Nuclear Decommissioning Authority

Dounreay Site Restoration Ltd

DSG(2013)C025

# Strategic Environmental Assessment

## Site Specific Baseline

### Dounreay

**March 2013**

An Environmental and Sustainability Report was published by the NDA as part of the Strategic Environmental Assessment (SEA) of the NDA Strategy. It was produced in compliance with the SEA Directive (2001/42/EC) and transposing regulations (S.I.1633, 2004).

The following pages contain specific baseline information for the Dounreay site, and a map of the local area. This information was used in the preparation of the Environmental and Sustainability Report and regularly updated information will be used as part of monitoring measures to identify trends in potential environmental impacts. A short introduction is followed by a table containing the current baseline information, organised by sustainability headings. The final section includes information about future developments and environmental issues.

The NDA and DSRL are committed to sharing information and making it accessible to all. In making this non-confidential environmental and sustainability information available we believe that it will provide a useful ongoing resource to the general public and stakeholders.

# Site Specific Baseline for Dounreay

## Dounreay

The Dounreay nuclear facility is located in Caithness and covers an area of 54 hectares. Construction of the site began in 1955, and all reactor and processing operations ceased in 2006. The site is currently undergoing decommissioning with an interim end state (IES) date of 2022-2025. The programme involves the removal of major hazards and construction of new waste treatment facilities. The programme also involves the coordinated removal of the majority of the buildings, conditioning of wastes for on-site interim storage and the planned disposal of Low Level Waste (LLW) in a new off-site facility. Interim storage of conditioned Intermediate Level Waste (ILW) will continue indefinitely until other arrangements are made, in line with published Scottish Government strategy which requires near site, near surface management. Contingency arrangements for greater than 100 years of storage are being made. The site may be released from its nuclear site licence by 2333, subject to the storage strategy developing further.

### Site End State Assumption

The preferred end state for the Dounreay facility is for the site to be restored to a point when the site would be de-licensed by 2333, the Final End Point. All work to restore the site will be completed by the IES. Some residual contamination, redundant site infrastructure, and foundations will be left in-situ unless there is an over-riding safety or regulatory requirement.

### Current Environmental Baseline

**Table 2: Baseline Data across all topics for Dounreay**

| SEA Objective | Key Environmental Baseline | Source |
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| **Air Quality** | Previous studies have shown that baseline levels of a number of key (non-radioactive) pollutants such as benzene; 1,3-butadiene; carbon monoxide; nitrogen dioxide; and particulates ($PM_{10}$) are comfortably below the relevant UK air quality strategy objectives.<br><br>SEPA has granted DSRL an authorisation under the Radioactive Substances Act 1993 (as amended). Dounreay discharges gaseous radioactive wastes to the atmosphere via numerous stacks that are grouped into six geographical groupings. As part of this authorisation, SEPA has placed rolling 12-month limits on the activity that can be discharged according to the radionuclide or group of radionuclides in the discharge.<br><br>Alpha, beta and tritium discharges are very small fractions (single | Prepared for UKAEA by Atkins (2004) *Dounreay Site Wide Environmental Statement (SWES) Air Quality Baseline Report.*<br><br>DSRL (2012) *The December 2012 Monthly Report of Discharges in Compliance with the RSA Authorisations Assurance/RSA/Dec12* |

