SaxaVord Spaceport AEE V2.1

Assessment of Environmental Effects

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Abbreviations and Glossary

Abbreviations & Glossary
Saxa Vord Spaceport AEE 2.1

Term	Expanded Term
'effect'	The term '*effect*' is defined as the consequences for the receptor of an impact.
'impact'	The term '*impact*' is defined as a change experienced by a receptor (this can be beneficial, neutral or adverse)
'receptor'	used throughout the Assessment of Environmental Effects (AEE) process and is defined as the element in the environment affected by a development (e.g. a bird in the case of ornithology)
AADF	Annual Average Daily Flow
AADT	Annual Average Daily Traffic
ABPmer	Global Marine Consultancy Services
ACH	Advanced Chain Home
AD	Alert Distance
AEE	Assessment of Environmental Effects
AIS	Automatic Identification System
Al	Aluminium
ALARP	As Low as Reasonably Practical
AOB	Apparently Occupied Burrows
AOD	Above Ordnance Datum
AON	Apparently Occupied Nests
AQAL	Air Quality Assessment Level
AQAP	Air Quality Action Plan
AQIA	Air Quality Impact Assessment
AQMA	Air Quality Management Area
AQOs	Air Quality Objectives
AQS	Air Quality Strategy
BAP	UK Biodiversity Action Plan
BBPP	Breeding Birds Protection Plan
BGS	British Geological Survey
BRRC	Blue Ridge Research and Consulting LLP
BT	British Telecom
CAA	Civil Aviation Authority
CAFS	Cleaner Air for Scotland Strategy
CAR	Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended in 2018)
CCA	Coastal Character Areas

Term	Expanded Term
CCIA	Climate Change Impact Assessment
CCP	Climate Change Plan
CCS	Considerate Constructors Scheme
CCTs	Coastal Character Types
Cd	Cadmium
CEOI-ST	Centre for Earth Observation Instrumentation and Space Technology
CH	Chain Home
CIBSE	Chartered Institution of Building Services Engineers
CIEEM	Chartered Institute for Ecology and Environmental Management
CifA	Chartered Institute for Archaeologists
CIRIA	Construction Industry Research and Information Association
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COMAH	The Control of Major Accident Hazards Regulations (2015)
CoNaW Regs	The Control of Noise at Work Regulations
CoPA	The Control of Pollution Act
COSHH	The Control of Substances Hazardous to Health
CRTN	Calculation of Road Traffic Noise
CTMP	Construction Traffic Management Plan
Cu	Copper
Db	Decibel is a unit of measurement
DEFRA	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
DIO	Defence Infrastructure Organisation
DMP	Dust Management Plan
DMRB	Design Manual for Roads and Bridges
DPOs	Draft Plan Options
DWQR	Drinking Water Quality Regulator
EAC	Environmental Assessment Criteria
EC	European Commission
EcIA	Ecological Impact Assessment
ECoW	Ecological Clerk of Works
ECS	ECS Transport Planning Ltd
EEA	European Economic Area
EEZ	UK Exclusive Economic Zone
EfT	Emissions factor Toolkit (Defra)
EHO	Environmental Health Officer

Term	Expanded Term
EIA	Environmental Impact Assessment
ELV	Exposure Limit Value
EMODnet	European Marine Observation and Data Network
END	Assessment and Management of Environmental Noise
EPS	European Protected Species
EPUK	Environment Protection UK
ERL	Effects Range-Low
ESGOSS	Ecological Steering Group on the Oil Spill in Shetland (UK)
FCS	Favourable Conservation Status
FID	Flight Initiation Distance
GCR	Geological Conservation Review
GDL	Gardens and Designed Landscapes
GDP	Gross Domestic Product
GHG	Greenhouse Gas Emissions
GLVIA	Guidelines for Landscape and Visual Impact Assessment
GNSS	Global Navigation Satellite System
GO	Ground Investigation
GPPs	Guidance for Pollution Prevention
GPS	Global Positioning System
GVA	Gross Value Added
GWDTE	Groundwater Dependent Terrestrial Ecosystems
H	Hydrogen
Ha	Hectares
He	Helium
Hepla	Hermitage Environmental Planning and Landscape Architecture Limited
HEPS	Historic Environment Policy for Scotland
HES	Historic Environment Policy for Scotland
Hg	Mercury
HGVs	Heavy Goods Vehicles
HMRC	Her Majesty's Revenues and Customs
HRAs	Habitat Regulations Assessments/Appraisals
HSL	The Health and Safety Laboratory
Hu	Human
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
IAQM	Institute of Air Quality Management
ICAO	The International Civil Aviation Organisation
ICES	International Council for the Exploration of the Sea

Term	Expanded Term
IEA	Institute of Environmental Assessment
IEMA	Institute of Environmental Management and Assessment
IHT	Institution of Highways and Transportation
JIT	Just In Time
kVA	A kVA is 1,000 volt-amps
LAmax	A-weighted, maximum sound level
LAQM	Local Air Quality Management
Las	Local Authorities
LBAP	Shetland Local Biodiversity Action Plan
LCA	Coastal Edge Landscape Character Areas
LDP	Local Development Plan
LCTs	Landscape Character Types
LEAV	Lower Exposure Action Value
LGVs	Light Goods Vehicles
Li	Lithium
LLAs	Local Landscape Areas
LLDR	Local Landscape Designation Reviews
LOx	Liquid Oxygen
LRCC	Launch and Range Control Centre
LSPF	Launch Site Processing Facility
LSPs	Launch Service Providers
LUPS-GU31	Land Use Planning System Guidance Note 31
LVIA	Landscape and Visual Impact Assessment
LVs	Launch Vehicles
m^3	Cubic meters
MCA	Marine Coastguard Agency
MCMS	Marine Case Management System
MERA	Marine Environmental Risk Assessment
MMO	Marine Management Organisation
MOD	Ministry of Defence
MPAs	Marine Protected Areas
m/s	Meters per second
N_2H_4	Hydrazine
NAEL	National Atmospheric Emissions Inventory
NAFC	NAFC Marine Centre
NAMMCO	North Atlantic Marine Mammal Commission
NAQS	National Air Quality Strategy

Term	Expanded Term
NATO	North Atlantic Treaty Organisation
NBN	National Biodiversity Network
NCAP	National Collection of Aerial Photography
NCMPA	Nature Conservation MPAs
NCN	National Cycle Network Routes
NEAFC	North East Atlantic Fisheries Commission
NHZ	Natural Heritage Zone
NIEA	Northern Ireland Environment Agency
NIRs	Natura Impact Reports – information/Reports to inform an Appropriate Assessment, shadow habitats regulations assessment
NISs	Natura Impact Statements
NMF	National Modelling Framework
nmol/L	Nanomoles per litre
NMPi	Marine Scotland's National Marine Plan interactive
NMPs	Noise Monitoring Positions
NMS	National Museum of Scotland
NO_2	Nitrogen Oxide
NOAA	National Oceanic and Atmospheric Administration
NO_x	Nitrogen oxides
NPF3	National Planning Framework 3
NRA	Navigational Risk Assessment
NRHE	National Record of Historic Environment
NRW	Natural Resources Wales
NSA	National Scenic Area – chapter 5
NSRs	Noise Sensitive Receptors
NTS	Non-Technical Summary
NVC	National Vegetation Classification
ONS	Office for National Statistics
OS	Ordnance Survey
OSA	Outer Space Act
PAC	Pre-Application Consultation Report
PAHs	Polycyclic Aromatic Hydrocarbons
PAN	Planning Advice Note
PBDEs	Polybrominated Diphenyl Ethers
PCA	Peatland Condition Assessment
PCBs	Polychlorinated Biphenyls
PET	polyethylene terephthalate
PM_{10}	Particulate Matter with a diameter of 10 micrometers or less

Term	Expanded Term
$PM_{2.5}$	Particulate Matter with a diameter of 2.5 micrometers or less
PMP	Peat Management Plan
PPC	Pollution and Prevention Control
PPE	Personal Protective Equipment
PPGs	Pollution Prevention Guidance Documents
ppm	Parts per million
PTS	Permanent Threshold Shift
RAF	Royal Airforce
RBMP	River Basin Management Plans
RCAHMS	Royal Commission on the Ancient and Historical Monuments of Scotland
RCP	Representative Concentration Pathway
RIES	Reports on the Implications for European Sites
RIGS	Regionally Important Geological and Geomorphological Sites
RP-1	Highly refined form of kerosene similar to jet fuel
RRH	Remote Radio Head
RSPB	Royal Society for the Protection of Birds
RTPI	Royal Town Planning Institute
Sabs	Scottish Annual Business Statistics
SACs	Special Areas of Conservation
SAs	Sustainability Appraisals
SAT	Shetland Amenity Trust
SAT-SG-75	SEPA Supporting Guidance – sector specific guidance: construction sites (SEPA 2018)
SBL	The Scottish Biodiversity List
SCA	Seascape Character Area
SCMP	Scheduled Monument Consents Policy
SEAs	Strategic Environmental Assessments
SEL	Sound Exposure Level
SENEL	Single Noise Exposure Level
SEPA	Scottish Environment Protection Agency
SG	Scottish Government
Shetland Space Centre	The Proposed Project
SIA	Space Industry Act
SIC	Standard Industrial Classification
SLM	Sound Level Meter
SLQ	Special Landscape Qualities Assessment
SM	Scheduled Monument

Term	Expanded Term
SMC	Scheduled Monument Consent
SMR	Sites and Monuments Record
SNH	Scottish Natural Heritage
SO_2	Oxides of Sulphur 11.4.36
SoNA	Survey of Noise Attitudes Study
SPA	Special Protection Area
SPP	Scottish Planning Policy
SSC	Shetland Space Centre
SSSI	Site of Special Scientific Interest
SST	Sea Surface Temperature
STMP	Spectator Traffic Management Plan
SuDS	Sustainable Drainage Systems
SWBSG	Scottish Windfarm Bird Steering Group
TA	Transport Assessment
TAN	Technical Advice Note
TBT	Tributyltin
TEL	Transporter / Erector / Launcher Vehicle
TGN	Technical Guidance Note
TS2020	Tourism Scotland Strategy
TTROs	Temporary Traffic Regulation Orders
TTS	Temporary Threshold Shift
UK BAP species and habitats	Action plans for the most threatened species and habitats (called 'UK BAP species and habitats') were set out to aid recovery – 6.2.4
UKEAV	Upper Exposure Action Value
UKSA	UK Space Agency
UXO	Unexploded Ordnance
VFR	Visiting Friends and Relatives
VHF	Very High Frequency radio
VMEs	Vulnerable Marine Ecosystems
VOCs	Volatile` Organic Compounds
VSRs	Vibration Sensitive Receptors
W	Wildlife
WEWSA	Water Environment and Water Services (Scotland) Act
WFD	Water Framework Directive
WFDAs	Water Framework Directive Assessments
WHO	World Health Organisation
WHO ENG	World Health Organisation – Environmental Noise Guidelines for the European Region

Term	Expanded Term
WW2	World War 2
ZTV	Zone of Theoretical Visibility
µg	Microgram
µm	Micrometers

Space Terminology

Terminology
Launch Vehicle
Sounding Rocket
Sub Orbital
Orbital
Impact Zone
EZI

Glossary

AEE	**Assessment of Environmental Effects** The systematic process of identifying, quantifying and evaluating the potential effects of the proposed activities on the environment. The purpose of AEE is *'to ensure that applicants for spaceport licences have considered the potential environmental effects of their intended activities and, if necessary, taken appropriate and proportional steps to avoid, mitigate or offset the risks and their potential effects'*. (CAA et. al. 2021).
AOD	**Above Ordnance Datum** In the British Isles, an ordnance datum or OD is a vertical datum used by an ordnance survey as the basis for deriving altitudes on maps. A spot height may be expressed as AOD for "above ordnance datum".
AQMA	**Air Quality Management Area** Since December 1997 each local authority in the UK has been carrying out a review and assessment of air quality in their area. This involves measuring air pollution and trying to predict how it will change in the next few years. The aim of the review is to make sure that the national air quality objectives will be achieved throughout the UK by the relevant deadlines. These objectives have been put in place to protect people's health and the environment. If a local authority finds any places where the objectives are not likely to be achieved, it must declare an Air Quality Management Area there. This area could be just one or two streets, or it could be much bigger. Then the local authority will put together a plan to improve the air quality - a Local Air Quality Action Plan.
AQS	**Air Quality Strategy** This strategy sets out the comprehensive actions required across all parts of government and society to improve airy quality. The strategy sets out how we will protect the nations health and protect the environment.
BBPP	**Breeding Bird Protection Plan** All birds, their nests and eggs are protected by the Wildlife & Countryside Act 1981 as amended by the Nature Conservation (Scotland) Act 2004
CAR	**Water Environment (Controlled Activities Regulations)** It details which activities are regulated by SEPA and what regulatory controls apply over activities which may affect Scotland's water environment.
COMAH	**The Control of Major Accident Hazards Regulations (2015)** The Control of Major Accident Hazards (COMAH) Regulations ensuring that businesses: "Take all necessary measures to prevent major accidents involving dangerous substances. Limit the consequences to people and the environment of any major accidents which do occur"
CoNaW Regs	**The Control of Noise at Work Regulations** The Control of Noise at Work Regulations 2005 place a duty on employers within Great Britain to reduce the risk to their employees health by controlling the noise they are exposed to whilst at work. ... The regulations replaced the 'Noise at work regulations 1989' which previously covered noise in the workplace.
DMRB	**Design Manual for Roads and Bridges** Information about current standards relating to the design, assessment and operation of motorway and all-purpose trunk roads in the UK.

ECoW	**Environmental Clerk of Works** The ECoW role involves monitoring to ensure that site-based construction activities are delivered. Working with site personnel, so as to avoid contravention of relevant wildlife law, and so that the works comply with planning consent commitments and the ecology elements of principal contractor documentation. Such works may also aid the discharge of planning conditions. The ECoW also pro-actively identifies and resolves ecological issues, however minor, that could otherwise give rise to third party criticism of the scheme and ensures that the workforce is aware of their responsibilities. This helps ensure that work proceeds in accordance with the project plan.
EHO	**Environmental Health Officer** Responsible for carrying out measures for protecting public health, including administering and enforcing legislation related to environmental health and providing support to minimise health and safety
EZI	**Environmental Zone of Influence** The zone of influence is the area around the site that may be affected by the proposed changes within the site. Impacts could include the removal or alteration of habitat or increase human presence on or around the site.
FCS	**Favourable Conservation Status** Conservation Status will be taken as Favourable when population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and the natural range of the species is neither being reduced nor is likely to be reduced.
FID	**Flight Initiation Distance** The distance at which a bird flees from perceived danger is defined as the flight initiation distance and could be used to designate separation distances between birds and stimuli that might cause disturbances.
GPPs	**Guidance for Pollution Prevention** GPPs provide environmental good practice guidance for the whole UK, and environmental regulatory guidance directly to Northern Ireland, Scotland and Wales only.
GVA	**Gross Value Added** Defined as output as basic prices minus intermediate consumption (purchaser prices), it is the balancing item of the national accounts' production. GVA can be broken down by industry and institutional sector.
GWDTE	**Groundwater Dependent Terrestrial Ecosystems** Groundwater Dependent Terrestrial Ecosystems (GWDTE) are wetlands which critically depend on groundwater flows or chemistries. As part of the assessment of groundwater status you have to assess if it has been significantly damaged and if the pressure causing this damage has happened via a groundwater body.
Launch Vehicle (LV)	**Launch Vehicle** A launch vehicle or carrier rocket is a rocket propelled vehicle used to carry a payload from Earth's surface to space usually to Earth orbit or beyond.

LBAP	**Local Biodiversity Action Plan** Local Biodiversity Action Plan Partnerships operate at the local authority level. They were set up in the UK following the Rio Earth Summit in 1992 in response to the UK becoming a signatory to the Convention on Biological Diversity. Most local authorities work in partnership with both national environmental agencies and local biodiversity organisations to deliver local biodiversity action plans. Either the local authority employs a dedicated biodiversity officer or, as part of other posts in the local authority, an officer supports the partnership.
NEAFC	**North East Atlantic Fisheries Commission** The North East Atlantic Fisheries Commission is a regional fisheries management organisation that maintains controls over fishing and fishing related acts in the North East Atlantic Ocean.
NMPI	**National Marine Plans Interactive** Is an interactive tool which is part of the Marina Scotland Open Data Network, and has been designed to assist in the development of national and regional marine planning. Allows you to view different types of information and, where appropriate, links have been provided to the related parts of Scotland's Marina Atlas, the National Marina Plan as well as links to data sources to facilitate data download.
Orbital	**Orbital** An orbital flight circles the earth at least once, in a stable way, to achieve this you have to go super fast.
PMP	**Peat Management Plan** Peat is a body of sedimentary material, usually dark brown or black in colour, comprising the partially decomposed remains of plants and organic matter that is preserved in anaerobic conditions within an essentially waterlogged environment. Peatlands hold large stocks of poorly protected carbon and excavation of peat will result in large carbon losses from the excavated peat and also the areas affected by drainage. In the majority of cases excavated peat will be regarded as waste in law and regulatory controls will apply to its storage and/or disposal.
PTS	**Permanent Threshold Shift** The damage can become permanent (permanent threshold shift, PTS) if sufficient recovery time is not allowed before continued sound exposure. When the hearing loss is rooted from a traumatic occurrence, it may be classified as noise-induced hearing loss, or NIHL.
RRH	**Remote Radio Head** A remote radio head (RRH), also called a remote radio unit (RRU) in wireless networks, is a remote radio transceiver that connects to an operator radio control panel via electrical or wireless interface. When used to describe aircraft radio cockpit radio systems, the control panel is often called the radio head.
RIGS	**Regionally Important Geological and Geomorphological Sites** Regionally important sites are locally designated sites of local, national and regional important for geodiversity in the United Kingdom.

SLM	**Sound Level Meter** Used for acoustic measurements, commonly handheld with a microphone. They provide readings on the noise level in an environment and usually return a measurement in decibels (dB).
SMC	**Scheduled Monument Consent** A monument which has been scheduled is protected against ground disturbances or unlicensed metal detecting. Written consent must always be obtained before any work on a scheduled monument can begin.
Sounding Rocket	**Sounding Rocket** Sounding rockets are one or two stage solid propellant rockets used for probing the upper atmospheric regions and for space research. They also serve as easily affordable platforms to test or prove prototypes of new components or subsystems intended for use in launch vehicles and satellites.
SPA	**Special Protection Areas** A Special Protection Area is a designation under the European Union Directive on the Conservation of wild birds. Under the Directive, Member States of the European Union (EU) have a duty to safeguard the habitats of migratory birds and certain particularly threatened birds.
SPP	**Scottish Planning Policy** A statement of Scottish Government Policy on how nationally important land use planning matters should be addressed across the country.
SSSI	**Site of Special Scientific Interest** A Site of Special Scientific Interest (SSSI) is a formal conservation designation. Usually, it describes an area that's of particular interest to science due to the rare species of fauna or flora it contains - or even important geological or physiological features that may lie in its boundaries.
SST	**Sea Surface Temperature** Sea surface temperature (SST) is the water temperature close to the ocean's surface. The exact meaning of surface varies according to the measurement method used, but it is between 1 millimetre (0.04 in) and 20 metres (70 ft) below the sea surface.
Suborbital	**Suborbital** Suborbital flights may go into space, then their path (or trajectory) carries them back to earth.
SuDS	**Sustainable Drainage Systems** Sustainable drainage systems (also known as SuDS, SUDS, or sustainable urban drainage systems) are a collection of water management practices that aim to align modern drainage systems with natural water processes.
TAN	**Technical Advice Note** The Technical Advice Note provides guidance which may assist in the technical evaluation of noise assessment.
UXO	**Unexploded ordnance** Unexploded bombs, and explosive remnants of war are explosive weapons that did not explode when they were employed and still pose a risk of detonation, sometimes many decades after they were used or discarded

UKVEA	**Upper Exposure Action Value** The upper exposure action value is set at a daily or weekly average noise exposure of 85 dB, above which the employer is required to take reasonably practicable measures to reduce noise exposure, such as engineering controls or other technical measures.
VOCs	**Volatile` Organic Compounds** Volatile organic compounds (VOCs) are compounds that easily become vapours or gases. VOCs are released from burning fuel such as gasoline, wood, coal, or natural gas. They are also released from many consumer products such as; cigarettes and solvents.
WFD	**Water Framework Directive** The Water Framework Directive (WFD) sets out objectives for the water environment. These include the protection, enhancement and restoration of surface water, groundwater and water dependent protected areas and prevention of deterioration. Environmental standards and conditions are needed to set the level of control to meet these objectives.
WHO	**World Health Organisation** WHO's primary role is to direct international health within the United Nations' system and to lead partners in global health responses.
WHO ENG	**World Health Organisation Environmental Noise Guidelines** The Environmental Noise Guidelines aim to support the legislation and policy making process on local, national and international level. The WHO guideline values are public health-oriented recommendations, based on scientific evidence of the health effects and on an assessment of achievable noise levels.
ZTV	**Zone of Theoretical Visibility** Also known as a Zone of Visual Influence, is a computer-generated tool to identify the likely (or theoretical) extent of visibility of a development. The elevation (or a set of elevations) of the development is tested against a 3D terrain model.
µg	**µg** In the metric system a microgram or microgramme is a unit of mess equal to one millionth of a gram. The unit system is µg according to the International System of Units.

Volume I Non-Technical Summary

Non-Technical Summary

Volume I – Non-Technical Summary

1. Non-Technical Summary

1.1 Introduction

1.1.1 ITPEnergised has prepared this Assessment of Environmental Effects Report (AEE Report) on behalf of Shetland Space Centre Limited ('the Applicant') in regard to two separate but related applications to the Civil Aviation Authority (the regulator) for licenses under the Space Industry Act 2018.

1.1.2 The Applicant intends to operate a vertical launch spaceport, to be known as the SaxaVord Spaceport (and for purposes of this AEE Report referred to as 'the Proposed Project') situated at Lamba Ness on Unst, Shetland. The Proposed Project will be operated to launch sub-orbital sounding rockets and small satellites into either polar or sun-synchronous, low-earth orbits.

1.1.3 As set out in the National Space Policy (UK Government 2018) and the later National Space Strategy (UK Government, 2021), the UK aims to become the European hub for commercial spaceflight and related sector technologies. The UK Government is committed to building one of the most innovative and attractive space economies in the world, supporting the growth of a robust and competitive commercial space sector growing the value of the UK Space Sector to £40 billion by 2030, representing approximately 10% of the global market.

1.1.4 An independent assessment (DEIMOS et al, 2017) of potential areas for the vertical launch of small satellites as part of the SCEPTRE project on behalf of the UK Space Agency (UKSA), identifies Saxa Vord as being the optimal location in the UK for launching small satellites into space from a technical perspective. Favourable characteristics include the high latitude and the geographic location, giving the Proposed Project the best orbital access conditions in the UK which enables launch trajectories to remain entirely clear of inhabited areas.

LaunchUK and Pathfinder Test Launch

1.1.5 Through its LaunchUK initiative to help grow the UK's spaceflight capabilities, the UK government is funding a range of industry-led projects including £31.5 million to establish launch services. The UK Space Agency has selected Lockheed Martin to help implement its vision for the UK Spaceflight Programme and, with a grant from the UK Space Agency, Lockheed Martin is leading a team to execute several strategic projects with a goal of providing the first vertical space launch in the early 2020s, the Pathfinder Launch. The strategic projects include the UK's first spaceport and the team will support the development of the nation's first commercial spaceport (the Proposed Project) at Lamba Ness on Unst.

Space Industry Act 2018

1.1.6 The Space Industry Act 2018 received Royal Assent on 15 March 2020 and provides a legal framework for the licensing of space activities, sub-orbital activities and associated activities carried out in the UK.

1.1.7 The Act requires that person or organisation wishing to undertake the following to obtain a relevant license:

- launch a launch vehicle from the UK;
- return a launch vehicle launched elsewhere than the UK to the UK landmass or the UK's territorial waters
- operate a satellite from the UK
- conduct sub-orbital activities form the UK
- operate a spaceport in the UK, or
- provide range control services from the UK.

1.1.8 As the applicant wishes to operate a vertical spaceport (at the SaxaVord Spaceport) and provide range control services (at the Launch and Range Control Centre, LRCC) they are required to apply for a both a spaceport licence and a range control licence. However, AEE is only relevant to applications for spaceport licences.

Space Industry Regulations 2021

1.1.9 The Space Industry Regulations 2021 (the Regulations) set out in more detail the requirements for each licence the Regulators Licensing rules, which specify what information the UK Civil Aviation Authority (CAA), the regulator, requires in support of an application.

Relevant Guidance

Guidance for the Assessment of Environmental Effects

1.1.10 The CAA, with the UK Space Agency, the Department for Business, Energy and Industrial Strategy and the Department for Transport, issued guidance note '*Guidance for the Assessment of Environmental Effects*' in July 2021. The guidance sets out what is required by the regulator regarding assessment of environmental effects as part of a licence application under the Act.

1.1.11 The guidance describes the two licence types required by the Applicant as follows:

- *A spaceport licence is one granted under Section 3 of the Act and authorises a person or organisation to operate a spaceport (i.e., a site from which spacecraft or carrier aircraft can be launched or a site at which controlled and planned landings of spacecraft can take place). Spaceports can be licenced for vertical or horizontal launches (or potentially both)… A person or organisation holding a spaceport licence is referred to as a spaceport licensee.*
- *A range control licence is one granted under Section 7 of the Act authorising a person or organisation to carry out range control services in relation to spaceflight activities. That includes identifying an appropriate range; coordinating the use of a range ;issuing protective notifications and monitoring the range. A person or organisation holding a range control licence is referred to as a range control licensee.*

1.1.12 As the Applicant wishes to operate a vertical launch spaceport (the SaxaVord Spaceport) and provide range control services (at the Launch and Range Control Centre, LRCC) they are required to apply for a both a spaceport licence and a range control licence. However, AEE is only relevant to applications for spaceport licences.

Guidance to the regulator on environmental objectives relating to the exercise of its functions under the Space Industry Act 2018

1.1.13 The Department for Transport issued its document '*Guidance to the regulator on environmental objectives relating to the exercise of its function under the Space Industry Act 2018*' in 2021, clarifying the government's environmental objectives relating to spaceflight and associated activities in the UK:

The environmental objective for spaceflight are to:

- *Minimise emissions contributing to climate change resulting from spaceflight activities*
- *Protect human health and the environment from the impacts of emissions on local air quality arising from spaceflight activities*
- *Protect people and wildlife from the impacts of noise from spaceflight activities*
- *Protect the marine environment from the impact of spaceflight activities.*

1.1.14 The objectives presented in the guidance are noted to be consistent with the environmental topics that must be addressed in an AEE. Consideration of the environmental objectives has been included as relevant in the AEE technical assessment chapters.

1.2 Approach to AEE

1.2.1 AEE is the systematic process of identifying, predicting and evaluating the environmental effects of a proposed project. The AEE Report sets out the conclusions of the AEE process undertaken in relation to the Proposed Project. Where appropriate, it also sets out mitigation measures designed to prevent, reduce and, if at all possible, offset significant effects. An assessment of residual effects, those expected to remain following implementation of mitigation measures, is also presented.

1.2.2 The key stages in the AEE process are presented in Chapter 2 of the AEE Report, with an overview of the specific methodology adopted for each technical study provided within the respective technical chapters (Chapters 4 to 15).

1.2.3 In line with the CAA guidance, effects on the following environmental features have been considered:

- Population and human health
- Biodiversity (ecology and ornithology)
- Air quality
- Noise and vibration
- Water
- Marine environment
- Climate
- Land, Soils and Pear
- Landscape, Seascape and Visual Impact
- Material assets and cultural heritage
- Accidents and Disasters.

Environmental Zone of Influence

1.2.4 The environmental zone of influence (EZI) of the AEE, in other words the spatial scope or geographical coverage of the assessment, takes into account:

- the extent of the Proposed Project (refer to Drawing 3.1);
- the nature of the baseline environment, sensitive receptors and the likely impacts that could arise; and,
- the distance over which predicted effects are likely to remain significant and, particularly, the existence of pathways which could result in the transfer of effects to a wider geographical area than the extent of proposed physical works.

1.2.5 For all topics except marine and transboundary, the EZI (study area) is based on orbital launches in order to maintain a precautionary approach. In relation to marine and transboundary effects (Chapter 10), as the trajectories and likely impact zones for returning material from the two types of LVs proposed (orbital and sub-orbital) are spatially distinct, there is need to assess two EZIs, one for orbital launches (Study Area A) and one for sub-orbital launches (Study Area B).

1.2.6 Details of the EZI(s) relevant to each technical assessment are detailed in AEE Report Volume II, Chapters 4 to 15.

1.3 Proposed Project

Location

1.3.1 The Proposed Project is located at Lamba Ness on Unst, the most northerly of the Shetland Islands, and comprises a vertical launch spaceport including a launch pad complex, tracking stations and assembly/integration hangar buildings with associated security fencing, access and servicing.

1.3.2 The Proposed Project is centred on reference point 466500 E, 1215500 N and occupies an area of approximately 80.8 hectares (ha), approximately 2.5 km north-east of the settlement of Norwick.

1.3.3 The closest residential locations are properties in Norwick, located approximately 2 km south-west of the Proposed Project.

1.3.4 The location of the Proposed Project and the wider context is shown on Figure NTS-1.

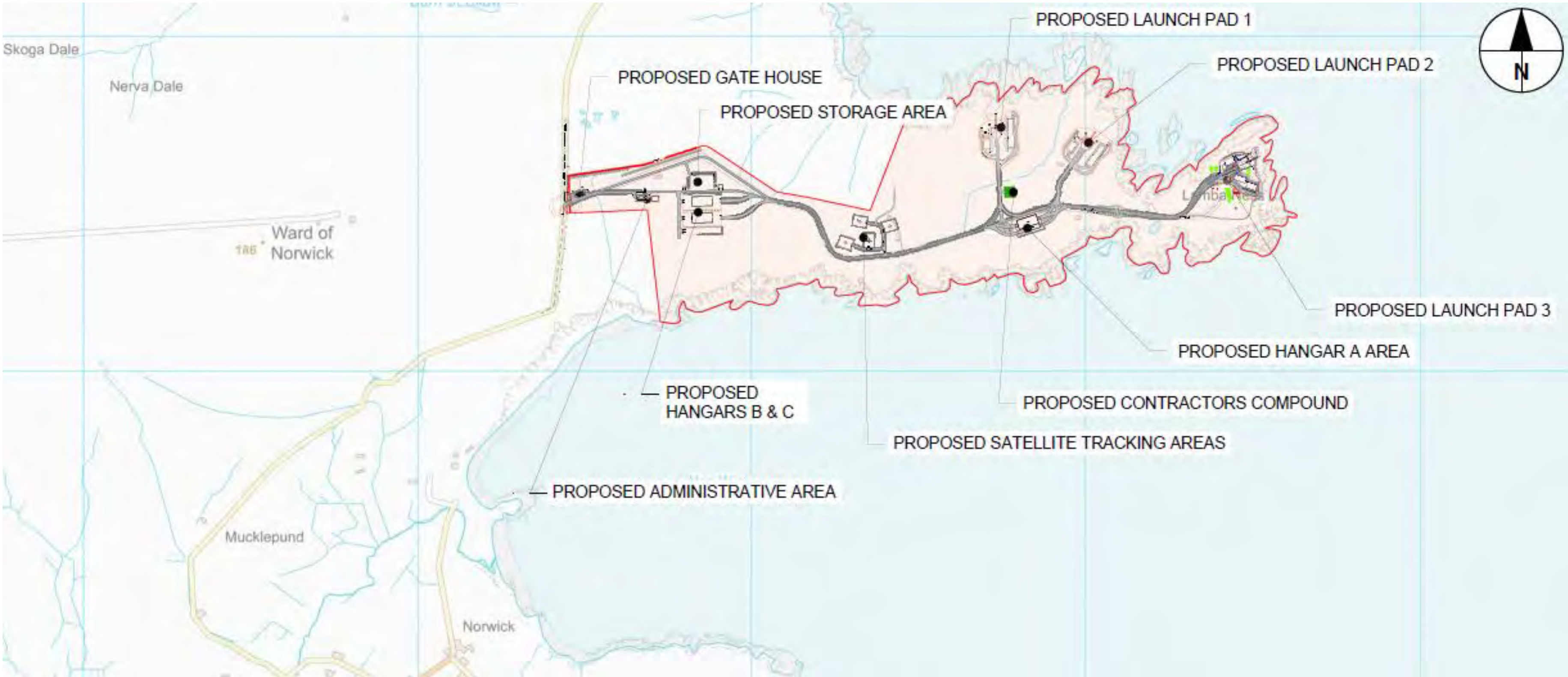

Figure NTS-1 Location and Context of Proposed Project

Proposed Project Description

1.3.5 The Proposed Project will be operated to launch sub-orbital sounding rockets and small satellites into either polar or sun-synchronous, low-earth orbits. The layout at the Proposed Project allows for launches by multiple launch service providers (LSPs) using a range of different rocket (launch vehicle - LV) types and is designed to accommodate LVs between 13 m and 30 m in height. LV widths are anticipated to be between 1–2 m and will not have additional boosters at the sides.

1.3.6 All launches will take place in a northerly direction over the sea. For safety reasons, LVs will not fly over inhabited areas. Launches from the Proposed Project will avoid both oil fields to the west and east of Shetland; they will also avoid the Faroe Islands and Iceland to the north-west and Norway to the north-east.

1.3.7 The infrastructure required for the Proposed Project consists of:

- Launch Site: located on the Lamba Ness peninsula and comprising three launch pad complexes, each incorporating a launch pad, ground services storage and control, lightning protection masts, liquid and compressed gas storage and water deluge tanks for launch operations;
- Satellite Tracking Station: an area of hardstanding housing satellite tracking and telemetry devices located on the Lamba Ness peninsula;
- Launch Site Processing Facility (LSPF) hangar buildings (two): located on the Lamba Ness peninsula, a building where the LVs are assembled and the payload (the satellites) integrated into the LVs;
- Administration Building, Pyrotechnics Store, and Hazardous Materials Store located adjacent to the LSPF on the Lamba Ness peninsula;
- Integration Hangar/TEL building: located on the Lamba Ness peninsula, a forward position building close to the launch pads housing the transporter erector launcher (TEL) and where the final integration activities take place as required;
- Support Infrastructure: located on the Lamba Ness peninsula including access, an internal track system and a series of small temporary buildings;
- Gate House, including a tourist information area, located on the Lamba Ness peninsula; and
- Wildlife Hide: located on the Lamba Ness peninsula.

1.3.8 The Proposed Project includes three separate launch pads to facilitate launches by a range of LSPs in order to be competitive, flexible and sustainable. For hazardous ground operations and launch operations risk will be managed collaboratively in accordance with Spaceport Operator and Launch Operator license requirements.

1.3.9 There will only ever be single launches from the Proposed Project; there will be no simultaneous launches from multiple launch pads.

1.3.10 Subject to securing the appropriate permissions, consents and licences, the intention is to initiate the construction of the Proposed Project in early 2022, with the first launch later in 2022.

