Appendix 2.1

Environment Agency Consent to Discharge
Notice of variation with introductory note

Environmental Permitting (England & Wales) Regulations 2010

Halite Energy Group Limited

Gas Storage Caverns in the
Preesall Salt Deposits
Fleetwood
Lancashire

Variation application number
017290628/V001

Permit number
017290628
Gas Storage Caverns in the Preesall Salt Deposits, Fleetwood, Lancashire
Permit Number 017290628

Introductory note

This introductory note does not form a part of the notice

The following notice gives notice of the variation of an environmental permit.

This is an administrative variation to change the effective start date of the permit.

The schedules specify the changes made to the original permit.

The status log of a permit sets out the permitting history, including any changes to the permit reference number.

<table>
<thead>
<tr>
<th>Status log of the permit</th>
<th>Date</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application 017290628/V001 (Admin variation)</td>
<td>Duly made 12/08/2011</td>
<td>Application to vary the start date</td>
</tr>
<tr>
<td>Variation determined 017290628</td>
<td>24/08/2011</td>
<td>Variation issued.</td>
</tr>
</tbody>
</table>

End of introductory note
Notice of Variation

Environmental Permitting (England and Wales) Regulations 2010

The Environment Agency in exercise of its powers under regulation 20 of the Environmental Permitting (England and Wales) Regulations 2010 varies

Permit number
017290628

issued to:
Halite Energy Group Limited ("the operator"),
whose registered office is:
Unit 5 St Georges Court
Kirkham
Lancashire
PR4 2EF

company registration number 04145789

to operate a water discharge activity at
Gas Storage Caverns
In the Preesall Salt Deposits
Fleetwood
Lancashire

to the extent set out in the schedules.

The notice shall take effect from 23/12/2010

Name Date
Grant Wilson 24th August 2011

Authorised on behalf of the Environment Agency
Schedule 1 – conditions to be deleted
None

Schedule 2 – conditions to be amended

6 Start Date

There shall be no discharge under the terms of this permit until 1 January 2014 or the start of commissioning of the solution mining facility, whichever is sooner. The consent holder shall give the agency at least 28 days written notice before making the discharge.

Schedule 3 – conditions to be added
None
Canatxx Gas Storage Limited
Unit 5, St Georges Court
St Georges Park
Kirkham
PR4 2EF

Our ref: CC/93/07
Your ref:  
Date: 16 May, 2007

Dear Sir

Application to discharge trade effluent from Gas Storage Caverns in the
Presell Salt deposits
App no: C/208/P/04

Schedule 10

I enclose our formal consent to discharge in relation to your application. You are now
the holder of this Consent and should ensure that the conditions of the Consent are
complied with at all times.

If you consider that the conditions of the consent are unreasonable, you have a right
of appeal to:

Secretary of State, Defra
c/o The Environment Appeals Team
The Planning Inspectorate
Room 4/12 Eagle Wing
Temple Quay House
2 The Square
Temple Quay
Bristol. BS1 6PN

Your appeal must be given in writing within three months of the date of issue of the
consent and must include a statement of the grounds for the appeal. You should
also send a copy of the appeal to us at the address below.

This Consent is an important document. The right to discharge effluent may be
valuable to you. The document should be kept safe, probably with the Deeds of the
property where appropriate.

If you want to revoke (cancel), or vary (change/amend) the Consent in any way,
please contact us. Similarly, if you change your contact address while continuing to
hold the Consent, please let us know.

This Consent covers water quality considerations only. It does not give any right or
permission to discharge where land is not owned by the applicant. In addition, for

The Environment Agency
Ghyll Mount, Gillan Way, Penrith 40 Business Park, Penrith, Cumbria, CA11 9BP
Tel: 08708 506506 Fax: 01768 865606
www.environment-agency.gov.uk
discharges to watercourse it does not imply the suitability, with regard to volumetric capacity, of the receiving watercourses. It is the responsibility of the applicant to identify and negotiate, with the riparian owners as necessary, any requirement for downstream improvement works. Failure to do so could result in a Common Law action by the riparian owner.

You should be aware that those discharges which outfall directly into 'main river' may require a Land Drainage Consent from the Environment Agency before the outfall may be constructed. Any new outfall to a watercourse should be constructed so that it does not protrude or cause interference with flows. This is in addition to any discharge consent which may be granted. A charge will be levied to cover the processing costs of the Land Drainage Consent application.

Please ensure that the sample point for this discharge is maintained so that it is accessible to officers of the Environment Agency and that a direct sample of the effluent may be readily and safely taken at all times.

Public Register
Details of the application for consent are placed on our Public Register which is open for inspection by the public.

Annual charges
Under our current scheme of charges, this consented discharge will attract an annual charge from the start date of the discharge as given in the consent. You will be charged from this date whether or not you are actually discharging. Information on our charges is available through our website at www.environment-agency.gov.uk/charges. If you do not have access to the internet, a hard copy is available from me on request.

Change of Consent Holder
If in the future the name of the Consent Holder is due to change, both you and the new holder must inform us in writing before the change. We can then transfer the rights and charges to the new holder and send a certificate to confirm the transfer of consent.

If you have any queries please contact me.

Yours faithfully

PAM BARNES
Authorisations Officer

Direct dial: 01768 215799
Direct fax: 01768 865505
CONSENT TO DISCHARGE

Water Resources Act 1991
Section 88 - Schedule 10
(as amended by the Environment Act 1995)

TO: Canatxx Gas Storage Limited
Unit 5, St. Georges Court
St. Georges Park
Kirkham
PR4 2EF

Company Registration Number
4145789

The ENVIRONMENT AGENCY ("The Agency") in pursuance of its powers under the Water Resources Act 1991 (as amended by the Environment Act 1995), HEREBY CONSENTS to the making of a discharge of TRADE EFFLUENT, as follows:

Trade Effluent (comprising of brine arising from solution mining of salt stratum using seawater)

FROM: Gas Storage Caverns in the Pressell Salt deposits

AT: below the Fleetwood Penninsular

TO: the Irish Sea, 2.3 Km west of the coastline at Fleetwood

SUBJECT TO: the conditions set out in the following Schedule:

Trade Effluent (comprising of brine arising from solution mining of salt stratum using seawater)

Schedule No. 017290628-01

Subject to the provisions of Paragraphs 7 and 8 Schedule 10 of the Water Resources Act 1991 (as amended by the Environment Act 1995), no Notice shall be served by the Agency, altering this Consent without the agreement in writing of the Consent Holder, during a period of 4 years from the date this Consent takes effect.

This Consent is issued on the 16th day of March 2007 and shall take effect on 1st January 2009 or the start of commissioning of the solution mining facility whichever is the sooner.

Signed.................................................................
PAUL SIMMONS
Acting Team Leader Regulatory Water Quality
CONDITIONS OF CONSENT TO DISCHARGE

Trade Effluent (comprising of brine originating from solution mining of salt stratum using seawater) ("the Discharge")

FROM: Gas Storage Caverns
       Preesall
       Fleetwood Penninsular

GENERAL

1. Site Operation

   (a) The site shall be operated and effluent shall be treated in a manner which, so far as reasonably practicable, minimises the polluting effects of the Discharge made from the site on controlled waters.

   (b) This condition does not require:

       (i) any higher standard to be achieved in relation to any characteristics of the Discharge which is specifically regulated by conditions 17,18,19 and 22 than is required by those conditions;

       (ii) any alteration of site operations or a change in the type of treatment used.

2. Nature of Discharge

The Discharge shall consist solely of brine arising from the solution mining of salt stratum using seawater.

3. Place of Discharge

The Discharge shall be made in the manner and at the place specified as:

   (a) discharging via a 900 millimetre diameter pipe terminating with a diffuser consisting of 2 ports of maximum diameter 0.3 metre arranged as one terminal pair and at a height of 1 metre above the sea bed;

   (b) discharging to the Irish Sea;

   (c) at National Grid Reference SD 2883 4542.
4. Sampling Point Requirements

An appropriately labelled sample point shall be provided and maintained at National Grid Reference SD 3330 4670, or some other point as agreed in writing with the Agency, so that a representative spot sample of the Discharge may be obtained. The Consent Holder shall ensure that all constituents of the Discharge pass through the said sampling point at all times and in any legal proceedings it shall, for the purposes of Section 10 of the Rivers (Prevention of Pollution) Act 1961, be presumed, until the contrary is shown, that any sample of the Discharge taken at the said sampling point is a sample of what was being discharged into controlled waters.

5. Notice of Change

The Consent Holder shall notify the Agency in writing of any known or planned introduction or material change in respect of Discharges from the premises to which this Consent relates, to controlled waters that may increase or introduce into the effluent any “dangerous substance” (set out in Annex 1 to this notice as updated from time to time and notified to the Consent Holder in writing), or any other substance considered by the Consent Holder as likely to increase the polluting effects of the Discharge from the facility on controlled waters.

6. Start Date

There shall be no discharge under the terms of this Consent until the 1st January 2009 or the start of commissioning of the solution mining facility whichever is the sooner. The Consent Holder shall give the Agency at least 28 days written notice before making the Discharge.