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| | figure percentages) of the corresponding authorised discharge limits. For the rolling 12-months to the end of December 2012, the highest alpha, beta and tritium aerial discharges from the site were from the FCA North and South Stacks grouping. | |
| | From September 2012 through February 2013, the operations at Dounreay resulted in the release of 13380 tonnes of $CO_2$ indirectly through the consumption of 16.1 GWh (58 TJ) of electricity and directly with the consumption of both heavy fuel oil (58 TJ) and kerosene (8 TJ). During this period Dounreay consumed a total of 124 TJ of energy.<br><br>The majority of the Dounreay site is located approximately 20m Above Ordnance Datum (AOD). Studies have been conducted to consider rates of coastal erosion, in particular, in relation to the coast line adjacent to the ILW Shaft. Coastline recession rates of around 1-2m in 200 to 300 years have been estimated, taking into account sea level rise. The Shaft will have its waste inventory retrieved prior to IES such that there will be no short-term operational issues associated with coastal erosion over this period. The existing LLW disposal facility will have its waste inventory retrieved unless a case is made that it is safe to remain in situ.<br><br>In the longer term, parts of the site will be more susceptible to sea level rise and coastal erosion over timescales of several hundred to thousands of years, if no additional mitigation measures are applied. In practice, such issues have been considered within the development of site end state options and the development of the new Dounreay LLW disposal facilities, which are currently under construction. | NDA (2005)<br>;<br>Nexia Solutions (2008)<br><br>NDA (2008) |
| | There are no designated conservation sites identified on the site. There are, however, Sites of Special Scientific Interest (SSSIs), Special Areas of Conservation (SACs), Special Protection Areas (SPAs), Ramsar and Ancient Woodland Inventory (AWI) sites in the surrounding area.<br><br>Part of the Sandside Bay SSSI is within land owned by the NDA and leased to a farming tenant. It is notable for its dunes and links habitat and coastal vegetation communities.<br><br>A number of protected species were recorded on, or next to the site, including Otters, (European Protected species under Annex IV of the Habitats Directive) and breeding birds, such as Arctic Tern.<br><br>Species of flora including the Oyster Plant, which is nationally uncommon, are found on the Dounreay beach and the nationally uncommon Scottish Primrose which is confined to Caithness, | UKAEA (2002)<br><br>UKAEA (2006)<br>;<br>Environment Agency<br>Dounreay NLLWF<br><br>SNH (2009) |

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| | Orkney and North Sutherland. *Primula scotica* are protected and found to the east of the Site. Approximately 4,000 primroses were translocated and fenced off to prevent any damage during the construction phase of the new LLW disposal facilities.<br><br>In 2010, an area of approximately 25,000m$^2$ (2.5 hectares) on the Dounreay site was identified for a bee meadow. The north coast of Scotland is home to some of the rarest species of bee in the UK including the Great Yellow Bumblebee and the UK Biodiversity Action Plan priority species, the Moss Carder Bee. The Bumblebee Conservation Trust advised the Site that any land providing foraging in the Dounreay area would add a link to other bee foraging areas around the north coast. Wild flowers were encouraged in the meadow, supplemented by a specific mowing regime that would encourage the bees. A number of bees recorded during 2011 and 2012 included the rare Great Yellow and Moss Carder species. Other recorded species included the White Tailed, Common Carder, Garden, Broken Belted and Cuckoo Bumblebees. Significant positive media coverage of the project has been generated during this time.<br><br>As the bee meadow project was a success, in 2012, it was proposed to create a ground-nesting bird habitat to the west of the existing wildflower meadow.<br><br>A summary of bird species found in the area include Fieldfare; Redwing; Bunting; Snow Bunting; Hen Harrier; Merlin; Whopper Swan and Whimbrel wintering birds (all listed on Schedule 1 of the Wildlife and Countryside Act 1981 and Nature Conservation (Scotland) Act 2004).<br><br>A holistic approach to biodiversity should recognise that biodiversity is more than just the reflection of designated sites. It is an interrelated network of habitats and species, of which designated sites and species are those that are most fragile or rare and require the highest degree of protection. A Dounreay Biodiversity Action Plan 2011-2013 was published in June 2011. The plan will be developed further beyond 2013 in line with the decommissioning programme as the site is restored.<br><br>Some of the 2011-2013 biodiversity actions include:<br><br>• The translocation of Scottish Primrose (*Primula scotica)* plants from within the new LLW disposal facilities construction site. The project will monitor the impact of the translocation and will continue to monitor throughout the project;<br><br>• Providing a bird-friendly cap on Landfill 42 to attract the Common Gull, Arctic Tern and Oyster Catchers to the area. This should detract them from nesting in unsuitable locations | SNH (2009) *Citation for Special Protection Area (SPA) East Caithness Cliffs* [http://www.snh.org.uk/about/directives/eastcaithB433704.pdf] |

