storage.*]	3,705	4,126
Operation *[Filling and storing. Refurbishment. Includes £6,200M for Security]*	10,530	11,171	Operation [*Includes construction after first waste emplacement and transport of waste to the facility (£710M).*]	4,310	4,800
Closure [*Emptying and decommissioning]*	1,610	1,708	Decommissioning and completion (closure) [*Includes institutional control*	355	395

[27] Estimates taken from '*Galson Sciences Ltd. CoRWM criteria discussion paper: cost. 2005'*

[28] Adjusted using outturn data; the latest national accounts figures from ONS - Last updated 28 March 2008

			and monitoring (£25M)]		
Total	**17,195**	18,241	Total	**9,470**	10,546

Tables A2 and A3 show how costs in Table A1 are spread through time.[29]

Table A2

Option 3: Interim Stores, Above Ground, At Location, Protected	
	Dates
Development	2005 – 2040
Design and Construction	2005 – 2125
Operation	2005 – 2295
Decommissioning and Completion	2295 – 2305

Table A3

Option 7: Deep Geological Disposal (All Wastes)	
	Dates
Development	2005 – 2020
Design and Initial Construction	2020 – 2040
Operation	2040 – 2105
Decommissioning and completion (closure)	2105 – 2205

[29] Tables taken from: '*Galson Sciences Ltd. CoRWM criteria discussion paper: cost. 2005*'

These costs presented in two tables are based on the assumptions set out in paragraph 31 of the Evidence Base and the uncertainties in paragraph 32.

How we got from Table A1 to Table A4 and the NPV

The costs of Option 3 (the adjusted figures) and Option 7c (the adjusted figures in Table A1 above) have been subtracted against each other to get net values. Positive figures that is years were the costs of Option 7c outweigh the cost of Option 3 are additional cost (or net cost in Table A4 below). Negative figures were periods were costs of Option 3 were higher than the costs of option 7c these are listed as net savings in Table A4 below. These net figures were then discounted to get the net present value see Table A4 below.

Table A4: Breakdown of net figures the recommended option 7c relative to the baseline 3[30]

£m (2008 prices), central estimates	Standard Discount	Reduced Discount
Present Value of Net Costs	735	739
Present Value of Net Savings	263	264
Present value and Net Present Value[31]	-472	-474

Explanation of table A4

The cost presented in the Table A4 above looked at the overall costs of the baseline (option 3) and the overall costs of the recommended option (7c) see Table A1 above. For the purposes of this Impact Assessment we have subtracted the costs of recommended option against the baseline annually over 300 years to work out the additional cost of the recommended option relative to the baseline (the net figure). Table A4 above presents these net figures.

The net figures (non-discounted) have then been discounted over a period of 300 years, which results in the discounted costs of the recommended option as using the declining standard discount rate schedule (see Table A1 above) is £472m whereas the cost faced using the reduced rate is £474m over 300 years presented in the summary and evidence front sheet.

[30] The figures of this table are derived from the costs of Table A1

[31] This is the present value of the additional costs of the recommended option relative to the baseline option 3. It is also the net present value (discounted figure) of the recommended option (option 7c) as there are no monetised benefits

Annex II: Outcome of Impact Tests not referred to in the Evidence Base

Competition Assessment

The proposal introduces no competition issues; normal competition rules will be applied by NDA in buying goods and services from its supply chain, as is the case with all other NDA purchasing activity.

Small Firms Impact Test

The proposal does not introduce any costs for small firms. Small firms are expected to be part of the supply chain for developing a geological disposal facility and this should benefit from the proposal.

Legal Aid

The Proposal does not create new criminal sanctions or civil penalties.

Sustainable development

CoRWM's Guiding Principle 4 explicitly embraced 'the natural, as well as the human, environment' in its aim for sustainable development. This was actively pursued in all aspects of the Committee's work and reflected the values which the Committee believed were integral to the development of a successful waste management policy. In particular the values of equity (fairness) and sustainability played a vital role in the assessment and recommendation of waste management options.

When considered over all time, long-term storage was not regarded as a sustainable and permanent solution to the problem. Most CoRWM members considered that starting to implement some form of geological disposal as soon as practicable would reduce the burdens handed on to future generations. In the case of indefinite storage these burdens included the need for refurbishing stores and repackaging the waste as both deteriorate with time.

Carbon Impact Assessment

The Proposal could have an effect on carbon emissions. The proposal relates to the management of legacy radioactive wastes. If the proposed facility is also used for the disposal of spent nuclear fuel or reprocessed waste arising from a new generation of nuclear reactors, the availability of the facility will make nuclear generation more attractive, with consequent reduction in the carbon discharges per kilowatt of energy produced. However, this should not be taken into account in this Impact Assessment, but rather in the Impact Assessment associated with Government policy on new nuclear power generation.

Other Environmental Issues

CoRWM considered all relevant environmental issues in its options' analysis – see the section in the Evidence Base relating to options' assessment and options' assessment criteria. These included:

- Impact of radiation on ecosystems
- Impact of chemical pollution on ecosystems
- Impact of physical disturbance (noise, vibration, light pollution and earthworkings) on ecosystems
- Use of natural resources

In general, these environmental challenges are expected to be lower, when considered over all time, for permanent disposal than for long-term storage.