1.3.11 The layout of the Proposed Project is shown on Figure NTS-2.

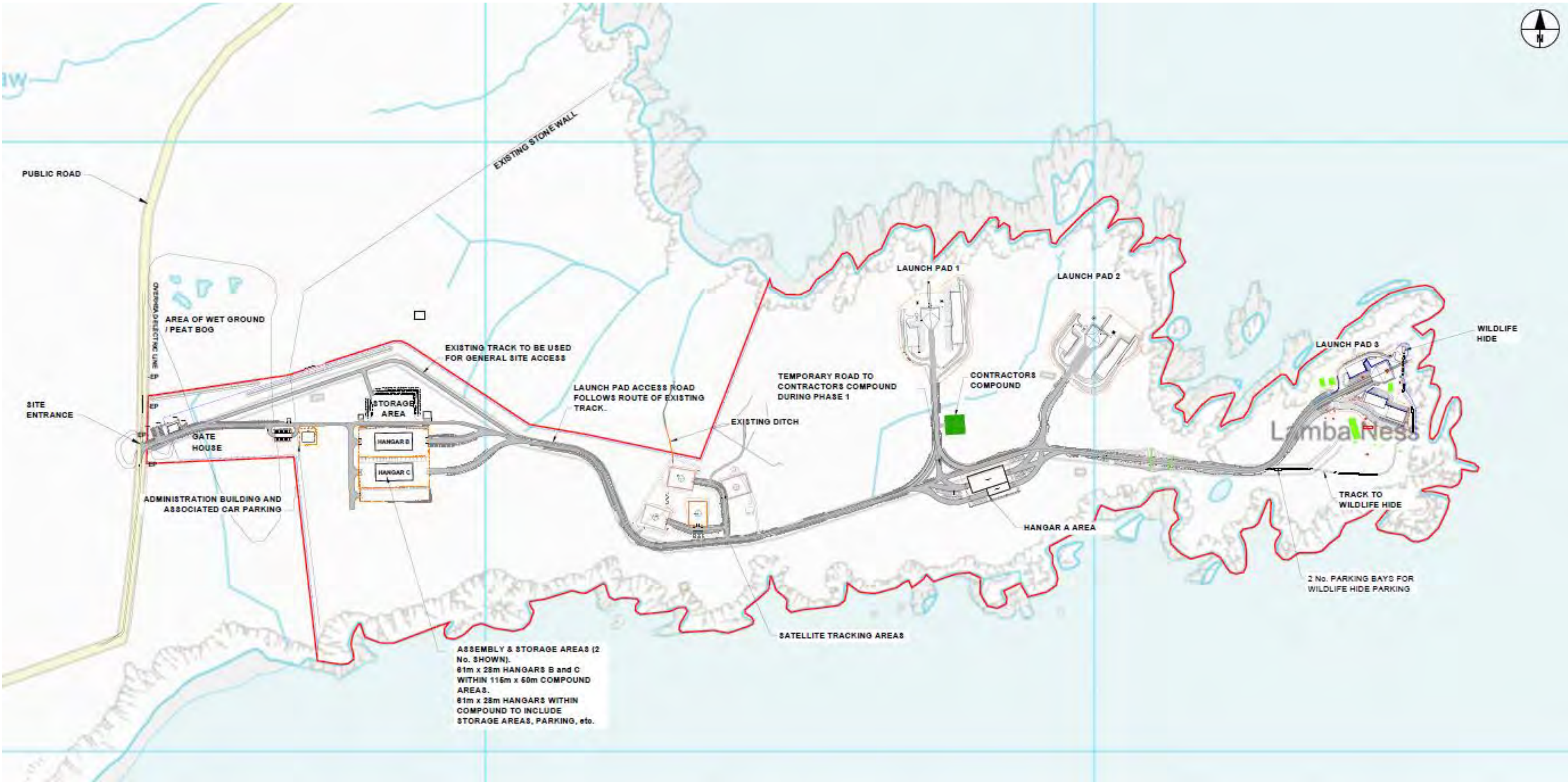

Figure NTS-2 Proposed Project Layout

Environmental Budget

1.3.12 The Applicant is looking to achieve a maximum of 30 launch events per year from the Proposed Project. However, in the first year of operation (2022) it is anticipated that there will be up to 10 launches, made up of both orbital and sub-orbital rockets.

1.3.13 Whilst the Applicant has not yet determined a specific timeframe for operations, when required for the purposes of this AEE an operational period of 30 years has been assumed, aligning with the current land lease for the Proposed Project. For all other aspects and topics, the combined effects of up to 30 launches over any given one-year period is considered to be most appropriate and therefore for the purposes of this AEE the effects of the Applicant's environmental budget have been assessed so as to give the predicted effects over any one year.

Environmentally Sensitive Periods of Time

1.3.14 Following consultation with NatureScot during the planning application stage, the Applicant committed to a no-launch window whereby no satellite launches or static tests will be carried out between mid-May and the end of June so as to avoid disturbing birds during the critical incubation and early brooding period.

1.4 Population and Human Health

1.4.1 The population of Unst has declined significantly over the last century, reaching 632 people in the latest Census (2011), and is expected to decrease further. The population decline has been caused in part by the closures of Baltasound Airport in 1996 and RAF Saxa Vord in 2006. These closures have also depressed job opportunities in Unst, and incomes in Unst and the North Isles tend to be lower than in other parts of the Shetland Islands. When compounded with higher living costs, this results in the area around the Proposed Development being one of the least affluent areas in the Shetland Islands.

1.4.2 The Proposed Project represents a transformational and much needed economic development opportunity for Unst and for the Shetland Isles and will generate significant beneficial local effects through:

- employment associated with operation of the Proposed Project;
- demand for goods and services to support the operation of the Proposed Project;
- hosting temporary workers from the launch companies who will then utilise local shops, hospitality and other amenities; and,
- attracting tourists who will visit to watch launches and/or explore the Proposed Project (including outside the current summer tourism season).

1.4.3 The predicted economic effects are considered to be major beneficial (significant) locally.

1.4.4 Full operation of the Proposed Project will see a maximum of 30 launch events per year. During operation, beneficial economic impacts are expected to arise from three main sources:

- employment associated with operation of the Proposed Project;
- accommodation for temporary workers during launches; and,
- space tourism activity.

1.4.5 It is estimated that employment associated with this level of activity will generate:

- £4.9 million GVA and 139 jobs in Unst;
- £7.5 million GVA and 209 jobs in The Shetland Islands; and,
- £9.3 million GVA and 255 jobs in Scotland.

1.4.6 The total effect from operation of the Proposed Project is therefore assessed as being:

- major beneficial (significant) for Unst;
- minor beneficial for The Shetland Islands; and,
- negligible for Scotland.

1.4.7 In addition, the Proposed Project is also expected to result in a series of wider, less quantifiable, benefits for the economies of Unst, the Shetland Islands and Scotland including:

- Making Scotland more competitive in the small satellite space sector, by providing a location from which launch activity could be carried out.
- Diversifying the economic base of Unst and the Shetland Islands towards the space sector.
- Offering a wider range of employment opportunities and new career paths available to young people in Unst and in the Shetland Islands.
- Acting as a catalyst for further investment; and,
- Encouraging investment in the tourism sector, as launch activities extend the tourism season and provide additional visitors to Unst and to the Shetland Islands.

1.5 Ornithology

1.5.1 Targeted and licensed breeding bird surveys were undertaken following agreed standardised survey methods between 2018 and 2020 within the ornithological study area. A total of 135 bird species were recorded during breeding bird surveys. There was direct evidence of potentially sensitive and specially protected bird species breeding within, and adjacent to, the Proposed Project boundary.

1.5.2 Ornithological designated site interests on the Hermaness, Saxa Vord and Valla Field SPA (and overlapping Hermaness Site of Specific Scientific Interest (SSSI) and Saxa Vord SSSI) and the following non-designated wider countryside ornithological birds are taken forward for assessment: red-throated diver, merlin, black guillemot, common guillemot, puffin, razorbill, shag, kittiwake, fulmar, ringed plover, golden plover, whimbrel, curlew, dunlin, Arctic tern, Arctic skua, great skua and a confidential Schedule 1 species.

1.5.3 To understand potential impacts of loud, short duration noise events, a background literature review of noise impacts on relevant bird species was undertaken. This literature review looked at how impulsive noise (from various sources including aircraft, fireworks, military ranges and rocket launches) impacted on birds in order to help assess the potential noise impacts of the launches.

1.5.4 Potential impacts have been assessed for the operational phase of the Proposed Project. The magnitude of predicted operational effects is either ‘no effect’ or ‘negligible’ for all bird species except one, a confidential Schedule 1 species. For this species, minor magnitude operational effects were considered likely to be significant in the absence of mitigation; however, after mitigation, all residual effects are predicted likely to be not significant.

1.5.5 The Applicant has agreed to provide a purpose built wildlife watching hide within the Proposed Project Boundary for locals and visitors to use at the tip of Lamba Ness. The Applicant is willing to consider potential community ownership of the wildlife watching hide and also contribute towards providing an annual maintenance budget for hide repairs and improvements.

1.5.6 After mitigation, all residual effects are predicted likely to be not significant.

1.6 Ecology

1.6.1 Targeted and licensed baseline ecology surveys, following best practice guidance, were undertaken between 2018 and 2020.

1.6.2 The Habitats Study Area is dominated by four Phase 1 habitats: wet modified bog/wet heath, wet modified bog, coastal grassland, and semi-improved acid grassland.

1.6.3 Numerous otter field signs were recorded during targeted surveys. There were six-seven otter holts within the Otter Study Area and up to four additional otter holts within the 500 m buffer. The holts were invariably within inaccessible cliff locations, between boulders or inside caves/crevices. Scats and footprints, including those of adults and young, were also recorded in the abandoned buildings across Lamba Ness. Otter use of an underpass was particularly noticeable. It was considered likely that otters use this underpass as a regular route to cross from the north to south side of Lamba Ness (and vice versa) and so is likely to be functionally important to otter use of the Lamba Ness area.

1.6.4 No evidence of freshwater pearl mussels was found in the Burn of Norwick Study Area.

1.6.5 Potential impacts assessed were considered. Impacts on sensitive ecological receptors were avoided and minimised wherever possible with mitigation incorporated into the Proposed Project design process.

1.6.6 The assessment predicts one likely significant residual effect, at the study area/local level, on coastal grassland habitat in relation to land-take from the construction and continued operation of the Proposed Project. The assessment does not predict any other likely significant ecological residual effects associated with the Proposed Project.

1.6.7 Opportunities for ecological enhancement are described in the Outline Habitat Management Plan.

1.7 Air Quality

1.7.1 Consideration has been given to the potential effects of the Proposed Project on local air quality. Potential impacts have been predicted at representative ecological and human health receptors in proximity to the Proposed Project and associated transportation routes.

1.7.2 Proposed project-generated traffic is predicted to have an effect of negligible significance on air quality, therefore resulting in no likely significant effect.

1.7.3 Generator emissions are predicted to have no perceptible impact at any identified receptors. The emissions from generators are predicted to have an effect of negligible significance on local air quality, therefore resulting in no likely significant effect. Emissions are also expected to reduce over the lifetime of the Proposed Project due to the Applicant's intention to secure a permanent three phase power supply in time.

1.7.4 Launch event emissions are predicted to have no perceptible impact at any identified receptors under prevailing wind directions. The maximum predicted impact at a sensitive receptor is predicted to occur with north-easterly winds which occur typically for less than 10 % of the year. The maximum predicted 8-hour concentration of CO is 28% of the AQS. Emissions from launch events are therefore considered to have an effect of negligible significance on air quality, therefore resulting in no likely significant effect.

1.8 Noise

1.8.1 Potential noise and vibration effects associated with the Proposed Project have been assessed with regard to static engine tests, launches and non-launch activities.

1.8.2 Noise effects associated with road traffic and non-launch activities have been assessed as not significant, resulting in no likely significant effect.

1.8.3 Noise during engine tests and launches will be audible at noise sensitive receptors and levels will exceed the criterion for community annoyance associated with aircraft noise. Instantaneous noise levels will be below the threshold at which damage to hearing may occur.

1.8.4 The short duration of audible noise 'events' associated with engine tests and launches, and their infrequent occurrence, will reduce the associated levels of annoyance to below that which may be associated with aircraft noise from conventional airports. Accordingly, adverse health effects are not anticipated.

1.8.5 Noise at noise sensitive receptors associated with launches is below the level at which the potential for cosmetic damage to structures is likely. Noise effects associated with engine tests and launches have therefore been assessed as not significant, resulting in no likely significant effect.

1.8.6 Vibration (air overpressure) associated with static engine tests and launch events has been evaluated and found to result in a low likelihood of damage complaints and has therefore been determined to be not significant, resulting in no likely significant effect.

1.8.7 Standard mitigation has been considered in the derivation of effect significance. Committed mitigation measures include a commitment to meeting noise limits for fixed and mobile plant items and maintaining good communications with the local community with regard to all activities of the Proposed Project.

1.9 Water

1.9.1 There are no statutorily designated sites relevant to hydrology or hydrogeology within Proposed Project boundary. The Norwick Meadows SSSI is approximately 800 m south-west of the Proposed Project and is designated for sand dunes and valley fen. There is no hydrological continuity between the Proposed Project and the Norwick Meadows SSSI.

1.9.2 There are a number of drains and small watercourses within and near to the Proposed Project site, all of which drain into the sea.

1.9.3 Habitats indicative of potential moderate groundwater dependency have been identified across much of the Proposed Project site, although based on the site geology and the distribution of these habitats, they are interpreted as being surface water or rainwater fed. The only area of potential ground water dependent terrestrial ecosystem considered to be actually fed by groundwater is more than 250 m from any proposed infrastructure.

1.9.4 Likely operational effects include sedimentation or pollution of the water environment from surface runoff and fuel/chemical leaks and spills, and effects on the local groundwater quality and flow regime.

1.9.5 Standard/embedded mitigation measures include no bulk storage of fuels at the Proposed Project and appropriate spill control procedures alongside a suitable Drainage Strategy to control and treat surface and foul drainage.

1.9.6 No new on-site water abstraction is proposed. Water required for site operation will be sourced from a nearby Ministry of Defence reservoir or tankered onto site as required.

1.9.7 The significance of residual effects on hydrological and hydrogeological receptors is considered to be minor and not significant.

1.10 Marine and Transboundary Effects

1.10.1 Effects on the marine environment will arise from the return to earth of LVs, and their associated recovery (in the case of sub-orbital launches). Such marine effects may occur in Scottish waters or in the waters of other countries (i.e., transboundary effects), specifically Denmark (Faroe Islands, Greenland), Iceland, and Norway (including Jan Mayen).

1.10.2 Two environmental zones of influence have been defined for the purpose of this chapter: the orbital study area (Study Area A) and the sub-orbital study area (Study Area B). The study areas encompass the expected impact zones for the return of orbital LVs and sub-orbital payloads.

1.10.3 Study Area A comprises mostly deep water with a small amount of continental shelf and many bathymetric features. Study Area B comprises the continental shelf waters around the Shetland Islands. The water quality of these study areas is high, in that they do not have significant local input of anthropogenic contaminants such as metals, microplastics, and hydrocarbons. The study areas support numerous marine biota such as plankton, benthic habitats, fish and shellfish, seabirds, and marine mammals. Study Area A has few marine protected areas whereas there are more in Study Area B.

1.10.4 In Study Area A, human activities are concentrated in the southern portion (as far as the Faroe Islands to the north). This includes shipping and navigation, oil and gas cables and pipelines, and commercial fishing. There is occasional use of the area for military activities. Marine archaeology is poorly known and so assumed to be present. In Study Area B, vessel density is mostly low with small areas of increased density. Active and transiting fishing vessels are widespread in Study Area B. There is presence of oil and gas infrastructure, subsea cables and pipelines, marine renewable energy, dredge disposal sites, tourism, and marine archaeological features as shown on Drawings 10.7 – 10.9.

1.10.5 Several standard operating procedures are included as part of the project design which reduce the risk to human receptors from the proposed operations. It is anticipated that an exclusion zone will be implemented around the precited returning LV impact zones (and the recovery vessel, in the case of sub-orbital launches). Communications to other maritime users of the location of LV impact zones will comprise Notice to Mariners, NAVTEX warnings and Sécurité messages.

1.10.6 For Study Area A, the orbital launches have the potential to affect the aforementioned water quality, biodiversity and human activities. The pathways of effect have been identified: impacts from the presence of the LV and associated materials, such as metals, microplastics, and hydrocarbons; impacts from direct strike; impacts from disturbance/displacement associated with presence of the LV/recovery vessels and associated exclusion zones; and impact at the seabed from when the LV comes to rest.

1.10.7 As sub-orbital launch vehicles are expected to be recovered, the effect pathways associated with the input of contaminants from LVs, and the impacts at the seabed, have been scoped out for Study Area B. Impacts from disturbance/displacement and direct strike have been considered for Study Area B.

1.10.8 The potential impacts on water quality, biodiversity, and human activities in the study areas have been assessed. All pathways have a negligible or minor risk of a likely significant effect on the receptors.

1.10.9 Because the risk is negligible or minor there is no requirement to apply mitigation in order to reduce the risk further. Accordingly, the residual effect to the receptors is also negligible or minor with no likely significant effects.

1.11 Climate Change

1.11.1 An assessment of the potential effects of greenhouse gas (GHG) emissions associated with the Proposed Project on climate change has been undertaken.

1.11.2 The assessment considered emissions arising from the operation of the Proposed Project including transportation and electricity and fuel consumption.

1.11.3 A climate resilience assessment has been carried out to assess the vulnerability of the Proposed Project to climate change.

1.11.4 The assessment evaluated the impact of climatic variables such as wind speed, precipitation and temperature on sensitive receptors associated with the Proposed Project.

1.11.5 The climate baseline was characterised using Met Office climate data for the period 1981-2001.

1.11.6 Potential climate change effects caused by GHG emissions associated with the Proposed Project should be considered significant in accordance with IEMA best practice guidance. These GHG emissions in the context of overall annual emissions by the Shetland Islands are considered minor and not significance.

1.11.7 Mitigation measures, including the switch to electrical power and the continued decarbonisation of passenger and freight transport, will contribute to reducing GHG emissions.

1.11.8 Climate resilience impacts on the Proposed Project associated with high temperatures are considered to be of negligible significance.

1.11.9 High wind speeds are predicted to have an effect of minor significance on the Proposed Project.

1.11.10 The effects of heavy precipitation on the Proposed Project are considered to be of minor significance.

1.11.11 Standard mitigation has been considered in the inference of effect significance. Committed mitigation measures include installing deluge pumps to protect against fire, undertaking a dust impact assessment and implementing a dust management plan, establishing a drainage system to minimise flood risk, suspending activities during extreme weather events, and providing personnel with appropriate PPE.

1.12 Land, Soils and Peat

1.12.1 The Proposed Project comprises three launch pads and ancillary buildings and access infrastructure. The site is a relatively flat area on the Lamba Ness peninsula with high, rocky cliffs forming the north, east and south boundaries.

1.12.2 There are no statutorily designated sites relevant to geology within the Proposed Project boundary. The Norwick SSSI is approximately 150 m west of the Proposed Project along the coastal cliffs, is designated for its geological interest and also subject to a GCR classification which extends into the Proposed Project boundary. The Norwick Meadows SSSI is approximately 800 m south-west of the proposed project and is designated for sand dunes and valley fen.

1.12.3 Geology across the Proposed Project site comprises till and/or morainic deposits, with blown sand and localised organic soils, peat and deep peat, over low-permeability igneous and metamorphic rock.

1.12.4 Likely operational effects include pollution of the land, soils and peat from surface runoff and fuel/chemical leaks and spills, and indirect impact on peatland through changes to the hydrological regime.

1.12.5 Standard mitigation measures include appropriate design of site drainage including incorporation of sustainable drainage systems, no bulk storage of fuels at the Proposed Project, and appropriate spill control procedures.

1.12.6 The significance of residual effects on geological receptors is considered to be minor and not significant.

1.13 Landscape, Seascape and Visual Impact Assessment

1.13.1 A Landscape and Visual Impact Assessment has been undertaken for the Proposed Project. It sets out the predicted effects on the landscape, which, in the context of Shetland and this assessment, also includes effects on coastal and seascape character.

1.13.2 The assessment includes consideration of effects upon designated landscapes including the Shetland National Scenic Area and other locally designated landscapes such the draft Local Landscape Areas.

1.13.3 From a visual perspective, the assessment considers effects upon residents at settlements, users of the assessment consider effects upon residents at settlements, users of roads and recreational routes, which include tourists. This was informed by assessment of visual effects at a series of representative viewpoints, which were agreed with NatureScot and Shetland Islands Council.

1.13.4 The assessment of in-combination effects between the component parts of the Proposed Project is incorporated into the main assessment of landscape and visual effects. Some limited in-combination interactions will occur.

1.13.5 The proposed launch pads will need to be lighted at night for a short term during individual launch cycles for reasons of safety. The lighting will extend visual effects into hours of darkness for local visual receptors.

1.13.6 Whilst it is always necessary to take account of and to balance the wide range of technical and environmental requirements, it is also a requirement to seek to optimise the layout design through mitigation measures embedded into the project design to reduce the resulting effects from a landscape and visual perspective. Landscape and visual input into the Proposed Project design has been provided through the design development stages of the project. These measures include the careful selection of colour in the proposed built forms, sensitive use of construction materials, and a careful approach to the manipulation of the land form to accommodate the new structures.

1.13.7 A number of significant effects are predicted including significant landscape effects on the landscape character of the site and its surroundings, visual effects on residents at settlements and tourists including recreational walkers.

1.13.8 Effects on the fabric of the landscape will be limited in extent. The physical changes to the landscape, such as the construction of access tracks, launch pads, and buildings will occupy only a small portion of the overall site area and the existing use of the land for grazing will persist.

1.13.9 The Proposed Project is focussed away from the scattered settlement and coastal crofting land and is positioned on the Lamba Ness peninsula. The site has previously been the focus for the large-scale development of the wartime Skaw Radar Station with many of the original structures, buildings and tracks remaining evident in this coastal landscape. The Proposed Project has been carefully planned to retain the integrity of the remaining Skaw Radar facility, by using the existing site access and by positioning the proposed built forms in less prominent positions within the landscape and, avoiding the remains of the Skaw Radar Station where possible. Whilst the effects will be significant locally to the site, and for some visual receptors in local views to the site, it is considered that these can be accommodated in this open, diverse coastal landscape.

1.14 Cultural Heritage and Archaeology

1.14.1 The archaeology assessment identifies the archaeological and cultural heritage significance of the Proposed Project Site and assesses the potential for direct and settings effects on cultural heritage assets and features resulting from the operation of the Proposed Project. This chapter also identifies measures that should be taken to mitigate predicted adverse effects.

1.14.2 Major and significant direct and setting effects are predicted upon the Scheduled remains of RAF Skaw (Site 3) resulting from the operation of the Proposed Project. This would result from the removal of a number of features associated with the construction, use and abandonment of RAF Skaw and, from the construction of new and large-scale structures associated the Proposed Project. The impacts would adversely affect the integrity of the asset's setting.

1.14.3 Moderate and significant setting effects are expected on the Inner Skaw Scheduled Monument (Site 2 Moderate and significant setting effects are expected on the Inner Skaw Scheduled Monument (Site 2) as a result of the Proposed Project. There would be no direct effects upon the Scheduled Monument. The relationship of the component parts of the asset to each other and to its surroundings would still largely be legible and so the integrity of the asset's setting would not be adversely affected.

1.14.4 Significant effects upon RAF Skaw and on the setting of Inner Skaw Scheduled Monuments are acknowledged and a programme of compensatory measures are proposed to enhance the understanding and appreciation of these designated assets and provide increased access to them through implementation of a Conservation Management Plan and Interpretation Strategy.

1.14.5 The Conservation Management Plan represents a commitment to the ongoing management and maintenance of the Skaw radar station site during operation of the Proposed Project and presents a range of broad policies to allow for this commitment to be met. An outline of proposed conservation works, and an assessment of their priority is provided within the Conservation Management Plan. In making these management, maintenance and repair recommendations, the aim has been to retain the surviving buildings and structures in a safe and manageable condition whilst respecting and preserving their significance. In addition, a programme of annual inspection and maintenance will be carried out on all structures to control unwanted vegetation growth, stabilise loose brickwork and make good any localised areas of failing mortar, with regular inspections formalized to identify any defects

1.14.6 In terms of residual effects, vibration monitoring will take place during the operational phase to ensure that the potential for any impact upon upstanding remains resulting from vibration during launch events is identified early and that further steps are taken to avoid or minimise any harm. As such any direct residual effects resulting from vibration during the operational phase are predicted to be negligible and not significant. There would be major and significant residual setting effects upon RAF Skaw and moderate and significant residual setting effects upon Inner Skaw.

1.15 Accidents

1.15.1 A list of potential events was drawn up based on the expected activities at the Proposed Project.

1.15.2 Natural disasters including flooding and tectonic activity are considered highly unlikely given the location of the Proposed Project. Extreme weather effects have been addressed in the Climate Change Chapter 11 of this AEE Report and it is considered that the proposed infrastructure design provides sufficient resilience to the effects of extreme weather events over the design life of the Proposed Project.

1.15.3 Accident events were subcategorised into failure of containment of propellant, diesel fuel and hazardous materials, ignition and off-nominal launch scenarios. The effects on generic on-site human and wildlife receptors and off-site designated habitat sites were considered for each of these events.

1.15.4 Failures of containment were generally considered to be minor or moderate significance and largely restricted to the areas immediately within the vicinity of the release point, given the quantities in use and the rapid expected evaporation and/or dispersion of the majority of bulk liquids and gases used. Certain losses, notably of diesel and the satellite thruster propellant hydrazine, were considered to be major with the potential for significant effects owing to their likely environmental persistence and toxicity to humans and other wildlife respectively. Mitigation will be through management procedures, robust containment and restrictions on the quantities stored at the Proposed Project.

1.15.5 Again, noting the environmental context, ignition events are considered to be major with potential for significant effects inasmuch as damage to health or loss of life to human and wildlife receptors would be possible if in close proximity to the event. In the unlikely event that ignition of flammable materials (RP-1 rocket propellant, diesel or hydrazine) occurred, the initial blast radius would be relatively small (well within the Proposed Project boundary) and the subsequent blaze limited in duration by the quantities stored and used. Mitigation will be through the restriction of ignition sources from flammable materials through standard operating practices. Uncontrolled ignition events during launches are managed via the LV design process and integrity checks.

1.15.6 Off-nominal launch scenarios are considered to be of major significance should a ground strike take place, with potential for severe damage to human, wildlife and habitat receptors from impact and subsequent ignition of remaining propellant. Mitigation is inherent to the remote, northerly launch site location and exclusively northward launch trajectories to be used. Water strikes were considered of moderate significance as wildlife receptors could potentially be impacted and are discussed in the Marine Effects Chapter 10 of this AEE Report.

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Volume II AEE Report

Chapter 1 Introduction

Introduction

1. Introduction

1.1 Introduction

1.1.1 ITPEnergised has prepared this Assessment of Environmental Effects Report (AEE Report) on behalf of Shetland Space Centre Limited ('the Applicant') in regard to two separate but related applications to the Civil Aviation Authority (the regulator) for licenses under the Space Industry Act 2018.

1.1.2 The Applicant intends to operate a vertical launch spaceport, to be known as the SaxaVord Spaceport (and for purposes of this AEE Report referred to as 'the Proposed Project') situated at Lamba Ness on Unst, Shetland. The location of the Proposed Project and a layout plan of the Proposed Project are shown on Drawings 3.1 and 3.2 in Volume III and described in more detail in section 1.5 below.

1.1.3 The Proposed Project will be operated to launch sub-orbital sounding rockets and small satellites into either polar or sun-synchronous, low-earth orbits.

1.2 The Applicant

1.2.1 The Applicant for the Proposed Project is Shetland Space Centre Limited (SSC). SSC was established in 2017 as a project specific company for the Proposed Project. SSC is a limited company incorporated in Scotland (Company no. SC575537) and having its registered office at Orbital House, 15 Castle Road, Grantown-On-Spey, Scotland, PH26 3HN.

1.3 Background

UK Space Strategy

1.3.1 Growth in demand for meteorological, telecommunications, earth observation and Global Navigation Satellite Systems (GNSS) satellite services has led to rapid growth and diversification within the space industry and a marked shift from state to private provision. In the UK in 2018 the industry was worth more than £16 bn (annual growth exceeds three per cent) and comprised around 1,000 companies and organisations (UK Government, 2018). Glasgow produces more satellites than any other European city. However, currently, the "missing link" for the UK is launch capability.

1.3.2 As set out in the National Space Policy (UK Government 2018) and the later National Space Strategy (UK Government, 2021), the UK aims to become the European hub for commercial spaceflight and related sector technologies. The UK Government is committed to building one of the most innovative and attractive space economies in the world, supporting the growth of a robust and competitive commercial space sector growing the value of the UK Space Sector to £40 billion by 2030, representing approximately 10% of the global market.

UK Space Agency Site Selection

1.3.3 An independent assessment (DEIMOS et al, 2017) of potential areas for the vertical launch of small satellites as part of the SCEPTRE project on behalf of the UK Space Agency (UKSA), identifies Saxa Vord as being the optimal location in the UK for launching small satellites into space from a technical perspective. Favourable characteristics include the high latitude and the geographic location, giving the Proposed Project the best orbital access conditions in the UK which enables launch trajectories to remain entirely clear of inhabited areas. The assessment identifies the key advantages of Saxa Vord as the following:

- *Excellent orbit accessibility offering unrivalled payload performance.*
- *Good civil infrastructure already present.*
- *Lowest disruption to commercial aviation.*

Further information on the site selection process is provided in AEE Report Volume II, Chapter 4.

LaunchUK and Pathfinder Test Launch

1.3.4 Through its LaunchUK initiative, to help grow the UK's spaceflight capabilities, the UK government is funding a range of industry-led projects including £31.5 million to establish launch services.

1.3.5 The UK Space Agency has selected Lockheed Martin to help implement its vision for the UK Spaceflight Programme and, with a grant from the UK Space Agency, Lockheed Martin is leading a team to execute several strategic projects with a goal of providing the first vertical space launch in the early 2020s, the Pathfinder Launch. The strategic projects include:

- The UK's First Spaceport: The team will support the development of the nation's first commercial spaceport (the Proposed Project) at Lamba Ness on Unst;
- Provision of a Launch vehicle and ancillary equipment;
  - Advanced 6U CubeSat Pathfinder: As part of the programme, Lockheed Martin teammate Orbital Micro Systems will create and fly a UK-built pathfinder test to validate the performance of a Small Launch Orbital Manoeuvring Vehicle (SL-OMV) and ground system. The pathfinder will help lay the ground work for planned satellite constellations that are designed to deliver low latency weather observation to commercial and government customers.
  - Innovative CubeSat Delivery Vehicle: Once it reaches orbit, the first rocket launched will release a SL-OMV, built specifically by Moog in the UK for the UK Spaceflight Programme.
- Supporting development of the UK Regulatory Environment; and
- Overseeing the Pathfinder Launch and subsequent data analysis.

1.4 Regulatory Requirements and Guidance Documents

Space Industry Act 2018

1.4.1 The Space Industry Act 2018 received Royal Assent on 15 March 2020 and provides a legal framework for the licensing of space activities, sub-orbital activities and associated activities carried out in the UK.

1.4.2 The Act requires that person or organisation wishing to undertake the following to obtain a relevant license:

- launch a launch vehicle from the UK;
- return a launch vehicle launched elsewhere than the UK to the UK landmass or the UK's territorial waters
- operate a satellite from the UK
- conduct sub-orbital activities form the UK
- operate a spaceport in the UK, or
- provide range control services from the UK.

1.4.3 As the Applicant wishes to operate a vertical launch spaceport (the SaxaVord Spaceport) and provide range control services (at the Launch and Range Control Centre, LRCC) they are required to apply for a both a spaceport licence and a range control licence. However, AEE is only relevant to applications for spaceport licences.

Space Industry Regulations 2021

1.4.4 The Space Industry Regulations 2021 (the Regulations) set out in more detail the requirements for each licence the Regulators Licensing rules, which specify what information the UK Civil Aviation Authority (CAA), the regulator, requires in support of an application.

Relevant Guidance

Guidance for the Assessment of Environmental Effects

1.4.5 The CAA, with the UK Space Agency, the Department for Business, Energy and Industrial Strategy and the Department for Transport, issued guidance note '*Guidance for the Assessment of Environmental Effects*' in July 2021. The guidance sets out what is required by the regulator regarding assessment of environmental effects as part of a licence application under the Act.

1.4.6 The guidance describes the two licence types required by the Applicant as follows:

- *A spaceport licence is one granted under Section 3 of the Act and authorises a person or organisation to operate a spaceport (i.e., a site from which spacecraft or carrier aircraft can be launched or a site at which controlled and planned landings of spacecraft can take place). Spaceports can be licenced for vertical or horizontal launches (or potentially both)… A person or organisation holding a spaceport licence is referred to as a spaceport licensee.*
- *A range control licence is one granted under Section 7 of the Act authorising a person or organisation to carry out range control services in relation to spaceflight activities. That includes identifying an appropriate range; coordinating the use of a range; issuing protective notifications and monitoring the range. A person or organisation holding a range control licence is referred to as a range control licensee.*

1.4.7 AEE is only relevant to applications for spaceport licences and launch operator licences; so whilst reference to the LRCC has been made in this document for information; no assessment of the effects from the LRCC has been undertaken.

Guidance to the regulator on environmental objectives relating to the exercise of its functions under the Space Industry Act 2018

1.4.8 The Department for Transport issued its document '*Guidance to the regulator on environmental objectives relating to the exercise of its function under the Space Industry Act 2018*' in 2021, clarifying the government's environmental objectives relating to spaceflight and associated activities in the UK:

The environmental objective for spaceflight are to:

- *Minimise emissions contributing to climate change resulting from spaceflight activities*
- *Protect human health and the environment from the impacts of emissions on local air quality arising from spaceflight activities*
- *Protect people and wildlife from the impacts of noise from spaceflight activities*
- *Protect the marine environment from the impact of spaceflight activities.*

1.4.9 The objectives presented in the guidance are noted to be consistent with the environmental topics that must be addressed in an AEE. Consideration of the environmental objectives has been included as relevant in the AEE technical assessment chapters.

1.5 The Proposed Project

1.5.1 The Proposed Project will be operated to launch sub-orbital sounding rockets and small satellites into either polar or sun-synchronous, low-earth orbits. The layout of the spaceport allows for launches by multiple launch service providers (LSPs) using a range of different rocket (launch vehicle - LV) types and is designed to accommodate LVs up to 30 m in height. Launches will take place in a northerly direction over the sea.

1.5.2 The Proposed Project consists of the following and where appropriate throughout, the term “Proposed Project” shall mean all of the following elements, except where highlighted:

- Launch Site: located on the Lamba Ness peninsula and comprising three launch pad complexes, each incorporating a launch pad, ground services storage and control, lightning protection masts, liquid and compressed gas storage and water deluge tanks for launch operations;
- Satellite Tracking Station: an area of hardstanding housing satellite tracking and telemetry devices located on the Lamba Ness peninsula;
- Launch Site Processing Facility (LSPF) hangar buildings (two): located on the Lamba Ness peninsula, a building where the LVs are assembled, and the payload (the satellites) integrated into the LVs;
- Administration Building, Pyrotechnics Store, and Hazardous Materials Store located adjacent to the LSPF on the Lamba Ness peninsula;
- Integration Hangar/TEL building: located on the Lamba Ness peninsula, a forward position building close to the launch pads housing the transporter erector launcher (TEL) and where the final integration activities take place as required;
- Support Infrastructure: located on the Lamba Ness peninsula including access, an internal track system and a series of small temporary buildings;
- Gate House, including a tourist information area, located on the Lamba Ness peninsula; and
- Wildlife Hide: located on the Lamba Ness peninsula.