7. Substantial Change

(a) A discharge shall not be made from the site if it would cause a significant increase in the polluting effects of the Discharge on controlled waters.

(b) An increase in the polluting effects of the Discharge on controlled waters is not significant for the purposes of this condition if it relates to any characteristic of the Discharge which is specifically regulated by conditions 17, 18, 19 and 22 of this Consent but it may be significant if it is caused by a change in some other characteristic of the Discharge.
8. Recording and Reporting

(a) The Consent Holder shall establish and operate a documented maintenance programme and record all non-routine actions undertaken, including failure of the diffuser, which may have adversely affected effluent quality. Copies of the programme shall be made available for inspection by the Agency's officers at all reasonable times.

(b) On request the Consent Holder shall supply the Agency with a written report on the maintenance and all non-routine actions, which may have adversely affected effluent quality.

9. Operational Surveillance Condition

(a) The Consent Holder shall maintain records that demonstrate to the satisfaction of the Agency:

(i) Knowledge and understanding by the Consent Holder of the composition of materials supplied to them and any changes in formulation of process inputs to the collecting, sewerage and/or treatment system;

(ii) Any changes in processes that may result in a change in the dangerous substances composition of the effluent discharge.

(b) The records kept in accordance with paragraph (a) above shall be made available to the Agency on request.

10. Investigate and Monitor Condition

If the Agency is of the opinion that the dangerous substances in the Discharge have changed significantly or that a significant change is likely then at the request of the Agency, the Consent Holder shall undertake any necessary investigations and provide an assessment of the source and quantity of specified List I and List II Substances (as defined in the Dangerous Substances Directive 76/464/EEC) within the Discharge.

11. Effluent and Receiving Waters Quality Monitoring

(a) The Consent Holder shall undertake a programme of effluent and receiving waters quality monitoring specified in the "Fleetwood Gas Caverns Discharge Consent Application Proposed Monitoring Programme" attached as Annex 3 to this Consent.

(b) The "Fleetwood Gas Caverns Discharge Consent Application Proposed Monitoring Programme" attached as Annex 3 to this Consent may be varied from time to time by written agreement between the Consent Holder and the Agency.

(c) The Consent Holder shall supply the Agency with a report on the monitoring carried out for part (a) above, at a frequency and in a form agreed in writing with the Agency.
12. Ecological Monitoring

(a) The Consent Holder shall undertake a programme of baseline and continued ecological monitoring in accordance with the methodology and at a frequency specified in the "Fleetwood Gas Caverns Discharge Consent Application Proposed Monitoring Programme" attached as Annex 3 to this Consent.

(b) The "Fleetwood Gas Caverns Discharge Consent Application Proposed Monitoring Programme" attached as Annex 3 to this Consent may be varied from time to time by written agreement between the Consent Holder and the Agency.

(c) The Consent Holder shall supply the Agency with a report on the monitoring carried out for part (a) above, at a frequency and in a form agreed in writing with the Agency.

13. Maintenance

(a) The Consent Holder shall maintain the outfall pipe and diffuser in an efficient operational condition, so as to minimise the probability of blockages or other failures.

(b) At the request of the Agency, an alarm system shall be provided to notify the Consent Holder in the event of failure of the diffuser.

(c) The Consent Holder shall implement periodic inspections of the integrity and performance of the diffuser and outfall pipe at a minimum frequency to be agreed in writing with the Agency.

(d) On request the Consent Holder shall supply the Agency with a written report on the maintenance of the outfall pipe and diffuser and all non-routine actions undertaken.

VOLUME

14. Volume

The volume of the Discharge shall not exceed 80,000 cubic metres per day.

15. Rate

The rate of discharge shall not exceed 926 litres per second.
16. Flow Measurement

(a) A continuous flow monitoring and recording system, to a specification provided by
the Agency, shall be provided and operated to record the total daily volume, and the
instantaneous or 15-minute integrated flow every 15 minutes of the Discharge. An
on-site visual display from which instantaneous or 15-minute integrated flow
readings can be readily obtained by the Agency shall be provided and operated.
The Consent Holder shall hold records of the flow readings.

(b) As soon as practicable after completion of the flow system installation and
subsequently on the expiry of any certificate issued, the Consent Holder shall
employ an independent expert to certify that the installation and its quality
management system complies with the Agency's specification. The independent
expert shall be accredited to a competency scheme approved by the Agency. A
copy of the certificate shall be sent to the Agency and the certifier's report shall be
provided to the Agency on request. If a certificate issued for a flow system has no
expiry date included then the certificate shall be deemed to expire five years after
the issue of the certificate.

(c) The Consent Holder shall produce and maintain a documented quality management
system, approved by the independent expert and to the satisfaction of the Agency,
specifying procedures for the calibration, operation and maintenance of the flow
measurement equipment. The flow measurement equipment shall be calibrated,
operated and maintained by the Consent Holder in accordance with the provisions
of the quality management system. The Consent Holder shall keep a record of
these procedures available for inspection by the Agency and provide a copy to the
Agency on request.

(d) The Consent Holder shall record all failures of the continuous flow measurement
system and any other breaks in the flow record. The reasons for all significant
failures and breaks, which lead to missing or suspect data, and all steps taken to
prevent a re-occurrence shall be recorded and details shall be provided to the
Agency on request. A failure or break is significant for the purposes of this condition
if it prevents the calculation of the total daily volume to the required level of
uncertainty. The Consent Holder shall ensure that as far as possible the recorder
remains fully operational at all times. Any failures shall be remedied as soon as
possible.

(e) Records of the flow readings or the reasons for any breaks in the record, as
described in condition (d) above, shall be provided to the Agency when requested,
in a format specified by the Agency.

(f) Flows of the Discharge shall be measured at National Grid Reference SD 3330
4670, or such other point as is agreed by the Agency.
COMPOSITION

17. Numeric

(a) Absolute salinity of the Discharge shall not exceed 260 practical salinity units;

(b) The Discharge shall not contain more than 100 milligrammes per litre of suspended solids (measured after drying at 105°C);

(c) The pH of the Discharge shall not be greater than 9 nor less than 6.

18. Absolute Limits

The Discharge shall not contain more than:

(a) 0.24 microgrammes per litre of tributyl tin;

(b) 3.0 microgrammes per litre of total cadmium.

19. Temperature

The temperature of the Discharge shall not exceed 28 °C.

20. The Dangerous Substances List I Condition

(a) The quantity of List I Substances (as defined in the Dangerous Substances Directive 76/464/EEC) in the Discharge shall not increase above:

(i) the levels specifically regulated by condition 18 (b); and

(ii) the levels in the Discharge on the date of effect of this Consent where no specific level is authorised; and

(b) notwithstanding (a) above, the concentration of List I Substances in the Discharge shall not exceed the concentration specified in 'List I General Standards' in Annex 2.
21. **The Dangerous Substance List II Condition**

(a) The quantity of List II Substances (as defined in the Dangerous Substances Directive 76/464/EEC) in the Discharge shall not increase above:

(i) the levels specifically regulated by condition 18 (a); and

(ii) the levels in the Discharge on the date of effect of this Consent where no specific level is authorised; and

(b) notwithstanding (a) above, the Discharge shall not contain quantities of any List II Substances such as to cause or contribute to the concentration of that substance in the receiving water exceeding the relevant Environmental Quality Standard (EQS).

22. **Oil**

As far as is reasonably practicable, the facility shall be operated so as to prevent the Discharge from containing any significant trace of visible oil or grease.

23. **Impact**

Should the Discharge cause:

i) the salinity of the receiving waters to exceed 40 practical salinity units at any point further than 50 metres measured from the centre point of the diffuser, and/or;

ii) the salinity of the receiving waters to exceed ambient plus 10% of ambient at any point further than 250 metres measured from the centre point of the diffuser, and/or

iii) the concentration of tributyl tin in the receiving waters to exceed 0.002 microgrammes per litre at any point further than 150 metres measured from the centre point of the diffuser, or such other point as agreed in writing with the Agency, and/or;

iv) the concentration of total copper in the receiving waters to exceed 5 microgrammes per litre at any point further than 150 metres measured from the centre point of the diffuser;

then the Discharge shall cease. The Discharge shall not re-commence without the prior written agreement of the Agency.
## ANNEX 1