Health Impact Assessment

CoRWM considered health impacts, and in particular those impacts arising from radiation, in its options' analysis – see the section in the Evidence Base relating to options' assessment and options' assessment criteria. These impacts included:

- Public exposure to radiation over first 300 years.
- Public exposure to radiation beyond 300 years.
- Number of deaths or serious accidents to members of the public
- Protection of workforce from exposure to radiation
- Protection of workforce from death, industrial accidents, occupational diseases and serious injuries
- Noise impacts

In general, these health risks are expected to be lower, when considered over all time, for permanent disposal than for long-term storage.

Race /Disability/Gender

There are no limitations on meeting the requirements of the Proposal on the grounds of race, disability or gender. The Proposal does not impose any restriction or involve any requirement for a person of a particular racial background, disability or gender. Conditions apply equally to all individuals and businesses involved in the activities covered by the proposal.

Human Rights

The Proposal is consistent with the Human Rights Act 1998.

Rural Proofing

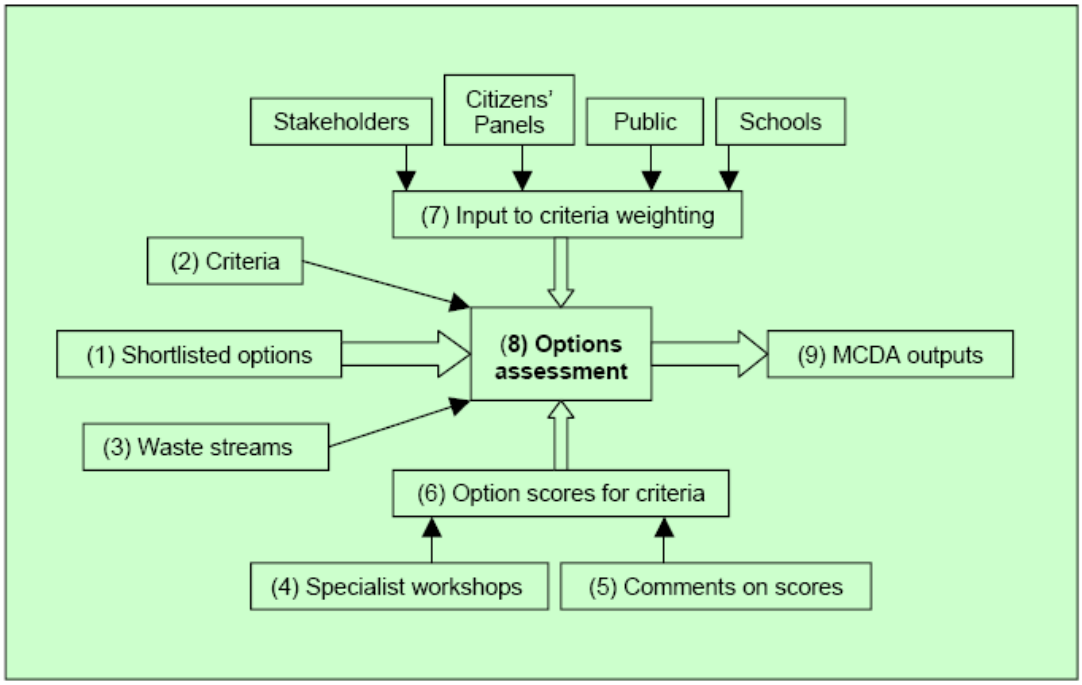
The location of any geological disposal facility has not yet been established, but the proposed facility could be located in a rural area. Normal planning procedures will apply.

By the time any application for a geological disposal facility is made, a new planning system is likely to be in place, implementing proposals in the May 2007 Planning White Paper, “Planning for a Sustainable Future”. Whilst not having yet taken a final decision, Government is currently inclined to look towards applying the new planning system for the geological disposal facility. Government considers that it is likely to be regarded as a nationally significant infrastructure project and believes that the new arrangements could assist the delivery of agreements with local communities.

At each stage of the process increasingly detailed assessments will be made of potential sites. Criteria derived from various sources, including from requirements under Strategic Environmental Assessment (SEA), Sustainability Appraisal (SA) and Environmental Impact Assessment (EIA) will take into account the appropriate rural proofing measures. The NDA are developing proposals for the site assessment methodology and this is available on the NDA website at www.nda.gov.uk/strategy/waste/geological-disposal.cfm.

