

TABLE OF CONTENTS

1.0	INTRODUCTION.....	1-1
1.1	ISLANDMAGEE STORAGE.....	1-1
1.2	PROJECT SUMMARY	1-2
1.2.1	Background.....	1-2
1.2.2	Outline of Proposed Development	1-4
1.3	PROJECT JUSTIFICATION.....	1-7
1.3.1	Types of Gas Storage	1-7
1.3.1.1	<i>Salt Cavern Gas Storage Facilities within the UK.....</i>	<i>1-7</i>
1.3.2	Gas Supply to Northern Ireland	1-8
1.3.3	The role of Gas Storage to meet UK and Ireland Gas Demand	1-8
1.3.4	Integration with Renewable Energy Generation	1-9
1.3.5	Current UK and Ireland Storage Capacity	1-9
1.3.5.1	<i>Current UK and Ireland Storage Facilities</i>	<i>1-10</i>
1.3.6	Future storage requirements in the UK and Ireland.....	1-11
1.3.7	Potential Cost Benefit	1-12
1.3.8	Gas storage and the National Interest	1-13
1.3.9	Operation of the Islandmagee storage facility.....	1-13
1.4	CONSIDERATION OF ALTERNATIVES	1-15
1.4.1	Alternative Locations.....	1-15
1.4.1.1	<i>Location of Caverns</i>	<i>1-15</i>
1.4.1.2	<i>Location of Above Ground Facilities</i>	<i>1-18</i>
1.4.1.3	<i>Alternative Locations for Sea water intake and Brine Outfall pipelines</i>	<i>1-23</i>
1.4.2	Alternative Designs	1-26
1.4.3	Alternative Processes	1-26
1.4.3.1	<i>Alternative uses of Waste Brine.....</i>	<i>1-26</i>
1.4.3.2	<i>“Do Nothing”.....</i>	<i>1-30</i>
1.5	PLANNING POLICIES	1-31
1.5.1	International Context.....	1-31
1.5.2	Planning Control	1-32
1.5.3	Regional/Local Policy.....	1-33
1.5.3.1	<i>Regional Development Strategy for Northern Ireland 2025 (RDS).....</i>	<i>1-33</i>
1.5.3.2	<i>Area Plan.....</i>	<i>1-36</i>
1.5.3.3	<i>Planning Policy Statements (PPS).....</i>	<i>1-37</i>
1.5.4	FURTHER CONSIDERATIONS	1-40
1.5.4.1	<i>Minister’s Statement -May 2009</i>	<i>1-40</i>
1.5.4.2	<i>Control of Major Accidents Hazards Regulations (Northern Ireland) 2000.....</i>	<i>1-41</i>
1.5.5	SUMMARY.....	1-41
1.6	PLANNING LEGISLATION	1-43
1.6.1.1	<i>Major Economic Developments</i>	<i>1-43</i>
1.6.1.2	<i>Major Infrastructure Projects</i>	<i>1-44</i>
1.6.2	The Planning (Environmental Impact Assessment) Regulations (NI) 1999	1-44
1.6.2.1	<i>Conservation (Natural Habitats, etc) (Amendment) Regulations (Northern Ireland) 2007. t</i>	<i>1-46</i>
1.6.3	Other Consents.....	1-46

1.6.3.1	FEPA Licensing.....	1-46
1.6.3.2	The Crown Estate.....	1-47
1.6.3.3	Waste Disposal Legislation.....	1-47
1.6.3.4	Hazardous Substances.....	1-48
1.6.3.5	Gas Order.....	1-48
1.7	SCOPE AND FORMAT OF THE EIS	1-49
1.7.1	Scope of EIS.....	1-49
1.7.2	Format of the EIS.....	1-50
1.7.3	Scoping Matrix	1-51
2.0	CONSULTATIONS	2-1
2.1	INTRODUCTION	2-1
2.2	STATUTORY AND RELEVANT BODIES CONSULTATION.....	2-1
2.3	STAKEHOLDER CONSULTATION	2-3
2.3.1	Local Interest Groups.....	2-3
2.3.2	Public Consultation	2-4
2.3.2.1	Questionnaire.....	2-6
2.3.3	Local Authorities	2-7
2.4	FURTHER PUBLIC CONSULTATION	2-7
2.5	PRESS AND INTERNET	2-9
2.6	CONCLUSIONS	2-9
3.0	SITE DESCRIPTION.....	3-1
3.1	SITE LOCATION	3-1
3.2	SITE CONTEXT AND LAND USE.....	3-2
3.2.1	Main Gas Plant	3-2
3.2.2	Brine Leaching Facility.....	3-5
3.2.3	Wellpad	3-5
3.2.4	Sea Water Intake Pumping Station.....	3-6
3.2.5	Sea Water Intake and Brine Outfall pipeline routes.....	3-7
3.2.6	Review of Former Site Land Use and Ground Stability	3-9
3.3	LARNE LOUGH.....	3-11
3.4	ISLANDMAGEE	3-13
3.4.1	Ballylumford Power Station.....	3-13
3.5	INFRASTRUCTURE	3-14
3.5.1	Electricity.....	3-14
3.5.2	Gas Pipelines.....	3-14
3.5.3	Oil pipeline	3-16
3.5.4	Larne Crossing Pipeline Cathodic Protection	3-16
3.6	LARNE AND THE EASTERN SHORE OF LARNE LOUGH.....	3-16
3.6.1	Larne.....	3-16
3.6.2	Glynn	3-16
3.6.3	Magheramorne.....	3-16
4.0	PROJECT DESCRIPTION.....	4-1
4.1	PROPOSED DEVELOPMENT	4-1

4.1.1	Gas Plant Facility	4-1
4.1.2	Sea Water and Brine Pumping Facilities (Leaching Plant)	4-1
4.1.3	Wellpad	4-2
4.1.4	Sea Water Intake Pumping Station	4-2
4.1.5	Connecting Pipelines	4-2
4.1.5.1	Seawater Intake Pipeline	4-2
4.1.5.2	Brine Outfall Pipeline.....	4-3
4.1.5.3	Gas Pipeline.....	4-3
4.1.6	Temporary Set Down and Storage Compound.....	4-4
4.1.7	Civil Engineering Works.....	4-9
4.1.7.1	Main Gas Plant Facilities.....	4-9
4.1.7.2	Leaching Plant.....	4-10
4.1.7.3	Proposed Source of Required Additional Fill Material	4-10
4.1.7.4	Civil works methodology	4-11
4.1.8	Construction of Buildings	4-11
4.1.8.1	Equipment Deliveries	4-14
4.1.8.2	Cold Vent.....	4-14
4.1.8.3	Plant Commissioning	4-14
4.1.8.4	Summary.....	4-15
4.2	PIPELINE CONSTRUCTION.....	4-17
4.2.1	Pre- construction works	4-17
4.2.2	Construction: Pipeline Spread technique.....	4-17
4.2.2.1	Construction Sequence.....	4-18
4.2.2.2	Road Crossings.....	4-25
4.2.2.3	Watercourses	4-25
4.2.2.4	Woodlands and Hedgerows	4-26
4.2.2.5	Conservation Areas.....	4-26
4.2.2.6	Existing Pipelines and Other Services	4-26
4.2.2.7	Crossing Construction Methods.....	4-26
4.2.3	Thrust Boring	4-27
4.2.4	Pipe Jacking.....	4-28
4.2.5	Horizontal Directional Drilling (H.D.D.).....	4-29
4.2.6	General Pipeline Technical Considerations	4-32
4.2.6.1	Corrosion Protection	4-33
4.2.6.2	Construction Impacts and Mitigation	4-33
4.2.7	Construction Constraints.....	4-35
4.2.8	Supervision of Construction Activities.....	4-35
4.2.9	Operation and Maintenance.....	4-36
4.3	WELLPAD CONSTRUCTION	4-37
4.3.1	Construction Sequence.....	4-37
4.3.1.1	Topsoil Strip	4-37
4.3.1.2	Subsoil Strip	4-38
4.3.1.3	Site construction.....	4-38
4.3.1.4	Operations.....	4-39
4.4	SEA WATER INTAKE	4-39
4.4.1	Construction Phase.....	4-39