<table>
<thead>
<tr>
<th>No.</th>
<th>Substance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Mercury and its compounds</td>
</tr>
<tr>
<td>2.</td>
<td>Cadmium and its compounds</td>
</tr>
<tr>
<td>3.</td>
<td>Hexachlorocyclohexane (lindane and related compounds)</td>
</tr>
<tr>
<td>4.</td>
<td>Carbon tetrachloride</td>
</tr>
<tr>
<td>5.</td>
<td>DDT (the isomers of 1,1,1-trichloro-2,2-bis(p-chlorophenyl) ethane)</td>
</tr>
<tr>
<td>6.</td>
<td>Pentachlorophenol (PCP)</td>
</tr>
<tr>
<td>7.</td>
<td>Aldrin</td>
</tr>
<tr>
<td>8.</td>
<td>Dieldrin</td>
</tr>
<tr>
<td>9.</td>
<td>Endrin</td>
</tr>
<tr>
<td>10.</td>
<td>Isodrin</td>
</tr>
<tr>
<td>11.</td>
<td>Hexachlorobenzene (HCB)</td>
</tr>
<tr>
<td>12.</td>
<td>Hexachlorobutadiene (HCBD)</td>
</tr>
<tr>
<td>13.</td>
<td>Chloroform</td>
</tr>
<tr>
<td>14.</td>
<td>Polychlorinated biphenyls</td>
</tr>
<tr>
<td>15.</td>
<td>Dichlorvos</td>
</tr>
<tr>
<td>16.</td>
<td>1,2-Dichloroethane</td>
</tr>
<tr>
<td>17.</td>
<td>Trichlorobenzene</td>
</tr>
<tr>
<td>18.</td>
<td>Atrazine</td>
</tr>
<tr>
<td>19.</td>
<td>Simazine</td>
</tr>
<tr>
<td>20.</td>
<td>Tributyltin compounds</td>
</tr>
<tr>
<td>21.</td>
<td>Triphenyltin compounds</td>
</tr>
<tr>
<td>22.</td>
<td>Trifluralin</td>
</tr>
<tr>
<td>23.</td>
<td>Fenitrothion</td>
</tr>
<tr>
<td>24.</td>
<td>Azinphos-methyl</td>
</tr>
<tr>
<td>25.</td>
<td>Malathion</td>
</tr>
<tr>
<td>26.</td>
<td>Endosulfan</td>
</tr>
<tr>
<td>27.</td>
<td>Lead</td>
</tr>
<tr>
<td>28.</td>
<td>Chromium</td>
</tr>
<tr>
<td>29.</td>
<td>Zinc</td>
</tr>
<tr>
<td>30.</td>
<td>Copper</td>
</tr>
<tr>
<td>31.</td>
<td>Nickel</td>
</tr>
<tr>
<td>32.</td>
<td>Arsenic</td>
</tr>
<tr>
<td>33.</td>
<td>*Iron</td>
</tr>
<tr>
<td>34.</td>
<td>*pH if outside the range 5.5 to 9.0</td>
</tr>
<tr>
<td>35.</td>
<td>*Boron</td>
</tr>
<tr>
<td>36.</td>
<td>Vanadium</td>
</tr>
<tr>
<td>37.</td>
<td>PCSD'S</td>
</tr>
<tr>
<td>38.</td>
<td>Cyfluthrin</td>
</tr>
<tr>
<td>39.</td>
<td>Sulcotrifurone</td>
</tr>
<tr>
<td>40.</td>
<td>Flucytrifurone</td>
</tr>
<tr>
<td>41.</td>
<td>Parmethrin</td>
</tr>
<tr>
<td>42.</td>
<td>4-Chloro-3-methyl-phenol</td>
</tr>
<tr>
<td>43.</td>
<td>2-Chlorophenol</td>
</tr>
<tr>
<td>44.</td>
<td>2,4-Dichlorophenol</td>
</tr>
<tr>
<td>45.</td>
<td>2,4-D (ester)</td>
</tr>
<tr>
<td>46.</td>
<td>2,4-D (non ester)</td>
</tr>
<tr>
<td>47.</td>
<td>1,1,1-Trichloroethane</td>
</tr>
<tr>
<td>48.</td>
<td>1,1,2-Trichloroethane</td>
</tr>
<tr>
<td>49.</td>
<td>Bentazone</td>
</tr>
<tr>
<td>50.</td>
<td>Benzene</td>
</tr>
<tr>
<td>51.</td>
<td>Biphenyl</td>
</tr>
<tr>
<td>52.</td>
<td>Chloronitrotoluenes</td>
</tr>
<tr>
<td>53.</td>
<td>Demeton</td>
</tr>
<tr>
<td>54.</td>
<td>Dimethoate</td>
</tr>
<tr>
<td>55.</td>
<td>Linuron</td>
</tr>
<tr>
<td>56.</td>
<td>MCPA</td>
</tr>
<tr>
<td>57.</td>
<td>Mecoprop</td>
</tr>
<tr>
<td>58.</td>
<td>Mevinphos</td>
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<tr>
<td>59.</td>
<td>Napthalene</td>
</tr>
<tr>
<td>60.</td>
<td>Omethoate</td>
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<tr>
<td>61.</td>
<td>Toluene</td>
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<tr>
<td>62.</td>
<td>Triazophos</td>
</tr>
<tr>
<td>63.</td>
<td>Xylene</td>
</tr>
<tr>
<td>64.</td>
<td>Cyanide</td>
</tr>
<tr>
<td>65.</td>
<td>Azinphos-ethyl</td>
</tr>
<tr>
<td>66.</td>
<td>Fenthion</td>
</tr>
<tr>
<td>67.</td>
<td>Parathion</td>
</tr>
<tr>
<td>68.</td>
<td>Parathion-methyl</td>
</tr>
<tr>
<td>69.</td>
<td>Trichloroethylene</td>
</tr>
<tr>
<td>70.</td>
<td>Tetrachloroethylene</td>
</tr>
<tr>
<td>71.</td>
<td>Dioxins</td>
</tr>
<tr>
<td>72.</td>
<td>PAHs</td>
</tr>
<tr>
<td>73.</td>
<td>Nonyl phenol</td>
</tr>
<tr>
<td>74.</td>
<td>Nonyl phenyl ethoxylate</td>
</tr>
<tr>
<td>75.</td>
<td>Di-ethylhexyl phthalate</td>
</tr>
<tr>
<td>76.</td>
<td>Bisphenol-A</td>
</tr>
<tr>
<td>77.</td>
<td>Diazinon</td>
</tr>
<tr>
<td>78.</td>
<td>Chlorfenvinphos</td>
</tr>
<tr>
<td>79.</td>
<td>Chlorotoluron</td>
</tr>
<tr>
<td>80.</td>
<td>Isoproturon</td>
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<tr>
<td>81.</td>
<td>Diuron</td>
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<tr>
<td>82.</td>
<td>Propetamphos</td>
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<td>83.</td>
<td>Flumethrin</td>
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<td>84.</td>
<td>Amitraz</td>
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<tr>
<td>85.</td>
<td>High-Cis Cypermethrin</td>
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<td>86.</td>
<td>Cyromazine</td>
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<tr>
<td>87.</td>
<td>Deltamethrin</td>
</tr>
<tr>
<td>88.</td>
<td>Cypermethrin</td>
</tr>
</tbody>
</table>

This list is applicable as at 1 December 1998 and will be updated as and when changes to the relevant legislative requirements occur.

*Notification to the Agency by the Consent Holder is only required in respect of changes to trade effluents likely to cause significant changes to the pH value, and/or iron or boron concentrations, of the crude sewage.*
## ANNEX 2

### List I General Standards

<table>
<thead>
<tr>
<th>Substance</th>
<th>Limit Total Concentration (ug/l)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Aldrin</td>
<td>0.02</td>
</tr>
<tr>
<td>2. Dieldrin</td>
<td>0.02</td>
</tr>
<tr>
<td>3. Endrin</td>
<td>0.01</td>
</tr>
<tr>
<td>4. Isodrin</td>
<td>0.01</td>
</tr>
<tr>
<td>5. Carbon tetrachloride</td>
<td>24.0</td>
</tr>
<tr>
<td>6. Chloroform</td>
<td>24.0</td>
</tr>
<tr>
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<tr>
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</tr>
<tr>
<td>17. Tetrachloroethylene</td>
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ANNEX 3

Fleetwood Gas Caverns Discharge Consent Application
Proposed Monitoring Programme
Fleetwood Gas Caverns
Discharge Consent Application

Proposed Monitoring Programme

02 October 2006
Report no: NH50679-M001-03

Hyder Consulting
Fleetwood Gas Caverns
Discharge Consent Application

Proposed Monitoring Programme

Author: N Barcock
Checker: S Lowther
Approver: A Saunders

Report no: NHS0679-M001-03 Date: 02 October 2006

This report has been prepared for Canabxx Gas Storage in accordance with the terms and conditions of appointment for Discharge Consent Application dated TBC. Hyder Consulting (UK) Ltd (2212959) cannot accept any responsibility for any use of or reliance on the contents of this report by any third party.
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Introduction

Canalba Gas Storage Ltd (CGSL) proposes to create gas storage caverns in the Preesall Salt deposits below the Fleetwood Peninsula. The caverns will be created by a washing process in which water is pumped into the deposits, dissolving the salt. The brine created in this process would be pumped out and discharged to the Irish Sea via an outfall approximately 1-2 km west of Rossall, near Fleetwood.

As part of the environmental requirements of the proposal CGSL is required to demonstrate that the discharge of high salinity brine will not have a detrimental impact on the local marine environment.

