WASTE STREAM	9A73	Contaminated Gravel

SITE Berkeley

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Nuclear Restoration Services Ltd (NRS)

WASTE TYPE ILW

WASTE VOLUMES

	Reported (m^3)
At 1.4.2025	= 47.0
Future arisings:	
Total future arisings:	**0.0**
Total waste volume:	**47.0**

OR

Conditioned (m^3)	Packaged (m^3)

Number of waste packages in stock: At 1.4.2025…… - packages

Comment on arising rates: -

Additional information on quantities: Gravel will be removed from the vault when the wastes accumulated in the vault are retrieved. There will be no further arisings of this waste.

Uncertainty factors on volumes:

Stock (upper):	x 1.20	Arisings (upper):	x -
Stock (lower):	x 0.80	Arisings (lower):	x -

WASTE SOURCE Contaminated gravel (stone chippings) on the floor of the vault. The gravel was applied before any waste was discharged to the facility.

PHYSICAL CHARACTERISTICS

General description: The waste comprises the gravel that was placed at the bottom of the vault, along with the associated sludge type material. This material, known as the amalgam, consists of the waste materials which have dropped in from the waste above during the history of filling the vaults, and which will also fall in during the waste retrieval phase. The gravel will therefore contain graphite chunks, springs, dusts, ion exchange material, Magnox sludge, made up of magnesium carbonate and magnesium hydroxide, and mild steel corrosion products, from the waste containers and Miscellaneous Contaminated Items streams. The gravel is coarse in nature, typically 50mm in diameter, but of unknown chemical composition. It may be either silica or limestone based material. There is a range in the volume of the vaults amalgam due to the uncertainties in how much each waste item will contribute to the amalgam. There are no large items that may require special handling.

Changes since waste generated: -

Bulk density (t/m^3): ~ 1.5

Comment on density: The gravel is coarse in nature (typically 50mm across) and is assumed to be either limestone or silica based.

CHEMICAL COMPOSITION

General description and components (%wt): The chemical composition of the gravel chippings is not known, although it is likely to be either silica or limestone based material. Magnesium carbonate and magnesium hydroxide will be present, along with phenol formaldehyde and alumino-silicate ion exchange materials. Fission products, actinides and other activation products will be present as contaminants.

Chemical state: Alkali

Sheet metal proportion / thickness: Metals will be present as corrosion products or as small item contamination so metal thicknesses are expected to be typically 1 or 2 mm.

Metals and alloys (%wt):

	(%wt)	Type(s) / Grades(s) with proportions	% of total C14 activity
Stainless steel	NE	-	
Other ferrous metals	NE	Only trace metallic content would be expected to be associated with the original gravel, but there may be contamination from the wastes resting on the gravel.	
Iron		-	
Aluminium	= 0	-	
Beryllium	TR	-	
Cobalt		-	
Copper	= 0	-	
Lead	= 0	-	
Magnox/Magnesium	NE	-	
Nickel	NE	Nimonic.	
Titanium		-	
Uranium		-	
Zinc	= 0	-	
Zircaloy/Zirconium	NE	-	
Other metals	= 0	No "other" metals present.	

Organics (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics	= 0	-	
Paper, cotton	= 0	-	
Wood	= 0	-	
Halogenated plastics	= 0	-	
Total non-halogenated plastics	= 0	-	
Condensation polymers	= 0	-	
Others	= 0	-	
Organic ion exchange materials	NE	-	
Total rubber	= 0	-	
Halogenated rubber	= 0	-	
Non-halogenated rubber	= 0	-	
Hydrocarbons		-	
Oil or grease		-	
Fuel		-	
Asphalt/Tarmac (cont.coal tar)		-	
Asphalt/Tarmac (no coal tar)		-	
Bitumen		-	
Others		-	
Other organics	NE	-	

Other materials (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials	NE	-	
Inorganic sludges and flocs	= 0	-	
Soil	= 0	-	
Brick/Stone/Rubble	~ 100.0	-	
Cementitious material	= 0	-	
Sand		-	
Glass/Ceramics	= 0	-	
Graphite	NE	-	
Desiccants/Catalysts		-	
Asbestos	= 0	-	
Non/low friable		-	
Moderately friable		-	
Highly friable		-	
Free aqueous liquids	NE	-	
Free non-aqueous liquids	NE	-	
Powder/Ash	NE	-	

COMPONENTS OF MATERIALS, WASTE PROPERTIES, MATERIALS NOT CONTRIBUTING TO MASS

Inorganic anions (%wt):

	(%wt)	Type(s) and comment
Fluoride	NE	-
Chloride	NE	-
Iodide	NE	-
Cyanide	= 0	-
Carbonate	NE	-
Nitrate	NE	-
Nitrite	NE	-
Phosphate	NE	-
Sulphate	NE	-
Sulphide	NE	-