Annex III – Multi-Criteria Decision Analysis

Overview of the multi-criteria decision analysis (MCDA) assessment process run by CoRWM[32]



This shows CoRWM's MCDA process in more detail. It involved assessing the shortlisted options (1) against a set of criteria (2) identified as being important through engagement with stakeholders and the public. This assessment was done initially for HLW and then for each of the other waste streams (3) by considering what changes in the assessment might arise from the characteristics of that waste. The scoring (quantified performance assessment) of the options against the criteria was carried out by specialists with appropriate expertise and knowledge (4) and there was an opportunity to comment on those scores (5). The scores were fed into the Hiview model, a software programme that was being used for the MCDA assessment (6). The relative importance of the criteria used to assess the options is a value-laden judgement. While CoRWM made the final judgement on the weight that should be given to each criterion, a wide selection of stakeholders and members of the public provided input that was taken into account (7). CoRWM undertook the options assessment in public (8), producing baseline models for each waste stream, and exploring the implications of varying option scores and criteria weights in sensitivity testing. The outputs of the MCDA (9) were analysed and discussed, providing a good understanding of how each of the options was expected to perform, and where the strengths and weaknesses of each lay.[33]

MCDA weighting criteria

Headline Criterion	Sub-Criterion	Extent to which the option is expected to …
1 Public Safety, the first 300 years Individual – short term (up to 300 years)	1 Radiation	protect individual members of the public from exposure to radiation during the first 300 years
	2 Non-radiation	minimise the numbers of deaths and serious accidents by the public (attributable to its construction and operation)
2 Public Safety, Individual – long term (longer than 300 years)	3 Radiation	protect individual members of the public from exposure to radiation beyond 300 years
3 Worker Safety	4 Radiation	protect workers involved in its operation from exposure to radiation
	5 Non-radiation	minimise deaths, industrial and occupational

[32] Figure taken from CoRWM report
[33] Ibid

Headline Criterion	Sub-Criterion	Extent to which the option is expected to …
		diseases and serious injuries as a consequence of its construction and operation
4 Security	6 Misappropriation	prevent unauthorised removal of hazardous material
	7 Vulnerability to terrorist and other attack— preemplacement of waste	withstand reasonably foreseeable malicious and purposeful attacks, taking into account transport and emplacement timescales
	8 Vulnerability to terrorist and other attack—post emplacement of waste	withstand reasonably foreseeable malicious and purposeful attacks
5 Environment	9a Radiological pollution <300 years	minimise radioactive releases that could have harmful effects on ecosystems, flora and fauna, and/or the built environment over a timescale less than 300 years.
	9b Radiological pollution >300 years	minimise radioactive releases that could have harmful effects on ecosystems, flora and fauna, and/or the built environment over a timescale beyond 300 years.
	10 Chemical pollution	minimise chemical releases that could have harmful effects on ecosystems, flora and fauna, and/or the built environment over the timescale of interest.
	11 Physical disturbance	minimise the effects of noise, vibration, light pollution and earthworkings on ecosystems, flora and fauna during construction, operation and post-operation
	12 Use of natural resources	minimise the use of natural resources, including energy, construction materials, packaging materials and water;. also consider change of land use and indirect impacts
6 Socio-Economic	13 Employment	employ people over the option's lifetime
	14 Spin-off	create, in addition to direct employment, significant spin-off opportunities: e.g. jobs, skills, knowledge in both technology and business, and investment
7 Amenity	15 Visual	create a visual impact
	16 Noise	create a noise impact at the boundary of the site for a single instance of the option
	17 Transport	create a transportational impact outside the site boundary for a single instance of the option
	18 Land take	create an impact at a single site on a single individual through surface land take
8 Burden on Future Generations	19 Cost	reduce the financial liability (whole life costs) imposed on future generations
	20 Effort	reduce managerial effort for all aspects of implementation imposed on future generations, including the pre-operational phase
	21 Worker Dose	reduce exposure of the workforce imposed on future generations
	22 Environmental impact	reduce the environmental burden imposed on future generations, taking into account

Headline Criterion	Sub-Criterion	Extent to which the option is expected to …
		pollution, physical disturbance, use of natural resources, visual impact, noise, transport and surface land take
9 Implementability	23 Technical	employ currently established, tested and proven technical methods for the design, construction and operation of the option, including decommissioning, if irrelevant
	24 Regulatory requirements	be fully consistent with international, EU and national law and regulatory requirements
10 Flexibility	25 Flexibility	allow for future choice and respond to unforeseen or changed circumstances over the 300 years
11 Costs	26 Costs	minimise total costs of the final management of wastes, taking into consideration: • development • implementation • operation • closure • monitoring

Explanation of MCDA weightings[34]

For each set of sub-criteria under a headline criterion, the one criterion showing the largest swing in value from point 1 to point 9 on the scale was assigned a weight of 100. Then a judgement was made on the remaining sub-criteria weights under that headline criterion as proportions to 100 that represented the magnitudes of their swings compared to the swing of 100.

At the end of this task, one criterion under each headline criterion was assigned a weight of 100, but from one headline criterion to the next, those sub-criteria aren't necessarily of equal relative importance, so the next step was required.

The 10 sub-criterion scales, each weighted 100, are to be compared, since one 100 may represent a larger or smaller value swing than another 100. This process was be carried out by making paired comparisons, so that only two scales at a time were compared. [35]

[34] Taken from: CoRWM Document Number: 1666: Completing and exploring the MCDA models, 28-30 March 2006, Catalyze

[35] CoRWM Document Number: 1666: Completing and exploring the MCDA models, 28-30 March 2006, Catalyze