As a requirement of the Discharge Consent Application for the Brine discharge to the Irish Sea (Consent Number 017290628) the Environment Agency has requested that a detailed monitoring programme be established to assess the performance of the cavern washing infrastructure, outfall performance and impacts on the Irish Sea in the vicinity of the discharge.

The monitoring programme should seek to provide for effluent, receiving waters and ecological monitoring so as to satisfy various brine discharge consent conditions and develop an ‘Environmental Monitoring Plan’ for the brine discharge to be agreed by the Environment Agency before the discharge is commenced.

The Environmental Monitoring Plan will be kept under review throughout the life of the discharge with any changes being agreed by the Environment Agency.
2 Plant operation and maintenance

A requirement of the Environmental Monitoring Plan will be to monitor and manage the operation of the cavern washing process and return key operating data to the Environment Agency.

2.1 Design and operation philosophy

In keeping with its obligations, the developer has adopted safety design standards that ensure safety, and meet or exceed all legal provisions and industry standards.

The cavern design has been and will continue to be conducted within the world-wide standards specified for the industry and referred to elsewhere. All parts of the gas compression and processing areas and all gas pipelines will be constructed in accordance with the Institution of Gas Engineers standards or other applicable standards.

2.1.1 Construction Safety

CGSL’s philosophy will be to comply with all legislative requirements and Codes of Practice. In particular, CGSL will ensure that the construction phase of its proposals will be undertaken in terms of the requirements laid down by the Health and Safety at Work etc Act 1974 and the CDM Regulations.

All contractors will be selected with particular care and their track records will be carefully scrutinised to ensure that the highest standards of Health and Safety are maintained. All on-site activities will be subject to detailed inspection by the Health and Safety Executive.

2.1.2 CGSL Safety Policy

CGSL acknowledges its duties under UK legislation (Health and Safety at Work Act 1974, COMAH, Hazardous Substance Regulations) and common law to ensure all workers, members of the public and others are not put into danger by the development and operation of the facility, and recognises that the primary responsibility for this rests with CGSL’s Board of Directors. CGSL therefore undertakes to:

- Ensure that all aspects of the design, construction and operation of the facility meet or exceed the standards imposed by law;
- Accept responsibility for the health and safety of its employees, contractors, customers and members of the public;
- Ensure that all employees, contractors and visitors to the site receive appropriate training and guidance in the health, safety and environmental aspects of their work at all stages;
- Ensure that all environmental standards are met or exceeded; and
- Conduct operations in a way which causes the least disturbance and risk to the local community.

In order to carry out these responsibilities, CGSL will:
- Provide and maintain safe and healthy working conditions for all personnel on the site at all times;
- Put in place a specific organisational framework in which responsibility for the safe conduct of construction work and operations is clearly defined;
- Appoint competent personnel to the relevant roles within that framework to ensure that the rules laid down are observed;
- Where necessary, ensure that outside expertise is utilised to enhance health and safety matters;
- Make effective arrangements with external safety organisations for regular audits of procedure, emergency planning measures and any other liaison required;
- Carry out regular safety meetings and exercises, both internally and in collaboration with the external safety authorities; and
- Ensure a rigorous procedure is in place for the accurate and timely reporting of potentially unsafe events and practices, and that all matters arising through this process are vigorously pursued to a satisfactory resolution.

2.1.3 Operations, Security, Maintenance and Training

The main contractor will be required to demonstrate that CDM Regulations are met in terms of the resources available to deliver the project. This responsibility will include the need to liaise with the relevant statutory organisations including the Health and Safety Executive, Environment Agency, and local authorities' emergency planning officers, together with residents' groups, parish councils and community associations throughout the life of the project.

In addition there will be a requirement to produce relevant management structures and safety plans. On-site and off-site emergency plans will be produced and approved by the relevant authorities and emergency services.

2.2 Quality control & management

This category covers the operation, maintenance and calibration of continuous monitoring instruments.

Under the terms of the discharge consent (and any future Abstraction License) routine monitoring will be required of the:
- Abstracted flow from Wyre Docks.
- Abstracted water quality, in particular the presence of key pollutants.
- Discharge flow to the outfall
- Discharge water quality, in particular continuous monitoring of salinity and spot sampling for key pollutants originating from the salt and Dock water.

The monitoring programme and specifications will be undertaken in accordance with current best practise and guidance as provided in the Environment Agency ‘Water Quality Consenting Guidance Flow Measurement of Discharges’ 15_05, 09-08-06 and ‘Water Quality Consenting Standard Flow Measurement of Discharges’ EAS2310/3/27, 25-07-02. The programme and operating procedures monitoring works will be recorded in a Quality Control Manual for use by CGS staff. The establishment of flow and water quality monitoring sites will be subject to relevant audit and calibration during and post installation. Reporting to the Environment Agency will be undertaken on a regular basis.

The monitoring will be supported by:

- Continuous monitors to be linked to a permanent display panel. With the exception of monitors deployed in the Irish Sea.
- Periodic monitoring and inspection of specific plant, e.g. marine outfall.
- Regular testing, calibration and audit of monitors as appropriate.
- Collection of periodic samples – analysis to be undertaken by a suitably accredited laboratory.
- Quality control procedures will be put in place for all continuous monitors and documented in a Quality Control Manual, a copy of which will be maintained on site.
- Quality control manual to be produced for the certified flow monitoring system, in compliance with consent condition 16(c).
- Operational staff to be suitably trained and made aware of the limit values specified in the consent.

### 2.2.1 Outfall maintenance & monitoring

The design life of the outfall and diffuser should be in excess of the discharge programme from the gas storage facility. However, consent condition 13 requires periodic inspection of the integrity and performance of the diffuser and outfall pipe at a minimum frequency to be agreed in writing with the Environment Agency.

It is proposed that such monitoring be conducted by diver survey at a frequency of quarterly during first year of discharge and annually in summer thereafter. The monitoring would include:
- Periodic monitoring events whereby divers would be required to make a visual inspection of outfall and diffuser.
- Video footage to be obtained where possible.
- Written reporting to include comment upon the integrity of the outfall and diffuser and any action taken.

2.2.2 Discharge and intake flow monitoring

The requirements for flow measurement of the final effluent are given in condition 16 of the consent.

Flow of intake of dock water will be measured as a requirement of the abstraction license. Flow of discharge water will be measured as a requirement of the Discharge Consent.

- Intake flow monitoring will be undertaken using a continuously recording gauge located at NGR SD 3334 4680; this location is approximate and is to be confirmed. The gauge and flume will be constructed to Environment Agency specifications and in accordance with any specific conditions as specified in the Abstraction License.
- Discharge flow monitoring will be undertaken, at the location SD 3330 4870, as specified in consent condition 4.
- Flow monitoring will be undertaken at a frequency to be agreed with the Environment Agency but would typically be at 15 minute intervals.
- Where necessary a flume or similar structure will be constructed for flow monitoring. The specification of the flow monitoring site is to be agreed with the Environment Agency. A level of redundancy, e.g. a standby monitor, will be provided where appropriate.
- Flow monitors will be constructed, calibrated and audited in accordance to current industry best practice and as per EA guidance 'Water Quality Consenting Standard Flow Measurement of Discharges' EAS2310/3/27, 25-07-02. The choice of monitor has yet to be determined but would be specified and agreed in consultation with the Environment Agency.
- Full details and specifications will be given in the Quality Control Manual detailing the procedures for calibration, operation and maintenance of the flow monitor.
- A copy of the manual is to be kept on site and is to be made available for inspection upon request by the Agency.
- MCERTS requirement for compliance purposes. A certified inspector will be commissioned to report on the standard of the installation of the flow system.
- This equipment will be installed, calibrated and maintained in line with the manufacturers' instructions, engineering best practice and MCERTS guidance.
2.2.3 Influent water quality monitoring

Quality monitoring of the dock water is not a requirement of the Water Resources Act 1991 consent to discharge. However as the dock water may contain potential pollutants monitoring is proposed in order to ensure that these do not compromise the consent condition for the brine discharge.

The abstraction of dock water for this development requires an abstraction license. Conditions required to regulate the volume of abstraction will be specified in the license. Compliance with the abstraction license will require flow measurement however, for operational purposes monitoring of the dock water quality prior to cavern washing may take place.

- Seawater will be drawn from the Fish Dock at Fleetwood, through the existing inlet and associated culvert, which is 1.22m in diameter. A screen will be installed in the culvert. A suitable sample access point will be installed, downstream of the filter, within the seawater pipeline or within the seawater pumping station (NGR SD 3334 4680; TBC).

- *In situ* measurement of temperature and salinity will be carried out using a suitable hand held instrument during sampling. Instrument calibration will be undertaken as appropriate and detailed in the Quality Control Manual.

- Water quality samples would be taken following appropriate guidelines and protocols to prevent contamination and degradation of samples. Appropriate training will be provided to staff undertaking sampling work.

- Samples will be analysed by a suitably accredited laboratory to detection limits to be agreed with the Environment Agency.