1.5.3 Subject to securing the appropriate permissions, consents and licences, the intention is to initiate the construction of the Proposed Project in early 2022, with the first launch later in 2022, following a 10-month construction programme for the first phase of works.

1.5.4 A full description of the Proposed Project is provided in AEE Report Volume II, Chapter 3.

1.6 Environmental Budget

1.6.1 The Applicant is looking to achieve a maximum of 30 launch events per year from the Proposed Project. However, in the first year of operation (2022) it is anticipated that there will be up to 10 launches, made up of both orbital and sub-orbital rockets.

1.6.2 Whilst the Applicant has not yet determined a specific timeframe for operations, when required for the purposes of this AEE an operational period of 30 years has been assumed, aligning with the current land lease for the Proposed Project. This applies in particular to the process of calculating total mass of returning components, required for the Marine and Transboundary assessment (Chapter 10).

1.6.3 For all other aspects and topics, the combined effects of up to 30 launches over any given one-year period is considered to be most appropriate and therefore for the purposes of this AEE the effects of the Applicant’s environmental budget have been assessed so as to give the predicted effects over any one year.

Precautionary Approach

1.6.4 For all topics excluding marine and transboundary, the AEE has been based on a worst case assumption that all 30 launches per year are orbital launches.

1.6.5 For the assessment of marine and transboundary effects (Chapter 10), sub-orbital and orbital LVs result in different impact zones and so both LV types have been assessed to provide information on all aspects of operation of the Proposed Project. Within this assessment it has been assumed that all sub-orbital activities will reach 47 km altitude.

1.7 Site Description

1.7.1 The Proposed Project is located at Lamba Ness on Unst, the most northerly of the Shetland Islands, and comprises a vertical launch spaceport including three launch pad complexes, tracking stations and assembly/integration hangar buildings with associated security fencing, access and servicing.

1.7.2 The Proposed Project is centred on reference point 466500 E, 1215500 N and occupies an area of approximately 80.8 hectares (ha). It is approximately 2.5 km north-east of the settlement of Norwick.

1.7.3 There are no residential properties located within the boundary of the Proposed Project Site, with the closest property, the Haa, located approximately 0.6 km away. The Haa is uninhabited and will remain so for the duration of operation of the Proposed Project as it is unfit for habitation due to an unhealthy water supply. Accordingly, it has not been considered as a residential receptor and the closest residential receptors are therefore the properties in Norwick, located approximately 2 km south-west of the Proposed Project.

1.8 Designated Sites

1.8.1 A plan showing relevant designated sites within the vicinity of the Proposed Project is included as Drawing 1.1.

Geology, Hydrology, Hydrogeology Designations

1.8.2 There are no statutorily designated sites relevant to geology, hydrology or hydrogeology within the boundaries of the Proposed Project.

1.8.3 No internationally designated sites relevant to geology, hydrology or hydrogeology (i.e., Special Areas of Conservation) are located within the AEE environmental zone of influence (EZI). However, two relevant nationally designated sites are located within the EZI:

- The Norwick Site of Special Scientific Interest (SSSI) is approximately 150 m west of the Proposed Project along the coastal cliffs. It is designated for its geological interest (structural and metamorphic geology).
- The Norwick Meadows SSSI is approximately 800 m south-west of the Proposed Project. It is designated for sand dunes and valley fen.

Ecological Designations

1.8.4 There are no statutorily designated sites relevant to ecology within the boundaries of the Proposed Project.

1.8.5 There are a number of national and international statutorily designated sites relevant to ecology in the vicinity of the Proposed Project, with 10 designated sites within 10 km as follows:

- Hermaness, Saxa Vord and Villa Field Special Protection Area (SPA) - Designated for breeding birds: fulmar (Fulmarus glacialis), gannet (Morus bassanus), great skua (Stercorarius skua), common guillemot (Uria aalge), kittiwake (Rissa tridactyla), puffin (Fratercula arctica), red-throated diver (Gavia stellata), shag (Phalacrocorax aristotelis) and breeding bird assemblages;

- Keen of Hamar Special Area of Conservation (SAC) - Designated for upland habitats: base rich scree, dry heath and grasslands on soils rich in heavy metals;
- Keen of Hamar Site of Special Scientific Interest (SSSI) - Designated for Calaminarian grassland and serpentine heath and vascular plant assemblages;
- Hill of Colvadale and Sobul SSSI - Designated for Arctic sandwort (Arenaria norvegica), breeding Arctic skua (Stercorarius parasiticus), whimbrel (Numenius phaeopus), calaminarian grassland and serpentine heath and breeding bird assemblages;
- Valla Field SSSI - Designated for breeding great skua and red-throated diver;
- Crussa Field and Heogs SSSI - Designated for breeding Arctic skua, whimbrel, vascular plant assemblages, Calaminarian grassland and serpentine heath and breeding bird assemblages;
- Hermaness SSSI - Designated for breeding gannet, great skua, guillemot, puffin and breeding seabird colony;
- Saxa Vord SSSI - Designated for breeding fulmar, guillemot and breeding seabird colony;
- Norwick Meadows SSSI - Designated for sand dune habitats and valley fen wetlands; and,
- Fetlar to Haroldswick Marine Protection Area - Designated for aggregation of breeding birds: black guillemot (Cepphus grylle), horse mussel beds, circalittoral sand and coarse sediment communities and kelp and seaweed communities on sublittoral sediment.

1.8.6 The Hermaness, Saxa Vord and Valla Field SPA lies approximately 1.5 km west of the Proposed Project along the northern Unst coastline. The SPA consists of 100-200 m high sea cliffs and adjoining areas of grassland, heath and blanket bog, and the seaward extension extends approximately 2 km into the marine environment to include the seabed, water column and surface. The boundary of the SPA is coincident with that of the Saxa Vord SSSI and Hermaness SSSI which are located approximately 3 km and 4 km north-west of the Proposed Project respectively.

1.8.7 The high cliffs and stacks of the Hermaness SSSI support large colonies of nesting seabirds, with some species individually reaching numbers of national importance. Inland from the cliffs, the bog and heath vegetation provide nesting habitat for one of the largest colonies of great skua in the world, representing over 3 % of the global population.

1.8.8 The Saxa Vord SSSI contains several skerries which, along with the sea cliffs, support a wide range of seabirds. This SSSI site is notified for its nationally and internationally important breeding fulmar and guillemot populations and for the seabird colony as a whole. The site supports a breeding colony of fulmar and guillemot contributing to 1.2% and 0.4% of the British population respectively.

Landscape Designations

1.8.9 Seven small areas of coastal landscape in Shetland have been identified as being of outstanding scenic interest. These designated areas make-up the Shetland National Scenic Area and comprise Shetland's scenic highlights and epitomise the range of coastal forms varying across the Island group.

1.8.10 One NSA sub-unit, Hermaness, is located within the EZI. The identified special qualities of the Hermaness sub-unit are as follows:

- the stunning variety of the extensive coastline;
- the hidden coasts;

- the effects and co-existence of wind and shelter;
- a sense of remoteness, solitude and tranquillity;
- the notable and memorable coastal stacks, promontories and cliffs;
- the distinctive cultural landmarks; and,
- northern light.

1.8.11 Three Local Landscape Areas (LLAs) are identified within the EZI, of which only one has the potential to be affected by the Proposed Project to a level that could result in significant effects: the LLA at Haroldswick and Skaw.

Archaeological Designations

1.8.12 There are a number of national and international statutorily designated archaeological sites relevant to the Proposed Project.

1.8.13 The Proposed Project extends across the southern portion of the Scheduled Area of RAF Skaw. RAF Skaw is the northernmost 20th century Chain Home Radar Station and is composed of two areas. Numerous individual features within the southern portion of RAF Skaw have been recorded, including the remains of radar structures, domestic blocks and defensive structures.

1.8.14 Inner Skaw Scheduled monument is located immediately north of the Proposed Project. The designated asset comprises the remains of a multiperiod settlement with associated agricultural remains which dates from the Early Historic period onwards.

1.8.15 The Scheduled Monument of St John's Church at Norwick is a multi-period asset which encompasses an Iron Age broch and the remains of a post-medieval chapel located approximately 1.2 km south-west of the Proposed Project.

1.8.16 There are two Listed Buildings located within one kilometre of the Proposed Project. The Banks, Norwick, a group of Category C Listed 19th century crofts, are recorded approximately 670 m south-west of the Proposed Project. Another Category C Listed boat-roofed shed is located approximately 740 m north of the Proposed Project.

1.9 Environmentally Sensitive Periods of Time

No-launch Window

1.9.1 Following consultation with NatureScot during the planning application stage, the Applicant committed to a no-launch window whereby no satellite launches or static tests will be carried out between mid-May and the end of June so as to avoid disturbing birds during the critical incubation and early brooding period. This commitment has subsequently been reflected in planning condition 15 for the Proposed Project.

Night-time Operations

1.9.2 Night-time effects are relevant to both the noise and landscape and visual impact assessment chapters.

1.9.3 Regarding Noise, for the purposes of the AEE the night-time period has been assumed to be 23:00 – 07:00, as defined in Noise Guidance Document PAN1/2011 TAN.

1.9.4 Of the proposed 30 launches per year, when taking into account the no-launch window agreed between mid-May to the end of June, the Applicant anticipates that in any one month there may be three-four launches. As discussed in Chapter 8, given the proposed frequency of launches and the short duration of the associated noise events, and with reference to the 2006 Basner study which states that restricting additional awakenings due to aircraft noise to a maximum of one event per night is anticipated to have no adverse effect on human health, adverse effects associated with sleep disturbance due to night-time launches are considered to be minimal, resulting in no likely significant effect.

1.9.5 In terms of visual impact, as discussed in Chapter 13, Shetland has long hours of daylight in the summer months, when the effects of safety lighting at the Proposed Project will be minimal, but there will be long hours of darkness in winter when the effects will extend over longer durations. In Shetland in winter at this latitude it can be dark from 3pm through to 9am, which includes times when people will be active and able to be affected by the proposed lighting. Lighting may also be seen to interfere with natural phenomena such as the Northern Lights, when it occurs.

1.9.6 Night-time drawings are provided within the AEE to illustrate the effects of lighting at night from two selected viewpoints, representative of the local residential clusters that will experience direct views towards the Proposed Project.

1.9.7 The effects of lighting on night-time views is likely to be significant in the winter months, particularly in closer views, i.e., locations within approximately 1-2 km where the Proposed Project is visible. In summer months, however; when the islands are typically more populated with tourists and more people will be outside, most people will be asleep during the very short hours of darkness at this latitude, and the effect of the lighting will be not significant. Between these two extremes, the duration and intensity of lighting and thus level of significance of effects will gradually increase as the natural daylight tapers off.

1.9.8 Although potentially significant during winter months, the effects of launches will be short term and temporary, with lighting reduced to the minimum required for site security and occasional maintenance operations outside of launch cycles.

1.10 Planning History and Relevant Conditions

1.10.1 A planning application for the Proposed Project was lodged with Shetlands Islands Council in January 2021 and planning permission granted on 30 March 2022 (document reference 2021/005/PPF).

1.10.2 The planning permission document makes reference to the 'Schedule of Environmental Commitments' included as Table 18.1 in the EIA Report and contains a number of additional conditions relating to minimisation of environmental effects of the Proposed Project. Both of these documents have been taken into account when considering the operational effects of the Proposed Project for AEE.

1.10.3 Relevant extracts from conditions relating to operation of the Proposed Project of particular note are included below for information and addressed in the corresponding technical chapters:

- Condition 9 Habitat Management Plan: …the HMP shall also set out the proposed habitat management of the development site during the period of construction, operation, decommissioning, restoration and aftercare of the land, and shall provide for the maintenance, monitoring and restoration of the habitat on site, and for reporting on progress and for review of the HMP… (Chapter 6 Ecology);
- Condition 11 Scheduled Monument Condition Survey and Monitoring: (11a)… a scheme detailing monitoring of the condition of the Scheduled Monument during the operational phase of the development [must be] submitted to the Planning Authority and accepted by it… (11b) a scheme of vibration monitoring to take place during the operational phase of the development [must be] submitted to and agreed in writing by the Planning Authority. (Chapter 14 Material Assets and Cultural Heritage);
- Condition 12 Conservation Management Plan: Prior to the development site becoming an operational vertical launch space port, the developer shall submit to the Planning Authority… a Conservation Management Plan [identifying] future conservation needs based on the approved Scheduled Monument Condition Survey

and the review of works required during the operational phase of the development… (Chapter 14 Material Assets and Cultural Heritage);

- Condition 15 Birds Breeding Season: …no launches or static tests are to be carried out… between mid-May and the end of June to avoid disturbing birds during the critical incubation and early brooding period. (Chapter 5 Ornithology);
- Condition 16 Breeding Birds Protection Plan: …operational works at the site shall progress in accordance with any mitigation measures contained within the approved Breeding Birds Protection Plan and the timescales contained therein… (Chapter 5 Ornithology);
- Condition 17 Otter Protection Plan: …The approved Otter Protection Plan shall be complied with during the carrying out and operation of the development herby permitted. (Chapter 6 Ecology);
- Condition 19 Operational Environmental Management Plan: Prior to the development site becoming an operational vertical launch space port, the developer shall submit to the Planning Authority… a detailed Operational Environmental Management Plan…[providing] a scheme of noise and vibration monitoring and include[ing] the routes to be taken on the public road network by vehicles associated with the operation and ongoing servicing of facilities at the development site. (Chapter 3 Proposed Project and Chapter 8 Noise); and
- Condition 20 Operational Management Plan: Prior to the development site becoming an operational vertical launch space port, the developer shall submit to the Planning Authority…a detailed Operational Management Plan (OMP). The OMP shall detail how the space port is to be operated. IT shall include the proposed mitigation measures and action s to be taken should an unexpected event or aeronautical incident occur… (Chapter 3 Proposed Project).

1.10.4 Copies of the EIA Report Table 18.1 'Schedule of Environmental Commitments' and planning permission 2021/005/PPF are included for reference as Appendices 1.2 and 1.3 respectively.

1.11 Purpose of Assessment of Environmental Effects (AEE)

1.11.1 The AEE process is the systematic process of identifying, predicting and evaluating the environmental effects of a proposed project. This AEE Report sets out the conclusions of the AEE process undertaken in relation to the Proposed Project. Where appropriate, it also sets out mitigation measures designed to prevent, reduce and, if at all possible, offset significant effects. An assessment of residual effects, those expected to remain following implementation of mitigation measures, is also presented.

1.11.2 The main findings and conclusions of the AEE Report are summarised in a Non-Technical Summary (NTS) presented in Volume I.

1.12 AEE Project Team

1.12.1 The assessment has been undertaken by ITPEnergised supported by external consultants as shown in Table 1.1. CVs for the AEE team are included in Appendix 1.1.

Table 1.1 – AEE Team

Discipline	Lead Specialist	Qualifications	Accreditations	Professional Experience (years)
Population and Human Health	Graeme Blackett, BiGGAR Economics	BA (Hons) Economics, University of Strathclyde	Member Economic Development Association Scotland Member Institute for Economic Development	30+
Ornithology	Dr Peter Cosgrove, Alba Ecology Ltd	PhD Ornithology	FCIEEM	25+
Ecology	Dr Kate Massey, Alba Ecology Ltd	PhD Ecology	MCIEEM	13+
Air Quality	Annie Danskin, ITPEnergised	BEng (Hons.) Environmental Engineering	Member of the Institution of Environmental Sciences (MIEnvSc)	20+
Noise and Vibration	Michael James, Blue Ridge Research and Consulting LLC	B.S., Mechanical Engineering, Virginia Tech M.S, Mechanical Engineering, Virginia Tech	BRRC founding member and principal. >50 military, civilian aviation, rockets, weaponry and blast noise studies including NASA and SpaceX	20+
	Simon Waddell, ITPEnergised	BSc (Hons) Environmental Geoscience, University of Edinburgh Post-graduate Diploma Acoustics and Noise Control, Institute of Acoustics	Member Institute of Acoustics (MIOA)	12+
Water, Land Soils and Peat	Jenny Hazzard, ITPEnergised	BSc Geological Engineering MSc Engineering Geology	Practitioner Member of IEMA	20+

Discipline	Lead Specialist	Qualifications	Accreditations	Professional Experience (years)
Marine Effects / Transboundary Considerations	Ian Reach, MarineSpace Ltd	BSc. (Hons) Marine Biology with Fish Biology	Professional Member of the Marine Biological Association UK	28+
Landscape, Seascape and Visual Impact	Peter Dunmow, Hepla	BA (Hons) Landscape Architecture Dip LA, Landscape Architecture MA (Hons) Landscape Architecture	Chartered Member of the Landscape Institute	28+
Cultural Heritage and Archaeology	Vicky Oleksy, AOC Archaeology Group	BA (Hons) Archaeology and History, MA (Commendation) Historical Archaeology	Member of the Chartered Institute for Archaeologists (MCIfA)	15+
Climate Change	Gavin Bollan, ITPEnergised	BSc (Hons) Environmental Science	Member of the Institution of Environmental Sciences, Fellow of the Institute of Air Quality Management, Chartered Scientist, Chartered Environmentalist	25+
Accidents and Disasters				
AEE co-ordination, introductory and concluding Chapters	Ruth Fain, ITPEnergised	MGeol. (Hons) Environmental Geology	Chartered Scientist (CSci) Member of the Institution of Environmental Sciences (MIEnvSc) NEBOSH General Certificate	19+

1.13 Availability of the AEE Report

1.13.1 On submission of the AEE, the CAA will undertake a formal public consultation process. The CAA will provide the opportunity for representations to be made on the Proposed Project via the CAA consultation hub: https://consultations.caa.co.uk/. All representations will be taken into account before making decisions on the application. Any representations on this AEE Report or the licence applications, should be made directly to the CAA.

1.14 References

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Chapter 2 Approach to AEE

2. Approach to AEE

2. Approach to AEE

2.1 Introduction

2.1.1 This AEE Report comprises a Non-Technical Summary (NTS), the main AEE Report text, accompanying drawings and technical appendices.

2.2 Legislation, Policy and Guidance

2.2.1 The Proposed Project comprises a vertical spaceport (SaxaVord Spaceport) and associated range control services (Launch and Range Control Centre, LRCC) and as falls to be regulated under the Space Industry Act 2018 ('the Act').

2.2.2 A planning application for the Proposed Project was lodged with Shetlands Islands Council in January 2021 and planning permission granted on 30 March 2022 (document reference 2021/005/PPF).

2.2.3 Section 11 of the Act stipulates that all applicants for a spaceport licence are required to submit an assessment of environmental effects (AEE) as part of their licence application. The regulator, the Civil Aviation Authority (CAA), is required to take the AEE into account when deciding whether to grant a licence and what, if any, conditions should be attached to such a licence, and cannot grant a spaceport licence until the AEE has been submitted.

2.2.4 AEE is only relevant to applications for spaceport and launch operator licences, and so is not required for the range control (LRCC) licence application.

2.2.5 Under section 11(4) of the Act the regulator can permit applicants to submit equivalent assessments, prepared previously, as part of the AEE.

2.2.6 Whilst this AEE is a standalone assessment wherein all topics have been assessed for operational phase environmental effects and the technical chapters written to reflect the AEE assessment, some of the technical appendices provided relate to previous assessments developed for the EIA and subsequent planning process (reference 2021/005/PPF). These documents are included in their original format because the operational phase elements of the reports relate directly to the AEE and it is considered disproportionate to duplicate these assessments as stand-alone AEE only assessments.

2.2.7 For the same reason, the reader may find reference to the LRCC and other aspects of the Proposed Project not directly relevant under AEE included within the appendices. This information should be discounted during consideration of the AEE.

2.2.8 There are no regulations for the AEE, however, under section 11(6) of the Act, the regulator is required to issue guidance. The AEE therefore follows the requirements set out in '*Guidance for the Assessment of Environmental Effects*' (CAA et. al. 2021).

2.2.9 In addition to this, and in lieu of any other specific technical guidance, regard has also been had to the established framework for conduction environmental impact assessments, required by the Town and Country Planning (Environmental Impact Assessment) Regulations 2017 and Marine Works (Environmental Impact Assessment) Regulations 2017. Within that framework, consideration has been given to the following:

- Guidelines for Environmental Impact Assessment, Institute of Environmental Management and Assessment (IEMA, 2006);
- A Handbook on Environmental Impact Assessment Version 5 (Scottish Natural Heritage, 2018);

- Shetland Local Development Plan (Shetlands Islands Council, 2014) and related supplementary guidance;
- The Ancient Monuments and Archaeological Areas Act 1979 (HMSO, 1979);
- The Historic Environment (Amendment) (Scotland) Act 2011 (HMSO, 2011);
- Historic Environment Policy for Scotland (Historic Environment Scotland, 2019b); and,
- Shetland Outdoor Access Strategy (Shetland Islands Council, 2019).

2.3 The AEE Process

2.3.1 The purpose of AEE is '*to ensure that applicants for spaceport licences have considered the potential environmental effects of their intended activities and, if necessary, taken appropriate and proportional steps to avoid, mitigate or offset the risks and their potential effects'*. (CAA et. al. 2021).

2.3.2 AEE is the systematic process of identifying, quantifying and evaluating the potential effects of the proposed activities on the environment. The key stages in the AEE process are presented in this chapter, with an overview of the specific methodology adopted for each technical study provided within the respective technical chapters (Chapters 4 to 15).

2.3.3 As stated in the CAA guidance document, the process of AEE can be broken down into four main stages as shown in Figure 2.1.

Figure 2.1 Overview of the AEE Process

2.4 Scope of the AEE

Environmental Zone of Influence

2.4.1 The environmental zone of influence (EZI) of the AEE, in other words the spatial scope or geographical coverage of the assessment, takes into account of a number of factors, in particular:

- the extent of the Proposed Project (refer to Drawing 3.1);
- the nature of the baseline environment, sensitive receptors and the likely impacts that could arise; and,
- the distance over which predicted effects are likely to remain significant and, particularly, the existence of pathways which could result in the transfer of effects to a wider geographical area than the extent of proposed physical works.

2.4.2 For all topics except marine and transboundary, the EZI (study area) is based on orbital launches in order to maintain a precautionary approach.

2.4.3 In relation to marine and transboundary effects (Chapter 10), as the trajectories and likely impact zones for returning material from the two types of LVs proposed (orbital and sub-orbital) are spatially distinct, there is need to assess two EZIs, one for orbital launches (Study Area A) and one for sub-orbital launches (Study Area B).

2.4.4 Details of the EZI(s) relevant to each technical assessment are detailed in AEE Report Volume II, Chapters 4 to 15.

Temporal Scope

2.4.5 The baseline year used for the assessment of effects is 2020. However, appropriate technical disciplines have carried out pre-assessment studies and/or literature reviews from wider timeframes, for example, ecology and ornithology surveys have been undertaken in 2018, 2019 and 2020 and the Climate, Heritage and Marine/Transboundary Effect chapters refer to datasets spanning the period 1970 – 2020 as relevant.

2.4.6 It is noted that the baseline year reflects the period before the Proposed Project has not been constructed. This is because the Proposed Project as yet has still to be constructed and therefore no 'with spaceport' baseline data is available at the time of writing. 2020 data has been used rather than 2022 data because it is considered disproportionate to duplicate surveys and assessments for AEE given that the spaceport has still not been constructed yet.

2.4.7 Whilst it is acknowledged that using a 2020 'without spaceport' baseline may result in an over-emphasis of effects; it is considered that this approach adds to the precautionary approach of the AEE and is a suitable methodology, given that the spaceport has yet to be constructed.

Environmental Budget

2.4.8 The Applicant is looking to achieve a maximum of 30 launch events per year from the Proposed Project. However, in the first year of operation (2022) it is anticipated that there will be up to 10 launches, made up of both orbital and sub-orbital rockets.

2.4.9 Of the total proposed 30 launches per year, when taking into account the no-launch window agreed between mid-May to the end of June, the Applicant anticipates that in any one month there may be three-four launches. It is noted however that this is not a fixed maximum budget; rather a working assumption developed on the basis that there will likely be a period of at least a week between launches due to operational constraints within the LV assembly facilities.

2.4.10 Whilst the Applicant has not yet determined a specific timeframe for operations, when required for the purposes of this AEE an operational period of 30 years has been assumed, aligning with the current land lease for the Proposed Project. This applies in particular to the process of calculating total mass of returning components, required for the Marine and Transboundary assessment (Chapter 10).

2.4.11 For all other topics, the combined effects over any given one-year period is considered to be most appropriate and therefore for the purposes of this AEE the effects of the Applicant's environmental budget have been assessed so as to give the predicted effects over any one year.

Precautionary Approach

2.4.12 For all topics excluding marine and transboundary, the AEE has been based on a worst case assumption that all 30 launches per year are orbital launches.

2.4.13 For the assessment of marine and transboundary effects (Chapter 10), sub-orbital and orbital LVs result in different impact zones and so both LV types have been assessed to provide information on all aspects of operation of the Proposed Project. Within this assessment it has been assumed that all sub-orbital activities will reach 47 km altitude.

2.5 AEE Preparation and Content

2.5.1 This AEE looks to identify, describe and assess the potential direct and indirect significant effects of the Proposed Project.

2.5.2 A spaceport AEE is described in section 11(3)(a) of the Act:

"Assessment of environmental effects" In relation to a spaceport licence, means an assessment of the effects that launch(es) of spacecraft or carrier aircraft from the spaceport in question, or launches of spacecraft from carrier aircraft launched from the spaceport, are expected to have on the environment.'

2.5.3 As required by the CAA guidance, this spaceport AEE covers all operations and activities intended to be carried out that may have an environmental effect from the spaceflight activities. Under the Act, AEE is only required to cover the operational phase of the Proposed Project.

2.5.4 In line with the CAA guidance, effects on the following environmental features have been considered:

- Population and human health
- Biodiversity (ecology and ornithology)
- Air quality
- Noise and vibration
- Water
- Marine environment
- Climate
- Land, Soils and Peat
- Landscape, Seascape and Visual Impact
- Material assets and cultural heritage
- Accidents and Disasters.

Consultation

2.5.5 Although there is no statutory requirement for applicants to undertake scoping, pre-application discussions with the CAA have taken place, with the scope of this AEE as outlined above discussed with the CAA on 9 July 2021.

2.5.6 Some of the consultation with statutory and non-statutory consultees in regard to operation of the SaxaVord Spaceport during the planning application phase is considered relevant to this AEE and, as such, relevant details have been included in the technical chapters alongside comments on subsequent additional post-planning consultations and any pertinent planning conditions arising from the SaxaVord Spaceport planning consent (2021/005/PPF).

Conducting the AEE

2.5.7 The Applicant has engaged competence experts, as detailed in Chapter 1, to conduct the AEE.

2.5.8 The main steps in each of the technical impact assessments for the Proposed Project are as follows:

- Baseline surveys (where appropriate and where possible given COVID-19 restrictions) to provide information on the existing baseline condition of the existing site and surrounding area.
- Consideration of the possible interactions between the Proposed Project and the existing and predicted future site conditions. These interactions or effects are assessed using stated criteria based on accepted guidance and best practice.
- Using robust design parameters for the Proposed Project, assessment of the likely significant effects, including direct effects and any indirect, secondary, short, medium and long-term, permanent and temporary, positive and negative effects.
- Identification of any uncertainties inherent in the methods used, the predictions made, and the conclusions drawn during the course of the assessment process.
- Identification of mitigation measures designed to avoid, reduce or off-set any significant adverse effects identified as well as enhancement measures that could result in beneficial effects.

- Assessment of the significance of any residual effects after mitigation, in relation to the sensitivity of the feature impacted upon and the magnitude of the effect predicted, in line with the relevant methodology.
- Reporting of the results of the AEE in this AEE Report.

Assessing Significance

2.5.9 Throughout the assessment, a distinction has been made between the term 'impact' and 'effect'. The Act refers to the requirement to report the significance of "effects". An impact is defined as the likely change to the characteristics/nature of the receiving environment as a result of the Proposed Project (e.g., noise from a launch), whereas the 'effect' relates to the significance of the impact (e.g., significant residual noise effect on residential properties). These terms have been adopted throughout this AEE Report to present a consistent approach to the assessment and evaluation of effects and their significance.

2.5.10 The exception to this is the landscape and visual impact assessment which classifies the level of physical and perceptual change to the receiving environment as the "magnitude of change" in line with the recommendations of the Guidelines for Landscape and Visual Impact Assessment third edition (Landscape Institue et al., 2013). However, this terminology should be considered interchangeable with "magnitude of impact".

2.5.11 In order to determine whether or not the potential effects of the Proposed Project are likely to be ‘significant’, a number of criteria are used. Criteria vary between topics but generally include:

- international, national and local designations or standards;
- relationship with planning policy and guidance;
- sensitivity of the receiving environment;
- magnitude of impact;
- reversibility and duration of the effect; and,
- inter-relationship between effects.

2.5.12 Effects that are considered to be significant, prior to mitigation but following the implementation of best practice, are identified within this AEE Report. The significance attributed to the resultant effect is informed by an exercise of professional judgement in relation to the sensitivity of the affected receptor(s) and the nature, duration, frequency and magnitude of the predicted changes/impacts. For example, a major adverse change/impact on a feature or site of low importance will have an effect of lesser significance than the same impact on a feature or site of high importance.

2.5.13 Table 2.1 is used as a guide to the relationship between the sensitivity of the identified receptor and the anticipated magnitude of an impact/change. Professional judgement is however equally important in establishing the suitability of this guiding ‘formula’ to the assessment of the significance of each individual effect.

Table 2.1 Inter-Relationship between Magnitude of Impact and Sensitivity of Receptor

		Sensitivity of Receptor / Receiving Environment to change			
		High	Medium	Low	Negligible
Magnitude of Impact / change	High	Major	Moderate to Major	Minor to Moderate	Minor to Negligible
	Medium	Moderate to Major	Moderate	Minor	Negligible
	Low	Minor to Moderate	Minor	Negligible to Minor	Negligible
	Negligible	Minor to Negligible	Negligible	Negligible	Negligible

2.5.14 The following terms are used in this AEE Report, unless otherwise stated, to determine the level of effects predicted to occur:

- **significant beneficial** or **adverse effect** – where the Proposed Project will result in a significant improvement (or deterioration) to the existing environment;
- **moderate beneficial** or **adverse** effect – where the Proposed Project will result in a noticeable improvement (or deterioration) to the existing environment;
- **minor beneficial** or **adverse** effect – where the Proposed Project will result in a small improvement (or deterioration) to the existing environment; and,
- **negligible** effect – where the Proposed Project will result in no discernible improvement (or deterioration) to the existing environment.

2.5.15 Using professional judgement and with reference to the Guidelines for Environmental Impact Assessment (IEMA, 2006), the majority of the assessments within this AEE Report consider effect levels of moderate or major to be significant, and effect levels of minor or negligible to be non-significant. If there are deviations from this, these are clearly stated within the individual technical chapters.

2.5.16 Summary tables that outline the predicted effects associated with an environmental issue, the appropriate mitigation measures required to address these effects and subsequent overall residual effects are provided in Chapter 16.

Assessing Cumulative Effects

2.5.17 Cumulative effects can be either inter-project or intra-project effects.

2.5.18 Inter-project cumulative effects are those where an environmental topic/receptor is affected by impacts from more than one project at the same time and the impacts act together.

2.5.19 Due to the location of the Proposed Project on the north coast of Unst, the most northerly of the Shetland Islands, for all but one of the technical disciplines assessed there are no potential inter-project cumulative effects as there are no other existing or proposed developments in the relevant EZI. The exception to this is the marine and transboundary assessment (Chapter 10) wherein the EZIs for sub-orbital and orbital launches extend across a large area and therefore the Proposed Project has the potential to interact with offshore wind, marine renewables, oil and gas, and subsea cable developments.

2.5.20 Intra-project cumulative effects are those where an environmental topic/receptor is affected by more than one impact from the same Proposed Project and the impacts act together.

2.5.21 Given that between environmental topics there is little overlap (for example air quality impacts have no effect on noise impacts etc.,) and because only one launch will occur at any given time, and launches will be phased with time enough for the EZI to return fully to the baseline state for all environmental topics between launches (i.e., no more than one launch within 24 hour period), for all but two of the technical disciplines assessed there are no potential intra-project cumulative effects. The exceptions to this are:

- the marine and transboundary assessment (Chapter 10) wherein the potential additive effects of multiple launches have been assessed through time; and
- the ornithology and ecology assessments (Chapters 5 and 6) wherein effects on birds and wildlife of noise impacts associated with satellite launches (Chapter 8) have been assessed.

2.5.22 Within this AEE Report, therefore, cumulative effects for each technical discipline are covered as required on a chapter by chapter basis with a summary of overall effects included in the summary of effects chapter (Chapter 16).

Assessing Mitigation Measures

2.5.23 The AEE is required to present a description of the measures proposed to avoid, reduce and, if possible, offset significant adverse effects. Wherever reasonably practicable, mitigation measures have been proposed for each significant environmental effect predicted, taking various forms including:

- changes to the scheme design;
- physical measures applied; and,
- measures to control particular aspects of the operation of the Proposed Project.

2.5.24 Where none of the above have been deemed practicable, the Proposed Project design is required to include measures to offset any significant adverse effects.

2.5.25 Monitoring measures are also required to examine the mitigation measures to ensure that they have the desired outcomes.

2.5.26 Mitigation measures and monitoring requirements are presented as commitments in order to ensure a level of certainty as to the environmental effects of the Proposed Project. For the avoidance of any doubt, the Applicant is committed to implementing all mitigation measures and monitoring requirements identified in this AEE Report.

Review of the AEE

2.5.27 Following submission of the AEE, the regulator will review the document to satisfy itself that the applicant's assessment is sufficiently robust and provides adequate protection of the environment.

2.5.28 As part of the review, the regulator will take into account comments received from the public or other organisations throughout the consultation process. The regulator can then:

- Determine that the environmental effects as set out in the AEE are acceptable and continue with its assessment of the licence application
- Request that the applicant revisits some areas of the AEE and then resubmits is;
- Determine whether to impose licence conditions.

Post Licence

2.5.29 The Applicant (licensee) will be responsible for required monitoring of environmental effects across all environmental zones of influence throughout operation of the Proposed Project.

2.6 Assumptions, Limitations and Uncertainty

2.6.1 The AEE process is designed to enable informed decision-making based on the best available information about the environmental implications of a Proposed Project. However, there will always be some uncertainty inherent in the scale and nature of the predicted environmental effects as a result of the level of detailed information available at the time of assessment, the potential for minor alterations to the Proposed Project following completion of the AEE Report and/or the limitations of the prediction processes.

2.6.2 A number of assumptions have been made during the AEE process and are described below:

- The principal land uses adjacent to the Proposed Project will remain unchanged during the course of the Proposed Project's lifetime.
- Information provided by third parties, including publicly available information and databases, are correct at the time of submission.

2.6.3 Specific assumptions may also be made with regard to the individual technical disciplines. As applicable, these are detailed within each chapter.

2.6.4 Any limitations to the AEE are summarised in each technical chapter, where relevant, together with the means proposed to mitigate these.