Materials of interest for waste acceptance criteria:

	(%wt)	Type(s) and comment
Combustible metals	NE	-
Low flash point liquids	= 0	-
Explosive materials	= 0	-
Phosphorus	= 0	-
Hydrides	= 0	-
Biological etc. materials	= 0	-
Biodegradable materials	0	-
Putrescible wastes	= 0	-
Non-putrescible wastes		-
Corrosive materials	= 0	-
Pyrophoric materials	= 0	-
Generating toxic gases	= 0	-
Reacting with water	NE	-
Higher activity particles		-
Soluble solids as bulk chemical compounds		-

Hazardous substances / non hazardous pollutants: -

	(%wt)	Type(s) and comment
Acrylamide		-
Benzene		-
Chlorinated solvents		-
Formaldehyde		-
Organometallics		-
Phenol		-
Styrene		-
Tri-butyl phosphate		-
Other organophosphates		-
Vinyl chloride		-
Arsenic		-
Barium		-
Boron	0	-
Boron (in Boral)		-
Boron (non-Boral)		-
Cadmium		-
Caesium		-
Selenium		-
Chromium		-
Molybdenum		-
Thallium		-
Tin		-
Vanadium		-
Mercury compounds		-
Others		-

Complexing agents (%wt): Yes

	(%wt)	Type(s) and comment
EDTA		-
DPTA		-
NTA		-
Polycarboxylic acids		-
Other organic complexants		-
Total complexing agents	TR	-

Physical components:

	Number	Type(s) and comment
Sources		-
Electronic & Electrical Equipment (EEE)		-
EEE Type 1		-
EEE Type 2		-
EEE Type 3		-
EEE Type 4		-
EEE Type 5		-

TREATMENT, PACKAGING AND DISPOSAL

Planned on-site / off-site treatment(s):

Treatment	On-site / Off-site	Stream volume %
Size reduction Decay storage Low force compaction Supercompaction (HFC) Incineration Drying/dewatering/liquid separation Tie down/fixatives/strippable coating/painting application Decontamination Metal treatment Recycling / reuse Thermal treatment, including vitrification Encapsulation Polymer encapsulation Other physical treatment Other chemical treatment Containerisation Treatment not yet determined None	On-site	100.0

Comments on planned treatments: -

Conditioning method: This stream will be packaged in 6m3 CB ND, the remainder of vault 1 waste will be co-packaged together in Concrete boxes (9A61, 9A62, 9A67, 9A32, 9A40, 9A48, 9A53) and Type VI DCIC containers (9A25, 9A31, 9A39, 9A47, 9A52, 9A60 and 9A66). Packages for vault 1 are assigned to 9A25, 9A32 & 9A73.

Conditioning plants:

Plant Name	Location
BRK MILWEP	Berkeley

Likely conditioning matrix: Unknown

Further information on the conditioning matrix: -

Waste Packaging:

Likely container type:

Container	Waste packaged (vol%)	Waste loading (m^3)	Payload (m^3)	Number of packages	Estimated start date for packaging
6 m^3 concrete box (SD)	100.0	3.7	5.8	13	-

Range in container waste loading: -

Other information on packaging and conditioning: -

Conditioned density (t/m^3): -
Conditioned density comment: -

Management Routes:

Disposal Route	Stream volume %	Raw density t/m^3	Start date
Expected to be consigned to a Near Site, Near Surface Disposal Facility (Scotland) Expected to be Non-NSD HAW managed under Scottish Government's policy Expected to be disposed to LLW Vaults NRS Dounreay Expected to be consigned to the Geological Disposal Facility Expected to be consigned to a Near Surface Disposal Facility Expected to be consigned to the LLW Repository Expected to be consigned to a Landfill Facility Expected to be disposed On-Site Expected to be managed by In-Situ Disposal Expected to be consigned to an Incineration Facility Expected to be consigned to a Metal Treatment Facility Expected to be Out of Scope Expected to be recycled / reused Disposal route not known	100.0		

Classification codes for waste expected to be consigned to a landfill facility:

Opportunities for alternative disposal routing: No

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Opportunity Confidence	Comment
-	-	-	-	-

RADIOACTIVITY

Source: Contamination may have been transferred to the chippings via direct contact with waste materials. The ability of the chippings to absorb soluble active materials depends on the chemical composition of the chippings themselves.

Uncertainty: The waste is assumed to be ILW. This can be confirmed only when the waste is retrieved. The gravel is not expected to be washed to reduce activity.

Measurement of radioactivities: The activity has been derived from the activities of the wastes contained in the vault.