- Water quality sampling will be undertaken monthly for the first year of the discharge. It is proposed that the frequency of monitoring is reviewed periodically with the Environment Agency to determine whether this can be reduced, depending on the outcome of results obtained and flow/load being discharged. Should there be sufficient confidence in the sample results it is proposed that sampling frequency is reduced to annually after the first year.

- Analysis will be carried out for the determinands listed below.

<table>
<thead>
<tr>
<th>Determinand</th>
<th>Aluminum</th>
<th>Copper</th>
<th>Silver</th>
<th>Tributyl tin</th>
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<tr>
<td></td>
<td>Arsenic</td>
<td>Iron</td>
<td>Zinc</td>
<td>Vanadium</td>
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<td>Lead</td>
<td>1,2-Dimethyl benzene</td>
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<td>Mercury</td>
<td>Benzene</td>
<td>Suspended Solids</td>
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<td></td>
<td>Chromium</td>
<td>Nickel</td>
<td>Toluene</td>
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2.2.4 Effluent water quality monitoring

Limits are set within the consent for absolute salinity, suspended solids, pH, temperature, tributyl tin and total cadmium by conditions 17, 18 and 19. In addition, condition 11(a) requires the consent holder to undertake a programme of effluent quality monitoring in agreement with the Environment Agency. Sampling will include:

- The discharge location specified in consent condition 3(c) is SD 2883 4642.
- The sampling point for discharge specified in consent condition 4 is SD 3330 4670.
- Continuous monitoring of salinity and temperature will be undertaken using suitable instrumentation and in accordance with current industry best practice. The choice of monitor has yet to be finalised but would be specified and agreed in consultation with the Environment Agency.
- Instrument set-up, audit and calibration will be undertaken in accordance with current industry best practice and in consultation with the Environment Agency.
- Monitoring will be undertaken at a frequency to be agreed with the Environment Agency but would typically be at 15 minute intervals.
- Samples will be taken following appropriate guidelines and protocols to prevent contamination and degradation of samples. Appropriate training will be provided to staff undertaking sampling work.
- Samples will be analysed by a suitably accredited laboratory to detection limits to be agreed with the Environment Agency.
- Water quality sampling will be undertaken monthly for the first year of the discharge. It is proposed that the frequency of monitoring is reviewed periodically with the Environment Agency to determine whether this can be reduced, depending on the outcome of results obtained and flow/load being discharged.

- Full details, procedures and specifications will be given in the Quality Control Manual detailing the procedures for calibration, operation and maintenance of the flow monitor.
- A copy of the manual is to be kept on site and is to be made available for inspection upon request by the Agency.
- It is proposed that the effluent is monitored for all listed substances, as specified below.

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<tr>
<th>Substance</th>
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<td>Cadmium</td>
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<td>Suspended solids</td>
</tr>
<tr>
<td>Chromium</td>
<td>Nickel</td>
<td>Toluene</td>
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</table>
3 Receiving water quality monitoring

3.1 Scope of monitoring
Condition 11(a) of the Discharge Consent requires the consent holder to undertake a programme of receiving water quality monitoring in agreement with the Environment Agency.

Under the terms of the consent (condition 23(i) and (iii)) a regulatory mixing zone has been established such that the salinity of the receiving waters should not exceed 40psu at any point further than 50m from the diffuser. Also, the salinity of the receiving waters should not exceed ambient plus 10% of ambient at any point further than 250m from the diffuser.

3.2 Routine Monitoring
It is proposed to undertake a series of surveys from a monitoring vessel. As a minimum the Environment Agency have requested the following:

- Two monitoring positions established at 50m/250m from the diffuser and in line with the centre of the plume (as derived from the modelling), one on either side of the diffuser to cover both ebb and flood tides.
- Continuously monitor salinity, tidal velocity and direction over a specified period in the ebb tide and in the flood tide.
- Water quality meter used to continuously record salinity and depth (of the probe).
- Velocity recorded using 'in-situ water current meter' deployed from the vessel.
- Undertaken quarterly for the first year of discharge and reviewed annually thereafter.

Given that the area to be surveyed is relatively small it is believed the minimum survey requirement can be comfortably met and that additional survey works can be carried out at little or no additional cost. The proposed survey scope would therefore provide:

1 Continuous Moving Vessel Acoustic Doppler Current Profiling (MVADCP) along the plume axis from 500m upstream to 500m downstream of the diffuser and at similar distances along a perpendicular axis. Transects would be recorded over a 13 hour tidal cycle at approximately 1 hourly intervals centred on slack water. This will produce a vertical slice of velocity distribution along the plume axis with vertical velocities at approximately 1m intervals and horizontal velocities at approximately 25m intervals. It should be noted that the ADCP will not be able to record velocity in the bottom
and surface 1m of the water column, although this is not considered to be a significant limitation and would be common to both vessel and bed mounted instruments.

2 At intervals along the velocity profile transect Conductivity Temperature Depth (CTD) downcasts and upcasts would be undertaken using a suitable calibrated instrument. This will provide high spatial resolution profiles of salinity, temperature and depth. Profiles would be taken at a minimum of 25m, 150m and 50m upstream and downstream of the discharge location and along the transverse plume axis. Where sufficient time is available during each transect it is proposed that additional profiles are undertaken at a number of further locations. It is recommended that these additional profiles are located at the discharge point (to one side of the diffuser) and at 25m and 100m from the diffuser in order to provide a more detailed representation of the plume.

Under the terms of the consent (condition 23(iii) and (iv)) a regulatory mixing zone has been established for Dangerous Substances such that the concentrations of TBT and total copper in the receiving waters shall not exceed the EQS at any point further than 150m from the diffuser.

3 During the ADCP / CTD transects water samples will be taken at the 50m and 150m profile locations along the major plume axis. Samples will be taken at surface, mid depth and bottom at HW and LW when concentrations would be expected to reach a maximum. This will provide a total of 24 samples per survey.

4 The concentration of TBT and total copper in the samples will be analysed at a suitably accredited laboratory to detection limits to be agreed with the Environment Agency.

5 It is also proposed to undertake a number of control samples at some distance offshore of the discharge location in order to determine background concentrations for comparison.

ADCP and CTD Surveys would be undertaken for spring and neap tides. Water sampling would be alternated between neap and spring tides for successive surveys. Survey would be undertaken quarterly for the first year of the discharge, due to uncertainty of effluent quality and lack of receiving water quality data.

The frequency of monitoring would be reviewed after first year of discharge, with a decision as to further monitoring and frequency of monitoring made in consultation with the Environment Agency depending on the outcome of results obtained.

3.3 Plume Tracking

The Environment Agency have also requested that a plume tracing survey be undertaken to determine salt concentrations in the entrance to Morecambe Bay.

Direct tracking of the saline plume will not be possible as:
• This would require a vessel to deploy a CTD probe along the sea bed, with consequent risks of damage and snagging due to the irregular topography.

• As the plume cannot be seen it would be difficult to maintain a survey vessel within the plume area. It would be necessary to rely on direct instrument readings in order to maintain the vessel within the plume, this can be a difficult exercise to carry out.

• At low concentrations the plume would be difficult to distinguish from the background salinity.

In order to aid tracking of the plume the use of a dye (such as rhodamine) was proposed. Mixing the dye with the discharge effluent would make the plume visible. However as the plume would remain in the bottom waters it could not be seen from a surface vessel. Tracking the plume with a fluorometer would therefore suffer the same limitations as tracking the saline water itself.

As an alternative the following strategy is proposed. Rhodamine dye would be deployed in the surface waters at the discharge point. This would allow the water mass travelling through the discharge point to be visually tracked and provide a general location of the leading edge of the plume to be seen. Dye release would begin at low water, i.e. during a slack water period and as the tide turns toward Morecambe Bay. The survey vessel would follow, or drift with the dye plume, dropping CTD (Conductivity / salinity), Temperature Depth) profiles at regular intervals along the dye plume axis and along the leading edge. To account for possible difference in bottom / surface water velocity the CTD profiles could be extended outside of the dye plume in order delineate the actual brine plume edge.

By following this approach it should be possible to both map the extent of the plume and the concentration of salt along it. The extent of plume mapping would be limited by the minimum visible / detectable concentration of dye. However based on previous surveys the plume should be visible close to the entrance to Morecambe Bay.

The dye tracing would be undertaken on a Spring and Neap tide once the outfall is operating at full capacity, in order to maximise the success of the survey and establish the excursion of the saline plume under a worst case condition. The survey would be programmed to coincide with the routine monitoring work.

3.4 Instrumentation and analysis

Survey instrumentation would be selected such as to provide the appropriate level of accuracy and resolution. All instrumentation would be appropriately calibrated and calibration data provided as necessary.

Water quality samples would be analysed by an appropriately accredited laboratory and within a timely fashion. Relevant sample collection and handling guidelines would be used to prevent contamination or degradation of samples prior to analysis.
3.5 **Vertical and horizontal control**

All Positions would be quoted relative to OSGB36 NGR.

The survey datum is to be ODN.