4.4.2	Operational Phase	4-40
4.5	PROVISIONAL CONSTRUCTION VEHICLES & PLANT EQUIPMENT ..	4-42
4.5.1	Gas Plant Facility	4-42
4.5.1.1	Excavation / Filling / Drainage.....	4-42
4.5.1.2	Piling.....	4-42
4.5.1.3	Installation of pre-fabricated gas plant equipment	4-42
4.5.2	Sea Water and Brine Pumping Facilities (Leaching Plant)	4-42
4.5.2.1	Excavation / Filling	4-42
4.5.2.2	Inclined drains	4-42
4.5.2.3	Installation of brine leaching plant equipment.....	4-42
4.5.3	Wellpad	4-43
4.5.3.1	Construction of wellpad:.....	4-43
4.5.3.2	Drilling phase.....	4-43
4.5.4	Sea Water Intake Pumping Station	4-43
4.5.5	Connecting Pipelines	4-43
4.5.5.1	Conventional Trenching	4-43
4.5.5.2	Directional Drilling	4-44
4.6	WELL DRILLING AND CAVERN CONSTRUCTION (LEACHING)	4-45
4.6.1	Drilling	4-45
4.6.2	Cavern Construction	4-50
4.6.2.1	Sump phase	4-51
4.6.2.2	Main and Roof Leaching Phase	4-52
4.6.3	Brine Flow Rates.....	4-52
4.6.3.1	Power Supply	4-53
4.6.3.2	Post Construction	4-53
4.7	PHASING AND TIMESCALES	4-54
4.8	WASTE MANAGEMENT	4-56
4.8.1	Introduction	4-56
4.8.2	Key Legislation	4-56
4.8.3	Construction Phase.....	4-56
4.8.4	Liquid Effluent and Spillages.....	4-56
4.8.4.1	Control of Surface Water Run-off.....	4-56
4.8.4.2	Fuel and Oils	4-57
4.8.5	Sewage	4-58
4.8.6	Solid Wastes	4-58
4.8.6.1	Mixed Waste.....	4-58
4.8.7	Drilling Waste.....	4-59
4.8.7.1	Fresh water drill cuttings	4-59
4.8.7.2	Oil coated drill cuttings	4-59
4.8.7.3	Oil based drilling fluid	4-60
4.8.8	Emissions during Pipeline Testing, Commissioning and Operation.....	4-60
4.8.8.1	Liquid Effluent.....	4-60
4.8.8.2	Solid Wastes	4-60
4.9	OPERATIONS	4-63
4.10	DECOMMISSIONING	4-65
4.10.1	Pipeline and Above Ground Facilities Decommissioning.....	4-65

4.10.2	Decommissioning of Caverns	4-65
4.10.2.1	CSA (Cavern Sealing and Abandonment) Requirements.....	4-65
4.10.2.2	Preparations for Cavern Sealing.....	4-66
4.10.2.3	Cavern Sealing.....	4-66
4.10.2.4	Monitoring.....	4-66
5.0	TERRESTRIAL FLORA, FAUNA AND BIRDS	5-1
5.1	INTRODUCTION	5-1
5.1.1	Study Area	5-1
5.1.2	Report Scope	5-2
5.1.2.1	Scope of Ecological Surveys.....	5-2
5.1.2.2	Appropriate Assessment.....	5-2
5.1.3	Project Description.....	5-2
5.2	METHODOLOGY	5-5
5.2.1	Key Sources	5-5
5.2.2	Consultation	5-6
5.2.3	Wintering Bird Desktop Study	5-6
5.2.4	Field Survey Methodology	5-7
5.2.4.1	Extended Phase 1 Habitat Survey	5-7
5.2.4.2	Bird Survey Methodology	5-8
5.2.4.3	Mammal Surveys.....	5-11
5.2.4.4	Reptiles & Amphibians	5-12
5.2.4.5	Invertebrates	5-12
5.2.5	Impact Assessment.....	5-12
5.3	BASELINE ASSESSMENT	5-14
5.3.1	Consultation	5-14
5.3.2	Sites Designated for Nature Conservation in Northern Ireland.....	5-14
5.3.2.1	Special Areas of Conservation (SACs) and Special Protection Areas (SPAs).....	5-14
5.3.2.2	Areas of Special Scientific Interest (ASSIs)	5-15
5.3.2.3	Ramsar Sites.....	5-16
5.3.3	Non-Designated for Nature Conservation in Northern Ireland	5-16
5.3.4	Protected Rivers	5-17
5.3.5	Protected Species (Existing Records)	5-17
5.3.6	Habitat Survey Results	5-18
5.3.6.1	Habitat Descriptions	5-20
5.3.6.2	Protected Floral Species & Habitats Recorded.....	5-24
5.3.6.3	Invasive Species	5-27
5.3.7	Bird Survey Results	5-27
5.3.7.1	Survey Conditions	5-27
5.3.7.2	Wintering Farmland Bird Survey Results	5-28
5.3.7.3	Breeding Farmland Bird Survey Results.....	5-30
5.3.7.4	Open Coast Waterbirds Survey Results	5-33
5.3.7.5	Key Species Accounts	5-35
5.3.7.6	RPS Open Coast Results vs. BTO NEWS Results.....	5-37
5.3.7.7	Black Guillemot Survey Results.....	5-37
5.3.7.8	Summary of Protected Bird Species Recorded	5-42

5.3.8	Mammal Survey Results	5-43
5.3.8.1	<i>Otter</i>	5-43
5.3.8.2	<i>Badger</i>	5-43
5.3.9	Invertebrates	5-45
5.4	IMPACT ASSESSMENT	5-48
5.4.1	Designated Sites	5-50
5.4.1.1	<i>Larne Lough SPA/Ramsar</i>	5-50
5.4.1.2	<i>Swan Island SPA/National Nature Reserve</i>	5-54
5.4.1.3	<i>Larne Lough ASSI</i>	5-60
5.4.1.4	<i>Portmuck ASSI/Gobbins pASSI</i>	5-63
5.4.2	Non-Designated Sites	5-65
5.4.3	Local Habitats & Wildlife	5-65
5.5	MITIGATION	5-72
5.5.1	Designated Sites	5-72
5.5.1.1	<i>Pollution Mitigation</i>	5-72
5.5.1.2	<i>Impact-specific Mitigation</i>	5-73
5.5.2	5.5.2 Non-Designated Sites	5-74
5.5.3	Local Habitats	5-74
5.5.3.1	<i>Pollution prevention mitigation</i>	5-74
5.5.3.2	<i>Impact-specific Mitigation</i>	5-74
5.6	RESIDUAL IMPACTS	5-76
5.7	COMPENSATORY MEASURES	5-76
5.7.1	Local Habitats and Wildlife	5-76
6.0	INTERTIDAL AND UNDERWATER FLORA & FAUNA, FISHERIES AND MARINE MAMMALS	6-1
6.1	INTRODUCTION	6-1
6.1.1	Survey Extent and Rationale	6-1
6.1.1.1	<i>Benthic Surveys</i>	6-1
6.1.1.2	<i>Intertidal Surveys</i>	6-2
6.1.1.3	<i>Marine Mammal Surveys</i>	6-2
6.1.1.4	<i>Pot Fishery Surveys</i>	6-2
6.1.2	Survey Components	6-3
6.1.2.1	<i>Intertidal Survey</i>	6-3
6.1.2.2	<i>Drop Down Video Survey</i>	6-3
6.1.2.3	<i>Diver Survey</i>	6-3
6.1.2.4	<i>Sediment Infaunal Survey</i>	6-3
6.1.3	Survey Outputs	6-3
6.2	INTERTIDAL FIELD SURVEYS	6-4
6.2.1	Methodology	6-4
6.2.1.1	<i>Littoral Survey</i>	6-4
6.2.2	Results	6-7
6.2.2.1	<i>Plates - Eastern Shore</i>	6-9
6.2.3	Plates - Larne Lough Shore	6-14
6.3	BENTHIC VIDEO BASELINE SURVEY	6-17
6.3.1	Methods	6-17