2.7 AEE Report

2.7.1 The AEE Report is comprised of four volumes:

- Volume I – Non-Technical Summary;
- Volume II – Main AEE Report;
- Volume III – Drawings; and
- Volume IV – Technical Appendices.

2.7.2 As suggested in the guidance document (CAA et.al. 2021), the AEE Report includes:

- a Non-Technical Summary (AEE Report Volume I);
- an Introduction (AEE Report Volume II, Chapter 1);
- Scope of the Assessment (this Chapter)
- description of the Proposed Project (AEE Report Volume II, Chapter 3);
- a description of the environmental baseline conditions, EZI, assessment methodology and conclusions on likely significant effects, including cumulative effects, of the Proposed Project on the environment (AEE Report Volume II, Chapters 4 to 15); and
- a description of the features of the Proposed Project and any measures envisaged in order to avoid, prevent or reduce and, if possible, offset likely significant adverse effects (AEE Report Volume II, Chapters 4 to 15 and summarised in Chapter 16).

2.7.3 References are included within each Chapter in Volume II.

2.7.4 Volume III contains the associated Drawings that inform the AEE Report.

2.7.5 Volume IV contains relevant supporting reports and information for each of the technical disciplines prepared to inform the AEE chapters in Volume 2 of the AEE Report.

2.8 References

CAA et. al. (2021) *Guidance for the Assessment of Environmental Effects* [online]. Available at https://publicapps.caa.co.uk/docs/33/(CAP2215)%20Guidance%20for%20the%20assessment%20of%20environmental%20effects.pdf.

Department for Transport. (2021) *Guidance to the regulator on environmental objectives relating to the exercise of its function under the Space Industry Act 2018* [online]. Avialable at *https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/995153/guidance-to-the-regulator-on-environmental-objectives-relating-to-the-exercise-of-its-functions-under-the-space-industry-act-2018.pdf*

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Chapter 3 Description of Proposed Project

3. Description of Proposed Project

3. Description of Proposed Project

3.1 Introduction

3.1.1 The Space Industry Act 2018 requires any organisation wishing to operate a spaceport or provide range control services in the UK to obtain a relevant licence.

3.1.2 The Proposed Project comprises a vertical launch spaceport (SaxaVord Spaceport) and associated range control services (Launch and Range Control Centre, LRCC) situated on Unst, Shetland. As such, the Applicant is applying to the UK Civil Aviation Authority (CAA) for a spaceport operator licence as required by the Space Industry Act 2018.

3.1.3 Section 11 of the Act stipulates that all applicants for a spaceport operator licence are required to submit an assessment of environmental effects (AEE) as part of their licence application. The regulator (the CAA) is required to take the AEE into account when deciding whether to grant a licence and what, if any, conditions should be attached to such a licence.

3.1.4 AEE is only relevant to applications for spaceport and launch operator licences, and so is not required for the range control (LRCC) licence application.

3.2 Background

3.2.1 The location of the Proposed Project is shown on Volume III Drawing 3.1

3.2.2 The Proposed Project comprises a launch area at Lamba Ness comprising three launch pad complexes, a satellite tracking station, launch vehicle integration buildings, roadways (largely re-using existing roads), fuel storage and ancillary infrastructure.

3.2.3 The Proposed Project will be operated to launch sub-orbital sounding rockets and small satellites into either polar or sun-synchronous, low-earth orbits. The layout at the Proposed Project allows for launches by multiple launch service providers (LSPs) using a range of different rocket (launch vehicle - LV) types and is designed to accommodate LVs between 13 m and 30 m in height. LV widths are anticipated to be between 1–2 m and will not have additional boosters at the sides.

3.2.4 All launches will take place in a northerly direction over the sea. For safety reasons, LVs will not fly over inhabited areas. Launches from the Proposed Project will avoid both oil fields to the west and east of Shetland; they will also avoid the Faroe Islands and Iceland to the north-west and Norway to the north-east.

3.3 Proposed Project Location

3.3.1 The Proposed Project is located at Lamba Ness on Unst, the most northerly of the Shetland Islands, and comprises a vertical launch spaceport including a launch pad complex, tracking stations and assembly/integration hangar buildings with associated security fencing, access and servicing.

3.3.2 The Proposed Project is centred on reference point 466500 E, 1215500 N and occupies an area of approximately 80.8 hectares (ha). It is approximately 2.5 km north-east of the settlement of Norwick.

3.4 Proposed Project Infrastructure

3.4.1 The infrastructure required for the Proposed Project consists of:

- Launch Site: located on the Lamba Ness peninsula and comprising three launch pad complexes, each incorporating a launch pad, ground services storage and control, lightning protection masts, liquid and compressed gas storage and water deluge tanks for launch operations;

- Satellite Tracking Station: an area of hardstanding housing satellite tracking and telemetry devices located on the Lamba Ness peninsula;
- Launch Site Processing Facility (LSPF) hangar buildings (two): located on the Lamba Ness peninsula, a building where the LVs are assembled and the payload (the satellites) integrated into the LVs;
- Administration Building, Pyrotechnics Store, and Hazardous Materials Store located adjacent to the LSPF on the Lamba Ness peninsula;
- Integration Hangar/TEL building: located on the Lamba Ness peninsula, a forward position building close to the launch pads housing the transporter erector launcher (TEL) and where the final integration activities take place as required;
- Support Infrastructure: located on the Lamba Ness peninsula including access, an internal track system and a series of small temporary buildings;
- Gate House, including a tourist information area, located on the Lamba Ness peninsula; and
- Wildlife Hide: located on the Lamba Ness peninsula.

3.4.2 A site layout plan of the Proposed Project is included as Drawing 3.2

3.4.3 The Proposed Project includes three separate launch pads to facilitate launches by a range of LSPs in order to be competitive, flexible and sustainable. For hazardous ground operations and launch operations risk will be managed collaboratively in accordance with Spaceport Operator and Launch Operator license requirements.

3.4.4 There will only ever be single launches from the Proposed Project; there will be no simultaneous launches from multiple launch pads.

3.4.5 Subject to securing the appropriate permissions, consents and licences, the intention is to initiate the construction of the Proposed Project in early 2022, with the first launch later in 2022.

3.5 Environmental Budget

3.5.1 The Applicant is looking to achieve a maximum of 30 launch events per year from the Proposed Project. However, in the first year of operation (2022) it is anticipated that there will be up to 10 launches, made up of both orbital and sub-orbital rockets.

3.5.2 Of the total proposed 30 launches per year, when taking into account the no-launch window agreed between mid-May to the end of June, the Applicant anticipates that in any one month there may be three-four launches. It is noted however that this is not a fixed maximum budget; rather a working assumption developed on the basis that there will likely be a period of at least a week between launches due to operational constraints within the LV assembly facilities.

3.5.3 Whilst the Applicant has not yet determined a specific timeframe for operations, when required for the purposes of this AEE an operational period of 30 years has been assumed, aligning with the current land lease for the Proposed Project. This applies in particular to the process of calculating total mass of returning components, required for the Marine and Transboundary assessment (Chapter 10).

3.5.4 For all other topics, the combined effects over any given one-year period are considered to be most appropriate and therefore for the purposes of this AEE the effects of the Applicant's environmental budget have been assessed so as to give the predicted effects over any one year.

Precautionary Approach

3.5.5 For all topics excluding marine and transboundary, the AEE has been based on a worst-case assumption that all 30 launches per year are orbital launches.

3.5.6 For the assessment of marine and transboundary effects (Chapter 10), sub-orbital and orbital LVs result in different impact zones and so both LV types have been assessed to provide information on all aspects of operation of the Proposed Project. Within this assessment it has been assumed that sub-orbital activities will reach 47 km altitude.

3.6 Proposed Project Operations

3.6.1 The duration of each launch period is expected to run for around four weeks, starting with delivery of the LV and ending with successful launch and facility clean down.

3.6.2 The operational phase will commence with the delivery to the Proposed Project of the following components:

- LVs
- Payloads
- Propellent and commodities

3.6.3 LVs and satellite payloads will be delivered by standard road containers while associated fuel and other required commodities will be delivered by ISO tanker/container lorries by road. This will be followed by assembly of the LVs in the LSPF/integration hangar prior to transfer across site to the relevant launch pad. Fuelling and preparation of the LVs for launch will be undertaken in situ at the launch pad.

3.6.4 The LV will then be launched, following which the launch pad will be cleaned down and all commodities removed.

3.6.5 All operational works will be subject to an Operational Environmental Management Plan (OEMP) to minimise environmental effects and an Operational Management Plan (OMP) which will detail how the space port is to be operated. The OMP will include the proposed mitigation measures and actions to be taken should an unexpected event or aeronautical incident occur. An outline OEMP has been submitted to Shetland Islands Council as part of the planning application for the Proposed Project, and a copy of that document included in Volume IV as Technical Appendix 3.1. The OMP is currently being developed by the Applicant and will be agreed with Shetland Islands Council prior to operation of the Proposed Project.

Launch Exclusion Zone (LEZ)

3.6.6 Whilst the Proposed Project will generally be accessible by the public, restrictions will be established when required. Launch pads and integration buildings will be fenced off from public access at all times both to protect against livestock and for security reasons.

3.6.7 In order to provide public safety, measures to control a launch exclusion zone (LEZ) will be implemented at specific periods of the launch, including the run-up to and during launch. The LEZ will include an area around the launch pad and a downrange sea and overflight exclusion zone.

3.6.8 The LEZ is defined as the area within which access by the public will be restricted in the run-up to and during a launch. The exact dimensions will be unique to each LV and will be defined by a “safety case”, which is a description of how the operation will be safely conducted. This will be prepared and sent to the CAA for approval as part of the separate licensing process.

3.6.9 Other Safety Clear Zones will be established to control risk during hazardous ground operations. Examples are when the LV is being transferred to the launch pad or when a ‘wet dress rehearsal’ is taking place. This is when the LV is fuelled and de-fuelled to test components. During such operations an appropriate public safety zone will be established around the relevant launch pad.

Launch Pads

3.6.10 Annotated launch pad layout plans are provided for Launch Pads 1, 2 and 3 as Drawings 3.3, 3.4 and 3.5 respectively.

3.6.11 Each launch pad will comprise a concrete slab with a launch pit sunk into it and either a flame deflection trench or a stool on which the LV will sit for launch.

3.6.12 Adjacent to each launch pad will be a water tank / pump house to deliver water inundation during each launch cycle. The water deluge system is only used during launch and is designed to deliver a large quantity of water to dampen acoustic loading on the LV and the launch pad during lift-off. The water also acts to reduce the temperature of LV exhaust gases, protecting the launch pad infrastructure.

3.6.13 The launch pad concrete slab will be surrounded on three sides by a wall to contain any deluge water, if required. The slab will fall towards the launch pit, such that any surface and deluge water will run-off into the launch pit. The launch pit is connected to a culvert via a manhole with a penstock valve permitting water to be diverted to an interceptor/storage tank (for collection and removal for off-site treatment) during fuelling and launch activities. When no launch activities are in operation, the penstock valve on the launch pit will be maintained open such that rainwater run-off from the launch pit will discharge into a filter trench prior to sea outfall.

3.6.14 The launch pads include areas for storage of fuels and gases using ISO road containers to allow the site to be cleared between launches. Launch pad fuel storage areas will have a contained concrete surface with run-off into channels which will discharge into a full-retention alarmed interceptor, before discharging into either a filter drain or drainage ditch.

3.6.15 Permanent lightning masts will be positioned either side of the launch pad, comprising telescopic towers which will be extended during a launch to their operational height of 46 m. At all other times the lightning masts will be retracted to their un-extended configuration of 25 m. As with other permanent structures proposed, they will be finished in a recessive grey colour.

Launch Vehicles

3.6.16 Orbital LVs are typically made up of two or three stages. Each stage contains its own engines (lower stages have more engines than upper stages), fuel and oxidizer. The satellites are carried at the top of the LV and are protected by fairings. Once the LV is outside of the majority of the atmosphere these fairings are jettisoned to reduce weight.

3.6.17 Large LVs (approximately 30 m in height and up to 850 kg payload) will generally launch from Launch Pad 3. Large and smaller LVs will be launched from Launch Pad 1 or Launch Pad 2. LVs generally use a mixture of RP-1 (a highly refined form of kerosene similar to jet fuel) and liquid oxygen (LOX) to fuel the first stage. Emissions data for specific LVs has been used in the assessment as required to generate representative launch scenarios. For the purposes of the AEE it has been assumed that there is no recovery of orbital LV components; however, it is noted that all launches affecting Icelandic waters will need to show consideration to the requirements set out in the memorandum of understanding between the Government of Iceland and the UK Government in relation to debris recovery, and that this information will be included in the associated future launch operator AEEs. Further information on representative LVs and launch scenarios is provided in Volume IV Technical Appendices 7.1 (Air Quality) and 8.1 (Noise).

3.6.18 Sub-orbital sounding rockets will also be launched from the Proposed Project. These LVs are much smaller, ranging from about 1.5 m to 8 m and use solid fuel, liquid fuel or a hybrid of both. Sub-orbital LVs are single-stage. Sub-orbital payloads are generally for research and development and may include micro gravity medical experiments or in-space testing of new space technology. It is therefore important for the payloads to return safely to earth, so a parachute system is generally employed. For the purposes of the AEE it has been assumed that recovery of sub-orbital LV components is undertaken.

Static/Hot Fire Testing

3.6.19 Static fire tests include operations such as individual engine testing prior to installation on a LV or tests of LV elements such as a stage. They are generally of short duration, for example 30 seconds, and require limited quantities of propellants.

Launch Operations

3.6.20 Each launch period will run for approximately four weeks, beginning with the delivery of the LV and payload to the site and ending with successful launch and deployment of the payload in orbit and clean-down of the facility.

3.6.21 Launches require specific conditions to allow them to succeed, therefore it is possible there will be night-time launches (night-time defined for this AEE as the period between 23:00 and 07:00 hours).

3.6.22 The key steps in a representative normal launch campaign are set out below.

LV and Payload Processing

3.6.23 The LV and payload will be delivered to the Proposed Project separately by the LSP for assembly, integration and testing. It is anticipated that the LV and payload elements will be delivered to the Proposed Project by road in road containers or vans. The LV integration process involves the assembly of the LV stages and the emplacement of payload into the fairing and will be undertaken under controlled conditions within the Launch Site Processing Facility (LSPF)/Integration Hangar.

Fuel and Hazardous Materials Transportation and Storage

3.6.24 Fuel will be transported to the Proposed Project in ISO road containers using a just in time supply strategy, as and when required. A delivery holding area will be located at the Proposed Project entrance, and containers held here before being taken to the respective launch pad. At the launch pad the containers are stored in the designated protected areas as shown on Drawings 3.3, 3.4 and 3.5.

3.6.25 Large volume fuel and gas containers will remain on their trailers for fuelling and de-fuelling. Fuel and gases will be piped to the LV above ground and in a below ground trench over the launch pad.

3.6.26 Small volumes of fuels and oils in containers will be off-loaded to the ground within the control areas of the launch pads to facilitate electrical and mechanical support during launches. These will be stored in accordance with best practice procedures, including being kept within a designated storage site in appropriate impermeable bunded containers/areas.

LV Propellant Loading

3.6.27 Once the LVs are integrated with payloads, they will be transported in a horizontal position to the relevant launch pad using the transporter erector launcher (TEL), normally between 24 hours and six hours before launch. Once in position on the launch pad, the LV will be raised to a vertical orientation using the TEL and connected to the launch pad electrical, fuel and communications systems through umbilical cables.

3.6.28 Once the LV is in a vertical position on the launch pad and prior to fuels being loaded, the LV tanks and overground fuel lines will be preconditioned using liquid nitrogen evaporation. Pressurant loading will then commence followed by loading of the fuels.

3.6.29 A 'wet dress rehearsal' may be carried out before launch. This will involve loading the LV with the fuels to function test the LV systems and then subsequently unloading the fuels. The fuels and liquid oxygen (LOX) will be returned to their relevant tanks, and any residual LOX will be released safely into the atmosphere. Once this has been successfully undertaken, the LV will be re-loaded with fuels prior to launch.

3.6.30 Wet dress rehearsals inherently have no significant environmental effects as nothing combusts during them and so have not been considered further in this AEE.

3.6.31 Safety Clear Zones and a Launch Exclusion Zone will be implemented at appropriate times to ensure the safety of the operation. The length of time restrictions are in place will be kept to the practicable minimum.

Launch, Ascent, Payload Deployment and Jettisoning of Objects

3.6.32 The LV will be fuelled from approximately two hours before launch. During this time, the required airspace and sea space management and monitoring procedures will be activated to ensure the flight safety compliance of the launch.

3.6.33 Approximately two minutes before launch, the LV will transition to its internal power source and continue to perform an autonomous series of preparatory configurations and status checks.

3.6.34 Approximately 20 seconds before launch the hold-down mechanism will be armed, and launch command control relinquished to the LV. First Stage ignition will occur at approximately two seconds before launch.

3.6.35 The LV will lift off from the launch pad following the ignition of the First Stage engines. A few minutes after launch, First Stage engine cut-off will occur, followed shortly by First Stage separation and Second Stage engine ignition. The First Stage will fall back to earth within a previously identified 'impact zone'. The Payload Fairing will separate shortly after Second Stage engine ignition. Second Stage engine cut off will occur several minutes after ignition, followed shortly afterwards by deployment of the payload.

3.6.36 The number of impact zones arising from a launch will depend on the number of stages in the LV, which may be one or two, and whether or not Stages/Fairings break up on re-entry. It is broadly anticipated that Stage 1 will remain intact upon returning to Earth, whereas the Fairing will break-up. Taking into account the impact zone for the payload fairing, up to three impact zones are expected per launch (Stage 1, Stage 2 and the payload fairing). The impact zones are expected to occur at a minimum distance of 200 km from the Proposed Project, and up to a maximum distance of 1,100 km. The indicative locations of impact zones have been provided by the LSPs and assessed in Chapter 10. The impact zone(s) will be subject to NAVTEX and Sécurité Notices to Airmen and Mariners to warn third parties to remain clear.

Launch Pad Clean-down

3.6.37 The clean-down operation will start following the launch with the launch pad facilities cleaned down and commodities replenished for the next launch operation.

Test Launches

3.6.38 For the purposes of this AEE, test launches have been considered as full launches within the Applicant's environmental budget.

Off-Nominal Launch Scenarios

3.6.39 Scrubbed or aborted launches inherently have no significant environmental effects and therefore are not considered further in the AEE.

3.6.40 Off-nominal launch scenarios are considered at length in Chapter 10 (Marine Environment) and Chapter 15 (Accidents) of this AEE Report.

3.6.41 It is anticipated that the deflagration following ignition of propellant during any launch failure would create a short-lived initial fireball potentially extending several tens of metres from the pad, with the residual propellant rapidly burning off over several minutes.

3.6.42 The initial deflagration radius is not expected to extend beyond the boundary of the Proposed Project and the duration of any subsequent propellant burn-off would be minimal in the open air.

3.6.43 Site survey work is planned to determine the quality of peat according to NatureScot classification, as an indicator of relative flammability of the substrate. The working expectation is that it will be low and will not be at risk of ignition following a rocket propellant deflagration.

3.6.44 Firefighting water will be limited to damping / suppression and hence not of a volume sufficient to mobilise any combustion products. Foam is highly unlikely to be deployed given the rapid burnout of any fires.

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Chapter 4 Population and Human Health

4. Population and Human Health

4. Population and Human Health

4.1 Introduction

4.1.1 Effects on Human Health from the Proposed Project are discussed in detail in the relevant technical chapters of this AEE Report - Air Quality (Chapter 7) and Noise (Chapter 8) and a summary of the findings presented in this Chapter for information.

4.1.2 This chapter sets out the effects of the Proposed Project on population and human health, and in particular focuses on the socio-economic effects including the economic impacts associated with its operation.

4.1.3 The population of Unst has declined significantly over the last century to an estimated level of around 700 people and is expected to decrease further. The population decline has been caused in part by the closures of Baltasound Airport in 1996 and RAF Saxa Vord in 2006. These closures have also depressed job opportunities in Unst, and incomes in Unst and the North Isles tend to be lower than in other parts of the Shetland Islands. When compounded with higher living costs, this results in the area around the Proposed Project being one of the least affluent areas in the Shetland Islands. In this context, the Proposed Project represents a transformational and much needed economic development opportunity for Unst and for the Shetland Isles.

4.1.4 This chapter is structured as follows:

- Section 4.2 sets out relevant legislation, policy and guidelines;
- Section 4.3 summarises the effects of the Proposed Project on human health;
- Section 4.4 describes the assessment methodology and significance criteria for other effects on population;
- Section 4.5 considers the baseline socio-economic and tourism conditions;
- Section 4.6 lists the receptors brought forward for assessment;
- Section 4.7 assesses potential effects;
- Section 4.8 considers any mitigation required;
- Section 4.9 assesses residual effects;
- Section 4.10 describes any cumulative impacts; and,
- Section 4.11 provides a summary of the chapter's findings.

4.2 Legislation, Policy and Guidelines

Legislation

Space Industry Act

4.2.1 The Space Industry Act (2018) regulates all spaceflight activities carried out in the United Kingdom, and associated activities. The Act requires any person or organisation to obtain the relevant licence to:

- launch a launch vehicle from the UK;
- return a launch vehicle launched elsewhere than the UK to the UK landmass or the UK's territorial waters;
- operate a satellite from the UK;
- conduct sub-orbital activities from the UK;

- operate a spaceport in the UK; or
- provide range control services from the UK.

Policy Documents

4.2.2 Whilst there is no policy specific to the assessment of the economic impacts of space ports, given the Proposed Project's characteristics, it is possible to follow existing guidance on the economic impacts from the planning regime. The economic analysis therefore follows the guidance set out in the Scottish Government's Draft Advice on Net Economic Benefit and Planning (Scottish Government, 2016).

Scottish Government Economic Strategy

4.2.3 In 2015 the Scottish Government published the Scottish Government Economic Strategy (Scottish Government, 2015). In order to make Scotland a more successful country over a range of dimensions, the strategy has at its core increasing sustainable economic growth. This relies on simultaneously boosting competitiveness and reducing inequality.

4.2.4 Four themes have been identified as key to generating sustainable economic growth: internationalisation, innovation, inclusive growth and investment.

4.2.5 The innovation and high-value activities carried out by the space sector, the potential to attract investment and international companies in the small satellite sector and, the possibility to support local economic growth, are all in line with the four themes identified in the Scottish Government's Economic Strategy.

4.2.6 In the summer of 2021, the Scottish Government established a new Advisory Council to develop a new 10 year national strategy for economic transformation. Whilst that has not yet been published the Scottish Government's priorities can be seen in the Programme for Government.

A Fairer, Greener Scotland – Programme for Government 2021-22

4.2.7 The Scottish Government's Programme for Government 2021-22 (Scottish Government, 2021) sets out the strategic aims and ambitions for a 'fairer, greener Scotland' over the next parliamentary term, and also the longer term priorities of the Scottish Government.

4.2.8 The space sector is specifically mentioned in the Programme for Government: "*One sector which offers significant potential is the space sector. We will support Scotland to become a leading European space nation by working with industry to deliver a full end to end solution for satellite design, manufacture and testing, launch and data exploitation, targeting a £4 billion share of the global space market. One step will be the development of a joint Scottish Government, industry and academia strategy for sector growth, to be launched in October 2021, and delivery of a dedicated launch capability by summer 2023, targeting a £4 billion share of the global space market, with 20,000 jobs in the sector by 2030.*"

4.2.9 In addition to its potential economic contribution, there are wider benefits from the operations of the sector. For example, the data collected from space support the tracking of climate variables, with 35 of the 45 essential climate variables that are set out by the UN relying on measurement from space. Satellite data have also either an important or supportive role in the monitoring of the UN's Sustainable Development Goals, which underpin its efforts to eradicate poverty and hunger across the world by 2030 (McKee, 2020).

Prosperity from Space

4.2.10 In 2018, the Space Growth Partnership, an industry group that brings together companies, academics, institutions and entrepreneurs involved in the space sector, published Prosperity from Space (Space Growth Partnership, 2018).

4.2.11 At the core of the strategy are four pillars:

- creating a National Space Programme to unlock increased private investment;
- creating the right environment for success by securing and building on existing strengths and market position;
- investing in people and places; and,
- continuing to drive growth from investment in ESA, Eumetsat and EU programmes.

4.2.12 The Proposed Project contributes towards addressing the need to maximise the value generated by UK space ports and launch activities, one of four market priorities identified in the strategy, and to spread the benefits from the space sector across the UK.

Shetland Islands Council Economic Development Strategy, 2018-2022

4.2.13 In 2018, Shetland Islands Council published its economic development strategy to 2022 (Shetland Islands Council, 2018a). The document provides a baseline of the Shetland economy, highlighting its strengths as well as some of the challenges it faces, including a declining population, underemployment, pressure on public services and Brexit.

4.2.14 The mission underpinning the strategy is to: *"enable and promote the ideal conditions for growth and to support our businesses, residents and communities to take advantage of the opportunities this will create"*. In order to fulfil this mission, the Economic Development Strategy sets outs six actions:

- to encourage private sector growth, diversification and development;
- to increase economic participation;
- to match economic development to skills and research and development;
- to ensure the representation of Shetland interests at national, regional and external level;
- to increase the attractiveness of Shetland as a place where to study, live and work; and,
- to increase the rate of innovation and adoption of new technologies.

Scotland's Outlook 2030

4.2.15 Following on from the Tourism Scotland 2020 strategy (Scottish Tourism Alliance, 2012), a collaborative network of industry experts created Scotland's Outlook 2030 (Scottish Tourism Alliance, 2020), which focuses on creating a world-leading tourism sector in Scotland that is sustainable in the long-term.

4.2.16 The strategy focuses on four key priorities: people, places, businesses and experiences. The strategy recognises the effects of climate change, technological advancements, Brexit and changing consumer behaviour on tourism and highlights the need for collaboration between government, communities and the public and private sectors.

Shetland Tourism Strategy, 2018-2023

4.2.17 The Shetland Tourism Strategy 2018-2023 (Shetland Tourism Association, 2018) was developed by a range of organisations with a stake in the development of the tourism sector in the Shetland Islands. These include Shetland Tourism Association, Shetland Islands Council, Visit Scotland, Highlands and Islands Enterprise, Lerwick Port Authority, Shetland Arts Development Agency and Shetland Amenity Trust.

4.2.18 The strategy is aligned with both the Tourism Scotland 2020 strategy (Scottish Tourism Alliance, 2012) and with three of the four priorities identified in the Shetland's Partnership Plan 2018-2028 (Various, 2018): participation, place and money.

4.2.19 The document identifies seasonality and constraints to capacity from air and boat services as two challenges for the tourism sector in the Shetland Islands. In particular, despite an increase in events throughout the year including Wool Week, tourism remains for the most part confined to the summer months.

4.2.20 The aim of the strategy is to: "*help make Shetland a year-round, sustainable tourism destination offering unique and outstanding visitor experiences*". To achieve this, three priority areas have been identified: leadership and collaboration, exploiting opportunities and enhancing visitor experience.

4.2.21 The launch activity taking place from the Proposed Project could diversify the portfolio of visitor attractions that the Shetland Islands can offer. The fact that launch activity would take place throughout most of the year may also allow businesses in the tourism sector to benefit from visits outwith the summer months.

Local Development Plan

4.2.22 Socio-economic considerations feature prominently in the Shetland Local Development Plan. The foreword notes that: "*The Shetland Local Development Plan sets out the Council's vision and spatial strategy that recognises existing development and promotes sustainable growth. The strategy is supported by a framework for delivery that will: promote economic growth; result in sustainably located and planned housing; support appropriate transport and infrastructure planning; and, conserve and protect biodiversity and the natural environment.*"

4.2.23 More specifically, GP1 Sustainable Development states that: "*Development will be planned to meet the economic and social needs of Shetland...*" and that is justified on the basis that: "*Enabling sustainable development requires coordinated action, combining economic competitiveness and social inclusion with environmental quality.*"

4.2.24 The Economic Development policies include ED1 Support for Business and Industry which states that: "*The Council encourages the creation of sustainable economic development opportunities and business developments in accordance with General Policies*".

Guidance

Guidance for the Assessment of Environmental Effects

4.2.25 The CAA document "Guidance for the Assessment of Environmental Effects"(July 2021) explains the process for completing an assessment of environmental effects as part of a licence application under the Space Industry Act and sets out the environmental topics likely to be affected by the proposed activities.

4.2.26 The Guidance requires that potential direct and indirect significant effects of proposed spaceflight activities on environmental features, including population and human health, are considered. The guidance further requires that:

- Specific potential effects are identified and, where possible, quantified;
- The focus of the AEE should be on significant effects arising from the proposed activities;
- The AEE should explain what other environmental assessments have been conducted in relation to the proposed activities (e.g., EIAs provided as part of a planning application) and whether they are being used in support of the AEE;
- Applicants for a spaceport licence set an environmental budget, comprising a maximum number of launches per launch vehicle type which can take place over the course of a year that can be carried out in an environmentally sustainable manner, taking into account the cumulative effect of all launches; and
- The AEE must address a range of environmental topics, including population and human health.

4.3 Human Health Effects: Summary

4.3.1 Effects on Human Health from the Proposed Project are considered to arise from operational effects on air quality and operational noise effects. These effects are assessed in detail in Chapter 7 and 8 respectively, and as such, a short summary of the findings presented here for information.

Air Quality

4.3.2 An assessment of the potential effects of emissions from the Proposed Project on local air quality has been undertaken.

4.3.3 Proposed project-generated traffic is predicted to have an effect of negligible significance on air quality, therefore resulting in **no likely significant effect.**

4.3.4 Generator emissions are predicted to have no perceptible impact at any identified receptors. The emissions from generators are predicted to have an effect of negligible significance on local air quality, therefore resulting in **no likely significant effect**. Emissions are also expected to reduce over the lifetime of the Proposed Project due to the Applicant's intention to secure a permanent three phase power supply in time.

4.3.5 Launch event emissions are predicted to have no perceptible impact at any identified receptors under prevailing wind directions. The maximum predicted impact at a sensitive receptor is predicted to occur with north-easterly winds, which occur typically for less than 10 % of the year. The maximum predicted 8-hour concentration of CO is 28% of the relevant air quality standard for human health. Emissions from launch events are therefore considered to have an effect of negligible significance on air quality**,** therefore resulting in **no likely significant effect**.

Noise

4.3.6 Potential noise and vibration effects associated with the Proposed Project have been robustly assessed with regard to static engine tests, launches and non-launch activities.

4.3.7 Noise effects associated with road traffic and non-launch activities have been assessed as not significant, resulting in **no likely significant effect**.

4.3.8 Noise during engine tests and launches will be audible at identified noise sensitive receptors and levels will exceed the criterion for community annoyance associated with aircraft noise. However, instantaneous noise levels will be below the threshold at which damage to hearing may occur.

4.3.9 Of the proposed 30 launches per year, when taking into account the no-launch window agreed between mid-May to the end of June, the Applicant anticipates that in any one month there may be three-four launches. Given the proposed frequency of launches and the short duration of the noise events associated with launches, and with reference to the 2006 Basner study which states that restricting additional awakenings due to aircraft noise to a maximum of one event per night is anticipated to have no adverse effect on human health, adverse effects associated with sleep disturbance due to night-time launches are considered to be minimal, resulting in **no likely significant effect**.

4.3.10 The short duration of audible noise 'events' associated with engine tests and launches, and their infrequent occurrence, will reduce the associated levels of annoyance to below that which may be associated with aircraft noise from conventional airports. Accordingly, adverse health effects are not anticipated. Noise effects associated with engine tests and launches have therefore been assessed as not significant, resulting in **no likely significant effect**.

4.5 Population Effects: Assessment Methodology and Significance Criteria

Environmental Zone of Influence

4.5.1 The study areas (equivalent to the EZI) considered in the population and human health assessment are:

- Unst;
- The Shetland Islands; and,
- Scotland.

Assessment of Socio-Economic Benefits

4.5.2 The assessment of socio-economic (population) benefits from operation of the Proposed Project follows the guidance and methodology set out in the 'Draft Advice on Net Economic Benefit and Planning' (Scottish Government, 2016). As a result, all the economic impacts considered are net of those benefits that would occur if the project did not go ahead.

4.5.3 The methodology has been complemented by BiGGAR Economics' experience on estimating the economic impacts from other projects and by its understanding of the local economy.

4.5.4 The analysis of economic impacts relies on two commonly used measures:

- Gross Value Added (GVA), a measure of the value that an organisation, company or industry adds to the economy through its operations. The analysis uses the production approach to measure this contribution, where the GVA is equal to the value of production less the value of the inputs used; and,
- Employment, which is measured in terms of headcount jobs supported when considering operational impacts.

4.5.5 For this assessment, the likely sources of economic impact from operation of the Proposed Project have been identified as economic activities linked to the operation of the Proposed Project including:

- the employment supported by the operations of the Proposed Project;
- temporary workers' spending on accommodation and subsistence; and,
- the spending of visitors viewing the launches.

4.5.6 The analysis relied on data from publicly available statistics, on conversations with the Applicant and previous experience. When assumptions were made throughout the analysis, these have been set out clearly and justified.

4.5.7 To estimate the impacts associated with the Proposed Project, the value of contracts carried out or the employment supported by them has been estimated from information given by the Applicant. The approach used to estimate the spending associated with tourism is slightly different, as the total number of visitors was estimated based on the maximum tourism capacity allowed by existing accommodation provision and links to the rest of the Shetland Islands. Turnover from tourism has been estimated by multiplying the total number of visitors by the average spending of visitors to the Shetland Islands.

4.5.8 Once total turnover or employment are estimated, economic activity is allocated to the economic sectors where it occurred based on the Office for National Statistics' (ONS) Standard Industrial Classification (SIC) codes (Office for National Statistics, 2009). In a similar way, spending and employment were allocated to the areas where they occurred.

4.5.9 The estimation of the direct GVA and employment supported by expenditure on project-related contracts and activities relied on applying sectoral level turnover per GVA, turnover per job or GVA per job ratios sourced from the Scottish Annual Business Statistics (SABS) (Scottish Government, 2019b).

4.5.10 Alongside direct GVA and employment impacts, the analysis considered indirect and induced economic impacts. Indirect impacts result from the spending taking place within the supply chains of those businesses that are awarded contracts related to the operation of the Proposed Project. Induced impacts refer to the benefits arising from the spending of salaries and wages by those employed in businesses carrying out contracts associated with the Proposed Project.

4.5.11 Indirect and induced impacts were estimated by applying the relevant Scottish GVA and employment Type 1 and Type 2 multipliers, as sourced from the Scottish Government 2016 Input-Output Tables (Scottish Government, 2019c).

4.5.12 In estimating net economic benefits, the analysis followed the guidance on additionality as set out in the Homes & Communities' Agency "Additionality Guide" (Homes & Communities Agency, 2014) and discounted impacts based on:

- leakage – any economic impacts benefitting those from outside the study area where a project takes place;
- displacement – any benefits to the area where the project takes place that are accounted for reduced activity in another geographical area; and,
- deadweight – any outcomes and benefits that are expected to arise if the project did not go ahead.

4.5.13 The assessment also includes consideration of wider economic benefits arising from the Proposed Project. These were not quantified but were described as part of the analysis.