Positioning would be by Real Time Kinematic (RTK) GPS or equivalent to provide a resolution in the horizontal of 5cm or better and to an accuracy of:

**Horizontal** 1 cm +/- 1mm per 1 km from base station
4 Ecological monitoring

Condition 12(a) requires the consent holder to undertake a programme of ecological monitoring in agreement with the Environment Agency.

Centre for Marine and Coastal Studies Ltd (CMACS) has been asked by Hyder Consulting Ltd to develop a marine ecological environmental monitoring programme for the proposed CGSL facility at Fleetwood.

The monitoring outlined here relates to potential ecological receptors that could be affected by water quality impacts, including the hypersaline brine discharge, or physical impacts through construction of the discharge pipeline across subtidal and intertidal areas. The proposed monitoring relates primarily to marine areas seaward of the outfall landing point (NGR SD 312 454) but also includes consideration of fish species that migrate up and down local rivers about which concern has been raised during the EIA consultation process.

The detail of the proposed ecological monitoring programme has been informed by:

- knowledge gained through investigations undertaken during the EIA;
- predictions about the nature and scale of impacts made in the EIA;
- representations raised during public and stakeholder consultations, even when no significant impacts have been predicted by the EIA.

Predictions about the spatial extent of the hypersaline plume are particularly important in determining suitable positions for ecological monitoring. A Delft3D model run by Hyder Consulting Ltd (2003) predicted that the maximum increase in the salinity of bottom waters 500m from the diffuser would be 5% above ambient condition. At 250m a maximum 10% elevation in salinity was predicted. The plume is predicted to disperse predominantly along a north-south axis, in line with the prevailing currents. Limited east-west dispersal is predicted and within 150m east or west of the discharge point the model predicted no elevation above ambient.

The brine discharge is anticipated to last for approximately 10 years. It is anticipated that the pipeline would be decommissioned after this period.
4.1 Sublittoral Surveys

Monitoring is required to confirm the nature and spatial extent of impacts from the hypersaline plume and the impacts from the construction and physical presence of the discharge pipeline.

4.1.1 EIA Baseline Survey

A sublittoral survey to inform the environmental impact assessment was undertaken by divers (WA Marine and Environment in August/September 2001). The survey was carried out at a series of sites established at 250m intervals along the discharge pipeline, from the seaward end to just before chart datum, and at varying distances from five potential diffusers locations (Figure 5-1). NB the environmental assessment subsequently identified a single diffuser (understood to be equivalent to the position of D5) as the preferred option.

![Diagram of sublittoral survey arrangement](image)

**Figure 4-1** Arrangement of dive sites in the original EIA survey (from WM Marine & Environment, 2001)

Each dive pair recorded habitat features, biotopes (JNCC Sublittoral Biotopes Manual, version 97.06 after Connor et al., 1997), depths, species present and abundance. Standard MNCR recording forms, incorporating...
the species codings of Howson and Picton (1997) and the abundance scales of Hiscock (1996) were used to describe each site.

The survey reported that sublittoral sites throughout the area surveyed had similar benthic communities and the biotope was described as *Fliustra foliacea* and other hydroid/bryozoan turf species on slightly scoured mixed substrata (MCR.Flu).

The substratum was mixed, consisting of gravel to boulder particle size in varying proportions with a heavy overlying silt layer, sometimes with fine sand. Parts of the substrata included boulder clay with near-surface anoxic conditions. Much of the smaller (up to small cobble) substrata was considered to be mobile, causing scour conditions. The fauna of these areas was considered likely to die back or be scoured clean during winter storms.

Small patches of boulder clay supported burrowing piddock bivalves, *Barnea candida* (MCR.Pid). This is a nationally scarce biotope.

Visibility was poor due to high turbidity which is likely to be the prevailing condition in this area.

### 4.1.2 Proposed Monitoring Surveys

The original EIA survey provides a good characterisation survey for monitoring purposes; however, it will be necessary to re-establish the baseline prior to pipeline construction and initial discharge of brine. This is partly because of the time that has elapsed since the EIA survey in 2001 and also because it is considered likely that certain additional monitoring techniques could be used, initially to enhance and support the diver survey and potentially to replace the need for diver survey if it can be shown that appropriate data are obtained.

The EIA survey provided semi-quantitative coverage of invertebrate epifauna and useful qualitative information on other groups such as demersal fish. The diver survey should be repeated at a sub-set of the original sites and also at new control and far-field locations.

Diver surveys do not, however, provide any useful information on smaller benthic infauna and so it is also considered important that some infaunal sampling is included in the environmental monitoring programme. It is recognised that the ground conditions will make benthic grab sampling difficult but a mini-Harmon type grab should obtain samples away from areas of boulder and large cobbles.

It is also suggested that a drop down camera be deployed at all stations with a minimum of 5 separate digital still images being collected from separate locations (at least 1-2 m apart) around each station.

The sublittoral survey will also be supported by beam trawl surveys undertaken for the epifaunal and fish survey (see Section 4.2, below).
It is recommended that survey stations are established as detailed in Figure 4-2 (discharge point monitoring) and Figure 4-3 (discharge pipeline monitoring). These are based as far as possible on a sub-set of the original EIA survey stations plus new sites: in the middle and far fields of impact from the plume (as predicted by modelling); to the east of the discharge point (to allow for monitoring of an anticipated smaller spread of the plume laterally from the discharge point); and potential control sites to enable natural variability in benthic ecology to be accounted for.

A total of 24 stations are envisaged (18 discharge monitoring stations and 6 pipeline monitoring stations). Diver, grab and camera surveys should be undertaken initially at all sites (except that there would be no grab sampling at pipeline stations) and for the first two post-discharge surveys (cf. Section 4.1.3). After this period of intensive monitoring it is anticipated that:

1. certain stations may be dropped where it can be shown that sufficient information can be obtained from a smaller sub-set of stations;
2. diver surveys may be replaced by camera and/or grab surveys and when it can be shown that the latter provide sufficient data for monitoring purposes.

The above would be subject to the agreement of the Environment Agency.

Further details of each survey method are provided in Appendix 1.
Figure 4-2  Proposed sample stations for saline discharge point monitoring
Figure 4-3  Proposed sample stations for discharge pipeline monitoring

4.1.3 Timing of surveys

Environment Agency have indicated in the heads of terms for environmental monitoring that sublittoral surveys are to be undertaken pre and post first discharge of the brine effluent, every two years during the period of discharge with a final survey after completion of the scheme. It is also stated that the surveys should be carried out in spring 'for comparative reasons' (NB the original EIA survey was late summer).

It is not yet known when construction and first discharge would occur. It is the consultant’s opinion that there is no reason why baseline and monitoring surveys must take place in spring; the EIA sublittoral survey was a characterisation survey and a monitoring baseline could be established any time during spring and summer (approximately April to September in
the marine environment). This will provide much greater flexibility to adapt the monitoring to the construction and operation (i.e. brine discharge) timetables.

A first (baseline) monitoring survey should take place prior to construction of the pipeline. This survey would be timed for either summer 2006 or spring 2007.

The timing of the second monitoring survey should be shortly (4-6 weeks) before first discharge of brine if this occurs between late April and September. The survey would then be repeated within 1 month of commencement of brine discharge and every two years thereafter.

If the brine discharge commences in winter the second monitoring survey would need to be timed for late summer. The first post-discharge monitoring (third monitoring survey) would then take place approximately 12 months later and then be repeated every other year.

CGSL have indicated that the discharge pipeline may be installed by directional drilling. In this event it would be appropriate to revise subtidal benthic monitoring. Since only water quality impacts could then affect benthic species only the discharge monitoring stations (and control sites) would be surveyed.

It is proposed that as and when benthic community recovery from the physical disturbance of pipeline installation is demonstrated, or community structure in impacted areas is stable, monitoring of the outfall corridor be discontinued. It is recommended that recovery be measured by use of a multivariate statistical approach (e.g. multidimensional scaling using PRIMER). Such an approach would allow similar communities to be clustered according to their community composition.

4.2 Epifaunal and Fish Surveys

Two metre scientific beam trawls are a standard technique to provide a semi-quantitative sample of epifauna. They also provide an indication of smaller demersal fish species, including flatfish and juvenile skates and rays.

A disadvantage is that data are not fully quantitative and that larger (and more mobile) fish species are not well sampled; however, such data are extremely hard to collect in the marine environment and beam trawls are often undertaken as a pragmatic method to monitor epibenthos.

It is proposed that 10 trawl stations are established between sublittoral monitoring stations as indicated in Figure 4-4. The position of trawls should be flexible initially (within the boundaries in Fig. 4-4) then fixed after the first survey so that subsequent trawls are repeated at the same locations.

No beam trawl surveys are proposed for the discharge pipeline monitoring.
The timing of beam trawl surveys would mirror the sublittoral surveys (cf. Section 4.1.3).

It may be possible to reduce the number of trawl stations after 2-3 years; however, since it should be possible to survey all stations in a single day this will not lead to any significant reductions to the survey programme.

Technical specifications for the trawls are provided in Appendix 1.