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| | on site. Additionally, bird boxes have been placed in the copse area to the South East of the site to encourage nesting and to maximise the diversity of species in that area;<br><br>Continue to manage the bee meadow which was set up as a foraging area for primarily attracting the rare Great Yellow Bumblebee. An initiative was undertaken to prepare and monitor the success of an on-site wildflower meadow, working with the Bumblebee Conservation Trust. The habitat is developing, with more wildflower being encouraged each year.<br><br>The Mill Lade provides a valuable | |
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| | A presentation about Dounreay's heritage work was given at an international heritage conference in Portsmouth organised by the Wessex Institute of Technology. Displays about Dounreay's heritage were set up for the Dounreay family day and Pennyland Primary School's 50th anniversary celebrations. | |
| **Groundwater, Geology and Soils** | Dounreay is underlain by rocks of the Caithness Flagstone Formation. These are predominantly grey siltstones with minor sandstones and limestones. The rocks are indurated (hardened) with very low porosity. Overlying Quaternary deposits are generally greater than 3m thick. No geological features of special importance have been identified. The solid strata and overlying deposits at the Site are typical of the much wider area and as such, there are no scarce or locally restricted deposits of note.<br><br>The Scottish Soil Framework indicates that there are a number of soil types in the area, notably mineral gleys.<br><br>Permeability is generally low and associated with fracturing, although the rocks are capable of yielding small amounts of water to wells (approximately 10 $m^3$ per day). In common with the rest of mainland Scotland, the rocks are designated as a groundwater body in the context of the Water Framework Directive, and a drinking water protected area. The groundwater quality in the area is considered to be generally good, although groundwater towards the coast becomes saline in winter.<br><br>Groundwater in some small areas of the site is known to be impacted by radioactive contamination. Control measures are in place for this and are authorised as necessary by SEPA. Localised contamination of groundwater by industrial solvents is being investigated.<br><br>Ground contaminated with hydrocarbons associated with diesel generator operation as part of the Dounreay Fast Reactor has been recovered, treated and disposed of. Further chemical and radiological contaminant characterisation of the groundwater and soils is ongoing. | UKAEA (2004) *Dounreay Environmental Statement*;<br><br>Scottish Government (2009) *The Scottish Soil Framework*;<br><br>Water Environment (Drinking Water Protected Areas) (Scotland) Order 2007 |
| **Surface Water Resources and Quality** | The Dounreay Burn, also known as the Mill Lade, flows through the site and is considered as being of good quality status in accordance with the Water Framework Directive. The coastal waters around Dounreay are also considered to be of high quality status in relation to the Water Framework Directive. Seawater and sediment samples are collected and analysed, and support this statement.<br><br>Works have been undertaken to divert clean surface water around the site, rather than flowing through the site's combined sewers. | DSRL (2012) *Dounreay Supplementary Environmental Monitoring Programme Data*<br><br>DSRL (2012) *The December 2012 Monthly Report of Discharges in Compliance with the RSA Authorisations Assurance/RSA/Dec12*<br><br>DSRL internal records |