Assessment of Potential Effect Significance

4.5.14 The assessment follows the evaluation methodology used in similar environmental impact assessments. This assesses the significance of a change in socio-economic conditions based on the sensitivity of the receptor and the magnitude of impact.

4.5.15 The following aspects were considered when appraising the sensitivity to changes in socio-economic conditions:

- the scale of the economy affected;
- its relative fragility; and,
- the diversification of its economic base.

4.5.16 For instance, an area with smaller economic activity is more sensitive to a change in employment than a relatively larger economic area. Equally, an economic area where activity is concentrated in one economic sector is more sensitive to the emergence of opportunities in another sector than an economy with a diversified economic base.

4.5.17 The magnitude of impacts is considered as follows:

- major if the project leads to a 4 % change in economic activity, which is more than double the average annual rate of growth for the Scottish economy;
- moderate if the project leads to a change in economic activity of 2 %, which is higher than the average annual rate of growth for the Scottish economy;
- minor if the project leads to a 1 % change in economic activity; and,
- negligible if the project leads to an increase in economic activity of less than 0.1 %.

4.5.18 The significance of changes is then assessed based on sensitivity and magnitude and professional judgement. The significance of effects is described below. In terms of assessment of environmental effect under the Space Industry Act 2018, major and moderate impacts are to be considered to result in significant effects.

Limitations to Assessment

4.5.19 Since there are no existing satellite space ports located in the UK or across Europe, it is not possible to rely on any evaluation carried out on the impacts from a similar development.

4.6 Population Effects: Baseline Conditions

Economic Context

4.6.1 The population of Unst has declined significantly over the last century to an estimated level of around 700 people and is expected to decrease further. The population decline has been caused in part by the closures of Baltasound Airport in 1996 and RAF Saxa Vord in 2006. These closures have also depressed job opportunities in Unst, and incomes in Unst and the North Isles tend to be lower than in other parts of the Shetland Islands. When compounded with higher living costs, this results in the area around the Proposed Project being one of the least affluent areas in the Shetland Islands.

4.6.2 Much of the economic history of Unst over the last seventy years has been characterised by the presence at Saxa Vord of a Royal Airforce (RAF) base, RAF Saxa Vord. Originally established in 1957 during the Cold War, the base has been an important feature of the Unst economy and has had a relatively strong link with the local community. Through it, the Ministry of Defence (MOD) played an important role as a local employer, alongside supporting jobs across other sectors. Around sixty years after its opening, the base was closed in 2006.

4.6.3 More recently, following incursions on the UK airspace by Russian fighter jets, a radar-based point was re-established. However, no permanent staff are based in Unst, since the radar system is operated remotely.

4.6.4 Since the RAF left the area, there has been an attempt to redirect the local economy. The Proposed Project represents a transformational and much needed economic development opportunity to diversify the local economy and bring investment to Unst.

Socio-Economic Characteristics

4.6.5 Baseline socio-economic characteristics have been determined for three study areas: Unst, The Shetland Islands and Scotland.

4.6.6 Data reflect the most recent evidence available. However, it is recognised that depending on its impact, the COVID 19 pandemic may have temporary or more lasting effects on socio-economic characteristics. Indeed, the space industry is considered likely to play an important role in economic recovery through the high-value jobs it supports and the range of activities it enables. Where data for Unst were not available specifically, information has been reported for the North and East Isles.

Population

4.6.7 In 2019, the population of the Shetland Islands was 22,920, around 0.4 % of Scotland's total population (National Records of Scotland, 2020a). While the National Records of Scotland do not provide population estimates below local authority areas, Visit Unst estimates that the population of Unst is currently around 700 people (Visit Unst, 2020a).

4.6.8 As shown in Table 4.1 below, the Shetland Islands has a slightly larger proportion of the population aged 0-15 than the Scottish average, and the proportion of the population of working age is lower than the Scottish average.

Table 4.1 2019 Population Estimates

	Unst*	Shetland Islands	Scotland
Population	700	22,920	5,463,300
0-15	-	18.3 %	16.9 %
16-64	-	61.2 %	64.0 %
65+	-	20.4 %	19.1 %

Source: (National Records of Scotland, 2020b), (Visit Unst, 2020a)

4.6.9 As shown in Table 4.2, by 2043 the population of the Shetland Islands is expected to decline to 21,579, a decrease of around 6 % on the 2018 population. In comparison, the population of Scotland is expected to increase by 2.5 % over the same period.

4.6.10 The Shetland Islands are also expected to have a smaller proportion (57.1 %) of the population of working age than Scotland (60.3 %) by 2043. Both the populations of the Shetland Islands and Scotland are expected to age over the period to 2043, but the trend is more marked in the Shetland Islands with 27.9 % of the population aged 65 or over - three percentage points higher than for Scotland.

Table 4.2 Population Projections (2018-2043), Shetland Islands and Scotland

	Shetland Islands		Scotland	
	2018	2043	2018	2043
Population	22,990	21,579	5,438,100	5,574,819
0-15	18.3 %	15.1 %	16.9 %	14.8 %
16-64	61.9 %	57.1 %	64.2 %	60.3 %
65+	19.8 %	27.9 %	18.9 %	24.9 %

Source: (National Records of Scotland, 2020a) (National Records of Scotland, 2020b)

4.6.11 In summary, the Shetland Islands has a younger than average population, with a smaller proportion of people of working age than the Scottish average. In addition, the number of people aged 65 or over is projected to increase significantly by 2043.

Economic Activity and Employment

4.6.12 As shown in Table 4.3 below, the 2019 economic activity rate in the Shetland Islands was 3.3 % higher than for Scotland overall. Similarly, the 2019 unemployment rate for the Shetland Islands was 2 % lower than the average for Scotland and the median annual pay of full-time workers in the Shetland Islands was higher than across Scotland as a whole.

Table 4.3 Economic Activity and Earnings (2019)

	Shetland Islands	Scotland
Economic Activity Rate (16-64)	80.8 %	77.5 %
Unemployment Rate (16-64)	1.5 %	3.5 %
Median Annual Pay of Full-time Workers (£)	£31,339	£30,000
% of Full Time Workers	60.8 %	74.7 %
% of Part Time Workers	39.2 %	25.2 %

Source: (Office for National Statistics, 2020a) (Office for National Statistics, 2020b) (Highlands and Islands Enterprise, 2019)

4.6.13 In its publication Shetland in Statistics, Shetland Islands Council collects detailed statistics on a range of subjects including the economy, tourism and demographics. Based on the latest publication (Shetland Islands Council, 2018b), as presented in Table 4.4 below, in 2017 the mean income in the North Isles of Shetland was £31,364, the lowest among the other areas of the Shetland Islands considered. The mean income of the lower quartile was also smaller in the North Isles (£15,256) than across other areas in the Shetland Islands.

Table 4.4 Mean Income and Income of the Lower Quartile - Shetland Islands

	Mean Income	Lower Quartile
Central Mainland	£40,644	£20,430
Lerwick & Bressay	£34,834	£16,473
North Isles	£31,364	£15,256
North Mainland	£36,533	£18,087
South Mainland	£42,477	£21,573
West Mainland	£35,351	£17,765
Whalsay & Skerries	£42,477	£16,704

Source: (Shetland Islands Council, 2018b)

4.6.14 As shown in Table 4.5 below, in 2018 agriculture, forestry and fishing were the main employers in the Shetland Islands, accounting for 18.8 % of total employment. Health and social care (14.1 %) and wholesale and retail trade (10.2 %) were other relatively important sectors in terms of employment.

4.6.15 However, in the North and East Isles of the Shetland Islands (including Unst), manufacturing was a large source of employment, accounting for 18.2 %, compared to 5.9 % for the Shetland Islands as a whole and 6.9 % for Scotland. Employment in the accommodation and food service sector was lower in the North and East Isles (2.2 %) than for the Shetland Islands (6.2 %) and the Scottish average (7.9 %).

Table 4.5 Business Register and Employment Survey, 2018

	North and East Isles	Shetland Islands	Scotland
Agriculture, forestry and fishing*	0.0 %	18.8 %	3.2 %
Mining and quarrying	0.0 %	0.5 %	1.1 %
Manufacturing	18.2 %	5.9 %	6.9 %
Electricity, gas, steam and air conditioning supply	0.0 %	1.0 %	0.7 %

	North and East Isles	Shetland Islands	Scotland
Water supply, sewerage, waste	0.0 %	0.7 %	0.8 %
Construction	2.2 %	8.6 %	5.5 %
Wholesale and retail trade	0.0 %	10.2 %	13.6 %
Transportation and storage	4.4 %	6.2 %	4.2 %
Accommodation and food service activities	2.2 %	6.2 %	7.9 %
Information and communication	0.0 %	1.3 %	3.1 %
Finance and insurance activities	0.0 %	0.2 %	3.4 %
Real estate activities	0.0 %	0.6 %	1.5 %
Professional, scientific and technical activities	4.4 %	3.4 %	7.0 %
Administrative and support service activities	4.4 %	3.8 %	7.9 %
Public administration and defence	6.7 %	5.0 %	6.0 %
Education	20.0 %	7.0 %	7.4 %
Human health and social work activities	22.2 %	14.1 %	15.1 %
Arts, entertainment and recreation	8.8 %	5.6 %	4.8 %
Total Employment	220	16,000	2,611,500

Source: (Office for National Statistics, 2019a) *excludes farm agriculture and includes aquaculture.

4.6.16 According to recent data from Her Majesty's Revenues and Customs (HMRC, 2020a) detailed in Table 4.6 below, by June 2020 at least 3,100 people in the Shetland Islands had been put on furlough due to COVID-19. The recipients of help from the Government support scheme for the self-employed totalled 600 people (HMRC, 2020b). The share of those placed on furlough with respect to the eligible population was higher in Scotland on average (30 %) than in the Shetland Islands (25 %). Similarly, in the Shetland Islands 68 % of those who could benefit from the Self-Employment Support Scheme applied for it, compared to 75 % across Scotland.

Table 4.6 Population on COVID-19 Government Support Scheme

	Shetland Islands		Scotland	
	Value	Eligible (%)	Value	Take-up rate
Coronavirus Job Retention Scheme	3,100	25 %	736,500	30 %
Self-Employment Income Support Scheme	600	68 %	155,000	75 %

Source: (HMRC, 2020a) (HMRC, 2020b)

4.6.17 In summary, economic activity is higher and unemployment is lower in the Shetland Islands when compared to Scotland as a whole. This is complemented by higher wages, though it is noted that part-time work is more prevalent in the Shetland Islands. Across the North Isles (including Unst) however, wages are lower than in other areas of the Shetland Islands.

Qualification Levels

4.6.18 Education qualification levels in the Shetland Islands are significantly lower than in Scotland as a whole as shown in Table 4.7 below. In Scotland, around 45 % of the population had an NVQ4 or equivalent in 2019, whereas in the Shetland Islands this figure was 27.5 %. Conversely, the proportion of the population with no qualifications is lower in the Shetland Islands at 2.6 % compared to 9.8 % for Scotland as a whole.

Table 4.7 Qualification Levels, % of population aged 16-64

	Shetland Islands	Scotland
% with NVQ4+	27.5 %	45.3 %
% with NVQ3+	49.7 %	60.8 %
% with NVQ2+	80.5 %	75.6 %
% with NVQ1+	93.7 %	83.5 %
% with other qualifications (NVQ)	3.7 %	6.7 %
% with no qualifications (NVQ)	2.6 %	9.8 %

Source: (Office for National Statistics, 2020a)

4.6.19 In summary, qualification levels are lower in the Shetland Islands than in Scotland as a whole with a lesser share of the population obtaining university and college level qualifications. The largest employer in the Shetland Islands is agriculture, forestry and fishing, whereas in the North and East Isles (including Unst), manufacturing, health and education are the largest sectors of employment.

Deprivation

4.6.20 According to the 2020 Scottish Index of Multiple Deprivation (Scottish Government, 2020a), which takes account of a wide range of measures of deprivation, none of the 15 % most deprived data zones in Scotland are located in the Shetland Islands. However, in the North and East Isles, geographical access to services scores low and the area is ranked in the most deprived 10 % under this specific indicator.

Tourism Context

4.6.21 Sustainable tourism is one of six sectors identified by the Scottish Government as comprising those industries where Scotland has a relative advantage. As detailed in Table 4.8 below, in 2017/2018, the sustainable tourism sector generated £39.7 million GVA in the Shetland Islands and £4.1 billion GVA in Scotland (Scottish Government, 2020b). In the same year, the sector employed 1,250 people in the Shetland Islands, compared to 218,000 people in Scotland as a whole. The sector has a similar weight in the economies of the Shetland Islands and Scotland supporting around 8 % of total employment.

Table 4.8 Employment and GVA in the Sustainable Tourism Sector

	Shetland Islands	Scotland
Employment	1,250	218,000
GVA (£m)	39.7	4,127.1

Source: (Scottish Government, 2020b)

4.6.22 The most recent evidence on tourism activity within the Shetland Islands comes from the Shetland Visitors Survey 2019 (Shetland Islands Council et al., 2020). In 2019 there were reportedly 80,128 visits to the Shetland Islands, which included visitors spending time in different locations of the Shetland Islands during a single visit.

4.6.23 For 69 % of visitors, the sceneries and landscapes were one of the reasons motivating a visit to the Shetland islands. History, culture and the ability to 'get away from it all' were mentioned by 49 % and 25 % of respondents respectively. Among visitor attractions, those related to history and heritage were the ones visited by tourists in Unst, with 27 % of leisure visitors to the Shetland Islands visiting Unst Heritage Centre & Unst Boat Haven and 21 % Viking Unst.

4.6.24 The survey also considered where visitors spent time while in the Shetland Islands. Visitors tended to spend most of their time in the Mainland of Shetland, with more than 50 % saying that they had visited Lerwick, South Mainland, Central Mainland and West Mainland. In 2019, around 34 % of visitors spent time in Unst, 1 % higher than was recorded in the previous 2017 visitors survey (Shetland Islands Council et al., 2018). Unst was also more popular among leisure visitors – 47 % of whom visited the island – than with those visiting friends and relatives and those coming to the island for business reasons

4.6.25 Whilst the preferred means of transportation for visitors once in the Shetland Islands is hiring a car, intra-island movements take place for the most part by ferry. To reach Unst from the Mainland of Shetland, it is necessary to use the ferry service from Toll (Shetland Mainland) to Ulsta (Yell) and from Gutcher (Yell) to Belmont (Unst). The journey between Lerwick and Unst may take between 90 and 120 minutes (Visit Unst, 2020b).

4.6.26 Over the period between May 2019 and March 2020, over 130,000 passengers used the ferry service serving Unst, Yell and Fetlar and a total 18,085 journeys were completed (Shetland Islands Council, 2020). The busiest months were those during the summer period and coincided with when the tourism season is at its peak.

4.6.27 There are a number of existing accommodation providers in Unst, ranging from hotels to self-catered cottages and hostels. Primarily these services are available during the summer season (April through to October) however, some smaller self-catered accommodation providers also operate on a restricted basis during the winter months. In total (in season), they can provide accommodation for approximately 230 visitors (Visit Unst, 2020a).

4.6.28 The Proposed Project and the launch activity associated with it provide an opportunity for Unst to diversify its offer to visitors by including space tourism to its attractions' portfolio. It may also result in visitors that would have already come to the island for other reasons, including its scenery or its heritage and history, to spend more time on Unst.

4.6.29 The launch activity associated with the Proposed Project is also expected to lead to an increase in business tourism, as the launch activity will require temporary staff from the launch companies to be on-site for a minimum of six weeks per launch event.

4.6.30 The increase in activity will provide existing businesses with opportunities to fill their offer of rooms. This may also lead to an extension of the tourism season to take advantage from the opportunities associated with launch activity as well as to expand existing provision.

4.6.31 In summary, the contribution of the tourism sector in the Shetland Islands economy is proportionately similar to that of Scotland as a whole. Most of the visitors to the Shetland Islands visit the islands to enjoy its naturalistic offer, explore its history and heritage and to unwind.

4.6.32 Unst and the North Isles receive a lower share of tourism than other areas of Shetland. This is partly because of their location, since it may take up to two hours and two ferry crossings to reach Unst from Lerwick. Accommodation providers in Unst can provide overnight accommodation for around 230 visitors and may benefit from the increase in demand associated from the Proposed Project.

4.7 Receptors Brought Forward for Assessment

4.7.1 The following receptors were brought forward for assessment:

- the economy of Unst;
- the economy of The Shetland Islands; and,
- the economy of Scotland.

4.9 Potential Effects

4.9.1 During operation of the Proposed Project, beneficial economic impacts are expected to arise from three main sources:

- employment associated with operation of the Proposed Project;
- accommodation for temporary workers during launches; and,
- space tourism activity.

Employment associated with operation of the Proposed Project

4.9.2 Once built, the Proposed Project will allow for launches by multiple launch service providers (LSPs) using a range of different rocket types. The Applicant is looking to achieve a maximum of 30 launch events per year. However, in the first year, it is anticipated that there will be up to 10 launches, made up of both orbital and sub-orbital rockets.

4.9.3 The Applicant anticipates that there will be three high skilled jobs linked to the operation of the Proposed Project, as well as a series of supporting roles including security, maintenance and provision of accommodation for the launch service providers' temporary staff, who will be present prior to and immediately after each launch.

4.9.4 Each of the jobs identified has been allocated to an industrial sector and the anticipated location of the job established. Of the 98 jobs to be supported by full operation of the Proposed Project, 63 are expected to be based in Unst and 35 elsewhere within the Shetland Islands.

4.9.5 To estimate the GVA associated operation of the Proposed Project, anticipated job numbers have been multiplied by the relevant sectoral GVA per job, based on Scottish Annual Business Statistics and a study on the UK space sector, "Size and Health of the UK Space Industry 2018" (London Economics, 2019).

4.9.6 Supply chain impacts have been estimated by applying the relevant Scottish Type 1 GVA and employment multipliers from the Scottish Input-Output Tables (Scottish Government, 2019c) to the GVA and employment estimated above.

4.9.7 The impact from the spending of salaries and wages created by the operation of the Proposed Project has been estimated using data on the gross/net salary per job from the Scottish Annual Business Statistics the London Economics report. It has been assumed that residents in Unst spend 30 % of their salaries in Unst, 50 % in the Shetland Islands (including Unst) and 70 % in Scotland (including the Shetland Islands). Likewise, residents of the Shetland Islands were estimated to spend 5 % of their salaries in Unst, 50 % in the Shetland Islands and 70 % in Scotland[1]. Impacts from workers' expenditure was then estimated based on the ratios and multipliers of the household spending sector.

4.9.8 Summing these elements together, it is estimated employment associated with operation of the Proposed Project will generate £3.3 million GVA and support 68 jobs in Unst. For the Shetland Islands this increases to £5.3 million GVA and 119 jobs, and for Scotland, £6.2 million GVA and 137 jobs as shown in Table 4.9 below.

[1] where the spending taking place in the Shetland Islands and Scotland were estimated based on BiGGAR Economics' analysis of households spending patterns, as reported in (Office for National Statistics, 2019).
To account for the fact that ratios from the Scottish Annual Business Statistics do not account for taxation, it was then necessary to discount workers' expenditure by 8 %, the share of UK household spending that is devoted to Value Added Taxation according to a 2013 study from the European Commission (European Commission, 2013).

Table 4.9 Economic Impact – Employment associated with the Proposed Project

	Unst	Shetland Islands	Scotland
Employment	68	119	137
GVA (£m)	3.3	5.3	6.2

4.9.9 The effect associated with employment is therefore assessed as:

- major beneficial (**significant effect**) for Unst;
- minor beneficial for The Shetland Islands; and,
- negligible for Scotland.

Accommodation for temporary workers during launches

4.9.10 LSPs will need to accommodate their own staff locally during preparation and decommissioning works prior to each launch. It is envisaged that some staff may also be permanently located in Unst, if LSPs find that they are using the Proposed Project on a frequent basis.

4.9.11 LSPs will pay for the maintenance (accommodation and food) of their staff while in Unst. This spending in turn will benefit local accommodation providers supporting their turnover and employment.

4.9.12 The Applicant anticipates that 50 LSP workers will be stationed on Unst for around four weeks during the lead-up to any given launch event. By multiplying staff days required by the number of launches it is estimated that LSP workers will stay on Unst for up to 42,000 days per year when the target of 30 launches per year is achieved.

4.9.13 Given the existing accommodation capacity in Unst and the available data on average occupancy rates for the Shetland Islands from the 2019 Scottish Accommodation Occupancy Survey (Moffat Centre et al., 2020), workers are unlikely to displace any other users of accommodation facilities in Unst. As a result, all of this impact is considered as additional.

4.9.14 Maintenance expenditure associated with these stays has been assumed to amount to an average of £50 per worker per day and, on this basis, spending on accommodation will amount to around £2.1 million, discounted by 8 % to account for spending on VAT.

4.9.15 By applying the turnover per GVA ratio from the Accommodation and Food Services activities from Scottish Annual Business Statistics, direct GVA and employment supported by this spending has been calculated. Supply chain impacts and income effects have been estimated by applying relevant Type 1 and Type 2 Scottish multipliers, as done in previous sections.

4.9.16 It is estimated that spending on food and accommodation from the temporary launch workers will generate £1.2 million GVA and support 55 jobs on Unst. For the Shetland Islands this increases to £1.4 million GVA and 59 jobs, and for Scotland £1.6 million GVA and 64 jobs as shown in Table 4.10 below.

Table 4.10 Economic Impact - Accommodation Spending

	Unst	Shetland Islands	Scotland
Employment	55	59	64
GVA (£m)	1.2	1.4	1.6

4.9.17 The effects associated with spending on accommodation is therefore assessed as:

- major beneficial (**significant effect**) for Unst; and,
- negligible for The Shetland Islands and Scotland.

Tourism Activity

4.9.18 Launches are anticipated to attract visitors to Unst and the Shetland Islands. Visitor spending will have economic benefits, supporting local businesses and increasing employment in the tourism sector.

4.9.19 The level of impact from tourism is based on the total number of visitors that are able to view any given launch. This will be constrained by the number of overnight stays available on Unst and by the capacity of the ferry links to carry visitors for day trips.

4.9.20 As set out previously, it is estimated that Unst has capacity for up to 230 overnight stays. However, 50 of these will be taken up by LSP workers as described in the previous section. In addition, 20 of the visitors are anticipated to be senior staff from the LSPs. Consequently, it has been assumed that there will be capacity to accommodate 160 visitors per launch.

4.9.21 Ferry capacity for day trips has been estimated using data from Shetland Islands Council, which states that the monthly peak number of passengers on the ferry to Unst, Yell and Fetlar in 2019 was 20,381. (Shetland Islands Council, 2020). This equates to a daily maximum of around 657 people per day. As day visitors must also travel home following the event, the maximum number of day visitors has been estimated as 329. In total, it is estimated that a maximum of 489 visitors will be able to view any given launch.

4.9.22 To determine the number of visitors over a year, it has been assumed that the number of visitors will decline by 5 % for subsequent launches, to account for possible saturation interest. During the first year, when 10 launches are anticipated, visitor numbers are therefore estimated at 3,922. For future years when the target of 30 launches per year is achieved, this is estimated to rise to 7,677 visitors.

4.9.23 Not all tourism activity can be considered as additional. Given the constraints in accommodation and ferry capacity, some visitors may displace other tourists that would have otherwise visited Unst for other reasons. As a result, it has been assumed that around 90 % of tourism activity will be additional with respect to Unst, 80 % with respect to the Shetland Islands and 50 % with respect to Scotland.

4.9.24 It has been assumed that overnight visitors will spend on average £448 during their stay in the Shetland Islands (Shetland Islands Council, 2018). In terms of the Scottish economy, predicted spend is higher at £726 per visit and takes into account of travelling costs to reach the Shetland Islands. It has been assumed that day visitors to Unst will spend on average £36[2] on the island. These visitors are considered as overnight visitors from the perspective of their spending in the Shetland Islands and in Scotland. Tourism spending has been discounted by 8 % to account for VAT, which is not included in the ratios from the UK Input-Output tables and multipliers.

4.9.25 Direct GVA and employment have been estimated by applying the turnover per GVA and turnover per job ratios for the Tourism sector, constructed using a series of industrial sector codes linked to accommodation, food and beverage and leisure activities. Indirect and induced impacts were then estimated making use of Scottish GVA and employment Type 1 and Type 2 multipliers.

4.9.26 It is estimated that tourism due to the Proposed Project will generate £0.4 million GVA and support 17 jobs on Unst. For the Shetland Islands this increases to £0.8 million GVA and 30 jobs, and for Scotland £1.5 million GVA and 54 jobs as shown in Table 4.11 below.

[2] based on data from the Great Britain Day Visitor Survey for day visits to the Shetland Islands (Kantar, 2019)

Table 4.11 Tourism Impact

	Unst	Shetland Islands	Scotland
Employment	17	30	54
GVA (£m)	0.4	0.8	1.5

4.9.27 The effect from tourism activity related to the Proposed Project is assessed as being**:**

- major beneficial (**significant effect**) for Unst; and,
- negligible for The Shetland Islands and Scotland.

Summary of Operational Effects

4.9.28 Summing the beneficial effects resulting from employment associated with the operation of the Proposed Project, accommodation for temporary workers during launches and space tourism activity, as detailed in Table 4.12 below, it is considered that the Proposed Project will generate:

- £4.9 million GVA and 139 jobs in Unst (representing a substantial increase in employment);
- £7.5 million GVA and 209 jobs across the Shetland Islands; and,
- £9.3 million GVA and 255 jobs across Scotland.

Table 4.12 Total Economic Impact from Operation of Proposed Project

	Unst	Shetland Islands	Scotland
Employment	139	209	255
GVA (£m)	4.9	7.5	9.3

The total effect from operation of the Proposed Project is therefore assessed as being:

- major beneficial (**significant effect**) for Unst;
- minor beneficial for The Shetland Islands; and,
- negligible for Scotland.

4.9.29 In addition, the Proposed Project is also expected to result in a series of wider, less quantifiable, benefits for the economies of Unst, the Shetland Islands and Scotland including:

- Making Scotland more competitive in the small satellite space sector, by providing a location from which launch activity could be carried out. This would complement the activities already carried out in the sector in Scotland and would mean that Scotland could offer the whole supply-chain for the small satellite sector.
- Diversifying the economic base of Unst and the Shetland Islands towards the space sector and away from the oil and gas industry, on which it currently relies heavily and is noted to be in decline. This diversification of the economic base may lead to an increase of the local economy’s resilience.
- Offering a wider range of employment opportunities and new career paths available to young people in Unst and in the Shetland Islands.
- Acting as a catalyst for investment. Once the Proposed Project is fully operational, it may become convenient for some launch companies to have permanent staff on the Shetland Islands, instead of dispatching temporary workers for each launch. Investment may also come from businesses supporting the operations of the space

centre, as a reliable stream of work may encourage them to invest or lead to the emergence of new businesses seeking to benefit from space-related contracts.

- Encouraging investment in the tourism sector, as launch activities extend the tourism season and provide additional visitors to Unst and to the Shetland Islands with another reason to spend time there.

4.10 Mitigation and Further Studies

4.10.1 No mitigation is applicable to this chapter as the effects were all assessed as beneficial.

4.10.2 The Applicant is committed to a further study of the socio-economic effects of the Proposed Project as part of its preparations for operation. The Applicant has partnered with the Open University to research development of socio-economic opportunities arising from the Proposed Project beyond the usual indicators.

4.10.3 The Open University study will develop a stakeholder analysis framework to assess the socio-economic benefits of the Proposed Project as part of the UK's Launch UK spaceflight programme. It is recognised that space ports can involve highly sensitive, rural areas, and consultations for stakeholder input analysis regarding socio-economic benefit assessments must be carefully planned (and tailored to the specific locale) in collaboration with local partners. Working with the Applicant, the Open University team will determine the stakeholders involved in the space port and define the most appropriate consultation and analytical process, thus enabling the Open University's socio-economic benefits evaluation framework to be applied. The focus of the framework is on determining the less tangible socio-economic benefits that arise from such activities, beyond the traditional financial analyses performed to date.

4.10.4 The study is currently in progress and will be reported as appropriate on completion.

4.11 Residual Effects

4.11.1 As no mitigation is required, the residual effects on socio-economic characteristics are assessed as being effectively the same as the potential effects set out in Section 14.6 above, as summarised below.

4.11.2 The residual effects from the operational phase of the Proposed Project are assessed as being:

- major beneficial (**significant effect**) for Unst,
- minor beneficial for The Shetland Islands; and,
- negligible for Scotland.

4.12 Cumulative Assessment

4.12.1 Cumulative effects can be either inter-project or intra-project effects.

4.12.2 Inter-project cumulative effects are those where an environmental topic/receptor is affected by impacts from more than one project at the same time and the impacts act together. Due to the location of the Proposed Project on the north coast of Unst, the most northerly of the Shetland Islands, there are no other existing or proposed developments with the potential to influence cumulative effects in the local EZI (Unst). The relative effect of the Proposed Project on the regional and national scale EZI has been assessed within this chapter already.

4.12.3 Intra-project cumulative effects are those where an environmental topic/receptor is affected by more than one impact from the same Proposed Project and the impacts act together. Whilst human health effects from the air quality and noise impacts are considered within this chapter, none of the effects directly impact between the disciplines and therefore there are no potential intra-project cumulative effects.

4.12.4 It is noted, however, that if the Proposed Project were to stimulate investment (for example, to provide additional visitor accommodation for those working on or viewing launches) or new entrepreneurial activity to take advantage of the supply chain opportunities that are expected to arise, this would further increase the economic impacts in the Unst and Shetland Islands economies, having a positive additive effect.

4.13 Summary

4.13.1 This chapter provides the human health and population assessment of the Proposed Project. The analysis has considered impacts associated with operation of the Proposed Project and how this fits into the local and national economic context.

4.13.2 The population of Unst has declined significantly over the last century, reaching 632 people in the latest Census (2011), and is expected to decrease further. The population decline has been caused in part by the closures of Baltasound Airport in 1996 and RAF Saxa Vord in 2006. These closures have also depressed job opportunities in Unst, and incomes in Unst and the North Isles tend to be lower than in other parts of the Shetland Islands. When compounded with higher living costs, this results in the area around the Proposed Project being one of the least affluent areas in the Shetland Islands.

4.13.3 The Proposed Project represents a transformational and much needed economic development opportunity for Unst and for the Shetland Isles and will generate significant beneficial local effects through:

- employment associated with operation of the Proposed Project;
- demand for goods and services to support the operation of the Proposed Project;
- hosting temporary workers from the launch companies who will then utilise local shops, hospitality and other amenities; and,
- attracting tourists who will visit to watch launches and/or explore the Proposed Project (including outside the current summer tourism season).

4.13.4 The predicted economic effects are considered to be major beneficial (**significant**) locally.

4.13.5 Full operation of the Proposed Project will see a maximum of 30 launch events per year. During operation, beneficial economic impacts are expected to arise from three main sources:

- employment associated with operation of the Proposed Project;
- accommodation for temporary workers during launches; and,
- space tourism activity.

4.13.6 It is estimated that employment associated with this level of activity will generate:

- £3.3 million GVA and support 68 jobs in Unst;
- £5.3 million GVA and support 119 jobs in The Shetland Islands; and,
- £6.2 million GVA and support 137 jobs across Scotland.

4.13.7 Spending on accommodation for temporary workers during launches is estimated to generate:

- £1.2 million GVA and support 55 jobs in Unst;
- £1.4 million GVA and support 59 jobs in The Shetland Islands; and,
- £1.6 million GVA and support 64 jobs across Scotland.

4.13.8 Spending by visitors coming to Unst for space tourism is estimated to generate:

- £0.4 million GVA and support 17 jobs in Unst;
- £0.8 million GVA and support 30 jobs in The Shetland Islands; and,
- £1.5 million GVA and support 54 jobs across Scotland.

4.13.9 Summing all these impacts together, it is estimated that the total impact from operation of the Proposed Project will be:

- £4.9 million GVA and 139 jobs in Unst;
- £7.5 million GVA and 209 jobs in The Shetland Islands; and,
- £9.3 million GVA and 255 jobs in Scotland.

4.13.10 The total effect from operation of the Proposed Project is therefore assessed as being:

- major beneficial (**significant**) for Unst;
- minor beneficial for The Shetland Islands; and,
- negligible for Scotland.

4.13.11 In addition, the Proposed Project is also expected to result in a series of wider, less quantifiable, benefits for the economies of Unst, the Shetland Islands and Scotland including:

- Making Scotland more competitive in the small satellite space sector, by providing a location from which launch activity could be carried out.
- Diversifying the economic base of Unst and the Shetland Islands towards the space sector.
- Offering a wider range of employment opportunities and new career paths available to young people in Unst and in the Shetland Islands.
- Acting as a catalyst for further investment; and,
- Encouraging investment in the tourism sector, as launch activities extend the tourism season and provide additional visitors to Unst and to the Shetland Islands.

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Chapter 5 Ornithology

5. Ornithology

5. Ornithology

5.1 Introduction

5.1.1 This AEE Report chapter considers the likely significant effects of the Proposed Project on birds, both on site and in the surrounding environmental zone of influence (EZI), during operation of the Proposed Project. The assessment is based upon comprehensive baseline data, comprising specifically targeted ornithological surveys of potentially important and legally protected bird species identified during a desk study and consultation feedback. It draws on pre-existing information, where appropriate, from other studies, survey data sources and relevant Chartered Institute for Ecology and Environmental Management (CIEEM) and NatureScot (previously Scottish Natural Heritage, SNH) guidance. The scope of the ornithological assessment excludes potential impacts on habitats, flora and other fauna, which are considered separately in Chapter 6: Ecology.

5.1.2 Alba Ecology Ltd. led on all aspects of the ornithological fieldwork and assessment in association with the Proposed Project. Alba Ecology is a Scottish-based multi-disciplinary ecological consultancy that has worked in the north of Scotland, and Shetland specifically, for many years. Alba Ecology's staff have led on and contributed to all aspects of Ecological Impact Assessment (EcIA) on several large-scale development projects, including the management of Ecological Clerks of Work (ECoW) teams, principal ornithological/ecological surveyors and advisors on planning applications, expert witness advice at Public Local Inquiry and the production of Environmental Statements, Habitat Regulations Assessments and Habitat Management Plans.

5.1.3 The ornithological surveyors used in the study area between 2018 and 2020 were Mr David Cooper, Mr Brydon Thomason and Dr Peter Cosgrove. These surveyors have extensive ornithological field experience of Shetland and Unst specifically. Surveyors carried out bird surveys in a systematic and objective manner, following recognised standardised methods. Those surveyors working near breeding birds listed in Schedule 1 of the Wildlife and Countryside Act 1981 (and as amended) were covered by relevant SNH Schedule 1 Bird Licences.

5.1.4 This chapter is supported by the following Appendices in Volume III (and associated ornithological drawings in Volume IV):

- Appendix 5.1: Shetland Space Centre Breeding Birds Survey Report, where further details of ornithological survey methodologies and data collected can be found.
- Appendix 5.2: Background literature review of noise impacts on birds for the Shetland Space Centre.
- Appendix 5.3 Outline Habitat Management Plan.

5.1.5 Confidential bird species information has been submitted to and assessed previously by the local planning authority, as part of the planning process for the Proposed Project.