6.3.2	Points Surveyed.....	6-17
6.3.3	Results.....	6-18
6.3.4	Discussion.....	6-18
6.3.4.1	Overview	6-18
6.3.4.2	Principal Station Groupings based on Video Observations	6-18
6.3.4.3	Station Group Descriptions	6-19
6.4	DIVE SURVEY.....	6-23
6.4.1	Survey Methodology	6-26
6.4.2	Summary table.....	6-27
6.4.3	DIVE 1 – Located at ROV Station 2 – (Depth 18m).....	6-29
6.4.4	DIVE 2 - Transect between ROV Stations 7&8 (T7-8) (Depth 26.2m–17.2m).....	6-35
6.4.5	DIVE 3 - Transect between ROV Stations 8 & 9 (Depth 16.5-12.2m)	6-40
6.4.6	DIVE 4 – Located at ROV Station 17 (Depth 33m).....	6-46
6.4.7	DIVE 5 – Located at ROV Station 19 (Depth 27m).....	6-50
6.4.8	DIVE 6 - 250m SE of Station 19 (Depth 27.5m)	6-54
6.4.9	DIVE 7 - 250m NW of ROV Station 19 (Depth 27m)	6-57
6.4.10	DIVE 8 - Transect between ROV Stations 20 & 21 (Depth 20m – 15m).....	6-60
6.4.11	DIVE 9 - Transect between ROV Stations 22 & 23 (Depth 14m – 8m).....	6-65
6.4.12	DIVE 10 - Transect between ROV Stations 31 & 32 (Depth 26.4m - 27.1m)	6-70
6.4.13	DIVE 11 - Transect between ROV Stations 32 & 33 (Depth 16.2m – 10.3m).....	6-74
6.4.14	DIVE 12 – Located at ROV Station 41 (Depth 5.2m).....	6-79
6.4.15	Habitat map.....	6-81
6.4.15.1	Habitat distribution.....	6-81
6.5	SEDIMENT INFAUNAL SURVEY.	6-84
6.5.1	Methodology	6-84
6.5.2	Sub-tidal Dredge Samples	6-86
6.5.3	Sub-tidal Grab Samples.....	6-86
6.5.4	Sample Processing.....	6-86
6.5.5	Data Analysis.....	6-86
6.5.6	Results And Habitat Assessment.....	6-87
6.5.6.1	Anchor Dredge	6-87
6.5.7	Van-Veen Grabs	6-90
6.6	ISLANDMAGEE STORAGE PROJECT BRINE DISCHARGE IMPACTS.....	6-91
6.6.1	Relevant Features of the Discharge	6-91
6.6.2	The Nature of Hypersaline Impacts	6-92
6.6.2.1	Overview of Impacts.....	6-92
6.6.3	Impacts Associated with Brine Discharges & How Organisms Adjust to these Changes	6-93
6.6.3.1	Overview of Osmoregulation.....	6-93
6.6.3.2	Osmoregulation, Osmosis and Osmotic Pressure.....	6-93
6.6.3.3	Extracellular and Intracellular Osmotic Responses	6-94
6.6.3.4	A note on Ionic Regulation	6-95
6.6.3.5	Interstitial salinities: water density.....	6-95
6.6.4	Impacts at Islandmagee.....	6-95
6.6.4.1	Overview of Habitats Influenced and Invertebrate Groups Affected.....	6-95
6.6.4.2	Nature of the Impact and Sources of Information	6-96

6.6.4.3	<i>Sensitivity of Individual Species and Groups of Invertebrates to Increased Salinity</i>	6-98
6.6.4.4	<i>Implications for Echinoderms of the Islandmagee Brine Discharge</i>	6-100
6.6.4.5	<i>Impacts on Algae at Islandmagee</i>	6-109
6.6.5	Summary of Impacts Based on A review of Physiology of Representative Invertebrate Groups	6-111
6.6.5.1	<i>Inner Zone of Greatest Impact – PSU Greater than 40</i>	6-111
6.6.5.2	<i>Intermediate Zone – PSU between 38 and 40</i>	6-112
6.6.5.3	<i>Low Impact Zone – PSU between 36 and 38</i>	6-112
6.6.5.4	<i>Non-impacted Zone - PSU between 34 and 36</i>	6-112
6.6.6	Timeline of the Impacts	6-113
6.6.7	Significance of the Impacts	6-113
6.6.7.1	<i>Severity of the Impact</i>	6-113
6.6.7.2	<i>The Scale of the Impact</i>	6-113
6.6.7.3	<i>Duration of the Impact</i>	6-114
6.6.7.4	<i>Rarity of the Species Impacted</i>	6-114
6.6.7.5	<i>Cumulative & In-combination Impacts</i>	6-114
6.6.8	Overall Significance of the Impact	6-114
6.6.9	MITIGATION	6-115
6.7	FISHERIES	6-116
6.7.1	Introduction	6-116
6.7.2	Methodology	6-116
6.7.3	Existing baseline	6-116
6.7.3.1	<i>Crustacean fishery</i>	6-117
6.7.3.2	<i>Bivalve fishery</i>	6-119
6.7.3.3	<i>Shellfish Aquaculture</i>	6-119
6.7.3.4	<i>Recreational sea angling</i>	6-122
6.7.3.5	<i>Migratory Salmonids</i>	6-122
6.7.4	Potential impacts	6-123
6.7.4.1	<i>Disposal of Brine to Sea</i>	6-123
6.7.4.2	<i>Suspended Solids</i>	6-126
6.7.4.3	<i>Impingement at sea water intake</i>	6-127
6.7.5	Mitigation measures	6-127
6.7.5.1	<i>Intake Design</i>	6-127
6.7.5.2	<i>Monitoring of Brine Dispersion</i>	6-127
6.7.5.3	<i>Use of Sentinel Organisms in Monitoring Programme</i>	6-127
6.7.5.4	<i>Monitoring of commercial shellfish stocks</i>	6-128
6.7.5.5	<i>Stock enhancement</i>	6-128
6.7.5.6	<i>Liaison with fishing industry</i>	6-128
6.7.6	Predicted Residual impacts	6-128
6.7.6.1	<i>Commercial fishing</i>	6-128
6.7.6.2	<i>Shellfish aquaculture</i>	6-128
6.7.6.3	<i>Impingement at Sea Water Intake</i>	6-129
6.7.6.4	<i>Salmonid Migrations</i>	6-129
6.7.6.5	<i>Sea Angling</i>	6-129
6.8	MARINE MAMMALS	6-130
6.8.1	Methodology	6-130

6.8.2	Study Area	6-131
6.8.3	Sightings of harbour porpoises (<i>Phocaena phocaena</i>)	6-132
6.8.4	Sightings of seals (<i>Halichoerus grypus</i> and <i>Phoca vitulina</i>)	6-136
6.8.5	Comments on possible impact of the proposed construction and operation of the brine outfall	6-138
6.8.5.1	Construction Phase of Brine Outfall and Sea Water Intake	6-139
6.8.5.2	Operation Phase of Brine Outfall	6-140
6.8.5.3	Residual Impacts on Marine Mammals	6-140
6.8.6	Plates Seal species, age and sex classes recorded during the Islandmagee Storage Project surveys	6-140
6.9	MARINE WATER QUALITY	6-145
6.9.1.1	The Water Framework Directive	6-145
7.0	AIR AND CLIMATE	7-1
7.1	CLIMATE	7-1
7.1.1	Existing Climate	7-1
7.1.1.1	Rainfall	7-1
7.1.1.2	Wind	7-3
7.1.2	Climate Impact	7-5
7.2	NOISE	7-7
7.2.1	Existing Noise Levels	7-7
7.2.1.1	Survey Details	7-7
7.2.1.2	Survey Results and Discussion	7-7
7.2.1.3	Noise Sensitive Receptors	7-9
7.2.2	Construction Noise Assessment	7-10
7.2.2.1	Construction Noise Limits	7-10
7.2.2.2	Noise Model Input	7-11
7.2.2.3	Prediction of Construction Noise Levels	7-13
7.2.2.4	Road Traffic Noise	7-16
7.2.3	Operational Noise and Above Ground Installations	7-17
7.2.3.1	Permissible levels for fixed plant at Gas Plant Storage Facility	7-17
7.2.4	Mitigation Measures	7-18
7.2.4.1	Choice of Plant	7-18
7.2.4.2	Screening	7-19
7.2.4.3	Monitoring	7-19
7.2.4.4	Appointment of a Responsible Person	7-19
7.2.5	Noise Residual Impacts	7-19
7.3	VIBRATION	7-20
7.3.1	Existing Environment	7-20
7.3.2	Potential Impacts during Construction Phase	7-20
7.3.2.1	Vibration Criteria	7-20
7.3.3	Mitigation Measures	7-21
7.3.3.1	Vibration Residual Impact	7-21
7.4	AIR QUALITY	7-22
7.4.1	Dust	7-22
7.4.2	Construction Phase	7-22

