

APPENDIX 1 INTRODUCTION

APPENDIX 1.1 ALTERNATIVE SITES SCORING MATRIX

No.	Criteria	Maximum Score	Weighting
1	Distance from electricity supply (110kv substation)	10	<100m 10 , 100-1000 5 , >1000 0
2	Distance from transmission network gas supply	10	<100m 10 , 100-1000 5 , >1000 0
3	Requirement to lay pipelines/cables across Larne Lough	10	yes 0 , no 10
4	min possible distance from 25m water depth for brine pipeline	10	0-2500m 10 , 2500-5000 5 , >5000 0
5	Will facilities break the skyline	5	yes 0 , partly 2 , no 5
6	Is the site a brownfield site	10	yes 10 , no 0
7	Any recorded sites within the area	5	yes 0 , no 5
8	Does the drilling site overlay basalt	5	yes 0 , no 5
9	Distance of perimeter from nearest residential property	10	<100m 0 , 100-200m 5 , >200m 10
10	Is the site reasonably flat/will significant earthworks be required	10	yes 10 , partially, 5 , no, 0
11	Is there any risk of contaminated land	5	yes 0 , no 5
12	Potential nuisance to residents in constructing pipelines	10	limited 10 , some 5 , significant 0
		100	

	Site A		Site B		Site C		Site D		Site E		Site B&C
1	0	3000m	10	75m	0	1040m	0	1300m**	0	1270m	10
2	0	3000m	10	60m	10	30m*	5	990m	0	1070m	10
3	0	yes	10	no	10	no	10	no	10	no	10
4	0	7000m	5	2900m	5	3300m	10	2500m	5	2700m	5
5	5	no	2	partly	5	no	0	partly	0	yes	2
6	10	yes	10	yes	0	no	0	no	0	no	10
7	5	no	0	yes	0	yes	5	no	5	no	5
8	5	no	0	yes	5	no	0	yes	0	yes	5
9	10	600m	5	118m	10	260m	0	40m	0	35m	5
10	10	yes	5	partially	0	no	10	yes	0	no	10
11	0	yes	0	yes	5	no	5	no	5	no	5
12	0	limited	10	limited	10	limited	0	significant	0	significant	10
	45		67		60		45		25		77

* NB only 30m if a new PRS is built into the Belfast Transmission Pipeline. Distance to Ballylumford PRS is 940m

** cabling will have to go around power station perimeter - connection to 275kv sub station not feasible

APPENDIX 1.2 ALTERNATIVE USES OF BRINE

Of the total salt production in the UK, approximately 30% is used as rock salt, principally for de-icing roads. The remaining 70% is consumed as brine, with 70% of this used in heavy inorganic chemical industry and 30% evaporated through a vacuum process to produce white salt which is used in a variety of different industries for thousands of different purposes.

Some of the most frequent uses of brine are outline below:

- Brine is used to pre-treat roads for winter storms. The solution is poured onto the roadways along with actual salt pellets to create a safer roadway (lowering the freezing point of the surface water, causing snow and ice to melt in lower temperature) when winter weather is in the forecast.
- Brine is used in removing heat from ice surfaces such as ice skating rinks. The brine is cycled through the refrigeration plant and returned under the slab of ice at a colder temperature. Brine is also used in cruise vessels' cooling systems.
- Brine is used in the offshore oil and gas industry where a pipeline, prior to commissioning, is flooded with a MEG/brine mix to prevent the formation of hydrates on production start-up.
- Within inorganic chemical production (chlor-alkali industry) brine is used for several different purposes to produce many differing end-products. It is used in the electrochemical process for the production of chlorine and caustic soda (sodium hydroxide, NaOH), and in the Ammonia-Soda Process for the production of Soda Ash (sodium carbonate, Na₂CO₃). The electrolysis of brine also produces the by-product of Hydrogen, used as a fuel for power generation and a process gas.
- Chlorine is one of the most important chemicals in the world's chemical industry with up to 60% of all chemical manufacturing in Western Europe depending on the element for uses such as sewage and effluent treatment, water disinfectant and to produce products such as plastics, polymers, and bleaches.
- Caustic soda is used in soap and detergents manufacturing, in alumina production and to produce paper. Soda ash is mainly used in the manufacture of glass, detergents and industrial chemicals.
- White salt produced from the evaporation of brine is sold as a chemical feedstock, for food processing and table use, water softening and in the production of animal feeds.
- Further refinement after evaporation produces 'Standard' Pure Dried Vacuum (PDV) Salt which complies with British Standard 998 for food use. Additives such as potassium iodate or potassium iodide can be mixed with PDV salt in order to meet customer specific requirements. The food industry not only re-packages this salt for table use, but also