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| | DSRL have been granted Controlled Activities Regulations (CAR) licences for non-radioactive discharges to be made to the North Atlantic Ocean via 6 outfalls at, or very close to, the low water mark. An application has been made to subsume these CAR licences into a single Waste Management Licence. SEPA have also granted an authorisation under the RSA 1993 (as amended) to discharge low level aqueous radioactive wastes to the North Atlantic Ocean from a single discharge point 600 metres off-shore.<br><br>As part of the RSA authorisation, SEPA has placed rolling 12-month limits on the radioactivity levels that can be discharged according to the radionuclides present in the discharge. For the rolling 12-month period to the end of December 2012 the aqueous liquid discharges were all less than 1% of the authorised limits, with the exception of with the exception of Tritium (1.38%) and Strontium-90 (4.30%)..<br><br>The potable and raw water consumption, on Site for the six month period of September 2012 through February 2013 was 117,854m$^3$. | (water consumption). |
| **Waste** | Dounreay is anticipated to generate some 4,500m$^3$ of (in-situ volume) ILW during decommissioning.<br><br>It is anticipated that there will be a total of about 75,000m$^3$ (in-situ volume) of LLW, including liquids, arising from decommissioning and operations.<br><br>DSRL has made a formal application to SEPA for a Waste Management Licence which will regulate the extended D6500 (Aggregates Recycling Facility), recycling activities at DN016, D8525 and DN060. The WML will be CAR compliant and will therefore control the non-radioactive discharges from the 6 outfalls referred to above.<br><br>Approximately 16,000 m$^3$ of soil contaminated by radioactive material requiring disposal as LLW is anticipated to be generated during decommissioning.<br><br>A vertical shaft was built at Dounreay in the 1950s and subsequently used for the disposal of ILW. The Shaft was not used after 1977. The shaft has now been isolated from the groundwater system by grouting the rock. Residual water entering the Shaft is currently being managed through the site's authorised Low Level Liquid Effluent system. The grouting operations have resulted in a 75% reduction in radioactive discharges from the Shaft. | NDA (2008) *Environment Agency Nuclear Sector Plan Data Reporting*;<br><br>NDA (2007) *Dounreay 2006/07 IWS*<br><br>SEPA (2009) [http://gis.sepa.org.uk/rbmp/pdf/150360.pdf];<br><br>DSRL (2010) *SPRI 2010*<br><br>NDA (2013) *Client Specification Dounreay, Revision 3, February 13, 2013* |

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| | Dounreay's inert waste landfill (Landfill 42) was re-profiled and closed with a low permeability cap in 2011. Monitoring is underway with a view to landfill licence surrender. | |
| **Economy, Society and Skills** | In 2010, the population of Caithness was 25,124, representing around 11.4% of the total population of the Highland Council area.<br><br>Caithness is made up of 3 Highland Council Areas: Thurso; Wick and Landward Caithness. In 2010, 61% of the population of Caithness was concentrated in the 2 main towns: Thurso (7672 people) and Wick (7792 people). Approximately 11,100 people were employed in Caithness.<br><br>The Caithness area is well served with schools: 18 primary schools and 2 secondary schools. Higher and further education services are available in the area, primarily through the North Highland College (a partner college of the University of the Highlands and Islands). In 2011, 15.3% of people had degree qualifications in the Caithness area, which is below the average figure for the Highland Council area (19.6%) and Scotland (19.5%). The percentage of people with no qualifications is slightly higher than the local authority area and Scottish figures (36.9% compared with 32.6% and 33.2% respectively). There is major investment in educational facilities (Centre for Energy and Environment; Engineering Skills Centre and a new high school in Wick) and training programmes (STEM and Workforce Transition) in the area.<br><br>There has been major investment in infrastructure, in particular at the 2 ports (Scrabster and Wick) as part of the economic diversification of the area into marine renewables and oil and gas sectors.<br><br>In September 2012 the number of employees at Dounreay was 810 (FTEs) DSRL staff. In February 2012, the 2006 Socio-Economic Impacts of Dounreay Decommissioning Baseline Study was updated. The report estimates the total employment at Dounreay is 1846 FTEs. This represents around 14% of the working population of Caithness and North Sutherland. Resource forecasts and staffing curves were updated to reflect the new lifetime plan and posted on the website in January 2012. It is estimated that £90 million of goods and services are purchased annually. 70% of this expenditure is made with companies within Caithness and North Sutherland. The closure of Dounreay will result in major social and economic challenges for the area.<br><br>The Dounreay Socio Economic Development Plan for 2012 – 2015 was issued on October 11, 2012. The plan details the commitments made by the PBO, SLC and NDA to contribute to | The Highland Council (www.highland.gov.uk)<br><br>DSRL *Dounreay Socio-Economic Development Plan (2009-10)*<br><br>DSRL (2012) *Dounreay Socio-Economic Developmen Plan (2012-2015)*<br><br>Scottish National Statistics (www.sns.gov.uk)<br><br>The Socio-Economic Impacts of Dounreay Decommissioning (February 2012) (www.cnsrp.org.uk) |