![Diagram of proposed trawl sample stations for saline discharge point monitoring]

**Figure 4.4 Proposed trawl sample stations for saline discharge point monitoring**

4.3 Migratory Fish Assessment

A concern raised by certain stakeholders during the environmental impact assessment has been that the hypersaline discharge could affect migratory fish movements. The primary concern relates to salmonids although eels also migrate up and down local rivers and are of some commercial
importance and both river and sea lamprey are migratory species that are known to occur locally.

The Environmental Statement concluded that mobile species, including fish, would be able to actively avoid the hypersaline plume and it is also held by CGSL and their expert environmental advisors that the spatial magnitude of the plume will be trivial in relation to the unaffected waters through which fish will be able to migrate freely.

Limited options are available for targeted monitoring. By their nature, the migratory fish of interest are not expected to spend any significant time in the vicinity of the saline discharge; such fish are very rarely caught during marine fish surveys other than by targeted commercial techniques which it would be undesirable to employ because sampling itself would potentially represent a significant impact to stocks.

The alternative is to monitor migratory fish in rivers through routine fish counts, rod and line catches or a combination of these approaches and to collate data on licensed commercial catches from estuaries. It would then be necessary to relate such data to the hypersaline discharge and to apply expert judgement to relate trends in local fish runs with both regional and national patterns.

Table 4-1 provides a summary of routinely collected data on migratory fish in local rivers. It is anticipated that such data could be utilised for environmental monitoring purposes although a formal request would need to be made.

<table>
<thead>
<tr>
<th></th>
<th>Dee</th>
<th>Ribble</th>
<th>Hodder</th>
<th>Wyre</th>
<th>Lune</th>
<th>Keer</th>
<th>Kent</th>
<th>Duddon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salmonids</td>
<td>Y</td>
<td>Y</td>
<td>Y°1</td>
<td>Y</td>
<td>Y</td>
<td>Y²</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>(rod and line)</td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Salmonids</td>
<td>Y</td>
<td>Y</td>
<td></td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>(commercial nets)</td>
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<td></td>
</tr>
<tr>
<td>Salmonids</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>(traps/counters)</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Eels</td>
<td>*3</td>
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<td></td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td></td>
<td></td>
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<tr>
<td>(commercial nets)</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

°1 data could be masked as Ribble catches;
°2 data could be masked as Lune catches.
°3 Environment Agency suggest that commercial net data may be available for the Dee but this is to be confirmed.
Salmonid rod catches. Catch data are collated at the end of the season when anglers complete licence returns. Data for any calendar year are usually available by March of the following year.

Commercial salmonid netting. This is now a heavily restricted activity and is understood only to take place between June and August in the Ribble and Lune. Data are returned monthly.

Salmonid count data. There are automatic fish counters on the Lune and Hodder (a tributary of the Ribble). Data are downloaded fortnightly and available monthly in arrears. Salmon/sea trout are differentiated based on size using calibration surveys. There is also a fish trap at Chester weir on the Dee.

Commercial eel netting. Total wet weight of elvers captured entering rivers is reported. Reporting frequency is currently unknown.

It must be noted that migratory fish stocks, including salmonids and eels, are highly variable and subject to pressures from a wide range of natural and anthropogenic factors including commercial exploitation, disease, habitat loss and degradation, fluctuations in predator and prey abundance and climatic variability. It will be very difficult to separate any impact on, for example, salmonid runs into local rivers due to the saline discharge from such confounding factors.

In light of the above, the following monitoring strategy is proposed:

1. routine data gathered by the Environment Agency (Table 4-1) would be collated bi-annually, in April (previous year’s rod catches plus past 6 months data for all other elements) and October (all available data except rod catches);

2. simple correlations would be made between fish runs and brine discharge concentration;

Migratory fish data would be available for local rivers (Wyre and Lune) closest to the discharge and other rivers in the region, the farthest of which (e.g. Dee and Duddon) will provide useful controls against which to compare runs in rivers closer to the discharge.

The presence of average or good runs in local rivers that correspond to elevated brine discharge is the best available evidence of no significant impact.

If there were poor fish runs in certain local rivers a variety of interpretations are possible:

- Poor runs in one or two rivers, particularly the Wyre, clearly correlated to brine discharge and occurring while other local rivers enjoy normal/good runs would suggest a possible impact;

- Poor runs in more distant rivers (e.g. Duddon) at the same time as average or good runs in rivers whose mouths are closer to the discharge point would not be indicative of an impact;
if there were poor runs across most or all local rivers that correlated well with brine discharge it would be necessary to put this into context with regional and national trends before commenting on how likely it was that an impact had occurred.

The timescale for comparison of water quality and fish data must be appropriate. Brine discharge data would be summarised at an appropriate temporal scale for each fish data.

A desk based feasibility study is currently being undertaken to assess and scope of one or more acoustic fish tagging / tracking studies. The desk study, into the use of acoustic tags and receiver technology, will be completed and the results of the study provided to the Agency as soon as possible prior to the commencement of the discharge.

In the event that the routine discharge monitoring did not support the discharge plume modelling; or where an assessment of salmonid data suggested a possible impact associated with the discharge, further investigations will be undertaken, i.e.:

**Step 1**  A field trial of the use of acoustic tags and receiver technology, to determine the practicality and feasibility of a full-scale study.

**Step 2**  Dependant upon the results of Step 1, and where practicality and feasibility can be demonstrated, an acoustic fish tagging / tracking exercise would be undertaken.

Progress to Step 2 would be subject to agreement between the Environment Agency and CGSL.

### 4.4 Plankton Assessment

Representations were raised during the environmental impact assessment because of concerns regarding 'juvenile fish species and sources of food in Morecambe Bay'. From the dispersion modelling it is not anticipated that the plume will significantly affect Morecambe Bay; however, monitoring is required in light of the concerns raised.

The composition of marine organisms within the plankton is highly variable and therefore it is extremely difficult to monitor the effects of a single impact in isolation from other factors such as climatic variability, wider water quality and trophic interactions within the marine environment. There are ongoing plankton surveys and long-term data sets available for Irish Sea plankton, notably through Environment Agency and Port Erin Marine Laboratory studies (Figure 4-5).
Figure 4-5  Positions of Port Erin Marine Laboratory's long-term monitoring sampling stations and other surveys. (reproduced from Kennington & Rowlands (2006) SEA area 6 Technical Report, Plankton Ecology of the Irish Sea).

It is not considered either practical or necessary to assess viability/mortality of plankton in tows from locally impacted sites (i.e. to confirm that mortality has occurred. The potential for a wider spatial scale impact is of much greater interest and so it is proposed that available long terms data sets are reviewed on a bi-annual basis (i.e. every 2 years) and data interpreted in relation to brine discharge.

The details of the data interpretation remain to be confirmed but it is recommended that an appropriately qualified specialist plankton ecologist with knowledge of the long term data sets be responsible for interpretations.

4.5  *Sabellaria alveolata* Monitoring

Monitoring of certain intertidal species and habitats is proposed to confirm an absence of impacts on environmental receptors through effects on water quality and/or the construction of the discharge pipeline and its physical presence in the intertidal environment.

Particular concern has been raised in relation to *Sabellaria alveolata*, a polychaete worm that forms characteristic 'hummocks' in the intertidal zone when large numbers of individuals aggregate and their sediment-derived...
tubes are combined. These aggregations are important features in the marine environment and nationally scarce.

It is proposed that distinct areas of S. alveolata reef within 500m either side of the intertidal section of the pipeline be mapped. This should be done by an experienced intertidal ecologist capable of reporting on the physical condition of the interest feature in addition to simple mapping of its distribution. The percentage cover of S. alveolata and associated flora and fauna would be quantified non-destructively using replicated small (e.g. 0.25 x 0.25m) quadrats thrown in randomised locations within the study area. It is estimated that approximately 20-30 quadrats either side of the pipeline would suffice; however, this will need to be confirmed by a power study.

Field mapping will be facilitated through use of a GPS system.

Monitoring should continue annually for at least 5 years since indirect effects on S. alveolata mediated through hydrodynamic changes associated with the presence of the pipeline may be subtle and take several years to detect. It may be possible to suspend this survey if equilibration to the pipeline is demonstrated.

A full photographic survey should accompany each field visit.

It should be noted that Canatox indicated that the discharge pipeline may be installed by directional drilling. In this event it would be appropriate to revise intertidal monitoring. It would be reasonable to consider shortening the period of monitoring if no adverse impacts have been detected two years after commencement of the hypersaline brine discharge.

4.6 Monitoring of Species of Concern

The following species have been identified by the Environment Agency as requiring specific monitoring:

- *Bernea candida* (Piddock)
- *Alyconium digitatum* (dead man’s fingers)
- *Urticina felina* (a sea anemone)
- Benthic fish, lobster, crab and shrimp

The first three species will be monitored under the sublittoral surveys (grab, diver and drop down camera).