7.4.3	Operation Phase	7-23
7.4.4	Dust Residual Impact.....	7-23
8.0	MATERIAL ASSETS	8-1
9.0	COASTAL PROCESSES	9-1
9.1	STUDY METHODOLOGY	9-1
9.2	MODELLING SYSTEM.....	9-2
9.2.1	Irish Sea Model.....	9-2
9.2.2	Islandmagee Model.....	9-3
9.2.3	Model Verification	9-6
9.2.3.1	Model Verification Data.....	9-6
9.2.4	Model verification results	9-9
9.3	BRINE DISPERSION MODEL.....	9-21
9.3.1	Computational Models	9-21
9.3.1.1	Initial Dilution Model	9-21
9.3.1.2	Medium and Far Dispersion Model	9-22
9.3.2	Data for the Brine Dispersion Study.....	9-22
9.3.2.1	Outfall Location	9-22
9.3.2.2	Brine Discharge Conditions.....	9-23
9.3.3	Brine Dispersion Model Results.....	9-24
9.3.3.1	Initial Dilution	9-24
9.3.4	Medium and Far Field Brine Dispersion.....	9-26
9.3.4.1	Brine dispersion during neap tides.....	9-28
9.3.4.2	Brine dispersion during spring tides.....	9-36
9.4	POTENTIAL FOR INCREASED SUSPENDED SEDIMENTS TO ARISE FROM LEACHING ACTIVITIES.....	9-39
9.4.1	Suspension of Insolubles within the leached salt.....	9-39
9.4.2	Potential for discharge of foam	9-40
9.5	H.D.D. BREAKOUT DISCHARGE CONDITIONS	9-41
9.6	SUMMARY AND CONCLUSIONS	9-43
9.6.1	Initial Dilution.....	9-43
9.6.2	Hydrodynamic Modelling.....	9-43
9.6.3	Dispersion Modelling.....	9-43
9.6.4	H.D.D. Breakout.....	9-43
10.0	CULTURAL HERITAGE	10-1
10.1	TERRESTRIAL AND INTERTIDAL ARCHAEOLOGY.....	10-1
10.1.1	Methodology for establishing baseline conditions.....	10-1
10.1.2	Baseline Conditions	10-2
10.1.2.1	Sites and Monuments Record.....	10-2
10.1.2.2	Industrial Heritage Sites	10-6
10.1.2.3	Historic Buildings.....	10-7
10.1.2.4	Defence Heritage Project.....	10-7
10.1.2.5	Shipwrecks.....	10-7
10.1.2.6	Previous Archaeological Investigations	10-8

10.1.2.7	<i>Ulster Museum Topographical Records</i>	10-9
10.1.2.8	<i>Historic Cartographical Evidence</i>	10-10
10.1.2.9	<i>Aerial Photographic Evidence</i>	10-12
10.1.3	Site Walkover.....	10-13
10.1.4	Potential Impacts	10-16
10.1.4.1	<i>Direct Impacts</i>	10-16
10.1.4.2	<i>Indirect Impacts</i>	10-19
10.1.5	Mitigation Measures.....	10-21
10.1.5.1	<i>Mitigation Measures for Direct Impacts</i>	10-21
10.1.5.2	<i>Mitigation Measures for Indirect Impacts</i>	10-23
10.1.6	Residual Impacts	10-23
10.2	SUBTIDAL ARCHAEOLOGY	10-51
10.2.1	Introduction	10-51
10.2.1.1	<i>The Proposed Development</i>	10-51
10.2.1.2	<i>The Receiving Environment</i>	10-51
10.2.1.3	<i>Photographic Data</i>	10-56
10.2.2	Impact of Development.....	10-61
10.2.3	Conclusions	10-61
10.2.4	Suggested Mitigation Measures.....	10-62
10.2.4.1	<i>Pre-construction Measures</i>	10-62
10.2.4.2	<i>Construction Phase Measures</i>	10-62
10.2.4.3	<i>Project Management Measures</i>	10-62
11.0	LANDSCAPE & VISUAL IMPACT ASSESSMENT	11-1
11.1	INTRODUCTION	11-1
11.2	STATEMENT OF AUTHORITY	11-2
11.3	METHODOLOGY	11-2
11.3.1	Landscape Assessment Terminology	11-2
11.3.2	Visual Assessment Terminology	11-4
11.3.3	Theoretical Zone of Visual Influence (ZVI).....	11-6
11.3.4	Photomontages.....	11-9
11.4	A STATEMENT OF SOURCE MATERIAL	11-9
11.5	BASELINE LANDSCAPE SETTING	11-9
11.5.1	Landscape and Visual Context	11-9
11.5.2	Landscape Character.....	11-10
11.5.3	Planning Designations	11-11
11.5.4	Northern Ireland Landscape Assessment Series.....	11-13
11.5.5	The Ulster Way/Long Distance Footpaths and Amenity	11-14
11.6	SUMMARY OF THE PROPOSED DEVELOPMENT	11-14
11.7	LANDSCAPE AND VISUAL ASSESSMENT	11-14
11.7.1	Description of the Sources of Impact.....	11-14
11.7.2	Landscape Character Impacts during Construction Stage and Commissioning 11-15	
11.7.3	Visual Impacts during Construction Phase and Commissioning.....	11-15
11.7.4	Zone of Visual Influence (ZVI)	11-16
11.7.5	Operation Phase Landscape Impacts.....	11-17

11.7.6	Operation Phase Visual Impacts.....	11-17
11.7.6.1	Visual Impact for residential properties.....	11-17
11.7.6.2	Views from Class A Roads.....	11-18
11.7.6.3	Class B roads.....	11-19
11.7.6.4	Viewpoints and Photomontages.....	11-19
11.7.6.5	Ulster Way/ Long Distance Paths and Amenity.....	11-24
11.7.6.6	Impacts on Planning Designations.....	11-24
11.7.6.7	Impacts on Historic Parks, Gardens and Demesnes.....	11-24
11.8	DESIGN RECOMMENDATIONS AND MITIGATING MEASURES.....	11-25
11.8.1	Mitigating Measures.....	11-25
11.8.1.1	Woodland Framework Planting.....	11-25
11.8.1.2	Management and Maintenance.....	11-26
11.8.1.3	Retention of Existing Trees.....	11-26
11.8.2	Design Recommendations.....	11-26
11.9	RESIDUAL IMPACTS	11-27
12.0	GEOLOGY AND HYDROGEOLOGY	12-1
12.1	REGIONAL SETTING	12-1
12.1.1	Seismic investigations to reveal deep geology in Larne Lough area.....	12-5
12.1.2	Surface geology in area of proposed facilities	12-7
12.2	HYDROGEOLOGY.....	12-12
12.2.1	Soils.....	12-13
12.3	DRAINAGE.....	12-14
12.3.1	Leaching Plant Site.....	12-15
12.3.2	Main Gas Plant Facility Site	12-15
12.3.3	Pipeline Routes.....	12-18
12.4	SLOPE STABILITY	12-18
12.4.1	Gas Plant Site.....	12-18
12.4.2	Leaching Plant Site.....	12-19
12.4.3	Wellpad Site.....	12-19
12.4.4	Sea Water Intake Pumping Station Site.....	12-19
12.5	SUBSIDENCE	12-20
12.6	IMPACT ASSESSMENT	12-21
12.6.1	Loss of Exposure	12-21
12.6.2	Rockfall	12-21
12.6.3	Aquifer Contamination	12-22
12.7	RESIDUAL IMPACTS	12-22
13.0	HUMAN BEINGS	13-1
13.1	INTRODUCTION	13-1
13.2	SOCIO-ECONOMIC PROFILE	13-1
13.3	TOURISM	13-2
13.3.1	Bathing Waters	13-6
13.4	CORPORATE AND SOCIAL RESPONSIBILITY	13-8
13.5	SAFETY.....	13-9
13.5.1	Introduction	13-9

13.5.2	Safety Credentials of Islandmagee Storage Limited.....	13-9
13.5.3	Operational Safety	13-10
13.5.4	Safety Legislation.....	13-12
13.5.5	Standards and Design Codes.....	13-13
13.5.5.1	<i>Pipelines</i>	13-13
13.5.5.2	<i>Caverns and Wellheads</i>	13-14
13.5.5.3	<i>Storage and Gas Plant Facilities</i>	13-14
13.6	CONCLUSIONS	13-14
13.6.1	Predicted Impacts	13-14
13.6.2	Mitigation Measures.....	13-15
13.6.3	Residual Impacts	13-15
14.0	SUMMARY OF IMPACTS AND MITIGATION MEASURES	14-1
14.1	INTRODUCTION	14-1
14.2	TECHNICAL DIFFICULTIES	14-1
14.3	CONCLUSIONS	14-4