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| | the to the Caithness and North Sutherland Regeneration Partnership objectives. This plan was revised in March 2013 and has been submitted to NDA for their approval. | |
| **Traffic and Transport** | Dounreay is served by a dedicated access road running north from the A836, approximately 13 km west of Thurso. The A836 provides the main east-west link along Scotland's north coast, and passes to the south of the Dounreay site.<br><br>According to surveys undertaken in 2004, traffic flows are relatively low with 2,550 vehicles per day (two-way) recorded on the A836 between Dounreay and Thurso, and 1,500 vehicles per day (two-way) on the A836 between Dounreay and Melvich (average annual daily traffic flow data).<br><br>A recent review of the validity of the baseline concluded that traffic flows have not significantly changed from 2004 levels.<br><br>A railway currently runs from Inverness north to Georgemas Junction, where the line splits with branches to Thurso and Wick. | UKAEA (2004) *Dounreay Environmental Statement*<br><br>DSRL (2012)<br><br>*Environment Statement – Shaft and Silo Waste Retrieval Facilities at Dounreay, Vol 2, Chapter 8* |
| **Land Use and Material Assets** | Dounreay is a construction, demolition and waste management site undergoing a major decommissioning and clean-up programme designed to restore the site to an agreed end state. The plan for decommissioning the site anticipates that all redundant buildings will be cleared by the IES, which is predicted to be reached in 2022-2025.<br><br>Approximately 180 facilities were built at Dounreay ranging from nuclear reactors, waste stores, laboratories, utility plants and administration offices. Some facilities are straightforward to dismantle but others require innovation and special care because of chemical or radiological hazards. Almost 50 facilities at Dounreay have a legacy of radioactive work, and special controls are in place around these facilities to contain the radioactivity.<br><br>Soil polluted by radioactivity and chemicals will also be dealt with by appropriate treatment and/or safe disposal. The least contaminated soil will be left in place when a case can be made that it is safe to do so. A strategy for this work has been discussed with regulators and published.<br><br>A programme of work has been completed to recover radioactive particles from the seabed that were released to the marine environment as a result of nuclear fuel reprocessing. Beach monitoring will continue for some time to provide public reassurance and determine the effect of the offshore work.<br><br>Negotiations are underway with the NDA and Regulators as part | UKAEA (2006) *Dounreay Environmental Statement*<br><br>www.dounreay.com<br><br>UKAEA (2008) *A strategy for contaminated land management and restoration* |