uses it in a wide range of dairy products, snacks, convenience foods, meat and fish products, canned vegetables, bakery products, confectionery, pickles and sauces.

- Salt and brine has been widely used as to reduce problems of hard water. A water softening system works by passing hard water through a cylinder containing ion-exchange resin in the form of millions of tiny beads. This resin attracts and exchanges the hardness minerals in the water. The resin is automatically "regenerated" by rinsing a small amount of brine through the cylinder; all the user has to do is occasionally add salt.
- Salt is traditionally used as a fixing agent, process chemical and preservative chemical in industries such as textiles and hide and skin. Industrial vacuum salt and PDV are typically used in this role.

Following the cessation of brine pumping in on Teesside in 2002, salt is now only produced in two areas in England; Cheshire and the North York Moors National Park. The Cheshire basin accounts for 85% of the total. The UK had an estimated total output of 5.8 million tonnes of salt in 2004, with over 95% produced in England and the remainder mined as rock salt at Kilroot in Northern Ireland. The Kilroot salt mines, located approximately 10 miles from the proposed site at Islandmagee, are based within the younger Triassic salt layer and are mined through conventional mechanical means for use as road grit. Controlled brine pumping takes place at the Holford and Warmingham brine fields in Cheshire and was formerly undertaken at Preesall in Lancashire and on Teesside. A large proportion of the brine produced is fed directly to inorganic chemical industries such as INEOS Chlor, one of the biggest chemical producing companies in Europe with the remainder evaporated to produce white salt mainly for use in the food industry. British Salt holds the greatest market share for sales of white salt (57%) and sells table salt under the well-known name Saxa, as well as through many supermarkets own-brand table salts. Furthermore the company is a major supplier of salt to the food industry for use in a vast quantity of products for everyday use. In some areas where salt has been solution mined for storage caverns (such as Yorkshire) brine has been returned to the sea through diffuser as it has proven impractical to attempt to re-use it in an effective manner; (such as through Chlor-Alkali industries or white salt evaporation) due to the location of the caverns in relation to companies which may have used the brine.

Within Northern Ireland there are relatively few industries which utilise large quantities of brine. A review of the food industry in Northern Ireland found that the only company that requires a significant quantity of brine is Castlewood Farm Products Ltd, based in Belfast. Research has also indicated that there are not any Pharmaceutical or Chlor-Alkali industries which use brine within Northern Ireland. However some companies involved in cheese production in the Republic of Ireland, such as production of 'feta' style cheese, require brine in the production process. Three cheese production companies were identified where brine delivery is potentially feasible:

- Irish Dairy Board – Gratton House Lower, Mount Street, Dublin 2
- Ryefield Farm – Stone Wall, Bailieboro, Co. Cavan
- Yeats Country Cheese Ltd – Convoy, Co. Donegal

Micro-Bio (Ireland) Ltd is Irelands only manufacturer of Chlor-Alkali products. Located in Fermoy Co. Cork, the company manufactures Caustic Soda Liquor, Hydrochloric Acid, and Sodium Hypochlorite using electrolytic cell membrane technology. However the site is logistically very far from the proposed works at Islandmagee and as such it would be impractical to transport such large quantities of brine from Islandmagee to Fermoy.

From the early 1950s to the late 1970s the town of Carrickfergus (approximately 13 miles by road from the site) was a significant textiles centre. Two large textile companies were in operation: Courtaulds, specialising in rayon, and ICI who manufactured polyester and polypropylene yarns (Carrickfergus Borough Council, 2009). However, due to increasing competition from the Far East in producing cheaper fabrics, both factories closed in 1981 with a resultant loss of 3,700 jobs. The textile industry in Northern Ireland is now largely confined to the North West region but has significantly declined with only a handful of major manufacturers remaining, who are mostly involved in assembling clothing using imported fabric and therefore would have limited requirement for salt. The last tannery in operation in Ireland closed in 2004 (BBC, 2004).