Chemical form of radionuclides:

H-3: Any tritium is expected to be present as water but some may be in the form of other inorganic compounds or as organic compounds.
C-14: Chemical form of carbon 14 has not been determined but may be graphite.
Cl-36: The chemical form of chlorine 36 in these wastes is not known.
Se-79: The selenium content is insignificant.
Tc-99: The technetium content is insignificant.
I-129: -
Ra: Radium isotope content is expected to be insignificant.
Th: The thorium isotope content is insignificant.
U: Chemical form of U isotopes has not been determined but may be oxides.
Np: The neptunium content is insignificant.
Pu: Chemical form of plutonium isotopes has not been determined but may be plutonium oxides.

WASTE STREAM **9A73** **Contaminated Gravel**

Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2025	Bands and Code	Future Arisings	Bands and Code	Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2025	Bands and Code	Future Arisings	Bands and Code
H 3	1.46E-03	D D 2			Gd 153		8		
Be 10	4.00E-09	D D 2			Ho 163		8		
C 14	2.00E-04	D D 2			Ho 166m		8		
Na 22		8			Tm 170		8		
Al 26		8			Tm 171		8		
Cl 36	8.00E-06	D D 2			Lu 174		8		
Ar 39		8			Lu 176		8		
Ar 42		8			Hf 178n		8		
K 40		8			Hf 182		8		
Ca 41	2.00E-06	D D 2			Pt 193		8		
Mn 53		8			Tl 204		8		
Mn 54		8			Pb 205		8		
Fe 55	9.22E-07	D D 2			Pb 210		8		
Co 60	9.38E-05	D D 2			Bi 208		8		
Ni 59	3.00E-04	D D 2			Bi 210m		8		
Ni 63	2.65E-02	D D 2			Po 210		8		
Zn 65		8			Ra 223		8		
Se 79	1.21E-09	D D 2			Ra 225		8		
Kr 81		8			Ra 226		8		
Kr 85		8			Ra 228		8		
Rb 87		8			Ac 227		8		
Sr 90	4.55E-04	D D 2			Th 227		8		
Zr 93	5.00E-06	D D 2			Th 228		8		
Nb 91		8			Th 229		8		
Nb 92		8			Th 230		8		
Nb 93m	9.79E-05	D D 2			Th 232		8		
Nb 94	1.00E-06	D D 2			Th 234	7.00E-07	D D 2		
Mo 93	6.99E-06	D D 2			Pa 231		8		
Tc 97		8			Pa 233	4.19E-08	D D 2		
Tc 99	2.00E-06	D D 2			U 232		8		
Ru 106		8			U 233		8		
Pd 107		8			U 234	6.05E-07	D D 2		
Ag 108m	1.94E-06	D D 2			U 235	2.00E-08	D D 2		
Ag 110m		8			U 236	5.01E-08	D D 2		
Cd 109		8			U 238	7.00E-07	D D 2		
Cd 113m		8			Np 237	4.19E-08	D D 2		
Sn 119m		8			Pu 236		8		
Sn 121m	2.38E-05	D D 2			Pu 238	6.94E-05	D D 2		
Sn 123		8			Pu 239	2.00E-04	D D 2		
Sn 126	4.35E-09	D D 2			Pu 240	2.00E-04	D D 2		
Sb 125		8			Pu 241	1.27E-03	D D 2		
Sb 126		8			Pu 242	6.00E-08	D D 2		
Te 125m		8			Am 241	3.49E-04	D D 2		
Te 127m		8			Am 242m	3.66E-07	D D 2		
I 129		8			Am 243	7.99E-08	D D 2		
Cs 134		8			Cm 242	3.02E-07	D D 2		
Cs 135	7.00E-08	D D 2			Cm 243	3.96E-08	D D 2		
Cs 137	4.62E-03	D D 2			Cm 244	2.01E-07	D D 2		
Ba 133		8			Cm 245		8		
La 137		8			Cm 246		8		
La 138		8			Cm 248		8		
Ce 144		8			Cf 249		8		
Pm 145		8			Cf 250		8		
Pm 147	4.28E-09	D D 2			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151	2.60E-05	D D 2			Unsp a				
Eu 152	1.19E-03	D D 2			Unsp b/g				
Eu 154	4.67E-04	D D 2			**Total a**	**8.20E-04**	*	**0**	*
Eu 155	1.55E-06	D D 2			**Total b/g**	**3.67E-02**	*	**0**	*

Bands (Upper and Lower)
A a factor of 1.5
B a factor of 3
C a factor of 10
D a factor of 100
E a factor of 1000

Note: Bands quantify uncertainty in the mean radioactivity.

Code
1 Measured activity
2 Derived activity (best estimate)
3 Derived activity (upper limit)
4 Not present
5 Present but not significant
6 Likely to be present but not assessed
7 Present in significant quantities but not determined
8 Not expected to be present in significant quantity
* Total calculated from the 114 declared radionuclides