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| | of the project to develop the site end state and future land use conditions.<br><br>The surrounding land is predominantly rural and used for agricultural purposes. It is recognised the Land Reform (Scotland) Act (2003) gives everyone statutory access rights to most land and inland water providing they exercise such rights responsibly. | |
| **Noise and Vibration** | A noise survey was undertaken in 2004. During the 12 months of the survey the highest level of noise recorded on or near the site was 52dB LAeq.<br><br>Further noise monitoring was undertaken in 2010 and throughout 2011 at 3 monitoring locations. The monitoring results for October to December 2010 show baseline levels at the 2 locations closest to sensitive receptors ranging from 48.9 to 67.9dB LAeq 1 hr.<br><br>The third location which is closer to the Dounreay site returned lower results ranging from 38.2 to 58.1dB LAeq 1hr. The results typically show higher ambient noise levels close to the receptors than the monitoring location close to the Dounreay site. This is expected to be a result of a high baseline and traffic noise from the A836. It indicates that the Dounreay site does not give rise to significant noise in excess of the ambient baseline.<br><br>The monitoring location closest to the site shows little variation between day-time and night-time noise levels whilst those closest to the road exhibit a more noticeable variation. This would suggest that the influence of Dounreay activities on ambient noise levels is low.<br><br>The exposed coastal environment and the proximity of the A836 means that the principal sources of noise in the vicinity of the Dounreay site are wind generated noise, waves breaking, traffic on the A836 and agriculture. | UKAEA (2005)<br>*Dounreay Environmental Statement*<br><br>DSRL (Aug 2010)<br>*New Low Level Waste Facilities, Noise Monitoring Plan*<br><br>DSRL (Oct 2010)<br>*New Low Level Waste Facilities, Noise Monitoring Report August 2010*<br><br>DSRL (Sept 2010)<br>*New Low Level Waste Facilities, Noise Monitoring Report*<br><br>*Noise Monitoring Report April - June 2011.*<br><br>*Dounreay New Low Level Waste Facilities*<br>*Noise Monitoring Report*<br>*NLLWF/3/REP/GLD/0842/IS/01*<br>*March 2012* |
| **Health and Safety** | During calendar year 2012 the average individual radiation dose attributable to Dounreay received by DSRL employees was 0.08 millisieverts and contractors was 0.10 millisieverts. From 1 October 2012 to 26 March 2013 there were two RIDDOR reportable incidents. The Total Recordable Incident Rate (TRIR) at 26 March is 0.61.<br><br>The total dose from all sources as shown in Radioactivity in Food and the Environment (RIFE 17) (including Dounreay discharges) in 2010, using the integrated habits survey data obtained in 2008, was assessed to have been 0.018 millisieverts or less than 2% of | DSRL (2013)<br>Site Safety & Environment Meeting Dounreay Monthly Safety Report – February 2013 (SSEM(13)P17), Updated to 26 March.<br><br>Environment Agency, et al. (October 2011)<br>*(RIFE 17 - 2012)* |

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| | the annual public dose limit (of 1 millisievert per year from all sources). | |

## Future Developments

There will be a trend of decreasing discharges over the period to the IES, with some short term increases during periods of increased demolition and waste processi

work are being reviewed by an independent expert group the Particles Retrieval Advisory Group (Dounreay) (PRAG(D)). The offshore work was intended to reduce the number of particles remaining and is expected to result in a reduction in the number and activity of particles coming ashore. A programme of beach monitoring and particle recovery continues to a schedule required specified by SEPA.

Soil and groundwater quality at Dounreay is being monitored and managed as part of the Dounreay decommissioning and restoration programme.

The Site has also made a case to significantly reduce its current Environmental Monitoring Programme (EMProg), in line with diminishing discharges. The thrust of the new proposals has been to reduce the number of crustacea and fish samples taken from the marine environment so as to prevent denudation of their populations. The new EMProg is anticipated to come into effect during 2013, subject to SEPA approval. The Food Standards Agency issued a revised Order made under the Food and Environment Protection Act (FEPA) at the end of September 2011 relating to the collection of crustacean within the 2 km exclusion zone centred on the old sea outfall. The revised Order allows DSRL to return surplus catch alive to sea, instead of disposing to landfill.

The site is rationalising the number of permits and licences it currently holds. This included surrender of its Pollution Prevention and Control (Part A) Permit in November 2011. Some of the requirements in the PPC permit were transferred into the RSA Liquid Authorisation by means of a variation to ensure the Authorisation is compliant with the Controlled Activities Regulations (CAR). DSRL has also submitted an application for a Site Wide Waste Management Licence which will subsume the current set of CAR licences covering non-radioactive releases and enable more efficient management of decommissioning rubble.

Activities on and around the Dounreay site interact with the environment in a wide variety of ways. In response to this, work has been undertaken to improve the processes for identifying and managing Environmental Aspects. Improved processes will allow a focussed approach to address aspects which have a real potential to impact on the environment.

Dounreay is entering a phase of large scale construction works and as such management of environmental nuisance has become particularly important. Measures have been taken to increase internal awareness of environmental nuisance and improvements have been made to management processes associated with the recording, prevention and mitigation of such issues. Some pro-active measures to address local resident concerns relating to nuisances have been taken, including the installation of a series of directional dust monitors around the site.

The site has closed its landfill and will eventually seek to surrender the associated Waste Management Licence.

**Map of Area Local to Dounreay**