Monitoring for benthic fish and crab would be partly covered by the scientific beam trawl work described under epifaunal and fish survey (Section 2.2). In addition, it is proposed that some commercial fishery monitoring be undertaken through a combination of:

1. review of local fishing records to be obtained through consultation with local fishermen;
2 potentially, targeted commercial fishery surveys (otter trawls, shrimp trawls and pot fishing surveys) could be carried out based on the sample station design outlined for the sublittoral survey (Figure 2).

No site specific surveys would be undertaken if sufficient data were available from existing activities.

4.7 Other Notes

Any personnel involved in ecological monitoring should collate wider ecological information such as observations of birds feeding on organisms killed by the saline plume (if present).

4.8 Programme

- Baseline sublittoral, epifaunal and fish surveys will be undertaken prior to construction of the outfall.
  - these surveys will be carried out pre- and post the first discharge of brine effluent.
  - surveys are to be repeated every 2 years for the duration of the discharge.
  - Following scheme completion, the survey is to be repeated.
  - Surveys will be carried out in the period spring to summer.
- Migratory fish assessments will be repeated every 1/2 years where considered necessary.
- Plankton assessment will be undertaken and repeated every 1/2 years where considered necessary.
- Monitoring of Sabellaria alveolata will be undertaken annually for the first 5 years of operation. There will be a baseline survey prior to construction works.
- Monitoring of species of concern will be undertaken within the proposed survey programme as appropriate.
5 Records, Reporting & Review

Various conditions of the consent require records and results either to be reported directly to the Agency or made available upon request.

Specifically these are to include:

- All records of continuous and periodic monitoring to be held on site.
- Data will be reported in a format as agreed with the Agency.
- An annual report will be submitted to the Agency summarising all the data obtained during that reporting period. This report will include a review of that data against data obtained during previous reporting periods and an assessment of the impacts of the discharge where appropriate.
- The environmental monitoring plan is to be reviewed on a regular basis to ensure it remains fit for purpose and all constituent monitoring parameters and surveys remain relevant and necessary.
- Should any additional monitoring be identified as necessary or, in the light of data gathered, should any of the existing monitoring be shown to be unnecessary, then the consent holder should seek agreement with the Agency to vary the currently approved environmental monitoring plan.

5.1 Data processing and reporting

The Annual Report will be provided to the Environment Agency, to a specification to be agreed (see Section 6). Flow and water quality data will also be provide digitally in Microsoft Excel spreadsheets.

The annual report will provide section for the following elements:

- Operation, Quality Control and Environmental Monitoring Plan
- Outfall maintenance & monitoring
- Discharge and intake flow monitoring
- Influent water quality monitoring
- Effluent water quality monitoring
- Receiving water quality monitoring
- Ecological monitoring

Flow and water quality monitoring data will also be provide digitally in Microsoft Excel spreadsheets.

The Report will include:

- Introduction
- Methodology
5.1.1 Operation, Quality Control and Environmental Monitoring Plan

A synopsis of the operation of the intake and discharge will be provided to include summary plots and tables. The synopsis will outline any operational items of note.

Where changes to the Environmental Monitoring Plan are recommended, these will be outlined for agreement with the Environment Agency.

Proposed changes to the Quality Control Manual, to reflect continuous improvement or changes to operation will be provided for agreement with the Environment Agency.

5.1.2 Intake / discharge flow

Summary statistics and time series data of the intake and discharge flows will be provided. Results would be presented by quarter and as cumulatively covering all previous sample periods.

5.1.3 Intake / discharge water quality

Water quality sampling results will be provided as time series and a summary of minimum, maximum, mean and standard deviation for the intake and discharge monitoring locations. Results would be presented by quarter and cumulatively covering all previous sample periods. Comparison will be made with Baseline data and previous years where appropriate.

5.1.4 Receiving water quality monitoring

Results will be provided as time series and a summary of minimum, maximum, mean and standard deviation for the transects and sample locations. Results would be presented by survey and cumulatively covering all previous sample periods. Comparison will be made with Baseline data and previous years where appropriate.
5.1.5 Ecological Monitoring

Results and conclusions from the ecological monitoring will be provided. Results would be presented by survey and cumulatively covering all previous sample periods. Comparison will be made with Baseline data and previous years where appropriate.

5.1.6 Digital Data

Flow and water quality data will be provide digitally in Microsoft Excel spreadsheet as date, time and flow. Separate worksheets would be provided for intake and discharge flow.

Water quality sample data will be provided digitally in Microsoft Excel spreadsheet as date, time and concentration for each determinand.
Appendix 1

Detailed specifications for sublittoral and epifaunal surveys
Diver Survey

Diver surveys will be a repeat of the EIA baseline survey at stations identified in this report.

Benthic Grab Sampling

The survey will deploy a 0.1m$^2$ Hammon grab (NB Day or Van Veen grabs will not be suitable) at each site (other than pipeline sites). Triplicate samples will be taken from each site (at least 1m apart) with sub-samples for particle size analysis collected from every replicate sample.

The survey should proceed in line with the most appropriate best practice guidelines.$^{1}$

The survey vessel should be positioned to within 10m of the target point using DGPS with actual sample position recorded with sub-2 metre accuracy. Positional format should be standardised (e.g. Decimal Degrees/WGS84).

The contents of the grab will then be transferred to a 1mm sieve and the surface of the sample photographed (with sample code clearly visible).

The balance of the sample will then be washed through a 1mm mesh sieve, finer sediments discarded and material retained on the sieve transferred to a labelled bucket. A separate waterproof label will be added to the sample bucket duplicating the main external label. Fixing of samples should take place back on shore (not at sea) using buffered 20% formalin solution to at least 5% final concentration.

Standard sample coding will comprise the following:

- Site Description (e.g. Fleetwood)
- Station ID/replicate a, b or c and date

(NB sample purpose, i.e. chemical analysis, psa or invertebrate is defined by container type).

Taxonomic$^{2}$ analyses will be required for all samples with faunal identification to species level wherever possible (except oligochaetes).

The following additional Quality Control standards should apply for field sampling:

- Digital photographs will be taken of all samples.
- DGPS derived locations will be provided for all sample locations.

$^{1}$ CEFAS (2002) Guidelines for the conduct of benthic studies at aggregate dredging sites.

$^{2}$ Taxonomic analyses by an NMBAGC accredited laboratory.
- Visual descriptions of sediment type will be made at the time of sampling, together with estimates of sample volume (as a measure of sampler efficiency). Sample containers will be clearly marked externally with date, sample id and project name. There will also be an internal plastic tag carrying the same information, marked using a suitable material.

- Samples will be rejected where objects such as stones or shells are suspected to have kept the jaws open or where for any other reason loss of finer fractions of the sediment is suspected.

- Samples will be rejected where depth of sediment is less than 5cm unless the sediment is very hard and/or coarse and it is clear that better samples cannot be obtained. Minimum sample volume will be 4 litres.

- If the first three samples are rejected the site will be moved at least 20m west or east and three further attempts made to obtain samples. After this the site will be considered unsuitable for grab sampling.

- PSA/TOC samples will be taken as a sub-sample of the faunal sample in each case in line with DTLR guidelines.

Health & Safety: a full survey risk assessment will be required prior to start of survey.
Camera Survey

A drop down camera will be deployed from a survey vessel. The following instructions should be followed:

- The camera system must be suitable for low visibility/turbid water conditions. There are systems available that provide good quality images even in low visibility (<30 cm), turbid water and these should be adopted.
- The vessel should be positioned to within 10m of the target point using DGPS with actual sample position recorded with sub-2 metre accuracy. Positional format should be standardised (e.g. Decimal degrees/WGS84).
- The vessel must be positioned and held on the mark during image capture, either using a small marker buoy to position the vessel against or a dynamic positioning system. This is to ensure that positional referencing is reliable.
- The camera is to be re-deployed a minimum of five times at each station to provide a series of images of the seabed to enable the epibenthic community to be accurately reported.
- If visibility conditions are good the camera may be deployed some distance above the seabed to increase the field of view.
- A marine biologist should be present on board the survey vessel during survey.

Health & Safety: a full survey risk assessment will be required prior to start of survey.
Beam Trawl Survey

Gear to be used: 2m scientific beam trawl with 4mm square cod end mesh, with a chain matrix between the beam and foot-ropes. Warp to be sufficiently long to ensure gear fishes the bottom properly. Tows will be into the current, at approximately 2 knots over ground.

Each beam trawl is to be approximately 300m in length (2 knots for five minutes = 309 metres).

All animals, including macroinvertebrates, to be identified and counted on board where possible. Very numerous organisms such as brittle stars to be counted by sub sampling where necessary. On occasion the sheer volume of the sample may necessitate sub-sampling. Samples of difficult organisms, or large samples which cannot be dealt with in time on board, should be preserved and taken to the laboratory for subsequent identification. A photograph of each beam trawl haul will be taken. As far as possible all captured organisms should be returned to the sea.

Commercially important fish species to be measured (fork length) and elasmobranches sexed.

DGPS fixes to WGS84 standard to be provided for beginning and ends of tows; these should be within 10m of target positions prior to survey.