LIST OF FIGURES

Figure 1.1 Islandmagee Storage Licensed Exploration Areas	1-2
Figure 1.2 Main Gas Network in Ireland	1-3
Figure 1.3 Conceptual Cavern Design	1-4
Figure 1.4 Above ground elements of the proposed gas storage scheme	1-5
Figure 1.5 Remaining UKCS Reserves and Long Term Production Trends	1-11
Figure 1.6 Contour Map showing Thickness of Permian Salt	1-16
Figure 1.7 Areas of land from where thick salt beneath lough can be accessed	1-17
Figure 1.8 Constraints to Locating Above Ground Facilities	1-21
Figure 1.9 Identified intake sites and intake/outfall pipeline corridors	1-24
Figure 1.10 British Salt Factory, Middlewich, Cheshire	1-29
Figure 1.11 Planning Hierarchy	1-33
Figure 1.12 Spatial Development Strategy	1-35
Figure 1.13 Format of the Environmental Impact Statement	1-51
Figure 3.1 Site Location (Regional Context)	3-1
Figure 3.2 General Layout of Above-Ground Elements of Gas Storage Facility	3-3
Figure 3.3 Location of Sea water Intake and Brine Outfall Pipelines	3-4
Figure 3.4 Pipeline Routes	3-8
Figure 3.5 Areas formerly used for disposal	3-9
Figure 3.6 Admiralty Chart of northern section of Larne Lough.	3-12
Figure 3.7 Environmental Designations	3-12
Figure 3.8 Infrastructure surrounding proposed site of gas storage facilities	3-15
Figure 4.2 Proposed platform levels - gas plant site	4-6
Figure 4.3 Cut and full areas and side slopes at gas plant site	4-7
Figure 4.4 Platform level and cut/fill areas at brine plant site	4-8
Figure 4.5 Working Width Layout – Mainline	4-18
Figure 4.6 Working Width Layout – Crossing	4-19
Figure 4.7 Reduced Working – Hedgerow Crossing	4-20
Figure 4.8 Seawater Intake Pumping Station	4-41
Figure 4.9 Schematic Drawing of Wells	4-46
Figure 4.10 Cavern spacing and preliminary layout	4-51
Figure 4.11 Leaching settings, brine saturation and geometrical volume	4-52
Figure 4.12 Schematic of Estimated Project Timeline	4-54
Figure 4.13 Flow diagram for gas operations	4-63
Figure 4.14 Annual potential utilisation profile	4-64
Figure 5.1 Conservation Designations	5-3
Figure 5.2 Ecological Survey Areas	5-4
Figure 5.3 Habitat Map (West)	5-25
Figure 5.4a Habitat Map (East)	5-25
Figure 5.4b Habitat Map (East)	5-26
Figure 5.5a Breeding Bird Territories (Map 1)	5-39
Figure 5.5b Breeding Bird Territories (Map 2)	5-39
Figure 5.5b Breeding Bird Territories (Map 2)	5-40
Figure 5.6a Black Guillemot Breeding Sites	5-40
Figure 5.6b Black Guillemot Breeding Sites	5-41
Figure 5.7a Mammal Activity (West)	5-46

Figure 5.7b Mammal Activity (East)	5-46
Figure 5.7b Mammal Activity (East)	5-47
Figure 6.1 Intertidal transects, Islandmagee eastern shore	6-5
Figure 6.2 Intertidal transects, Islandmagee western shore.....	6-6
Figure 6.4 Location of Dive Stations (East Coast)	6-24
Figure 6.5 Location of Dive Stations (West Coast)	6-25
Figure 6.6 Habitat Map.....	6-82
Figure 6.7 Map showing locations of Anchor Dredge samples.	6-85
Figure 6.8 Multi-dimensional scaling plot of the faunal dredges.	6-87
Figure 6.9 Cluster Diagram outlining the similarity between the sites.....	6-88
Figure 6.10 Survey areas, lobster monitoring programme.	6-118
Figure 6.11 Areas licensed for shellfish production in Larne Lough.....	6-120
Figure 6.12 Location of Larne and Glynn rivers	6-123
Figure 6.14 Detail of the Maiden Rocks (left) and the Isle of Muck.....	6-132
Figure 6.15 Locations of harbour porpoises in the study area	6-135
Figure 6.16 Water Framework Directive Coastal Waterbodies	6-146
Figure 7.1 30 Year Average 1971-2000 Maximum and Minimum Monthly Temperatures....	7-2
Figure 7.2 30 Year Average 1971-2000 Monthly Rainfall	7-2
Figure 7.3 Monthly Mean Wind Speed, 1971-2000.....	7-3
Figure 7.4 10 Year Annual Average Wind Rose for Aldergrove Station 1993-2002	7-4
Figure 7.5 January 2007- March 2010 Weather Data from Larne Weather Station.....	7-5
Figure 7.6 Measurement Location Plan	7-8
Figure 7.7 Noise sensitive locations, (Not to scale, for illustrative purposes only)	7-9
Figure 7.8 Noise sensitive locations, (Not to scale, for illustrative purposes only)	7-10
Figure 9.1: Extent of Irish Sea Tidal Surge Model.....	9-2
Figure 9.2: Extent of the detailed Islandmagee Tidal Model	9-4
Figure 9.3: Mesh and Bathymetry in the Castle Robin Area	9-5
Figure 9.4: Bathymetric Survey Extent.....	9-6
Figure 9.5: Location of Current Meter Points and Outfall Location at Islandmagee	9-7
Figure 9.6: Measured Total Water Level compared with Modelled Tidal elevations during a Neap Tidal Cycle	9-9
Figure 9.7: Measured Total Water Level compared with Modelled Tidal elevations during a Spring Tidal Cycle	9-10
Figure 9.8: Variation of Wind Speed during the Neap Tidal Cycle	9-10
Figure 9.9: Comparison of Modelled and Observed Neap Current Direction (above) and Speed (below) at M1	9-12
Figure 9.10: Comparison of Modelled and Observed Neap Current Direction (above) and Speed (below) at M2	9-13
Figure 9.11: Comparison of Modelled and Observed Neap Current Direction (above) and Speed (below) at M4	9-14
Figure 9.12: Comparison of Modelled and Observed Spring Current Direction (above) and Speed (below) at M1	9-15
Figure 9.13: Comparison of Modelled and Observed Current Direction (above) and Speed (below) at M2.....	9-16
Figure 9.14: Comparison of Modelled and Observed Current Direction (above) and Speed (below) at M3.....	9-17

Figure 9.15: Comparison of Modelled and Observed Spring Current Direction (above) and Speed (below) at M4	9-18
Figure 9.16: Mid Flood tidal patterns during a Neap Tidal Cycle	9-19
Figure 9.17: Mid Ebb tidal patterns during a Neap Tidal Cycle	9-20
Figure 9.18: Location of the Proposed Outfall.....	9-23
Figure 9.19: Brine plume trajectory, single outlet.....	9-25
Figure 9.20: Initial dilution prediction.....	9-26
Figure 9.21: Modelling zones implemented for medium and far field brine dispersion	9-27
Figure 9.22: Maximum Salinity during a Neap Tide Cycle – Bottom Layer 1	9-29
Figure 9.23: Salinity and Current Vectors at High Neap Tide – Bottom Layer 1	9-29
Figure 9.24: Salinity and Current Vectors at Low Neap Tide – Bottom Layer 1	9-30
Figure 9.25: Salinity and Current Vectors at Mid Ebb Neap Tide – Bottom Layer 1	9-30
Figure 9.26: Salinity and Current Vectors at Mid Flood Neap Tide – Bottom Layer 1.....	9-31
Figure 9.27: Maximum Salinity during a Neap Tide Cycle – Middle Layer 2.....	9-31
Figure 9.28: Maximum Salinity during a Neap Tide Cycle – Middle Layer 3.....	9-32
Figure 9.29: Maximum Salinity during a Neap Tide Cycle – Surface Layer 4.....	9-32
Figure 9.30: Vertical Profile of the Salinity distribution at low tide during a Neap Tide Cycle .	9-33
Figure 9.31: Vertical Profile of the Salinity distribution at mid flood during a Neap Tide Cycle	9-33
Figure 9.32: Vertical Profile of the Salinity distribution at mid ebb during a Neap Tide Cycle.	9-34
Figure 9.33: Maximum Temperature during a Neap Tide Cycle – Bottom Layer 1	9-34
Figure 9.34: Vertical Profile of Maximum Temperature distribution during a Neap Tide Cycle	9-35
Figure 9.35: Location of Vertical Profile Shown in Figure 4.17	9-35
Figure 9.36: Maximum Salinity during a Spring Tide Cycle - Bottom Layer 1	9-36
Figure 9.37: Salinity and Current Vectors at High Spring Tide – Bottom Layer 1	9-37
Figure 9.38: Salinity and Current Vectors at Low Spring Tide – Bottom Layer 1	9-37
Figure 9.39: Salinity and Current Vectors at Mid Ebb Spring Tide – Bottom Layer 1	9-38
Figure 9.40: Salinity and Current Vectors at Mid Flood Spring Tide – Bottom Layer 1.....	9-38
Figure 10.1 Recorded archaeology logical sites within 1km wide search corridor.	10-24
.....	10-25
Figure 10.2 Extent of scheduled area around anti-aircraft battery (ANT 041:050).....	10-25
Figure 10.3 Recorded Industrial Heritage sites within vicinity of pipeline.	10-26
Figure 10.4 Historic Buildings within 1km wide search corridor	10-27
Figure 10.5 Defence Heritage Project site within 1km wide search corridor	10-28
Figure 10.6 Recorded shipwrecks within vicinity of seawater intake and brine outfall pipes	10-29
Figure 10.7 Map of Belfast Lough drawn around 1570 possibly by Robert Lythe. Island Magee is partially drawn to northeast.....	10-30
Figure 10.8 First Edition Ordnance Survey sheet (1834)	10-31
Figure 10.9 Second edition Ordnance Survey sheet (1857)	10-32
Figure 10.10 1932 Edition Ordnance Survey sheet.	10-33
Figure 10.11 Layout of scheme showing proposed works.	10-34
Figure 10.12 Proposed Cultural Heritage mitigation.	10-35