5.1.6 The assessment involved the following key stages:

- Reference to relevant legislation, policy and guidance.
- Identification of the likely environmental zone of influence of the Proposed Project.
- Identification of potentially important ornithological receptors likely to be affected (baseline conditions) by the Proposed Project.
- Evaluation of important ornithological receptors and features likely to be affected by the Proposed Project.
- Identification of likely impacts and magnitude of the Proposed Project on important ornithological receptors.

- Assessment of the likely significant effects of the Proposed Project, including any mitigation and enhancement measures and any residual significant effects.

5.1.7 The term '*receptor*' is used throughout the AEE process and is defined as the element in the environment affected by a development (e.g., a bird in the case of ornithology). The term '*impact*' is also used commonly throughout the AEE process and is defined as a change experienced by a receptor (this can be beneficial, neutral or adverse). The term '*effect*' is defined as the consequences for the receptor of an impact.

5.2 Legislation, Policy and Guidelines

Legislation

Space Industry Act

5.2.1 The Space Industry Act (2018) regulates all spaceflight activities carried out in the United Kingdom, and associated activities. The Act requires any person or organisation to obtain the relevant licence to:

- launch a launch vehicle from the UK;
- return a launch vehicle launched elsewhere than the UK to the UK landmass or the UK's territorial waters;
- operate a satellite from the UK;
- conduct sub-orbital activities from the UK;
- operate a spaceport in the UK; or
- provide range control services from the UK.

5.2.2 As the Applicant wishes to operate a vertical spaceport (the SaxaVord Spaceport) and provide range control services (at the Launch and Range Control Centre, LRCC) they are required to apply for a both a spaceport licence and a range control licence. However, AEE is only relevant to applications for spaceport licences.

Space Industry Regulations 2021

5.2.3 The Space Industry Regulations 2021 (the Regulations) set out in more detail the requirements for each licence the Regulators Licensing rules, which specify what information the UK Civil Aviation Authority (CAA), the regulator, requires in support of an application.

Policy Context

5.2.4 Further relevant legislation and best practice guidance documents have been reviewed and taken into account as part of this ornithological assessment. The approach used to assess the significance of likely effects of the Proposed Project upon ornithological receptors is set in the context of:

- The Wildlife and Countryside Act 1981 (as amended);
- European Commission (EC) (2011) European Biodiversity Strategy;
- EC Directive 2009/147/EC on the conservation of wild birds (codified version). The so-called 'Birds Directive';
- EC Directive 1992/43/EEC on the conservation of natural habitats and of wild fauna and flora. The so-called 'Habitats Directive';
- The Conservation (Natural Habitats) Regulations 1994. The so-called 'Habitats Regulations';
- The Conservation of Habitats and Species Regulations 2010;

- The Nature Conservation (Scotland) Act 2004 (as amended);
- Scottish Government PAN 1/2013;
- Scottish Government Planning Circular 1 2017: The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017;
- Guidelines for Ecological Impact Assessment in the UK and Ireland (CIEEM, 2016; 2018; 2019 as amended);
- Regional Population Estimates of Selected Scottish Breeding Birds (SNH, now NatureScot);
- Natural Heritage Zones Bird Population Estimates. SWBSG (Scottish Windfarm Bird Steering Group) Commissioned Report: 150413;
- Scottish Government. The Scottish Biodiversity List (SBL);
- Scottish Government 2020. The Environment Strategy for Scotland: vision and outcomes;
- Biodiversity Net Gain: Good practice principles for development: A practical guide. (CIRIA, CIEEM and IEMA 2019);
- Biodiversity Net Gain in Scotland, CIEEM Scotland Policy Group, 2019;
- Strategic Plan for Biodiversity 2011-2020. Convention on Biological Diversity;
- 'Living Shetland' – the Shetland Local Biodiversity Action Plan (LBAP);
- The Shetland Local Development Plan (2014); and
- The Shetland Local Development Plan – Natural Heritage Supplementary Guidance (2012).

5.2.5 There is no Scottish or UK specific ornithological guidance on satellite/rocket launch facilities.

5.2.6 Scottish Planning Policy (Scottish Government, 2014) sets out the Scottish Government's national planning policies for the protection of biodiversity through the planning system. This seeks to ensure that projects provide biodiversity benefits where possible, not simply to avoid significant adverse effects. These policies are incorporated into development plans and are a material consideration in the determination of development proposals.

5.2.7 The UK Biodiversity Action Plan (BAP) was the UK Government's 2004 response to the Convention on Biological Diversity, to which the UK was a signatory. Action plans for the most threatened species and habitats (called 'UK BAP species and habitats') were set out to aid recovery. Following the publication of the Convention on Biological Diversity's 'Strategic Plan for Biodiversity 2011–2020' (Convention on Biological Diversity, 2010), its commitment to 20 'Aichi targets', agreed at Nagoya Japan in October 2010, and the launch of the European Biodiversity Strategy in May 2011, the UK Government has changed its strategic thinking.

5.2.8 The Scottish Biodiversity List (SBL) is a list of animals, plants and habitats that Scottish Ministers consider to be of principal importance for biodiversity conservation in Scotland, under the Nature Conservation (Scotland) Act 2004. The SBL therefore supersedes the UK BAP list of species and habitats. Nevertheless, since most existing planning policy and guidance requires consideration of, and makes explicit reference to, UK BAP species and habitats, these are still referred to where necessary.

5.2.9 The Shetland Local Development Plan (2014) contains policies and objectives to conserve and enhance the habitats and species that contribute to the unique character and heritage of Shetland. It has links to Supplementary Guidance on Local Nature Conservation Sites in Shetland and Supplementary Guidance on Natural Heritage. This guidance is provided to aid planning applicants and their agents when considering development in relation to their biodiversity responsibilities.

5.2.10 It is recognised that the term '*Favourable Conservation Status'* (FCS) as articulated within the EC Habitats Directive is not used in the EC Birds Directive, but SNH (now NatureScot) advises on its use and context in relation to consideration of birds. Conservation status is considered favourable where:

- Population dynamics indicate that the species is maintaining itself on a long-term basis as a viable component of its habitat.
- The natural range of the species is not being reduced, nor is it likely to be reduced in the foreseeable future.
- There is (and will continue to be) a sufficiently large habitat area to maintain its populations on a long-term basis.

5.2.11 Whilst considering a range of potential outcomes that could arise from the Proposed Project, the assessment reports the effects that are considered likely to be significant on the basis of evidence, standard guidance and professional judgement. It is these *likely significant effects* that the applicant is obliged to report, and that the decision maker is obliged to consider.

Relevant Guidance

Guidance for the Assessment of Environmental Effects

5.2.12 The CAA, with the UK Space Agency, the Department for Business, Energy and Industrial Strategy and the Department for Transport, issued guidance note '*Guidance for the Assessment of Environmental Effects*' in July 2021. The guidance sets out what is required by the regulator regarding assessment of environmental effects as part of a licence application under the Act.

5.2.13 The AEE Guidance requires that potential direct and indirect significant effects of proposed spaceflight activities on environmental features, are considered. The guidance further requires that:

- Specific potential effects are identified and, where possible, quantified;
- The focus of the AEE should be on significant effects arising from the proposed activities;
- Applicants for a spaceport licence set an environmental budget, comprising a maximum number of launches per launch vehicle type which can take place over the course of a year that can be carried out in an environmentally sustainable manner, taking into account the cumulative effect of all launches; and
- The AEE must address a range of environmental topics, including ornithology.

Guidance to the regulator on environmental objectives relating to the exercise of its functions under the Space Industry Act 2018

5.2.14 The Department for Transport issued its document '*Guidance to the regulator on environmental objectives relating to the exercise of its function under the Space Industry Act 2018'* in 2021, clarifying the government's environmental objectives relating to spaceflight and associated activities in the UK:

The environmental objective for spaceflight are to:

- *Minimise emissions contributing to climate change resulting from spaceflight activities*
- *Protect human health and the environment from the impacts of emissions on local air quality arising from spaceflight activities*
- *Protect people and wildlife from the impacts of noise from spaceflight activities*
- *Protect the marine environment from the impact of spaceflight activities.*

5.2.15 The objectives presented in the guidance are noted to be consistent with the environmental topics that must be addressed in an AEE.

5.3 Consultation

5.3.1 Extensive statutory consultation on ornithology was carried out during preparation and determination of the planning application for the SaxaVord Spaceport, where the Proposed Project will be operated. Where directly relevant to this AEE, consultation responses received during the SaxaVord Spaceport planning application period have been summarised in Table 5.1.

Table 5.1 Consultation Responses Relevant to AEE

Consultee	Summary ornithology response	Where and how addressed
SNH - Jonathan Swale 16/02/18	Following an approach on 06/02/20 by Alan Farningham of Farningham Planning Ltd into the scope and scale of ornithological surveys, Jonathan Swale of SNH responded on 16/02/18 as follows: *"The environmental assessment should consider the impacts on breeding birds of operation of the launch site, as well as its construction, so surveys should cover the area likely to be affected. Rocket launches could cause disturbance over a large area, but without information on the expected noise levels we aren't able to advise on the likely extent of disturbance nor on the area that should be surveyed to carry out the impact assessment. It may be necessary to assess possible impacts on seabirds within Hermaness, Saxa Vord and Valla Field SPA but this will not require additional survey work as we have recent data that can be used"*. Consideration of whimbrel within the Hill of Colvadale and Sobul SSSI was also recommended for potential works near that designated site. However, this area did not feature in the final planning Application Boundary, therefore is not reported on. SNH also advised that the cliffs around Lamba Ness were likely to support nesting fulmar, shag, black guillemot and possibly gulls and that these species should therefore be surveyed too.	The nature and scale of the ornithological study area is discussed within this chapter and also Appendix 5.1. Breeding bird survey data collected by Alba Ecology is presented in Volume IV Appendix 5.1. Consideration of potential noise impacts on birds is presented in Volume IV Appendix 5.2. Consideration of sensitive Schedule 1 species breeding information has been submitted to and assessed previously by the local planning authority, as part of the EIA process.

Consultee	Summary ornithology response	Where and how addressed
SNH - Glenn Tyler 24/05/20	Agreement on the proposed seabird (boat-based) survey methods and personnel was sought and agreed with Glenn Tyler at SNH (in a phone call on 24/05/18). Glen Tyler agreed that this approach was suitable and that three separate boat-based surveys spread across the first three weeks of June during suitable weather conditions was standard and 'sounded ideal', given the information available at the time. Surveys were undertaken in 2018 as per agreement with SNH.	Seabird survey data collected by Alba Ecology is presented in Appendix 5.1.
SNH – 28/05/20	Alba Ecology provided SNH with a draft version of Appendix 5.1.	Provided as part of a verbal agreement to share information/data ahead of the planning application submission.
SNH – 29/05/20 and 02/06/20	During data sharing with SNH it became apparent that SNH's existing bird data for the SPA (Special Protection Area) did not exist for the whole of the Hermaness, Saxa Vord and Valla Field SPA area. The SPA extends to Virdik but only the marine extension – it does not include the cliffs, which was the only section SNH monitors. Consequently, a gap in nesting seabird data for the area between Virdik and Ura was identified. On 02/06/20 SNH provided what up-to- date breeding bird data they had for the relevant designated sites.	Boat-based seabird surveys were conducted for the relevant 'gap' section of cliff in June 2020, which also coincided with the relaxation of COVID-19 restrictions for outdoor work. The same surveyors who undertook the 2018 boat-based seabird surveys conducted three boat-based seabird surveys between Virdik and Ura in June 2020.
SNH – 18/08/20	Alba Ecology provided SNH with a brief update on the 2020 survey results and a draft of Appendix 5.2.	Information provided as part of a verbal agreement to share information/data ahead of the planning application submission.
Royal Society for the Protection of Birds (RSPB) – 28/05/20	Alba Ecology provided RSPB with a draft version of Appendix 5.1.	Provided as part of a verbal agreement to share information/data ahead of the planning application submission.
RSPB – 18/08/20	Alba Ecology provided RSPB with a brief update on the 2020 surveys and a draft of Appendix 5.2.	Information provided as part of a verbal agreement to share information/data.

5.3.2 Following consultation with NatureScot subsequent to submission of the planning application, the Applicant has confirmed that no satellite launches or static tests will be carried out between mid-May and the end of June in order to avoid disturbance to breeding birds during the critical incubation and early brooding period.

5.3.3 It is also noted that the NatureScot consultation response includes a comment that if observations of birds attending the colonies during the pre-laying period (mid-April to mid-May) show that launches do not significantly increase disturbance, then this commitment may be subsequently relaxed/revisited.

5.3.4 The following potential impacts have been assessed in full in relation to the operation of the Proposed Project:

- Direct loss of foraging or breeding habitat due to displacement or avoidance.
- Indirect loss of foraging or breeding habitat due to displacement or avoidance.
- Death or injury of birds (including eggs and dependent young) through noise impacts associated with satellite launches.

5.3.5 Collision risk with birds striking the launch vehicle during take-off is not considered likely. Given the noise generated at launch, it is not considered likely that many birds would remain in the vicinity of the launch pads. At some satellite launch facilities, very occasional bird strikes have occurred e.g., vultures at the Kennedy Space Centre in Florida (Appendix 5.2) which do not occur on Unst.

5.4 Assessment Methodology and Significance Criteria

Consultation

5.4.1 In accordance with CIEEM best practice guidance, consultation was undertaken throughout the EIA process beginning with consulting with SNH on the nature and scale of ornithological surveys in February 2018. Draft ornithological survey results and the draft background literature review of noise impacts on birds for the Proposed Project were shared with both SNH and RSPB in June 2020, ahead of formal EIA reporting (Table 5.1).

Environmental Zone of Influence (EZI)

5.4.2 The main elements of the Proposed Project which have the potential to impact on ornithological receptors during operation are described in Chapter 3 and include:

- Launch Site: located on the Lamba Ness peninsula and comprising three launch pad complexes, each incorporating a launch pad, ground services storage and control, lightning protection masts, liquid and compressed gas storage and water deluge tanks for launch operations;
- Satellite Tracking Station: an area of hardstanding housing satellite tracking and telemetry devices located on the Lamba Ness peninsula;
- Launch Site Processing Facility (LSPF) hangar buildings (two): located on the Lamba Ness peninsula, a building where the LVs are assembled and the payload (the satellites) integrated into the LVs;
- Administration Building, Pyrotechnics Store, and Hazardous Materials Store located adjacent to the LSPF on the Lamba Ness peninsula;
- Integration Hangar/TEL building: located on the Lamba Ness peninsula, a forward position building close to the launch pads housing the transporter erector launcher (TEL) and where the final integration activities take place as required;
- Support Infrastructure: located on the Lamba Ness peninsula including access, an internal track system and a series of small temporary buildings;
- Gate House, including a tourist information area, located on the Lamba Ness peninsula; and
- Wildlife Hide: located on the Lamba Ness peninsula.

5.4.3 The Proposed Project provides the basic infrastructure for space vehicle launches. The Applicant is looking to achieve a maximum of 30 launch events per year from the Proposed Project. However, in the first year of operation (2022) it is anticipated that there will be up to 10 launches, made up of both orbital and sub-orbital rockets

5.4.4 Assessing the potential effects of disturbance on bird species is a complex issue which will vary depending on the type of disturbance (e.g., routine/predictable verses unusual/unexpected), topography, vegetation and the behaviour/tolerance of the bird species and even different individuals within species. Therefore, identifying a one-size-fits-all ornithological study area over which potentially affected breeding bird species should be surveyed is challenging. Consequently, this was considered in a number of different ways, which are outlined below.

5.4.5 In Scotland, all wild birds are legally protected, but some species are considered more sensitive to human related disturbance than others and they are specially protected under European, UK and Scottish legislation. Disturbance can have adverse effects on birds' breeding success, e.g., through chilling, overheating and desiccation of eggs or chicks, predation and starvation of chicks and ultimately the abandonment of a breeding territory. Therefore, the distance over which disturbance might potentially occur was considered particularly important when determining the ornithological study area.

5.4.6 Limited work has taken place on the impact of disturbance on most of the bird species potentially present within habitats on Unst. However, for two of the important species which breed on Unst, some guidance has been published on the distances at which they are likely to be affected by human-related disturbance. In Ruddock and Whitfield (2007), 80 % of experts canvased estimated static disturbance occurred at 500 m to 750 m for nesting and chick-rearing red-throated divers (*Gavia stellata*) and expert opinion suggested 'safe working distances' could exceed 500 m. Ruddock and Whitfield (2007) suggested that breeding red-throated divers are sensitive to human activity, visual disturbance and sudden noise events over relatively large distances (e.g., up to 500 m). Evidence from Viking Wind Farm studies in Shetland indicated that some individual red-throated divers (perhaps habituated) appear to tolerate moderate levels of disturbance in some situations. The size of waterbodies also has an impact; breeding divers are more easily disturbed and fly from smaller nesting lochans (where they presumably feel more vulnerable) than larger nesting lochs, where they have the ability to swim away and dive without taking flight.

5.4.7 Similarly, breeding merlins (*Falco columbarius*) are considered sensitive to human activity, visual disturbance and sudden noise events over large distances (e.g., up to 500 m) (Ruddock and Whitfield, 2007), particularly prior to egg laying and during incubation in Shetland (the late Mark Chapman, *pers comm*.). However, individual merlin pairs appear to tolerate moderate levels of disturbance in some situations. For example, merlins appear to be able to nest relatively close to public roads in Shetland, where regular (mostly predictable) disturbance occurs.

5.4.8 Based on Ruddock and Whitfield (2007), there is some limited evidence and expert opinion that sudden noise events up to 500 m to 750 m away from the two potentially affected bird species could be detrimental. Based on this, it might have been possible to recommend a one-kilometre survey buffer around the launch pad sites. However, none of the potentially affected target species had been monitored in relation to short-duration loud noise events of the magnitude of a launch. Furthermore, at the time of Pre-application consultation with SNH (2018) and determination of the ornithological study area, there was no information on predicted noise levels available. Consequently, this nominal one-kilometre survey buffer was not considered an adequate basis on which to determine the size of the ornithological study area.

5.4.9 During initial survey planning, there was no Planning Application red line site boundary, only an indicative boundary area. As a result, an arbitrary, but very large precautionary initial study area, was selected for breeding bird surveys, based on bird species likely to be present from existing data sources e.g., Pennington *et al*. 2004 and the habitats present. According to expert opinion (Ruddock and Whitfield, 2007), the greatest distance any UK species was predicted to be affected by human induced disturbance was 1.5 - 2 kilometres (for breeding golden eagle – which does not occur on Unst), and this was even considered by Ruddock and Whitfield to be overly precautious.

Nevertheless, given the lack of any empirical evidence or guidance, it was decided that doubling the greatest possible disturbance distance for any UK breeding bird, i.e., a four kilometre buffer from the Proposed Project, was a legitimate precautionary basis on which to proceed with breeding bird surveys to cover the potential zone of influence. Consequently, the size of the breeding bird study area (Drawing 5.1) was much larger than the final Proposed Project site boundary and it was centred on indicative launch pad site locations provided by the Applicant during initial discussions in early 2018.

5.4.10 A plan of the breeding birds study area (EZI) is included as Drawing 5.1.

Desk Study

5.4.11 An initial Desk Study was conducted in 2018 using the SNH's SiteLink website and Shetland Biological Records Centre data held for the study area. This was supplemented by existing knowledge of the breeding birds of Unst and consultation with SNH on the nature and scope of bird surveys. Given the time gap between 2018 and the current planning submission, the exercise was undertaken again from the same data providers, alongside up to date information from the National Biodiversity Network (NBN); a collaborative UK partnership created to exchange biodiversity information. This information was compiled into a report and is presented in Volume IV Technical Appendix 5.1.

5.4.12 The desk study identified several Annex 1, Schedule 1, UK BAP and SBL species previously recorded within the study area. Based on the results of the desk study, initial site-walkover, size/quality/importance of habitats present, EIA Scoping comments and feedback from the regulators, legal protection, the site and the exercise of professional judgement, the following potentially important ornithological receptors have been identified for further consideration:

- Nearby designated site species.
- Breeding red-throated diver.
- Breeding raptors, in particular merlin.
- Breeding waders, in particular whimbrel (*Numenius phaeopus*), curlew (*Numenius arquata*), ringed plover (*Charadrius hiaticula*), golden plover (*Pluvialis apricaria*) and dunlin (*Calidris alpina*).
- Breeding terns and skuas, in particular Arctic tern (*Sterna paradisaea*) and Arctic skua (*Stercorarius parasiticus*).
- Cliff nesting seabirds, in particular black guillemot (*Cepphus grylle*), common guillemot (*Uria aalge*), razorbill (*Alca torda*), puffin (*Fratercula arctica*), shag (*Phalacrocorax aristotelis*), fulmar (*Fulmarus glacialis*) and gulls.
- Potentially rare species, including confidential breeding Schedule 1 species.

5.4.13 There was no evidence from the desk study of the study area being especially important for non-breeding birds and SNH did not request non-breeding bird surveys. Consequently, surveys focussed on breeding birds.

Site Visit

5.4.14 A reconnaissance site visit by Dr Peter Cosgrove in late autumn 2017 determined that the Proposed Project area was predominantly open coastal/upland habitat characterised by peatland, grassland and sea cliffs (plus some buildings). The principal land use was sheep grazing through crofting and common grazings. There was potential for several specially protected bird species to be present, so breeding bird surveys were conducted under a SNH Schedule 1 licence.

Breeding Bird Surveys

5.4.15 Breeding bird surveys were undertaken monthly between April and July 2018 and 2019 within the ornithological study area. In 2020, additional Schedule 1 surveys were undertaken within the Proposed Project site boundary, to inform other surveyors working there of the potential avian sensitivities present through the production of an up to date Breeding Birds Protection Plan (BBPP) and associated on-site ECoW support.

Moorland Breeding Bird Surveys

5.4.16 The modified Brown and Shepherd (1993) Moorland Breeding Bird survey is the standard survey technique for moorland/upland breeding birds (Gilbert *et al.,* 1998) and is described in the SNH online guidance (e.g., SNH 2005; and subsequent updates). The main habitat was open moorland/grassland and so this survey technique was used across all parts of the study area. However, there were some wetter/marshy areas in the study area which were observed from the nearest edge. Further details are provided in Appendix 5.1.

5.4.17 Population estimates of terrestrial birds in the study area were derived by comparing the summary maps for each of the breeding survey visits. Registrations/territories plotted during each period were considered to be separate from one another if more than approximately 500 m apart for larger species, 300 m in the case of smaller species. If there was any doubt about whether more than one pair of birds was present in an area, the surveyor would sit quietly nearby and observe the behaviour, gender and number of birds present as per Brown and Shepherd's (1993) survey methodology. When compiling figures of breeding birds, the approximate central location of all registrations recorded from different survey visits is used to identify a notional territory centre (the species 'dot' on the relevant drawing) where a nest was not discovered. Surveys were undertaken in 2018 and 2019 as per agreement with SNH across the study area and additionally in 2020 for Schedule 1 species within the Proposed Project site boundary.

Breeding Raptor Surveys

5.4.18 SNH provides clear guidance in relation to raptor sensitivities and survey effort (2005; and subsequent updates). Breeding raptor surveys were undertaken to determine the location of any breeding merlins within the study area using standardised merlin survey methods (e.g., Hardey *et al*., 2013). These surveys also covered potential breeding habitats of kestrel and peregrine, were they to be present. Surveys were undertaken in 2018 and 2019 as per agreement with SNH across the study area and additionally in 2020 for Schedule 1 species within the Proposed Project Boundary. Further details are provided in Appendix 5.1.

Breeding Red-throated Diver Surveys

5.4.19 Following SNH standard guidance, searches for nesting red-throated divers were undertaken on all potentially suitable waterbodies within the study area. The waterbodies were visited at least twice during the breeding season if nothing was present. However, if the water body was occupied, sites were revisited later in the breeding season to determine nest locations and breeding success. Surveys were undertaken in 2018 and 2019 as per agreement with SNH across the study area and additionally in 2020 within the Proposed Project Boundary Further details are provided in Appendix 5.1.

Black Guillemot

5.4.20 Counts of individual adult black guillemots provide the most accurate survey method for this species (Gilbert *et al*., 1998). Two survey visits, a week or more apart during the first three weeks of April were undertaken. The surveys were conducted from first light until particular defined potential black guillemot cliff reaches were surveyed, during suitable, calm and clear weather conditions (as per Gilbert *et al*., 1998). The surveyor, who was familiar with the study area, moved along the coast counting all black guillemots on the sea, within about 300 m of the shore and any that were on land. Repeat counts were also undertaken in the afternoon for some reaches for comparative purposes. Surveys were undertaken in 2018 and 2019 as per agreement with SNH across the study area.

Cliff Nesting Seabirds

5.4.21 The standard method for surveying cliff nesting seabirds requires the number of individual adult birds per visit recorded or Apparently Occupied Nests (AON), which can either be summed and a mean produced over different survey visits undertaken or simply use the highest count to provide a maximum population estimate. The standard survey guidance recommends between two and five survey visits. Given the nature of the study area, with no low tide beach below the steep cliffs, boat-based counts were undertaken between the eastern edge of the Hermaness, Saxa Vord and Valla Field SPA (approximately Virdik) and The Nev (south-east of Hill of Clibberswick), as per agreement with SNH. No climbing down cliffs to count breeding seabirds was undertaken.

5.4.22 The razorbill, common guillemot and shag standard survey methods recommend surveys in the first three weeks of June in the north of Scotland in 'normal years' (June or July for gannets (*Morus bassanus*), June for fulmar, early-mid June for kittiwake (*Rissa tridactyla*). Consequently, boat-based surveys were scheduled for and undertaken during the first three weeks of June given the main species likely to be present on the cliffs (and where possible due to weather constraints, well-spaced across these 3 weeks). The two main sources of seabird survey guidance were followed: Gilbert *et al*., (1998) and JNCC Seabird Monitoring Handbook (Walsh *et al*., 2011).

5.4.23 Puffins are difficult to census due to their use of burrows, often in inaccessible locations. The most reliable way in which they are monitored is by long-term monitoring of Apparently Occupied Burrows (AOB) from sample areas, rarely possible in Shetland due to the steep and inaccessible nature of much of the terrain (Mitchell *et al.,* 2004). When these burrows cannot be accessed, as was the case within the study area, the standard survey methodology is to count individual birds on land, which provides a rough estimate of numbers present. However, in Shetland such previous counts have mostly taken place at the same time as the optimal count for other cliff nesting seabirds in June, when it is known that nonbreeding puffins also attend colonies and so can inflate numbers of presumed breeders present. This is a recognised limitation of the survey method in Shetland and needs to be recognised when comparing puffin data from other/previous surveys.

5.4.24 Further methodological detail on how each seabird species was counted is provided within the JNCC Seabird Monitoring Handbook (Walsh *et al*., 2011). These survey methods and proposed personnel were discussed and agreed with Glenn Tyler at SNH (in a phone call on 24/05/18; Table 5.1). Surveys were undertaken in 2018 as per agreement with SNH. Further details are provided in Appendix 5.1.

5.4.25 During data sharing with SNH in 2020 it became apparent that existing bird data for the SPA did not exist for the whole of the Hermaness, Saxa Vord and Valla Field SPA area. The SPA extends to Virdik but only the marine extension – it does not include the cliffs, which is the only section SNH monitors. Consequently, a gap in cliff nesting seabird data for the area between Virdik and Ura was identified. Fortuitously, this data gap was identified in May 2020, allowing boat-based seabird surveys to be organised for the relevant section of cliff in June 2020, which also coincided with the relaxation of COVID-19 restrictions for (socially distanced) outdoor work. The same experienced surveyors who undertook the 2018 boat-based seabird surveys conducted the 2020 boat-based seabird surveys between Virdik and Ura, providing consistency of experienced observers.

Assessment of Potential Effect Significance

5.4.26 This section defines the criteria used to evaluate the likely significance of predicted effects on important ornithological receptors due to the operation of the Proposed Project. A level of confidence (whether the predicted effect is certain, likely, possible or unlikely) is attached to the predicted effect.

Evaluating Conservation Importance

5.4.27 The ornithological receptors identified in the baseline studies have been evaluated following best practice guidelines (e.g., CIEEM, 2018). Identifying the importance of potential ornithological receptors was the first step of the process, and those considered potentially important and present were then subject to detailed survey and assessment. Those considered sufficiently widespread, unthreatened and resilient to the project impacts have been scoped out of further assessment as per best practice EcIA guidance (e.g., CIEEM, 2018).

5.4.28 Ornithological receptors can be important for a variety of reasons and the rationale used to define their importance has been explained to demonstrate a robust selection and evaluation process. Importance may relate, for example, to a designated site, to species rarity, to the extent to which they are threatened throughout their range, or to their rate of decline. Various characteristics contribute to the potential importance of ornithological receptors within a study area. Examples include:

- Naturalness of a bird population.
- Species, sub-species or varieties that are rare or uncommon, either internationally, nationally or more locally, including those that may be seasonally transient.
- Ecosystems and their component parts, which provide the habitats required by important bird species, populations and/or assemblages.
- Endemic bird species or locally distinct sub-populations of a species.
- Size of a bird population.
- Bird species in decline.
- Large populations of bird species or concentrations of species considered uncommon or threatened in a wider context.
- Bird species on the edge of their range, particularly where their distribution is changing as a result of global trends and climate change.

5.4.29 Guidance on EcIA sets out categories of ornithological or nature conservation importance that relate to a geographical framework (e.g., international through to local) together with criteria and examples of how to place a site or study area (defined by its ornithological attributes) into these categories. It is generally straightforward to evaluate sites or species populations designated for their international or national importance (as criteria for defining these exist e.g., SPA and SSSI), but for sites or populations of regional or local importance, criteria may not be easily defined.

5.4.30 According to CIEEM (2018) the importance of an ecological feature should be considered within a defined geographical context, and these should be adapted to suit local circumstances, as outlined in Table 5.2.

Table 5.2 Summary of Geographic Population Importance Criteria Used

Term	Use
International	For example, >1 % of European Community (EC) population, internationally designed site feature.
National	For example, >1 % of United Kingdom (UK) or Scottish population, nationally designated site feature.
Regional	For example, >1 % of the relevant Natural Heritage Zone (NHZ) population, regionally designed site feature.
Local	For example, within local area (<1 % of relevant NHZ population), local wildlife sites.

5.4.31 There is no fundamental biological reason to take 1 % of a population as the threshold level for establishing the level of geographic importance of a site. Nevertheless, this percentage is widely considered to be of value in developing measures that give an appropriate level of protection to populations and has gained acceptance on this basis throughout the world. The criterion was, for example, adopted by parties involved in the Ramsar Convention 1971. Thereafter, the 1 % level of national species totals has been taken as the basis of assessment in various countries, including Britain (Stroud *et al*. 1990).

5.4.32 For breeding bird species, SNH uses the NHZ (Natural Heritage Zone) as the appropriate regional biogeographical unit of assessment. Twenty-one zones covering Scotland have been drawn to reflect biogeographical differences between zones, with a high level of coherence within each zone. According to SNH "*the question as to whether there is an impact on a [bird] species regionally therefore may be translated into the question as to whether there is an impact within the relevant NHZ*". The Proposed Project is wholly within the Shetland NHZ and so this biogeographical unit is used for the regional population assessment.

5.4.33 The Scottish Wind Farm Bird Steering Group published a systematic review of NHZ bird populations across Scotland, including Shetland (Wilson *et al*., 2015), which is helpful in the context of determining regional bird population estimates. The Viking Wind Farm Environmental Statement also examined existing data sources and estimated relevant Shetland bird populations (Viking Energy Partnership, 2009), and provides useful additional information on Shetland priority bird population estimates. The regional population metrics reported in this chapter are mostly derived from the Scottish Wind Farm Bird Steering Group report and those used in the Viking Wind Farm ES and have been updated where more up to date population data/information was available.

5.4.34 The importance attached to an ecological receptor can also be determined according to legislative status. Some ecological receptors are subject to a general level of legal protection through e.g., the Wildlife and Countryside Act 1981 (as amended), or The Nature Conservation (Scotland) Act 2004 (as amended) and others under the Birds Directive. There is no clear guidance for conservation importance of ecological receptors other than those of European Protected Species and designated sites. The importance of other species and habitats is based on professional judgement using the characteristics outlined above. The status of potentially important receptors, such as being on the SBL, is also taken into consideration.

5.4.35 Nevertheless, and for the avoidance of doubt, CIEEM EcIA guidance (2018) makes it clear that species which appear on national lists e.g., Schedule 1 of the Wildlife and Countryside Act (1981 as amended) and SBL are not necessarily evaluated as of national importance simply by appearing on such a 'national' list. Importance evaluation must consider the number of individuals of species or area of habitat within a geographical context/scale, i.e., how many of a particular species are likely to be affected by the Proposed Project and what proportion of the local/regional/national population does this constitute. Legal listing/protection is a separate but important consideration.

Extent

5.4.36 According to CIEEM (2018) EcIA guidance, extent is the spatial or geographical area over which the predicted impact/effect may occur under a suitably representative range of conditions.

Magnitude

5.4.37 According to CIEEM (2018) EcIA guidance, magnitude refers to size, amount, intensity and volume. It should be quantified if possible and expressed in absolute or relative terms e.g., the amount of habitat lost, number of pairs lost, percentage decline in a species population. For consistency across all the topics within the AEE, magnitude terms are required and are clearly defined (Table 5.3), along with metrics in absolute and relative terms. There are a number of approaches for determining the significance of effects on ecological features. This includes methods for scoring and ranking impacts on the basis of subjective criteria. Results are often presented in the form of a matrix in which ecological value/importance and magnitude of impact are combined into a significance score. A matrix approach is commonly used in EIA by disciplines other than ecology to assign significant residual effects to categories (e.g., major, moderate, minor). CIEEM (2018) guidance discourages use of the matrix approach and artificial significance score. Spurious assessment should be avoided in which artificial numerical scores or significance rankings/categories are used without a clear definition of the criteria and thresholds that underpin them. In this chapter the approach used for assessing significance is outlined in paragraphs 6.4.45-6.4.47.

Table 5.3 Summary of Magnitude Criteria Used

Term	Definition
Major	Total/near total loss of a population due to mortality or displacement. Total/near total loss of breeding productivity in a population due to disturbance. e.g., ≥50 % of population affected.
Moderate	Moderate reduction in the status or productivity of a population due to mortality or displacement or disturbance. e.g., 10-49 % of population affected.
Minor	Small but discernible reduction in the status or productivity of a population due to mortality or displacement or disturbance. e.g., 1-9 % of population affected.
Negligible	Very slight reduction in the status or productivity of a population due to mortality or displacement or disturbance. Reduction barely discernible, approximating to the 'no change' situation. e.g., <1 % population affected.

Duration

5.4.38 According to CIEEM (2018) EcIA guidance, duration should be defined in relation to ornithological characteristics (such as the life cycle of a species). The duration of an activity may differ from the duration of the resulting effect caused by the activity. Impacts and effects may be described as short, medium or long-term and permanent or temporary and should be defined. In this assessment three timeframes are used: short-term (up to two years), medium-term (two-five years) and long-term (between five years and the lifetime of the Proposed Project).

Frequency and Timing

5.4.39 According to CIEEM (2018) EcIA guidance, the number of times an activity occurs will influence the resulting effect. For example, a single person walking a dog will likely have very limited impact on nearby wader utilisation of a wetland, but numerous dog walkers will subject the waders to frequent disturbance and could affect feeding success, leading to displacement of the birds and knock-on effects on their ability to survive. The timing of an activity may result in an impact if it coincides with critical life-stages or seasons e.g., bird nesting season.