It is unlikely that any of the above mentioned industries could make a significant contribution use of the estimated 26.9 million cubic metres of concentrated brine which will be leached from the caverns. In terms of quantities of salt to be extracted, an average volume of 840,000 cubic metres of salt per year over four years will be leached in order to create sufficient space for gas storage. In order to reuse the brine for white salt production, major evaporation works would be required; involving a significant capital investment and a substantial land bank. The works could be based around large heat pans which evaporate water from the brine to produce salt, or a complex vacuum process which evaporates the water through several stages, producing increasingly concentrated brine at each stage, and eventually white salt.

The British Salt works at Middlewich, Cheshire uses a six stage evaporation process which it claims gives superior efficiency and product quality compared with large pan evaporation. The six stage evaporation process requires considerably less energy inputs than large heated pan evaporation, as well as operating over a much smaller area than large pans. British Salt considers their Middlewich, factory to be one of the most modern in Europe, using the latest production technology and incorporating advanced ecological planning to ensure self-sufficiency, maximum production efficiency and forward-looking environmental disciplines. Nonetheless, despite this, the factory occupies a considerable footprint (approximately 12.5 hectares excluding additional open area storage and brine pond areas, seen below in Figure 1).

The factory produces 100 tonnes of salt per hour, 24 hours a day 355 days per year, resulting in an overall output in the region of 852,000 tonnes per annum. At Islandmagee a factory capable of a similar output to the British salt works at Middlewich would be required in order to cope with the quantities of brine being issued by the leaching process. However, the factory would then be decommissioned after only 4 years, unless further brine pumping took place in order to feed the works. Additional problems arise as transport of salt would be

necessary, resulting in around of 31,500 HGV trips to and from the site per annum (each with 27 tonne capacity) away from the site; representing an average of over 178 HGV movements per day to and from the site.

The British Salt factory at Middlewich relies greatly on outlying processed food and chemical industries which have been established over decades as a result of the long-standing presence of salt works in the locality and which take a significant proportion of the factory's output directly through conveyor belts and rail links as well as its own dedicated fleet of bulk tanker HGVs.



Figure 1 British Salt Factory, Middlewich, Cheshire

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In response to short-term shortages in supply of rock salt for road gritting in recent years due to unpredicted cold snaps in England, British Salt added a re-crystallised de-icing rock salt to their range of products. As already discussed above, Irish Salt Mining, based in Carrickfergus also produces de-icing salt, mined from the Triassic salts in this area using

conventional mechanical methods. At present, their output is approximately half a million tonnes (approximately 435,000m³) of rock salt per year. The brine extracted from the caverns at Islandmagee would represent approximately twice the present day annual output of the salt mines. If a purpose-built salt manufacturing plant were constructed to evaporate the brine to create a rock salt similar to British Salt's "Glacia" de-icing product, the additional salt arising through the extraction of brine from the proposed gas storage caverns at Islandmagee could only sustain road salt production at current levels for a maximum of eight years. RPS do not consider this to be a viable option in terms of economic or environmental sustainability.

The options to re-use the extracted super-saturated brine within any existing industry in Northern Ireland are extremely limited. Evaporating the brine to recrystallise salt into either white salt, PDV for food processing or coarse rock salt would require the construction of a manufacturing plant which would require a very substantial landbank causing a greater environmental footprint than the gas storage facilities themselves. In addition to this, a feasible means of transporting the finished product, such as extension to the existing railway network or sub-surface pipelines, again likely to cause significant environmental impact would be required as the road network at the site is not capable of sustaining large volumes of HGVs. Furthermore, there would be insufficient annual demand for the quantities of finished salt arising from the brine leaching process within Northern Ireland or indeed the island of Ireland to accommodate the product and therefore it would be likely that export routes would have to be established. This is unfeasible for such a short-term period. It is therefore considered that the most environmentally and economically sustainable means of disposing of the leached salt from the gas storage caverns is by returning it to the sea.