Figure 10.13 High Resolution Aerial Photograph showing Brine Outfall and Sea Water intake routes	10-64
Figure 10.14 Proposed Intake and Outfall routes superimposed on Multi beam sonar bathymetry.....	10-64
Figure 10.14 Proposed Intake and Outfall routes superimposed on Multi beam sonar bathymetry.....	10-65
Figure 10.15 Extract from First Edition OS Map.....	10-66
Figure 10.16 Shipwreck and SMR sites on Bathymetry	10-67
Figure 10.17 Shipwreck Names	10-68
Figure 11.1 Zone of Visual Influence.....	11-7
Figure 11.2 Photomontage Locations	11-8
PHOTOMONTAGES Photomontage of Viewpoint 1 - Existing View	11-29
Photomontage of Viewpoint 1 - Existing View.....	11-30
Photomontage of Viewpoint 1 - Predicted View during Operation Phase	11-31
Photomontage of Viewpoint 2 - Existing View.....	11-32
Photomontage of Viewpoint 2 - Predicted View during Operation Phase	11-33
Photomontage of Viewpoint 3 - Existing View.....	11-34
Photomontage of Viewpoint 3 - Predicted View during Operation Phase	11-35
Photomontage of Viewpoint 4 - Existing View.....	11-36
Photomontage of Viewpoint 4 - Predicted View during Operation Phase	11-37
Photomontage of Viewpoint 5 - Existing View.....	11-38
Photomontage of Viewpoint 5 - Predicted View during Operation Phase	11-39
Photomontage of Viewpoint 6 - Existing View.....	11-39
Photomontage of Viewpoint 6 - Predicted View during Operation Phase	11-40
Photomontage of Viewpoint 7 - Existing View.....	11-41
Photomontage of Viewpoint 7 - Predicted View during Construction Phase (Drilling)	11-43
Photomontage of Viewpoint 8 - Existing View.....	11-44
Photomontage of Viewpoint 8 - Predicted View during Construction Phase (Drilling)	11-45
Photomontage of Viewpoint 7 - Predicted View of Wellpad during Operation Phase	11-45
Photomontage of Viewpoint 8 - Predicted View of Wellpad during Operation Phase	11-47
Figure 12.1 Larne Basin and major Caledonian faults; structural insert map.....	12-1
Figure 12.2 Regional isopach map for Permian salt in the vicinity of Larne Lough.....	12-3
Figure 12.3 Imaging from seismic survey showing detail beneath Larne Lough.....	12-5
Figure 12.4 Depth map of the top of the Permian salt from 3D-seismic survey	12-6
Figure 12.5 Isopach map of the Permian salt from 3D-seismic survey	12-7
Figure 12.6 Surface Geology	12-8
Figure 12.7 Bedrock Aquifer Status	12-12
Figure 12.8 Superficial Aquifers	12-13
Figure 12.9 Soil Map	12-14
Figure 12.10 Schematic Drainage Proposal at Leaching Plant Site.....	12-16
Figure 12.11 Schematic of Drainage Proposal at Main Gas Plant Facility.....	12-17
Figure 13.1 Browns Bay Bathing Water	13-7

LIST OF TABLES

Table 1.1	Scoping Matrix.....	1-52
Table 2.1	List of Statutory and non-statutory bodies issued with written invitation.....	2-1
Table 4.1	Cut and Fill Volumes	4-10
Table 4.2	Typical wastes generated by Construction.....	4-61
Table 4.3	Potential Special Wastes generated by Construction	4-62
Table 5.1	Guidance on Describing the Ecological Value of Features	5-13
Table 5.2	Protected Flora & Fauna recorded in the grid square D40.....	5-17
Table 5.3	Habitats Recorded within the Study Area.....	5-18
Table 5.4	Priority Habitats within the Study Area	5-24
Table 5.5	Protected Flora within Scheme Area.....	5-27
Table 5.6	Bird Survey Weather Conditions	5-27
Table 5.7	Peak Counts of wintering Farmland Birds.	5-28
Table 5.8	Summary Table of Breeding Bird Territories within Survey Area	5-31
Table 5.9	Peak Counts for Open Coast Waterbirds	5-33
Table 5.10	Peak Open Coast Bird Counts for RPS and NEWS.....	5-37
Table 5.11	Black Guillemot Breeding Population Survey Results.....	5-38
Table 5.12	Black Guillemot Productivity Survey Results.....	5-38
Table 5.13	Summary Table of Protected Bird Species in All Surveys.....	5-42
Table 5.14	Summary of Badger Setts along Pipeline Route	5-43
Table 5.15	Butterflies Recorded in Scheme Area	5-45
Table 5.16	Criteria for Determining the Magnitude of Potential Ecological Impact*	5-49
Table 5.17	Estimating the Overall Ecological Appraisal Category	5-49
Table 5.18	Summary Table of Potential impacts on Larne Lough SPA /Ramsar.....	5-52
Table 5.19	Summary Table of Potential impacts on Swan Island SPA.....	5-58
Table 5.20	Summary of Impacts to Larne Lough ASSI	5-61
Table 5.21	Summary Table of Impacts on Gobbins Cliffs pASSI.....	5-64
Table 5.22	Summary of Potential Impacts on Local Habitats & Wildlife.....	5-67
Table 6.1	Irish Grid Positions for 8 intertidal transects at Islandmagee	6-7
Table 6.2	Video Survey Coordinates (Irish Grid).....	6-17
Table 6.3	Overview of the habitats identified during each dive	6-28
Table 6.5	Positions of benthic sampling stations.	6-84
Table 6.6	List of the most abundant Taxa	6-89
Table 6.7	Univariate descriptors of abundance and richness in the 10 dredge samples.	6-89
Table 6.8	Univariate descriptors of abundance and richness in the 3 Grab samples.	6-90
Table 6.9	Landings of lobster, brown crab and velvet crab into local ports, 2003-08	6-117
Table 6.10	Landings of King scallop to NI ports, 2003-08.....	6-119
Table 6.11	Shellfish production in Larne Lough, 2003-07	6-121
Table 6.12	Summary of discharge flow rates and total dissolved solids at Aldbrough.....	6-125
Table 6.13	Summary of salinity monitoring using sondes at Aldbrough.....	6-126
Table 6.14	Seal and porpoise survey days with TSR on North Irish Diver.....	6-130
Table 6.15	Locations and no. porpoises seen from survey boat (North Irish Diver)	6-133
Table 6.16	Group size of porpoise sightings	6-135
Table 6.17	Seal sightings at Maidens and Isle of Muck, surveys Sep-Dec 2008.....	6-137
Table 7.1	Daytime Noise Measurement Results	7-7
Table 7.2	Night time Noise Measurement Results	7-8

Table 7.3 Plant Sound Power Levels (construction phase works, Source levels taken from BS5228)	7-12
Table 7.4 Predicted noise levels at receptor locations for Phase 1.....	7-13
Table 7.5 Predicted noise levels at receptor locations for Phase 2.....	7-14
Table 7.6 Predicted noise levels at receptor locations for during night time	7-15
Table 7.7 Guidelines for Likelihood of Damage from Vibration	7-20
Table 9.1: Distance from Bed in metres at M1 – M4	9-9
Table 9.2: Table showing Water Column division into Layers within the Model.....	9-27
Table 10.1 Mitigation of Direct Impact.....	10-22
Table 10.2 Instances of Shipwrecking Events Recorded in the General Area	10-53
Table 10.3 Known Wreck-sites listed in the Historic Shipwreck Inventory	10-56
Table 10.4 Photographic images of seabed taken at Benthic Stations	10-58
Table 11.1 Significance of Landscape Impact.....	11-4
Table 11.2 Significance of Visual Impact	11-6
Table 12.1 Stratigraphic column of the Larne No. 2 Well.....	12-4
Table 13.1 Estimated Visitor Tourism Jan-Dec 2008/09	13-3
Table 13.2 Estimated Total Visitors by Home Area Jan-Dec 2008/ 09	13-3
Table 13.3 Estimated Holiday Visitors by Home Area Jan-Dec 2008/09	13-3
Table 13.4 Activities undertaken by visitors to Northern Ireland, 2008 (NITB).....	13-5