Reversibility

5.4.40 According to CIEEM (2018) EcIA guidance, an irreversible effect is one from which recovery is not possible within a reasonable timescale or there is no reasonable chance of action being taken to reverse it. A reversible effect is one from which spontaneous recovery is possible or which may be counteracted by mitigation. In some cases, the same activity can cause both reversible and irreversible effects.

Sensitivity

5.4.41 Another factor when assessing potential impacts is the sensitivity of the ornithological receptor under consideration (e.g., high, medium or low), which can vary in space and time. Different receptors respond differently to stimuli, making some particularly sensitive to development activities and others less so. Professional judgement is used when assigning a sensitivity value to an ornithological receptor and this is recorded in a clear and transparent way.

5.4.42 By way of example, sensitivity is determined according to species behaviour, using broad criteria set out in Table 5.4. Behavioural sensitivity can differ between species and between individuals of the same species. Therefore, sensitivity is likely to vary with both the nature and context of the disturbance activity as well as the experience and even personality of the individual bird. Sensitivity also depends on the activity the species is undertaking. For example, a species is likely to be less tolerant of disturbance close to its nest during the breeding season than at other times of year. Furthermore, breeding birds are widely considered to be more likely to abandon eggs rather than dependent young, which they may have developed familial ties to. Thus, sensitivity changes with both space and time.

Table 5.4 Summary of Sensitivity Criteria Used

Term	Definition
High	Species occupying remote areas away from human activities and exhibiting strong and long-lasting reactions to disturbance events.
Medium	Species that appear to be warily tolerant of human activities and exhibiting short-term reactions to disturbance events.
Low	Species occupying areas subject to frequent human activity and exhibiting mild and brief reaction to disturbance events.

Ecosystem Services

5.4.43 Ecosystem services are the benefits that people derive from the natural environment. The natural environment can be considered a stock of 'natural capital' from which many benefits flow e.g., social, health-related, cultural or economic (CIEEM, 2018).

Criteria for Evaluating Significance

5.4.44 Significance is a concept related to the weight that should be attached to predicted effects when decisions are made. A '*significant effect*' is an effect that either supports or undermines biodiversity conservation objectives for important receptors (CIEEM, 2018). There could be any number of possible impacts on important ornithological features arising from a development. However, it is only necessary to describe in detail the impacts that are considered likely to be significant. Impacts that are either unlikely to occur, or if they did occur are unlikely to be significant, can be scoped out.

5.4.45 In this assessment, a significant effect is defined as "*an impact on the integrity of a defined site or ecosystem and/or the conservation status of habitats or species within a defined geographical area*". Thus, the geographical terms of reference at which a predicted effect may be considered significant must also be defined (e.g., an effect on a species population evaluated to be of regional importance at a given site is likely to be either significant or not at the regional level). Effects can be considered significant at a wide range of scales from international to local.

5.4.46 There is sometimes confusion over geographical context, potentially important receptors and quantifying predicted effects and EcIA best practice guidance has struggled to articulate this clearly. For example, if a potentially important species appears on a conservation list e.g., the SBL and there is a predicted impact, the geographical context in which the receptor is found must be considered (CIEEM, 2018). Therefore, the simple presence of a species on the SBL within an area does not mean that likely effects are significant at the national (Scottish) level. For that to occur a Proposed Project must have likely significant effects on its national (Scottish) population.

Requirements for Mitigation

5.4.47 Best practice guidance e.g., CIEEM (2018) identifies a hierarchy of mitigation for potential impacts that seeks to:

- Avoid and prevent adverse ecological impacts, especially those that would likely be significant to important receptors.
- Minimise and reduce adverse impacts that cannot be avoided.
- Compensate and offset for any remaining likely significant residual impacts.

5.4.48 CIEEM EcIA guidance (2018) states that "*Avoiding and/or minimising negative impacts is best achieved through consideration of potential impacts of a project from the earliest stages of scheme design and throughout its development*". This approach to avoiding potential adverse impacts within a design layout is sometimes described as embedded mitigation or mitigation by design.

“*Mitigation by design is particularly beneficial as there is greater certainty that it will be delivered*” (CIEEM 2018).

5.4.49 This AEE Report chapter considers mitigation in the context of CIEEM guidance and also in relation to local planning authority guidance for protected species. The embedded mitigation is considered in the design layout and because of this, it is guaranteed through planning conditions for the Proposed Project. Where likely significant effects are predicted regardless of design layout, further mitigation is separately identified as per CIEEM best practice guidance.

Assessment of Residual Effect Significance

5.4.50 After assessing the potential impacts of the Proposed Project (incorporating embedded mitigation), all feasible attempts have been made to further avoid and mitigate predicted adverse ornithological impacts. Once measures to avoid and mitigate predicted ornithological impacts had been incorporated, assessment of the residual impacts was undertaken to determine the likely significance of their effects on important ornithological features.

Limitations to Assessment

5.4.51 Where assumptions within the assessment are made, these are explicitly identified and explained. Similarly, limitations in methods and knowledge of species' ecology are also identified and discussed, particularly where this is likely to affect the outcome of the assessment. As with any environmental assessment there will be elements of uncertainty. Where there is uncertainty, this is identified and reported transparently, along, where possible, with the measures taken to reduce it, assumptions made, and an explanation as to the likely extent that any uncertainties are likely to affect the assessment conclusions. In circumstances where there is uncertainty; evidence, expert opinion, best practice guidance and professional judgement have been used to evaluate what is considered biologically likely to occur if the Proposed Project is operational.

5.4.52 The level of certainty of impact prediction varies depending upon a range of parameters discussed already. For some elements e.g., land-take it is relatively straightforward to assess and quantify the area of habitat that is likely to be lost to development infrastructure and therefore quantify potential impacts of land-take on the habitats and species present. The main limitations in this assessment are common to most ornithological assessments because:

- Baseline surveys undertaken are based on sampling techniques, not absolute censuses. Results give an indication of the numbers of ornithological receptors recorded at the particular times that surveys were carried out (e.g., 2018, 2019 and 2020 for breeding bird surveys). Species occurrence changes over time and therefore the results presented in this AEE Report are snapshots in time.
- Putting ornithological survey results into a wider geographical context is sometimes challenging because some species have not been systematically surveyed beyond the study area. Thus, defining a receptor population as locally or regionally important is potentially difficult because local or regional population estimates do not exist for many taxa. Whenever such uncertainty exists, professional judgement and published evidence is used and populations in the study area or site have been assumed to be at their highest potential level of geographical/ornithological importance.

5.5 Baseline Conditions

Designated Sites

5.5.1 The desk study identified three designated sites (which overlap) where birds were a qualifying feature within the four-kilometre ornithological study area on Unst (Drawing 5.2). These are:

Hermaness, Saxa Vord and Valla Field SPA (6,833 ha)

5.5.2 According to SNH (https://sitelink.nature.scot/site/8512; Accessed July 2020) "*The Hermaness, Saxa Vord and Valla Field SPA lies in the north-west corner of the island of Unst, Shetland, at the northernmost tip of Britain. It consists of 100-200 m high sea cliffs and adjoining areas of grassland, heath and blanket bog. The boundary of the SPA is coincident with that of the Hermaness SSSI, Saxa Vord SSSI, and Valla Field SSSI. The seaward extension extends approximately 2 km into the marine environment to include the seabed, water column and surface.*

5.5.3 *Hermaness, Saxa Vord and Valla Field SPA qualifies under Article 4.1 by regularly supporting populations of European importance of the Annex I species red-throated diver (average of 26 proven breeding pairs for 1994 - 1999, 3 % of the British breeding population). It also qualifies under Article 4.2 by regularly supporting populations of European importance of the migratory species; gannet (16,400 pairs in 1999, 8 % of the British and 6 % of the world population), great skua (788 pairs in 1997, 9 % of the British and 6 % of the world population) and puffin (55,000 individuals in 1999, 6 % of the British and 3 % of the total population of the sub-species* F. a. grabae*).*

5.5.4 *The Hermaness, Saxa Vord and Valla Field SPA qualifies further under Article 4.2 by regularly supporting in excess of 20,000 individual seabirds. It regularly support 157,500 seabirds including nationally important populations of the following species: fulmar (19,539 pairs in 1999; 4 % of the GB population), shag (450 pairs in censuses in 1995 and 1999; 1 % of the GB population), common guillemot (25,000 individuals over two surveys carried out in 1996 and 1999; 2 % of the GB population) and kittiwake (922 pairs in 1999; 0.2 % of the GB population)".*

Hermaness SSSI (978 ha)

5.5.5 According to SNH (https://sitelink.nature.scot/site/776; Accessed July 2020) "*The high cliffs and stacks of the west and north support large colonies of nesting seabirds. A range of species occur in various nesting habitats including kittiwake on bare cliff ledges, herring gull and great black-backed gull on the summits of stacks and on sloping coastal rocks, shag and razorbill among cliff-foot boulders and black guillemot in rock crevices.*

5.5.6 *Some species individually reach numbers of national importance. These include gannet at 6 % of the British population, puffin (4 %), fulmar (3 %) and guillemot (1 %). Inland from the cliffs, the bog and heath vegetation provide nesting habitat for one of the largest colonies of great skua in the world, representing over 3 % of the global population*". Hermaness SSSI is part of Hermaness, Saxa Vord and Valla Field SPA.

Saxa Vord SSSI (55.47 ha)

5.5.7 According to SNH (https://sitelink.nature.scot/site/475; Accessed July 2020) "*The site is located on the coastline to the east of Saxa Vord hill overlooking Burra Firth and extends from Grisa Lee in the south to The Noup in the north. At the Noup the site boundary includes both sides of the headland and extends down the east coast to Ura. The site also contains several skerries which along with the sea cliffs support a wide range of seabirds. The site is notified for its nationally and internationally important breeding fulmar and guillemot populations and for the seabird colony as a whole.*

5.5.8 *The site supports a breeding colony of fulmar and guillemot contributing to 1.2% and 0.4% of the British population respectively*".

5.5.9 Beyond the four kilometre Ornithological Study Area (Volume III Drawing 5.2) there are other designated sites, some with ornithological features. Table 6.6 within AEE Report Chapter 6, Ecology, outlines biological designated sites within 10 km of the Proposed Project and includes the recently designated Fetlar to Haroldswick Marine Protection Area.

Ornithological Receptors

5.5.10 A summary of the principal findings from three years of targeted ornithological surveys (2018-2020) are provided below.

5.5.11 The study area was surveyed under SNH Schedule 1 licence for breeding birds in 2018 and 2019 by Mr David Cooper. Mr David Cooper and Mr Brydon Thomason undertook boat-based seabird counts in 2018 and 2020. In 2020 Mr David Cooper surveyed the Proposed Project boundary during the breeding season to inform summer survey visits by staff and other non-ornithological surveyors e.g., archaeologists. Both Mr David Cooper and Mr Brydon Thomason are highly experienced and competent, locally based ornithologists and used the relevant standard breeding bird survey methods during suitable weather conditions.

5.5.12 A total of 135 bird species were recorded in the study area during targeted breeding bird surveys. For full list of species recorded see Appendix 5.1. There is direct evidence from the study area surveys of potentially sensitive and specially protected bird species breeding within, and adjacent to, the Proposed Project and so these need to be considered further. These birds were considered '*wider countryside species*' for the purposes of evaluation and do not form part of any designated site feature.

5.5.13 The accompanying drawings provided for important ornithological receptors have been drawn showing distance bands away from the most westerly pad (Pad 1) with the following increments illustrated: 0-0.5 km; 0.5-1 km; 1-2 km; 2-3 km and 3-4 km.

Red-throated Diver

5.5.14 Evidence of breeding from three locations within the study area. Two breeding attempts in study area in 2018 – one failed and one presumed failed. Two breeding attempts in study area in 2019, both presumed successful as near-fledged juveniles observed at both sites.

Black Guillemot

5.5.15 The maximum count in 2018 was 84 black guillemots with 101 in 2019. The black guillemot surveys counted individual adult birds. The locations of breeding black guillemots are presented in Drawing 5.3.

Shag

5.5.16 The maximum boat-based count was 55 shag AON in 2018. The addition of a maximum 26 AON in the area between Virdik and Ura in 2020, provides an overall total of 81 shag AON within the four-kilometre study area (between Ura and The Nev). The locations of breeding shags are presented in Drawing 5.4.

Gannet

5.5.17 For clarity, no breeding gannets were recorded on boat-based surveys in 2018 and 2020.

Fulmar

5.5.18 The maximum boat-based count was 4,300 fulmar AON in 2018. The addition of 2,657 AON in the area between Virdik and Ura in 2020, provides an overall total of 6,987 fulmar AON within the four-kilometre study area (between Ura and The Nev). The locations of breeding fulmars are presented in Drawing 5.5.

Kittiwake

5.5.19 The maximum boat-based count was 55 kittiwake AON in 2018. The addition of no kittiwake AON in the area between Virdik and Ura in 2020, provides an overall total of 55 kittiwake AON within the four-kilometre study area (between Ura and The Nev). The locations of breeding kittiwake are presented in Drawing 5.6.

Black-headed Gull

5.5.20 A small black-headed gull (*Chroicocephalus ridibundus*) colony consisting of 11 pairs (2018) and 13 pairs (2019) was present at the Norwick Meadows (Drawing 5.6).

Common Gull

5.5.21 A moderate number of common gulls (*Larus canus*) bred, consisting of 22 pairs (2018) and 30 pairs (2019) at Braefield in a mixed gull colony (Drawing 5.6).

Lesser Black-backed Gull

5.5.22 A small number of lesser black-backed gulls (*Larus fuscus*) bred, consisting of 12 pairs (2018) and 10 pairs (2019) at Braefield in a mixed gull colony (Drawing 5.6).

Great Black-backed Gull

5.5.23 The maximum boat-based count was two great black-backed gull (*Larus marinus*) AON in 2018. The addition of a maximum six AON in the area between Virdik and Ura in 2020, provides an overall total of eight great black-backed gull AON within the four kilometre study area (between Ura and The Nev). The locations of breeding great black-backed gulls are presented in Drawing 5.6.

Herring Gull

5.5.24 There were no herring gull (*Larus argentatus*) AON recorded in 2018. The addition of five AON in the area between Virdik and Ura in 2020, provides an overall total of five herring gull AON within the four kilometre study area (between Ura and The Nev). Up to 16 pairs also bred in land at Braefield in a mixed gull colony, within the 3-4 km distance band. The locations of breeding herring gulls are presented in Drawing 5.6.

Common Guillemot

5.5.25 The maximum boat-based count was 80 individual common guillemots in 2018. The addition 20 individuals in the area between Virdik and Ura in 2020 provides an overall total of 100 individual common guillemots within the four kilometre study area (between Ura and The Nev). The locations of breeding common guillemots are presented in Drawing 5.7.

Razorbill

5.5.26 The maximum boat-based count was 11 individual razorbills in 2018. The addition of four individuals in the area between Virdik and Ura in 2020, provides an overall total of 15 individual razorbills within the four kilometre study area (between Ura and The Nev). The locations of breeding razorbills are presented in Drawing 5.8.

Puffin

5.5.27 The maximum boat-based count was 49 individual puffins in 2018. The addition of 76 individuals in the area between Virdik and Ura in 2020, provides an overall total of 125 individual puffins. The locations of puffins recorded on potentially suitable nesting habitat during the breeding season are presented in Drawing 5.9.

Merlin

5.5.28 Evidence of successful breeding near to, but not within the study area. One nearby successful breeding attempt in 2018 - a brood of three fledged merlin recorded around Northdale. Despite searching, no merlin nest was recorded within the study area, and it is not known where the fledged brood came from. One nearby successful breeding attempt in 2019. A female with fledged juveniles was recorded around between Skaw and Inner Skaw. Despite careful searching, no merlin nest was recorded within the study area, and it is not known where the fledged brood came from. Whilst it is assumed, they came from close to the study area boundary, it is possible they may have come from further away.

Ringed Plover

5.5.29 Evidence of multiple pairs breeding in study area. Nine breeding pairs were recorded in 2018 and ten breeding pairs recorded in 2019 (Drawing 5.10). Most of the pairs were found at Skaw, Lamba Ness and Norwick, including pairs within the Proposed Project boundary (Drawing 5.11).

Golden Plover

5.5.30 Evidence of multiple pairs breeding in study area. Seven breeding pairs were recorded in 2018 and 13 pairs in 2019 in the study area (Drawing 6.12). Breeding pairs were distributed throughout the study area including at Saxa Vord, Sothers Field, Northdale, Housi Field, Hill of Clibberswick and Swartling, including one pair within the Proposed Project boundary (Drawing 5.13).

Whimbrel

5.5.31 Evidence of multiple pairs breeding in study area. There were five breeding territories in 2018 and four in 2019. Further details were provided to the local planning authority for assessment during the planning application stage of the Proposed Project in accordance with SNH (2016) guidance.

Curlew

5.5.32 Evidence of multiple pairs breeding in study area. There were ca. 16 breeding territories in 2018 and ca. 13 in 2019 (Drawing 5.14). Given the distances breeding curlews can move, it is possible that some territories have been double-counted and without colour ringing it is not possible to be certain. Nevertheless, in areas where multiple curlew territories have been plotted close together e.g., Norwick Meadows, there was direct evidence of multiple pairs being present within a relatively small area, including pairs within the Proposed Project’s Planning Application boundary (Drawing 5.15).

Dunlin

5.5.33 Evidence of multiple pairs breeding in study area (Drawing 5.16). Five breeding territories were recorded in 2018 and four breeding territories recorded in 2019. Breeding territories were located in areas including Saxa Vord hill, Southers Field, Skaw, Lamba Ness and Housi Field, including one pair within the Proposed Project boundary (Drawing 5.17).

Arctic Tern

5.5.34 Evidence of multiple pairs breeding in study area (Drawing 5.18). A few small breeding colonies were present within the study area, with one pair on Hill of Clibberswick in 2018, two pairs in 2018 and three pairs in 2019 on Norwick beach and six pairs in 2018 and ten pairs in 2019 at Skaw.

Arctic Skua

5.5.35 Evidence of multiple pairs breeding in study area. Five pairs of Arctic skua recorded breeding in the study area in 2018 and 2019 (Drawing 5.19). Pairs occupied territories both years in areas such as Hill of Clibberswick, Ward of Norwick and Inner Skaw, including territories very close to the Proposed Project boundary (Drawing 5.20).

Great Skua

5.5.36 Highly variable numbers of great skua (*Stercorarius skua*) were recorded during surveys, reflecting the social nature of this species. Large numbers of non-breeding great skuas can hold territory in apparently suitable breeding habitats, making accurate estimates of actual number breeding difficult and with a high degree of uncertainty. It is considered the numbers of breeding pairs within the study area likely to be in the low tens, with breeding birds mainly concentrated over three kilometres away from the nearest launch pad. Great skua numbers were concentrated around Saxa Vord hill e.g., with minimum 17 nests recorded in June 2018 and groups of presumed non-breeders numbering up to 90 individuals. Additionally, within the three to four kilometre buffer, smaller numbers of great skua were recorded at Sothers Field and Housi Field (Drawing 5.21).

Confidential Schedule 1 species

5.5.37 Confidential bird species information, where information would have appeared in the relevant sections of this AEE Report chapter were it not for the fact that this information could endanger rare and legally protected species from wildlife crime, has been submitted to and assessed previously by the local planning authority, as part of the EIA process for the SaxaVord Spaceport facility. For confidentiality reasons, this information is not included in the AEE submission.

Natural Capital

5.5.38 The most easterly headland on Lamba Ness is regularly used by local people and visitors for bird watching and whale watching.

5.6 Receptors Brought Forward for Assessment

5.6.1 Ornithological designated site interests on the Hermaness, Saxa Vord and Valla Field SPA (and overlapping Hermaness SSSI and Saxa Vord SSSI) and the following non-designated wider countryside ornithological receptors are taken forward for assessment: red-throated diver, merlin, black guillemot, common guillemot, puffin, razorbill, shag, kittiwake, fulmar, ringed plover, golden plover, whimbrel, curlew, dunlin, Arctic tern, Arctic skua and a confidential Schedule 1 species. The numbers of most gull species (with the exception of kittiwake) were considered small and trivial in relation to their overall regional population size and so have been scoped out of further consideration, as was gannet.

Potentially Important Ornithological Receptors

5.6.2 The conservation/legal importance of potentially important ornithological receptors was determined using criteria set out in Table 5.5. The importance of a species from a legal perspective in this listing does not equate to the importance of population at a site. The conservation importance of the birds using a site is evaluated by considering the number of individuals of species present in the context of geographical populations. A site can hold a protected species of importance, but the population present may not be regionally, nationally or internationally important. Thus, the occurrence of a legally protected species listed in Table 5.5 does not mean a site is necessarily important for that species.

Table 5.5 Conservation Listing of Potentially Important Ornithological Receptors

Species	Conservation listing of target species
Red-throated diver	S1, A1
Gannet	Amber L
Black guillemot	Amber L
Common guillemot	Amber L
Puffin	Red L
Razorbill	Amber L
Shag	Red L
Kittiwake	Red L
Fulmar	-
Merlin	A1, S1, Red L
Ringed plover	Red L
Golden plover	A1

Species	Conservation listing of target species
Dunlin	A1 (*schinz*), Amber L
Whimbrel	S1, Red L
Curlew	Red L
Arctic tern	Amber L
Arctic skua	Red L
Great skua	Amber L
Key: A1 = EC Birds Directive Annex I species, S1 = UK Wildlife and Countryside Act Schedule 1 species, Amber L = UK Birds of Conservation Concern Amber List Species, Red L = UK Birds of Conservation Concern Red List species.	

5.6.3 Geographical population estimates for potentially important bird species within the study area are provided in Table 5.6.

Table 5.6 Geographical Population Estimates for Potentially Important Study Area Bird Species (breeding pairs unless stated)

Species	Shetland (Regional) population	Scotland population	UK (National) population	Europe population (International status)
Red-throated diver	407*	935-1,500	1,250	42,100-93,000 (Least Concern)
Gannet	42,183 AOS**	243,505 AOS**	295,000	683,000 (Least Concern)
Black guillemot	15,739 individuals***	18,750	19,500	304,000-742,000 individuals (Least Concern)
Common guillemot	172,681 individuals***	780,000	950,000	2,350,000-3,060,000 individuals (Least Concern)
Puffin	107,676 AOBs*	493,000	580,000	4,770,000-5,780,000 (Vulnerable)
Razorbill	9,492 individuals***	93,300	165,000	979,000-1,020,000 individuals (Near Threatened)
Shag	6,147 AON***	21,500-30,000	17,500	76,300-78,500 (Least Concern)
Kittiwake	16,732 AON***	282,200	205,000	1,730,000-2,200,000 (Vulnerable)
Fulmar	188,544 AOS***	486,000 AOS	350,000	3,380,000-3,500,000 (Least Concern)
Merlin	30*	800	1,150	32,000-51,600 (Least Concern)
Ringed plover	800-1,000*	4,900-6,700	5,300	140,000-213,000 (Least Concern)
Golden plover	5,665*	15,000	32,500-50,500	630,000-860,000 (Least Concern)

Species	Shetland (Regional) population	Scotland population	UK (National) population	Europe population (International status)
Dunlin	2,054*	8,000-10,000	8,600-10,500	426,000-562,000 (Least Concern)
Whimbrel	290*	400-500	310	343,000-402,000 (Least Concern)
Curlew	4,227*	58,800	58,500	212,000-292,000 (Near Threatened)
Arctic tern	24,716 AON***	47,300 AON	53,500	564,000-906,000 (Least Concern)
Arctic skua	516*	2,100	785	39,900-56,200 (Least Concern)
Great skua	6,846	9,650	9,650	16,300-17,200 (Least Concern)
Population estimate reference	*Wilson *et al.* 2015 **Murray *et al.* 2015 ***Mitchell *et al.* 2004	Wilson *et al.* 2015	Woodward *et al.* 2020	Birdlife International, 2015

AOB = Apparently Occupied Burrow, AOS = Apparently Occupied Site, AON = Apparently Occupied Nest. Quoting the most recent published estimate for geographical populations sometimes results anomalies, such as the apparently larger Scottish than UK population estimate for whimbrel. The UK population estimate of 310 pairs is more up to date than the older Scottish population estimate of 400-500 pairs. For whimbrel the 290 Shetland metric comes from work Dr Digger Jackson conducted in 2009 on the Viking Wind Farm and he reported that subsequent monitoring across west and central Shetland shows the population has not substantially changed since then. Furthermore, the 290 pairs metric originally quoted was based on a single survey visit and subsequent detailed whimbrel population monitoring work has shown that if two-three site visits are undertaken, then surveyors record ca. 10 % more pairs. Consequently, the actual Shetland whimbrel population size is probably around ca. 320 pairs (D. Jackson, *pers com.*).

5.6.4 The behavioural sensitivity of the potentially important ornithological receptors is described using criteria set out in Table 5.7. When available, the assumed distance thresholds and hence sensitivity for disturbance in Table 5.7 was predominantly based on expert opinion examined by Ruddock and Whitfield (2007), Gilbert *et al.*, (1998), Scottish Government (2012) and field experience. The assessment of behavioural sensitivity is primarily based on disturbance to breeding birds at the nest, not general disturbance of birds undertaking other activities. However, note that the Scottish Government (2012) assessment of sensitivity was largely based around disturbance at sea foraging and not at the nest and each species was given a 'Disturbance Score' out of 5, where scoring categories were: 1 (hardly any escape behaviour and a very short flight distance when approached), to 5 (strong escape behaviour, at a large response distance).

5.6.5 A potentially useful and recognised method used to describe potential disturbance to birds involves two basic measures of receptor response (Ruddock and Whitfield, 2007):

- 'Alert Distance' (AD) – the distance between the disturbance source and the bird; at the point where the bird changes its behaviour in response to the approaching disturbance event.
- 'Flight Initiation Distance' (FID) – the point at which the bird flushes or flies away from the approaching disturbance event.

5.6.6 Where known, the difference between AD and FID in potentially important ornithological receptors is described based on published and unpublished research sources. However, few studies have looked in enough detail at AD and FID to differentiate these with any degree of rigour or confidence and often simply describe a 'flushed at' distance instead (equivalent to FID).

5.6.7 To understand potential impacts of short duration loud noise events, a background literature review of noise impacts on birds for the Proposed Project (Appendix 5.2) was undertaken. This literature review looked at how impulsive noise (from various sources including aircraft, fireworks, military ranges and rocket launches) impacts on both bird populations and individual behaviour and breeding success in order to help assess the potential noise impacts of the launches. To do this, the review focussed on identifying impulsive noise studies for the species of interest on Unst and specifically within the ornithological study area. A variety of freely available databases have been searched including ResearchGate and Google Scholar. References considered included both peer-reviewed published scientific papers and grey literature reports. However, relevant literature was limited and so a wider literature search was conducted looking at other species including where possible analogous birds to those present in the ornithological study area.

5.6.8 Taking into account evidence from the literature review (Appendix 5.2), it is apparent that loud infrequent noise associated with rocket launches could be expected to impact on birds in close proximity to operational launch pads. Less clear, are the ecological effects and consequences of the short duration loud disturbance impacts on these birds. Most studies consider potential impacts (e.g., startled response, increased vigilance etc.) and do not show or demonstrate long-term population level consequences or effects. Nevertheless, space centres can hold good breeding populations of birds, many of them declining species and conservation priorities. For example, the land immediately adjacent to the Kennedy Space Centre in Florida, USA, is home to large breeding populations of wading birds (Smith & Breininger, 1995), despite being exposed to irregular loud impulsive noise events.

Table 5.7 Behavioural Sensitivity of Potentially Important Study Area Species

Species	Nature of sensitivity	Sensitivity level
Red-throated diver	Breeding birds are sensitive to human activity, visual disturbance and sudden noise events over large distances (up to 500 m). However, evidence from the Shetland Viking Wind Farm studies indicates that some individuals (perhaps habituated) appear to tolerate moderate levels of disturbance in some situations. The size of waterbodies also has an impact on FID; breeding birds are more easily disturbed and fly from small nesting lochans than large lochs, where they have the ability to swim away and/or dive without taking flight.	High at nest.
Gannet	Scottish Government advice (2012) on disturbance by wind farm structures, ship and helicopter traffic conducted a literature search focused on disturbance sensitivity of seabirds, and allocated scores by experts on sensitivity (1 = hardly any escape behaviour and a very short flight distance when approached, to 5 = strong escape behaviour, at a large response distance). Gannet scored 2. Gannets are highly traditional in where they breed (Mitchell *et al.,* 2004) and have increased at locations such as Sula Sgeir, where they are regularly disturbed and still exploited for food, with ca. 2,000 well-grown chicks harvested every year (Murray *et al.,* 2015).	Low at sea and nest.
Black guillemot	Scottish Government advice (2012) on disturbance by wind farm structures, ship and helicopter traffic conducted a literature search focused on disturbance sensitivity of seabirds, and allocated scores by experts on sensitivity. Black guillemot scored 3, sometimes flying from approaching boats hundreds of metres away (FID). Elsewhere, e.g., Lerwick Harbour, the species nests in harbour wall holes in very close	Moderate at sea. Low at nest.

Species	Nature of sensitivity	Sensitivity level
	proximity to regular, but also unexpected human disturbance (both visual and noise) on water and land.	
Common guillemot	Scottish Government advice (2012) on disturbance by wind farm structures, ship and helicopter traffic conducted a literature search focused on disturbance sensitivity of seabirds, and allocated scores by experts on sensitivity. Common guillemot scored 3, sometimes flying from approaching boats hundreds of metres away. Nest sensitivity considered to be moderate, with for example guillemots sometimes being flushed from ledges if boats get too close.	Moderate at sea and nest.
Puffin	Scottish Government advice (2012) on disturbance by wind farm structures, ship and helicopter traffic conducted a literature search focused on disturbance sensitivity of seabirds, and allocated scores by experts on sensitivity. Puffin scored 2. Nest sensitivity considered low, with puffins able to tolerate large numbers of humans within a few metres of nesting burrows e.g., Sumburgh Head RSPB Reserve.	Low at sea and nest.
Razorbill	Scottish Government advice (2012) on disturbance by wind farm structures, ship and helicopter traffic conducted a literature search focused on disturbance sensitivity of seabirds, and allocated scores by experts on sensitivity. Razorbill scored 3, sometimes flying from approaching boats hundreds of metres away. Nest sensitivity considered moderate.	Moderate at sea and nest.
Shag	Scottish Government advice (2012) on disturbance by wind farm structures, ship and helicopter traffic conducted a literature search focused on disturbance sensitivity of seabirds, and allocated scores by experts on sensitivity. Shag scored 3. Nest sensitivity considered to be moderate, with for example shag sometimes being flushed from ledges if boats get too close.	Moderate at sea and nest.
Kittiwake	Scottish Government advice (2012) on disturbance by wind farm structures, ship and helicopter traffic conducted a literature search focused on disturbance sensitivity of seabirds, and allocated scores by experts on sensitivity. Kittiwake scored 2. Nest sensitivity considered to be low.	Low at sea and nest.
Fulmar	Scottish Government advice (2012) on disturbance by wind farm structures, ship and helicopter traffic conducted a literature search focused on disturbance sensitivity of seabirds, and allocated scores by experts on sensitivity. Fulmar scored 1. Nest sensitivity also considered to be low.	Low at sea and nest
Merlin	Breeding merlin are particularly sensitive to human activity, visual disturbance and sudden noise events over large distances (up to 500 m). However, some individual merlins appear to tolerate moderate levels of disturbance in some situations. For example, some merlins appear to be able to nest relatively close to public roads, where regular disturbance occurs, including on Shetland.	High at nest
Ringed plover	Breeding ringed plovers have relatively small territories and regularly select to nest on man-made habitats in Shetland, such as road verges and quarries and so is not considered particularly susceptible or sensitive to human disturbance.	Low at nest

Species	Nature of sensitivity	Sensitivity level
Golden plover	Breeding golden plovers have relatively small territories are sensitive to human activity, visual disturbance and sudden noise events over moderate distances (~250 m).	Moderate at nest
Dunlin	Breeding dunlin have very small territories, are sensitive to human activity, visual disturbance and sudden noise events over moderate distances (~250 m).	Moderate at nest
Whimbrel	Breeding birds are usually considered sensitive to human activity, visual disturbance and sudden noise events. However, in Shetland whimbrel nest in short, grazed vegetation, periodically visited by crofters. Adult whimbrel on their breeding territories show disturbance responses to the presence of a moving or static person up to 250 m away (Massey *et al.,* 2016).	Moderate at nest
Curlew	Breeding birds are usually considered sensitive to human activity, visual disturbance and sudden noise events over moderate distances (~250 m). However, in Shetland curlews often nest and feed close to or on in-bye fields, which are regularly used by crofters, often on a daily basis.	Moderate at nest
Arctic tern	Scottish Government advice (2012) on disturbance by wind farm structures, ship and helicopter traffic conducted a literature search focused on disturbance sensitivity of seabirds, and allocated scores by experts on sensitivity. Arctic tern scored 2. Tern colonies are considered moderately sensitive; with total colony abandonment possible under some (poorly understood) circumstances.	Low at sea, moderate at nest
Arctic skua	Arctic skuas have relatively small nesting territories (sometimes within discrete colonies). Although birds aggressively defend territories, care needs to be taken around nests, especially not to flush young skuas which are vulnerable to predation by neighbouring adult Arctic and great skuas. Scottish Government advice (2012) on disturbance by wind farm structures, ship and helicopter traffic conducted a literature search focused on disturbance sensitivity of seabirds, and allocated scores by experts on sensitivity. Arctic skua scored 1.	Low at sea, low-moderate at nest
Great skua	Great skua colonies are relatively robust to human disturbance e.g., consider the 9,000 people who walk through the great skua colony at Hermaness annually [1]. Scottish Government advice (2012) on disturbance by wind farm structures, ship and helicopter traffic conducted a literature search focused on disturbance sensitivity of seabirds, and allocated scores by experts on sensitivity. Great skua scored 1.	Low at sea, low-at nest

5.6.9 The typical breeding calendar of the potentially important ornithological receptors within the study area is provided in Table 5.8. There is obviously overlap between the main egg laying/incubation period and the main period dependent young present. However, for simplicity, these main periods are separated out in Table 5.8.

[1] Jonathan Swale (SNH) reported in the press that visitor numbers to Hermaness had gone up by 50 % over the previous four years to 9,000 in 2019. https://www.shetnews.co.uk/2019/06/06/hermaness-path-to-be-upgraded-to-cope-with-rising-visitor-numbers/

Table 5.8 Typical Breeding Calendar of Potentially Important Study Area Species

Species	April		May		June		July		August		Sept		Reference
Red-throated diver													Incubation 27 days; Fledging 43 days[1,2,3]
Gannet													Incubation 43 days; Fledging 90 days[1,2,3]
Black guillemot													Incubation 23-40 days; Fledging 40 days[1,2,3]
Common guillemot													Incubation 34 days; Fledging 20 days[1,2,3]
Puffin													Incubation 42 days; Fledging 50 days[1,2,3]
Razorbill													Incubation 34 days; Fledging 20 days[1,2,3]
Shag													Incubation 31 days; Fledging 53 days[1,2,3]
Kittiwake													Incubation 29 days; Fledging 43 days[1,2,3]
Fulmar													Incubation 51 days; Fledging 49 days[3]
Merlin													Incubation 30 days; Fledging 30 days[4]
Ringed plover													Incubation 24 days; Fledging 24 days[1,2,3]
Golden plover													Incubation 29 days; Fledging 30 days[1,2,3]
Dunlin													Incubation 22 days; Fledging 20 days[1,2,3]
Whimbrel													Incubation 28 days; Fledging 30 days[1,2,3]
Curlew													Incubation 28 days; Fledging 34 days[1,2,3]
Arctic tern													Incubation 22 days; Fledging 23 days[1,2,3]
Arctic skua													Incubation 27 days; Fledging 28 days[1,2,3]
Great skua													Incubation 29 days; Fledging 44 days[1,2,3]

Red = typical main egg laying/incubation period, Yellow = typical main period dependent young present. Note, table does not include relay or 2nd brood dates. 1 = Gilbert *et al.,* 1998 (reprinted 2011); 2 = Forrester and Andrews, 2007; 3 = Snow and Perrins, 1998; 4 = Hardey *et al.,* 2013.