LIST OF PLATES

Plate 4.1 Typical Concrete Batching Plant	4-4
Plate 4.2 Installation of After Coolers	4-12
Plate 4.3 Installation of Compressors.....	4-12
Plate 4.4 Installation of Absorber Towers.....	4-13
Plate 4.5 General Construction Activity.....	4-13
Plate 4.6 Topsoil Stripping	4-19
Plate 4.7 Example of Reduced Working Width at Hedgerows.	4-20
Plate 4.8 Pipeline Stringing	4-22
Plate 4.9 Front End Welding	4-22
Plate 4.10 Trenching Machine.....	4-23
Plate 4.11 Lowering Pipeline into Trench.....	4-24
Plate 4.12 Thrust Bore Machine	4-28
Plate 4.13 Pipe Jacking.....	4-29
Plate 4.14 Typical Horizontal Directional Drilling Rig	4-30
Plate 4.15 HDD Entry Point.....	4-30
Plate 4.16 Horizontal Directional Exit Point.....	4-31
Plate 4.17 Typical Drilling Rig in operation.....	4-47
Plate 4.18 Typical drilling rig in operation at night.....	4-48
Plate 5.1 a&b Site of Gas Plant Facilities.....	5-77
Plate 5.2a&b Peregrine Falcon and Black Guillemots.....	5-78
Plate 5.3 Black Guillemot Breeding Site.....	5-79
Plate 5.4 Black Guillemot Breeding Site.....	5-80
Plate 5.5 Flora observed along pipeline route.....	5-81
Plate 5.6a&b Pipeline Route	5-82
Plate 5.7 Vent Stack Area	5-83
Plate 5.8a&b Neutral Flush below Gas Plant Facilities	5-84
Plate 5.9 Shingle habitats (NI priority habitat)	5-85
Plate 5.10 Invasive Species	5-86
Plate 5.11 Leaching Plant Site	5-87
Plate 5.12 Temporary Construction Set-down Area.....	5-87
Plate 5.13a&b Scrubland Area	5-88
Plate 5.14 Castle Robin Bay	5-89
Plate 5.15 Brine Pipeline Route	5-89
Plate 5.16 Black Guillemots	5-90
Plate 5.17 Badger Sett	5-90
Plate 5.18 Badger Sett 2	5-91
Plate 6.1 Eastern shore showing fissured blocks of bedrock.....	6-9
Plate 6.2 Eastern shore from higher vantage (view to SSE)	6-10
Plate 6.3 Large patch of <i>Cladophora rupestris</i> by rock fissure.....	6-10
Plate 6.4 Patch of <i>Lichina</i> over <i>Verrucaria</i> , with <i>Melarhaphe</i> and <i>Littorina</i> in pits and fissures in the rock.....	6-11
Plate 6.5 Barnacles on rock at extreme lower shore at low water.....	6-11
Plate 6.6 Shallow rock pool with encrusting calcareous red alga and limpets.	6-12

Plate 6.7 Small lower shore rock pool with encrusting calcareous red alga, <i>Corallina</i> and <i>Fucus serratus</i>	6-12
Plate 6.8 Narrow loose zone of <i>Corallina</i> and red algal turfs at extreme low tide. Note kelp (<i>Laminaria digitata</i>) in background).....	6-13
Plate 6.9 <i>Fucus</i> seaweed on mixed sediment – mid shore (near Transect 6 – view to the south).	6-14
Plate 6.10 Stretch of boulders between Transect 6 and 7 (view north to Ballylumford power station).....	6-14
Plate 6.11 Short stretch of exposed bedrock (baked limestone) between Transect 6 and 7 ..	6-15
Plate 6.12 <i>Littorina saxatilis</i> on small bare cobbles in the upper shore.....	6-15
Plate 6.13 <i>Pelvetia</i> on small cobbles and boulders on the upper shore (between T5 and T6)	6-16
Plate 6.14 <i>Ophiothrix</i> sp., <i>Ophiocomina</i> sp. and bryozoans on mixed sublittoral sediment (Station 2, Habitat 1)	6-30
Plate 6.15 <i>Flustra</i> sp., mixed bryozoans and hydroids on tide swept circalittoral mixed sediment (Station 2, Habitat 2).....	6-30
Plate 6.16 Algal encrusted boulder with <i>Pomatoceros</i> sp., <i>Balanus</i> sp. and <i>Echinus</i> sp. (Station 2, Habitat 3).	6-31
Plate 6.17 Example of one of the photo quadrat photographs taken at Station 2.	6-33
Plate 6.18 <i>Munida rugosa</i> , Station 2	6-33
Plate 6.19 The curled octopus, <i>Eledone cirrhosa</i> , at rest, Station 2	6-34
Plate 6.20 Dahlia anemone (<i>Urticina felina</i>) and hornwrack (<i>Flustra foliacea</i>), Station 2. ..	6-34
Plate 6.21 Juvenile sunstar (<i>Crossaster papposus</i>), barnacles and bryozoans (Transect 7-8, Habitat 1).....	6-36
Plate 6.22 Boulder with velvet swimming crab (<i>Necora puber</i>), barnacles (<i>Balanus</i> sp.), bryozoans (<i>Parasmittina</i> sp.), seaweed (<i>Desmarestia aculeata</i>) and urchins (<i>Echinus esculentus</i>), (Transect 7-8 Habitat 2).	6-37
Plate 6.23 Mixed kelps and scour-tolerant weeds, T7-8 (Transect 7-8 Habitat 3)..	6-38
Plate 6.24 Cobble supporting a sponge colony (<i>Cliona celata</i>) & opportunistic foliose red weeds. A variety of encrusting fauna are visible (bryozoans, polychaetes and barnacles) (Transect 7-8).....	6-38
Plate 6.25 Starfish (<i>Stichastrella rosea</i>) on mixed sediment, (Transect 7-8).	6-39
Plate 6.26 Variety of encrusting fauna/flora on mixed sediment, (Transect 8-9).....	6-41
Plate 6.27 Boulder with bryozoans (<i>Flustra foliacea</i>), seaweed (<i>Delesseria sanguinea</i>) and other encrusting flora and fauna (Transect 8-9)	6-42
Plate 6.28 Bedrock ledge encountered on Transect 8-9	6-43
Plate 6.29 Mixed kelp community on sand-scoured rocks, Transect 8-9	6-44
Plate 6.30 Starfish (<i>Leptasterias muelleri</i>) on cobbles, Transect 8-9,.....	6-44
Plate 6.31 Urchin (<i>Echinus esculentus</i>) among encrusted kelp stipes & rock, Transect 8-9. .	6-45
Plate 6.32 Unusual rock heap with urchin & foliose reds on Transect 8-9	6-45
Plate 6.33 Dragonet (<i>Callionymus lyra</i>) on circalittoral mixed sediment, Station 17	6-46
Plate 6.34 Tide-swept circalittoral mixed sediments typical of Station 17.	6-47
Plate 6.35 Starfish (<i>A. rubens</i> & <i>C. papposus</i> juv), bryozoans (<i>Securiflustra</i> sp.), Station 17.	6-48

Plate 6.36 Brittlestar (<i>Ophiura</i> sp.) on circalittoral mixed sediments, Station 17.....	6-48
Plate 6.37 Sponge (<i>Stelligera stuposa</i>) on mixed sediments, Station 17.....	6-49
Plate 6.38 Bryozoan-dominated community on mixed sediment. The main species visible are <i>Flustra foliacea</i> , <i>Eucratea loricata</i> and <i>Cellaria sinuosa</i> , Station 19.	6-51
Plate 6.39 Encrusted boulder with urchins (<i>Echinus esculentus</i>), bryozoans and an edible crab (<i>Cancer pagurus</i>), Station 19	6-52
Plate 6.40 Dwarf cuttlefish (<i>Sepiola atlantica</i>) among bryozoans, Station 19	6-52
Plate 6.41 Sunstar feeding on brittlestars among bryozoans, Station 19.....	6-53
Plate 6.42 Bryozoans (<i>Flustra</i> sp. and <i>Alcyonidium</i> sp.) on circalittoral mixed sediments, 250m SE of Station 19	6-55
Plate 6.43 Sunstar (<i>Crossaster papposus</i>) & <i>A. diaphanum</i> , 250m SE of Station 19.....	6-55
Plate 6.44 Bryozoans (<i>Flustra</i> & <i>Cellaria</i>), hydroid (<i>Hydrallmania falcata</i>) 250m SE of Station 19	6-56
Plate 6.45 Mixed sediment seafloor 250m NW of Station 19.	6-58
Plate 6.46 Polychaete tubes (<i>Bispira</i> sp. & <i>Chaetopterus</i> sp.) & bryozoans, 250m NW of Station 19	6-59
Plate 6.47 Urchin (<i>E. esculentus</i>), 250m NW of Station 19.....	6-59
Plate 6.48 King scallop (<i>Pecten maximus</i>) on mixed sediments. Transect 20-21. Numerous brittlestars (<i>Ophiura</i> sp.) polychaetes, barnacles and bryozoans are also visible.....	6-61
Plate 6.49 A variety of bryozoans (<i>Flustra</i> sp., <i>Securiflustra</i> sp. & <i>Cellaria</i> sp.), numerous brittlestars (<i>Ophiura</i> sp.), barnacles (<i>Balanus</i> sp.) on mixed sediment Transect 20-21.....	6-62
Plate 6.50 Starfish (<i>Asterias rubens</i>) and urchin (<i>Echinus esculentus</i>) on a sand-swept, encrusted boulder, Transect 20-21	6-63
Plate 6.51 Crab (<i>C. pagurus</i>), bryozoans and encrusting fauna, Transect 20-21	6-63
Plate 6.52 Bryozoans (<i>Securiflustra</i> sp., <i>Eucratea</i> sp.) on mixed sediments, Transect 20-21.....	6-64
Plate 6.53 Mixed sediments with a common starfish (<i>Asterias rubens</i>) T22-23, Nov 2009	6-66
Plate 6.54 Kelp park with encrusted stipes and urchin (<i>E. esculentus</i>), foliose red seaweeds, silt and coralline algae, Transect 22-23.....	6-67
Plate 6.55 Mixed kelps with encrusted stipes, and scour tolerant red seaweeds. This habitat was found adjacent to areas of mixed sediments on Transect 22-23	6-68
Plate 6.56 Urchin, cup corals (<i>Caryophyllia smithii</i>) & coralline algae on boulder, Transect 22-23	6-68
Plate 6.57 Lobster emerging from beneath encrusted boulders, Transect 22-23	6-69
Plate 6.58 <i>Alcyonidium</i> sp. & other bryozoans on mixed sublittoral sediments, Transect 31-32	6-71
Plate 6.59 Mixed sublittoral sediments with erect bryozoans (<i>Flustra</i> sp., <i>Securiflustra</i> sp. and <i>Eucratea</i> sp.), and barnacles, Transect 31-32	6-71
Plate 6.60 Erect bryozoan colony (<i>E. loricata</i>) on circalittoral mixed sediment, Transect 31-32	6-72
Plate 6.61 Pogge (<i>Agonus cataphractus</i>) on mixed sediment, Transect 31-32	6-72
Plate 6.62 Dragonet (<i>Callionymus lyra</i>) and erect bryozoan colonies, Transect 31-32	6-73
Plate 6.63 Anemone (<i>Actinothoe sphyrodeta</i>) on mixed sediments.....	6-73
Plate 6.64 Tide-swept bryozoan-dominated community – mixed sediments and boulders.....	6-75
Plate 6.65 Mixed kelps with scour tolerant/opportunistic red seaweeds, Transect 32-33.	6-76
Plate 6.66 Kelps, starfish and mixed reds on boulders and bedrock, Transect 32-33.	6-76

Plate 6.67 Encrusted boulder with cup corals (<i>C. smithii</i>), bryozoans, (<i>Parasmittina</i> sp.), velvet swimming crab (<i>Necora puber</i>), encrusting coralline alga (<i>Lithophyllum</i> sp.) and decaying sea beech (<i>Delesseria sanguinea</i>), Transect 32-33.	6-77
Plate 6.68 Urchin (<i>Echinus esculentus</i>) on encrusted boulder, Transect 32-33.	6-78
Plate 6.69 Sponge <i>Polymastia penicillus</i> , bryozoans (<i>Crisia</i> sp. and <i>Eucratea</i> sp.), Transect 32-33.	6-78
Plate 6.70 Swimming crab (<i>Liocarcinus depurator</i>) on sand with sand-tolerant seaweed (<i>Ahnfeltia plicata</i>) and anemones (<i>Sagartiogeton laceratus</i>).	6-79
Plate 6.71 Sponge (<i>Suberites ficus</i>), fish (<i>Pomatoschistus</i> sp.), weed (<i>A. plicata</i>), Station 41.	6-80
Plate 6.72 Anemones (<i>S. laceratus</i>) and sponge (<i>Cliona celata</i>) on old oyster shells, Station 41.	6-80
Plate 6.73 Harbour Porpoise	6-132
Plate 6.74 Whale observed feeding seaward of the Isle of Muck on 15/07/09.....	6-133
Plate 6.75 Two porpoises surface, part of group of 20–30 seen to north of Maidens on 11/09/09	6-136
Plate 6.76 Subadult female grey seal at West Light.....	6-140
Plate 6.77 Adult female grey seals at West Light, 11/09/09.....	6-141
Plate 6.78 Adult male and female grey seal resting together on Alan Rock, 11/09/09	6-141
Plate 6.79 Juvenile common seal (left) and juvenile grey seal female (right) at West Light 12/07/09	6-141
Plate 6.80 Adult male grey seal at Russell Rock, 27/9/08.....	6-142
Plate 6.81 Two adult female grey seals and 1 pup seen on 02/11, at West Light.....	6-142
Plate 6.82 Unidentified seal seen on West Light, beside an adult male-female pair of grey seals (re-entered water due to approach of boat, 27/9/08	6-143
Plate 6.83 Adult common seal at West Light, 12/07/09.....	6-143
Plate 6.84 Adult female grey seal (left) and adult male common seal (right); Mill Bay, Larne Lough – 11/09/09	6-144
Plate 10.1 Looking southeast across Castle Robin bay.	10-36
Plate 10.2 Area where saltwater intake pipe will run.	10-36
Plate 10.3 Looking north at area where seawater intake pipe will run.	10-37
Plate 10.4 Looking south along shoreline at area where brine outfall pipe will run.	10-37
Plate 10.5 Area of pasture field where the two pipes start to run southwest together.	10-38
Plate 10.6 Pasture fields where the two pipelines will run.....	10-38
Plate 10.7 Field where anti-aircraft battery (ANT 041:050) is located.....	10-39
Plate 10.8 Remains of scheduled protected anti-aircraft battery (ANT 041:050).	10-39
Plate 10.9 Scarped area along west side of field where pipelines will enter.	10-40
Plate 10.10 Post marking the line of the Scotland-Northern Ireland gas pipeline.	10-40
Plate 10.11 Looking northeast at fields and valley to west of Brown's Bay road.	10-41
Plate 10.12 Stream running north along valley floor.	10-41
Plate 10.13 The listed Historic Building, Inisreen (HB 06/04/026) located on the Brown's Bay road.	10-42
Plate 10.14 Terrain rising uphill to middle ridge of higher ground. Note scarp of rough ground.	10-42
Plate 10.15 Pasture field on top of middle field.	10-43
Plate 10.16 Terrain sloping steeply downhill to west on middle ridge.	10-43

Plate 10.17 Terrain sloping steeply uphill to the west and Ballylumford Hill. Note marginal ground and Moyle interconnector electricity station.	10-44
Plate 10.18 Large pasture field where the gold objects (ANT 041:031) were recovered in 1824.	10-44
Plate 10.19 The chambered grave (ANT 041:007) located adjacent to the Mill bay road with Druid's cottage (HB 06/04/015).	10-45
Plate 10.20 Looking northwest at area where main gas plant facilities will be located. Note height difference between field and power station.	10-45
Plate 10.21 Made ground within Ballylumford Powerstation where gas plant facilities will be located.	10-46
Plate 10.22 Armouring along shoreline where access road and vent will run. The landing place (IHR 06987:000:00) was located close to this spot.	10-46
Plate 10.23 Area of former limestone quarry where the pipelines will run. This area is now densely overgrown.	10-47
Plate 10.24 Pasture fields where pipelines will run. The settlement site (ANT 041:045) is located within this area.	10-47
Plate 10.25 Area of proposed wellpad adjacent to Larne Lough.	10-48
Plate 10.26 Area where access road will run north from the well pad.	10-48
Plate 10.27 Existing laneway running downhill from Ballylumford road. The standing stone (ANT 041:011) and the ecclesiastical site (ANT 041:008) are located in the adjacent fields.	10-49
Plate 10.28 Looking southwest towards locations of the mound (ANT041:012) and settlement site (ANT041:046).	10-50
Plate 10.29 Southeast-facing view across shingle foreshore at Castle Robin Bay	10-70
Plate 10.30 North-northeast view across proposed sea water intake pumping station site ..	10-70
Plate 10.31 South-facing view along cliffs beneath which outfall will be tunnelled	10-71
Plate 12.1 Upper Basalt Formation at Leaching Plant Site	12-9
Plate 12.2 Ulster White Limestone outcropping on beach south east of Vent Stack area ..	12-9
Plate 12.3 Lower Basalt Formation at Sea Water Intake Pumping Station Site	12-10
Plate 12.4 Mercia Mudstone Outcropping on foreshore at Millbay	12-10
Plate 12.5 Waterloo Fossiliferous Mudstone (Cloughfin)	12-11