5.6.10 A summary of the population size and percentage of geographical population estimates for potentially important study area bird species is provided in Table 5.9.

5.6.11 Whilst considering the potential consequences of loud impulsive noise events on important and sensitive bird species, consideration has also been given to SNH’s ornithological comments and advice on the recent 2020 Sutherland Space Hub planning application. The Caithness and Sutherland Peatlands SPA and the Ben Hutig and A'Mhoine SSSI are 31 m away from the nearest access road and 109 m away from the launch pad of that Proposed Project. Thus, that Proposed Project is very close to the designated sites and their breeding birds, which include dunlin, greenshank, golden plover and red-throated diver; three of which breed within the Proposed Project ornithology study area on Unst.

5.6.12 In SNH’s consultation response on the Sutherland Space Hub of 12/03/20 it stated that “*Disturbance through noise from launches has been evaluated in the EIAR and although the noise events are extremely loud they will be very short-lived. From our own experience of blasting for construction and from military jets, it appears that sudden, loud noise events have short-term effects and do not appear to result in the permanent displacement of breeding birds. Therefore, our advice is that there is no basis for concluding adverse impact from the launches themselves*”.

Table 5.9 Summary Population Size and Percentage of Geographical Population Estimates for Potentially Important Study Area Bird Species (breeding pairs unless stated). Study Area species in bold match or exceed nominal 1 % threshold of either the Regional or National population levels.

Species	Shetland (Regional) population	Scotland population	UK (National) population	Europe population	Population & % of Regional (& where relevant National) population within 4 km of launch pads (max est.)	Population & % of Regional population (& where relevant National) within 2 km of launch pads (max est.)	Population & % of Regional population within 1 km of launch pads (max est.)
Red-throated diver	407	935-1,500	1,250	42,100-93,000	2 (0.5 % of Regional pop)	0 (0 %)	0 (0 %)
Gannet	42,183 AOS	243,505 AOS	295,000	683,000	0 (0 %)	0 (0 %)	0 (0 %)
Black guillemot	15,739 individuals	18,750	19,500	304,000-742,000 individuals	101 ind (0.64 % of Regional pop)	50 ind (0.32 % of Regional pop)	25 ind (0.16 % of Regional pop)
Common guillemot	172,681 individuals	780,000	950,000	2,350,000-3,060,000 individuals	100 ind (0.0 6% of Regional pop)	27 ind (0.02 % of Regional pop)	0 ind (0 %)
Puffin	107,676 AOB	493,000	580,000	4,770,000-5,780,000	125 ind (0.06 % of Regional pop*)	35 (0.02 % of Regional pop*)	8 (0.004 % of Regional pop*)
Razorbill	9,492 individuals	93,300	165,000	979,000-1,020,000 individuals	15 (0.16 % of Regional pop)	0 (0 %)	0 (0 %)
Shag	6,147 AON	21,500-30,000	17,500	76,300-78,500	81 (1.32 % of Regional pop)	6 (0.1 % of Regional pop)	1 (0.02 % of Regional pop)
Kittiwake	16,732 AON	282,200	205,000	1,730,000-2,200,000	55 (0.32 % of Regional pop)	50 (0.3 % of Regional pop)	0 (0 %)
Fulmar	188,544 AOS	486,000 AOS	350,000	3,380,000-3,500,000	6,987 (3.7 % of Regional & 1.99 % of National pop)	2,635 (1.4 % of Regional pop)	1,170 (0.62 %)

Species	Shetland (Regional) population	Scotland population	UK (National) population	Europe population	Population & % of Regional (& where relevant National) population within 4 km of launch pads (max est.)	Population & % of Regional population (& where relevant National) within 2 km of launch pads (max est.)	Population & % of Regional population within 1 km of launch pads (max est.)
Merlin	30	800	1,150	32,000-51,600 (Least Concern)	0 (0 %), although one fledged brood recorded within study area	0 (0 %)	0 (0 %)
Ringed plover	800-1,000	4,900-6,700	5,300	140,000-213,000	10 (1.0-1.25 % of Regional pop)	8 (0.8-1.0 % of Regional pop)	3 (0.3-0.38 % of Regional pop)
Golden plover	5,665	15,000	32,500-50,500	630,000-860,000	13 (0.23 % of Regional pop)	4 (0.07 % of Regional pop)	1 (0.02 % of Regional pop)
Dunlin	2,054	8,000-10,000	8,600-10,500	426,000-562,000	5 (0.24 % of Regional pop)	3 (0.15 % of Regional pop)	1 (0.05 % of Regional pop)
Whimbrel	[290] D. Jackson pop est. ca. 320	400-500	310	343,000-402,000	5 (1.7 % of Regional & 1.6 % of National pop)] 1.6 % of Regional pop using D. Jackson pop est	[3 (1.04 % of Regional pop)] 0.9 % of Regional pop using D. Jackson pop est	[2 (0.69 % of Regional pop)] 0.63 % of Regional pop using D. Jackson pop est
Curlew	4,227	58,800	58,500	212,000-292,000	16 (0.4 % of Regional pop)	3 (0.07 % of Regional pop)	1 (0.02 % of Regional pop)
Arctic tern	24,716 AON	47,300 AON	53,500	564,000-906,000	13(0.05 % of Regional pop)	13 (0.05 % of Regional pop)	0 (0 %)
Arctic skua	516	2,100	785	39,900-56,200	5 (0.97 % of Regional pop)	3 (0.58 % of Regional pop)	1 (0.19 % of Regional pop)
Great skua	6,846	9,650	9,650	16,300-17,200	Low tens (<1 % of Regional pop)	0 (0 %)	0 (0 %)

AOB = Apparently Occupied Burrow, AOS = Apparently Occupied Site, AON = Apparently Occupied Nest. *metric assumes all individuals counted were breeding birds and AOB converted from number of individuals for comparative purposes.

5.7 Standard Mitigation

5.7.1 Following CIEEM (2018) guidance, the assessment process assumes the application of standard mitigation measures. A range of measures have already been in-built as part of the iterative design process (see below), to avoid the higher value species and their habitats. Standard mitigation measures which can be addressed in enforceable planning conditions also include the following:

- A detailed Breeding Birds Protection Plan, which will be informed by, and updated annually through, targeted breeding bird surveys.
- Following the NatureScot consultation response dated 11 March 2021, commitment to a no-launch window whereby no satellite launches or static tests will be carried out between mid-May and the end of June (subject to ongoing monitoring and appraisal).
- Species licensing, where planned activities may result in potential disturbance which would likely be considered unlawful under the 1981 Wildlife and Countryside Act and the 2004 Nature Conservation (Scotland) Act unless they were licensed.
- Implementation of an Outline Habitat Management Plan (Appendix 5.3).

5.8 Potential Effects

Designated Sites

5.8.1 Internationally important populations of birds are present within the Hermaness, Saxa Vord and Valla Field SPA, including red-throated diver (3 % of British population), gannet (8 % of British and 6 % of world population), great skua (9 % of British and 6 % of world population) and puffin (6 % of British population). The SPA also regularly supports over 150,000 breeding seabirds which include 4 % of the British fulmar population, 1 % of the British shag population, 2 % of the British common guillemot population and 2 % of the British kittiwake population (https://sitelink.nature.scot/site/8512; Accessed July 2020).

5.8.2 SNH provided Alba Ecology with the designated sites' breeding bird data on 02/06/20 (Table 5.10).

Table 5.10 Designed Site Breeding Bird Data (courtesy of SNH)

Species	Saxa Vord SSSI	Hermaness SSSI/NNR	Valla Field
Red-throated diver		5 pairs (2015-2016), 6 pairs (2018-2019)	12 pairs (2012-2013), average 18 pairs in past
Common guillemot	1,948 ind. (2017)	5,808 ind. (2016)	
Puffin	217 ind. (2017)	11,455 AOB (2017)*	82 ind. (2016)
Razorbill	42 ind. (2017)	139 ind. (2016)	
Shag	32 AON (2017)		
Kittiwake	95 AON (2017)	171 AON (2016)	
Fulmar	8,057 AOS (2016)	11,786 AOS (2016)	1,146 AOS (2016)
Gannet		25,580 AON (2014)*	
Merlin		1 pair (2018)	
Arctic skua		2 AON (2016, 2018, 2019), 1 AON (2017)	
Great skua		955 AON (2018)	198 AOT (2013)

*Puffin estimate calculated from counts of loafing birds and so has a wide margin of error (Jonathan Swale, *pers comm.*).
**Gannets were due to be counted in 2020 but surveys were postponed due to COVID-19. The colony is growing at around 3% p.a. so likely to be about 30,000 AON by now (Jonathan Swale, *pers comm.*)

5.8.3 The distance between the nearest land part of the Hermaness, Saxa Vord and Valla Field SPA (at the Noup) and the most westerly launch pad (Pad 1) is 3.79 km. This lies within the predicted maximum 90-100 dB level for Launch LAmax (A-weighted, maximum sound level) and 80-90 dB for Static LAmax. NatureScot holds the breeding bird data for all the SPA qualifying species (summarised in Table 5.10) and these species occur within the 90-100 dB level for Launch LAmax and 80-90 dB for Static LAmax or lower predicted noise levels the further away from the launch site the birds are.

5.8.4 In the context of the Sutherland Space Hub, the launch pad of which was 109 m from the nearest part of the Caithness and Sutherland Peatlands SPA, SNH considers "*loud noise events have short-term effects and do not appear to result in the permanent displacement of breeding birds. Therefore, our advice is that there is no basis for concluding adverse impact from the launches themselves*" and so it seems unlikely that Hermaness, Saxa Vord and Valla Field SPA birds, the nearest of which are approximate 3.79 km away from Pad 1, would be adversely affected by the predicted maximum noise levels at launch.

5.8.5 Under this scenario, the potential magnitude of adverse impacts of operational (noise) disturbance on designated site bird species would likely be **negligible**, with **no likely significant effects** predicted.

5.8.6 Notwithstanding the above, following the NatureScot consultation response (11 March 2021), commitment to a no-launch window whereby no satellite launches or static tests will be carried out between mid-May and the end of June has subsequently been made and this has been reflected in planning conditions for the Proposed Project.

Red-throated Diver

5.8.7 Red-throated diver is an Annex 1 and Schedule 1 species and therefore of high conservation importance (Table 5.5). The behavioural sensitivity of the species is considered to be high (Table 5.7). The regional, national and international population estimates of this species are known (Table 5.6). The Shetland NHZ red-throated diver population estimate is 407 pairs and without evidence to the contrary the species is likely to be in FCS within Shetland.

5.8.8 The species nests on the edge of freshwater lochs and lochans, often within blanket bog/peatland. The adults usually forage away from the breeding lochs, feeding in the sea, or occasionally large freshwater lochs and carry fish back to the chicks (Forrester and Andrews, 2007). Consequently, the breeding sites are a relatively predictable 'fixed constraint' insofar as they always nest within 1 m of a loch/lochan shore, can only use certain types of waterbody (whose characteristics are well known) and regularly use the same lochs and lochans over time.

5.8.9 Details of potential operational impacts on red-throated diver have been provided previously to the local planning authority in accordance with SNH (2016) guidance.

Black Guillemot

5.8.10 Black guillemot is an Amber listed species and therefore of moderate conservation importance (Table 5.5). The behavioural sensitivity of the species is considered to be low at the nest (Table 5.7). The regional, national and international population estimates of this species are known (Table 5.6). The Shetland NHZ black guillemot population estimate is 15,739 individuals and without evidence to the contrary the species is likely to be in FCS within Shetland.

5.8.11 The species typically nests on predator-free islands with suitable boulder beaches in loose colonies, or at lower densities on cliffs inaccessible to mammalian predators (Forrester and Andrews, 2007). The adults feed at sea and carry fish back to the chicks. Consequently, the breeding sites are a relatively predictable 'fixed constraint' insofar as they nest within the same boulder beach and cliff habitats over time.

5.8.12 With a maximum of 101 black guillemots breeding within the four kilometre study area, all will be within the range of elevated noise levels associated with the operation of the proposed Launch Facility. Table 5.12 outlines the maximum predicted dB levels on nesting black guillemot. From launch, the noise would rapidly (i.e., a matter of a small number of seconds) build from baseline to maximum, followed by a fairly rapid decrease back to baseline (tens of seconds).

Table 5.12 Maximum Predicted Decibel Levels at Black Guillemot Nesting Locations

Individuals	Pad 1		Pad 2		Pad 3	
Black guillemot	Launch LAmax	Static LAmax	Launch LAmax	Static LAmax	Launch LAmax	Static LAmax
13-14 ind, 0-0.5km	120-130dB	110-130dB	120-130dB	110-130dB	120-130dB	110-130dB
8-12 ind, 0.5-1km	110-120dB	100-110dB	110-120dB	100-110dB	100-110dB	100-110dB
25-27 ind, 1-2km	100-110dB	90-100dB	100-110dB	100-110dB	90-110dB	90-110dB
25-26 ind, 2-3km	90-100dB	90-100dB	90-100dB	90-100dB	90-100dB	80-100dB
10-25 ind, 3-4km	90-100dB	80-90dB	90-100dB	80-90dB	90-100dB	80-90dB

5.8.13 There is no direct evidence to suggest that the noise at launch would impact on, and adversely affect the success of, breeding black guillemot within the study area and there is also no threshold noise metric against which to compare potential effects on black guillemot. However, pigeon guillemot (*Cepphus columba*), a similar analogous Pacific species has shown adverse responses to fireworks near nesting sites in California (Appendix 5.2).

5.8.14 Breeding black guillemot are not considered particularly sensitive to human activity, visual disturbance and sudden noise events at the nest, as evidenced by the range of nesting sites provided by Forrester and Andrews (2007). Nevertheless, whether the pre-launch warning siren, followed by the low frequency rumble of the rocket, building to a maximum, followed by a rapid decrease back to baseline will be sufficient to allow the birds (in the underground nest) to cope with the noise is currently speculative. Based on the likely launch schedule, two to four launches would take place during the typical 23-40 day incubation period for black guillemot (Table 5.8). It should be noted that following the NatureScot consultation response (11 March 2021), commitment to a no-launch window whereby no satellite launches or static tests will be carried out between mid-May and the end of June has subsequently been made and this has been reflected in planning conditions for the Proposed Project.

5.8.15 If a worst-case (*not likely*) scenario is assumed (a failure for all study area breeding black guillemot directly related to a launch) then this would constitute an adverse impact on 101 individuals out of Shetland's 15,739 individual black guillemots, i.e., 0.64 % of the regional population (Table 5.9). If no such adverse response took place, then 0 % of the regional population would be adversely affected. Under both of these scenarios, a significant operational impact on the regional black guillemot population in Shetland is considered unlikely.

5.8.16 Under either of these scenarios, the potential magnitude of adverse impacts of operational disturbance combined on black guillemot would likely be **negligible**, with **no likely significant effects** predicted. Although black guillemot is a species of moderate conservation importance, the likely effects are judged to be not significant, i.e., there would be no detectable regional population level impacts and so the Shetland NHZ would not be adversely affected. Therefore, if the Proposed Project was operated, the available information indicates that conservation status would not likely be affected because (as articulated using three tests SNH (2006) use to consider FCS):

- Black guillemot is likely to maintain itself on a long-term basis as a viable component of its habitat in the Shetland NHZ.
- The natural range of black guillemot in the Shetland NHZ would not be reduced by the Proposed Project, nor would it become likely to be reduced in the foreseeable future.
- There would be (and would continue to be) a sufficiently large habitat area in the Shetland NHZ to maintain the black guillemot population on a long-term basis should the Proposed Project be operated.

Common Guillemot

5.8.17 Common guillemot is an abundant Amber listed species and therefore of moderate conservation importance (Table 5.5). The behavioural sensitivity of the species is considered to be moderate at the nest (Table 5.7). The regional, national and international population estimates of this species are known (Table 5.6). The Shetland NHZ common guillemot population estimate is 172,681 individuals and without evidence to the contrary the species is likely to be in FCS within Shetland.

5.8.18 The species typically nests in colonies, often containing many thousands of pairs, in locations inaccessible to mammalian predators e.g., ledges on sheer cliffs, tops of stacks and among boulders and flat ground on offshore islands (Forrester and Andrews, 2007). The adults feed at sea and carry fish back to the chicks. Consequently, the breeding sites are a relatively predictable 'fixed constraint' insofar as they nest within the same sheer cliff habitats over time.

5.8.19 With a maximum of 100 common guillemots breeding within the four kilometre study area, all will be within the range of elevated noise levels associated with the operation of the Proposed Project. Table 5.13 outlines the maximum predicted dB levels on nesting common guillemot. From launch, the noise would rapidly (i.e., a matter of a small number of seconds) build from baseline to maximum, followed by a fairly rapid decrease back to baseline (tens of seconds).

Table 5.13 Maximum Predicted Decibel Levels at Common Guillemot Nesting Locations

Individuals	Pad 1		Pad 2		Pad 3	
Common guillemot	Launch LAmax	Static LAmax	Launch LAmax	Static LAmax	Launch LAmax	Static LAmax
27 ind, 1-2km	100-110dB	90-100dB	100-110dB	100-110dB	90-110dB	90-110dB
20 ind, 2-3km	90-100dB	90-100dB	90-100dB	90-100dB	90-100dB	80-100dB
53 ind, 3-4km	90-100dB	80-90dB	90-100dB	80-90dB	90-100dB	80-90dB

5.8.20 There is no direct evidence to suggest that the noise at launch would impact on, and adversely affect the success of, breeding common guillemot within the study area and there is also no threshold noise metric against which compare potential effects on common guillemot.

5.8.21 A study (Dunnet, 1977) to explore the possibility that an increase in air traffic associated with oilfields off the north-east of Scotland was impacting on breeding seabirds recorded the reactions of a mixed seabird colony, including common guillemots, on the Buchan cliffs in relation to aircraft flying within 100 m. Virtually no behavioural reaction was reported as a result of the flyovers to within 100 m of the colony which was conducted during early egg laying and early nestling periods (Appendix 5.2).

5.8.22 Breeding common guillemots are considered moderately sensitive to human activity, visual disturbance and sudden noise events at the nest. Based on the literature available (Appendix 5.2) on common guillemot (called common murre in the USA publications) on disturbance from planes/helicopters suggests that this species is most sensitive to flushing in the pre-egg laying/early egg laying period. Flushing in this species occasionally causes eggs/chicks to be dislodged. However, it is not known if such dislodging of eggs/chicks is additive in terms of overall mortality, as sub-optimal nest locations regularly lose eggs/chicks naturally in the breeding season regardless. Whether the pre-launch warning siren, followed by the low frequency rumble of the rocket, building to a maximum, followed by a rapid decrease back to baseline will be sufficient to allow the birds to cope with the noise is currently speculative. Such activity would likely to be most severe during pre-egg laying and early incubation period. Based on the likely launch schedule, up to three launches would take place during the typical 34-day incubation period for common guillemot (Table 5.8). It should be noted that following the NatureScot consultation response (11 March 2021), commitment to a no-launch window whereby no satellite launches or static tests will be carried out between mid-May and the end of June has subsequently been made and this has been reflected in planning conditions for the Proposed Project.

5.8.23 If a worst-case (*not likely*) scenario is assumed (a failure for all study area breeding common guillemots directly related to a launch) then this would constitute an adverse impact on 100 individuals out of Shetland's 172,681 individual common guillemots, i.e., 0.06 % of the regional population (Table 5.9). If no such adverse response took place, then 0 % of the regional population would be adversely affected. Under both of these scenarios, a significant operational impact on the regional common guillemot population in Shetland is considered unlikely.

5.8.24 Under either of these scenarios, the potential magnitude of adverse impacts of operational disturbance combined on common guillemot would likely be **negligible**, with **no likely significant effects** predicted. Although common guillemot is a species of moderate conservation importance, the likely effects are judged to be not significant, i.e., there would be no detectable regional population level impacts and so the Shetland NHZ would not be adversely affected. Therefore, if the Proposed Project was operational, the available information indicates that conservation status would not likely be affected because (as articulated using three tests SNH (2006) use to consider FCS):

- Common guillemot is likely to maintain itself on a long-term basis as a viable component of its habitat in the Shetland NHZ.
- The natural range of common guillemot in the Shetland NHZ would not be reduced by the Proposed Project, nor would it become likely to be reduced in the foreseeable future.
- There would be (and would continue to be) a sufficiently large habitat area in the Shetland NHZ to maintain the common guillemot population on a long-term basis should the Proposed Project be operated.

Puffin

5.8.25 Puffin is a common Red listed species and therefore of high conservation importance (Table 5.5). The behavioural sensitivity of the species is considered to be low at the nest (Table 5.7). The regional, national and international population estimates of this species are known (Table 5.6). The Shetland NHZ puffin population estimate is 107,676 AOB and with recent evidence of an apparent decline the species in Shetland (e.g., Owen *et al.,* 2018), puffin is not likely to be in FCS within Shetland.

5.8.26 The species typically nests within burrows (dug in soil and less commonly among boulders) in colonies, in locations inaccessible to mammalian predators (Forrester and Andrews, 2007). The adults feed at sea and carry fish back to the chicks. Consequently, the breeding sites are a relatively predictable 'fixed constraint' insofar as they nest within the same burrow habitats over time.

5.8.27 With a maximum of 125 individuals breeding within the four kilometre study area, all will be within the range of elevated noise levels associated with the operation of the Proposed Project. Table 5.14 outlines the maximum predicted dB levels on apparently nesting puffin. From launch, the noise would rapidly (i.e., a matter of a small number of seconds) build from baseline to maximum, followed by a fairly rapid decrease back to baseline (tens of seconds).

Table 5.14 Maximum Predicted Decibel Levels at Puffin Nesting Locations

Individuals	Pad 1		Pad 2		Pad 3	
Puffin	Launch LAmax	Static LAmax	Launch LAmax	Static LAmax	Launch LAmax	Static LAmax
2 ind, 0-0.5km	120-130dB	110-130dB	120-130dB	110-130dB	120-130dB	110-130dB
6 ind, 0.5-1km	110-120dB	100-110dB	110-120dB	100-110dB	100-110dB	100-110dB
27 ind, 1-2km	100-110dB	90-100dB	100-110dB	100-110dB	90-110dB	90-110dB
23 ind, 2-3km	90-100dB	90-100dB	90-100dB	90-100dB	90-100dB	80-100dB
67 ind, 3-4km	90-100dB	80-90dB	90-100dB	80-90dB	90-100dB	80-90dB

5.8.28 There is no direct evidence to suggest that the noise at launch would impact on, and adversely affect the success of, breeding puffin within the study area and there is also no threshold noise metric against which compare potential effects on puffin.

5.8.29 A study (Dunnet, 1977) to explore the possibility that an increase in air traffic associated with oilfields off the north-east of Scotland was impacting breeding seabirds recorded the reactions of a mixed seabird colony, including puffins, on the Buchan cliffs in relation to aircraft flying within 100 m. Virtually no behavioural reaction was reported as a result of the flyovers to within 100 m of the colony which was conducted during early egg laying and early nestling periods (Appendix 5.2).

5.8.30 Breeding puffins are considered tolerant of human activity, visual disturbance and sudden noise events at the nest. Based on the literature available, puffins hearing range is between 500h hz to 6,000 hz (Appendix 5.2) so they would certainly hear the noise at launch. The presence of puffin nests in underground burrows will substantially reduce the potential noise at nests. Whether the pre-launch warning siren, followed by the low frequency rumble of the rocket, building to a maximum, followed by a rapid decrease back to baseline will be sufficient to allow the birds to cope with the noise is currently speculative. Such activity would probably be most severe during pre-egg laying and the incubation period (early April to the end of May). Based on the likely launch schedule, up to four launches would take place during the typical 42 day incubation period for puffin (Table 5.8). It should be noted that following the NatureScot consultation response (11 March 2021), commitment to a no-launch window whereby no satellite launches or static tests will be carried out between mid-May and the end of June has subsequently been made and this has been reflected in planning conditions for the Proposed Project.

5.8.31 If a worst-case (*not likely*) scenario is assumed (a failure for all study area breeding puffins directly related to a launch) then this would constitute an adverse impact on 125 individuals (assuming they were all breeders, which is unlikely) out of Shetland's 107,676 AOB (215,352 individuals), i.e., 0.06 % of the regional population (Table 5.9). If no such adverse response took place, then 0 % of the regional population would be adversely affected. Under both of these scenarios, a significant operational impact on the regional puffin population in Shetland is considered unlikely.

5.8.32 Under either of these scenarios, the potential magnitude of adverse impacts of operational disturbance combined on puffin would likely be **negligible**, with **no likely significant effects** predicted. Although puffin is a species of high conservation importance, the likely effects are judged to be not significant, i.e., there would be no detectable regional population level impacts and so the Shetland NHZ would not be adversely affected. Therefore, if the Proposed Project was operational, the available information indicates that conservation status would not likely be affected because (as articulated using three tests SNH (2006) use to consider FCS):

- Puffin is likely to maintain itself on a long-term basis as a viable component of its habitat in the Shetland NHZ.
- The natural range of puffin in the Shetland NHZ would not be reduced by the Proposed Project, nor would it become likely to be reduced in the foreseeable future.
- There would be (and would continue to be) a sufficiently large habitat area in the Shetland NHZ to maintain the puffin population on a long-term basis should the Proposed Project be operated.

Razorbill

5.8.33 Razorbill is an Amber listed species and therefore of moderate conservation importance (Table 5.5). The behavioural sensitivity of the species is considered to be moderate at the nest (Table 5.7). The regional, national and international population estimates of this species are known (Table 5.6). The Shetland NHZ razorbill population estimate is 9,492 individuals and without evidence to the contrary the species is likely to be in FCS within Shetland.

5.8.34 The species typically nests on open rocky coastlines, low cliffs and boulder scree slopes, particularly on offshore islands to high precipitous cliffs. Razorbills can nest individually or within loose groups

(Forrester and Andrews, 2007). The adults feed at sea and carry fish back to the chicks. Consequently, the breeding sites are a relatively predictable 'fixed constraint' insofar as they nest within the same cliff habitats over time.

5.8.35 With a maximum of 15 razorbills breeding within the four kilometre study area, all will be within the range of elevated noise levels associated with the operation of the Proposed Project. Table 5.15 outlines the maximum predicted dB levels on nesting razorbill. From launch, the noise would rapidly (i.e., a matter of a small number of seconds) build from baseline to maximum, followed by a fairly rapid decrease back to baseline (tens of seconds).

Table 5.15 Maximum Predicted Decibel Levels at Razorbill Nesting Locations

Individual	Pad 1		Pad 2		Pad 3	
Razorbill	Launch LAmax	Static LAmax	Launch LAmax	Static LAmax	Launch LAmax	Static LAmax
2 ind, 2-3km	90-100dB	90-100dB	90-100dB	90-100dB	90-100dB	80-100dB
13 ind, 3-4km	90-100dB	80-90dB	90-100dB	80-90dB	90-100dB	80-90dB

5.8.36 There is no direct evidence to suggest that the noise at launch would impact on, and adversely affect the success of, breeding razorbill within the study area and there is also no threshold noise metric against which compare potential effects on razorbill.

5.8.37 A study (Dunnet, 1977) to explore the possibility that an increase in air traffic associated with oilfields off the north-east of Scotland was impacting breeding seabirds recorded the reactions of a mixed seabird colony, including razorbills, on the Buchan cliffs in relation to aircraft flying within 100 m. Virtually no behavioural reaction was reported as a result of the flyovers to within 100 m of the colony which was conducted during early egg laying and early nestling periods (Appendix 5.2).

5.8.38 Breeding razorbills are considered low-moderately sensitive to human activity, visual disturbance and sudden noise events at the nest. Whether the pre-launch warning siren, followed by the low frequency rumble of the rocket, building to a maximum, followed by a rapid decrease back to baseline will be sufficient to allow the birds to cope with the noise is currently speculative. Such activity would probably be most severe during pre-egg laying and early incubation period (early April to the end of May). Based on the likely launch schedule, up to three launches would take place during the typical 34-day incubation period for razorbill (Table 5.8). It should be noted that following the NatureScot consultation response (11 March 2021), commitment to a no-launch window whereby no satellite launches or static tests will be carried out between mid-May and the end of June has subsequently been made and this has been reflected in planning conditions for the Proposed Project.

5.8.39 If a worst-case (*not likely*) scenario is assumed (a failure for all study area breeding razorbill directly related to a launch) then this would constitute an adverse impact on 15 individuals out of Shetland's 9,492 individual razorbills, i.e., 0.16 % of the regional population (Table 5.9). If no such adverse response took place, then 0 % of the regional population would be adversely affected. Under both of these scenarios, a significant operational impact on the regional razorbill population in Shetland is considered unlikely.

5.8.40 Under both of these scenarios, the potential magnitude of adverse impacts of operational disturbance combined on razorbill would likely be **negligible**, with **no likely significant effects** predicted. Although razorbill is a species of moderate conservation importance, the likely effects are judged to be not significant, i.e., there would be no detectable regional population level impacts and so the Shetland NHZ would not be adversely affected. Therefore, if the Proposed Project was operational, the available information indicates that conservation status would not likely be affected because (as articulated using three tests SNH (2006) use to consider FCS):

- Razorbill is likely to maintain itself on a long-term basis as a viable component of its habitat in the Shetland NHZ.
- The natural range of razorbill in the Shetland NHZ would not be reduced by the Proposed Project, nor would it become likely to be reduced in the foreseeable future.
- There would be (and would continue to be) a sufficiently large habitat area in the Shetland NHZ to maintain the razorbill population on a long-term basis should the Proposed Project be operational.

Shag

5.8.41 Despite being a common and widespread resident breeding species throughout Scotland (Forrester and Andrews, 2007), shag is a Red listed species and therefore of high conservation importance (Table 5.5). Relatively recent surveys of shags have revealed mixed fortunes across colonies from severe decline e.g., Foula (Heubeck *et al.,* 2014), relatively stable populations in the Outer Hebrides (Taylor *et al.,* 2018) to increases elsewhere such as Argyll and north-east Scotland (Forrester and Andrews, 2007). Nevertheless, whilst still numerous, when assessed in 1998-2002, the Britain and Ireland shag population revealed a widespread decline since the mid-1980s, for poorly understood reasons (Mitchell *et al.,* 2004).

5.8.42 The behavioural sensitivity of the species is considered to be low at the nest (Table 5.7). A study (Dunnet, 1977) to explore the possibility that an increase in air traffic associated with oilfields off the north-east of Scotland was impacting breeding seabirds recorded the reactions of a mixed seabird colony, including shags, on the Buchan cliffs in relation to aircraft flying within 100 m. Virtually no behavioural reaction was reported as a result of the flyovers to within 100 m of the colony which was conducted during early egg laying and early nestling periods (Appendix 5.2).

5.8.43 The regional, national and international population estimates of this species are known (Table 5.6). The Shetland NHZ shag population estimate is 6,147 individuals and without evidence to the contrary the species is likely to be in FCS within Shetland, Foula notwithstanding.

5.8.44 The species typically nests among boulders on small islands and at the bases of cliffs, in caves, crevices and less commonly on flat open ledges and high sea cliffs (Forrester and Andrews, 2007). The adults feed at sea and carry fish back to the chicks. Consequently, the breeding sites are a relatively predictable ‘fixed constraint’ insofar as they nest within the same boulder and cliff habitats over time.

5.8.45 With a maximum of 81 shag AON within the four kilometre study area, all will be within the range of elevated noise levels associated with the operation of the Proposed Project. Table 5.16 outlines the maximum predicted decibel dB levels on nesting shag. From launch, the noise would rapidly (i.e., a matter of a small number of seconds) build from baseline to maximum, followed by a fairly rapid decrease back to baseline (tens of seconds).

Table 5.16 Maximum Predicted Decibel Levels at Shag Nesting Locations

AON	Pad 1		Pad 2		Pad 3	
Shag	Launch LAmax	Static LAmax	Launch LAmax	Static LAmax	Launch LAmax	Static LAmax
1 AON, 0-0.5km	120-130dB	110-130dB	120-130dB	110-130dB	120-130dB	110-130dB
5 AON, 1-2km	100-110dB	90-100dB	100-110dB	100-110dB	90-110dB	90-110dB
24 AON, 2-3km	90-100dB	90-100dB	90-100dB	90-100dB	90-100dB	80-100dB
51 AON, 3-4km	90-100dB	80-90dB	90-100dB	80-90dB	90-100dB	80-90dB

5.8.46 There is no direct evidence to suggest that the noise at launch would impact on, and adversely affect the success of, breeding shag within the study area and there is also no threshold noise metric against which compare potential effects on shag. Dunnet’s (1977) research suggests that shag may have a tolerance for unexpected loud noises. However, the volume of a launch will exceed that of an aircraft flying within 100 m of nesting shags.

5.8.47 Breeding shags are considered to have low sensitive to human activity, visual disturbance and sudden noise events at the nest. Whether the pre-launch warning siren, followed by the low frequency rumble of the rocket, building to a maximum, followed by a rapid decrease back to baseline will be sufficient to allow the birds to cope with the noise is currently speculative. Based on the likely launch schedule, up to three launches would take place during the typical 31 day incubation period for shag (Table 5.8). It should be noted that following the NatureScot consultation response (11 March 2021), commitment to a no-launch window whereby no satellite launches or static tests will be carried out between mid-May and the end of June has subsequently been made and this has been reflected in planning conditions for the Proposed Project.

5.8.48 If a worst-case (*not likely*) scenario is assumed (a failure for all study area breeding shag directly related to a launch) then this would constitute an adverse impact on 81 AON out of Shetland's 6,147 AON, i.e., 1.32 % of the regional shag population (Table 5.9). If no such adverse response took place, then 0 % of the regional population would be adversely affected. The former worst-case scenario would constitute a **minor** impact on the regional shag population in Shetland. The question therefore follows, how likely is this worst-case complete breeding failure to occur? Based on Dunnet's (1977) work, it is apparent that shags can tolerate unexpected loud noises and with the vast majority of shag AON in the study area (75 out of the 81) greater than two kilometres away from launch sites, it seems highly unlikely that such a worst-case scenario would occur. Therefore, were any adverse effect to occur (and there is no direct evidence that it would) it would most likely occur on the six AON within two kilometres of the launch pad sites (ca. 0.1% of the regional population).

5.8.49 Consequently, the potential magnitude of adverse impacts of operational disturbance combined on shag would likely be **negligible**, with **no likely significant effects** predicted. Although shag is a species of high conservation importance, the likely effects are judged to be not significant, i.e., there would be no detectable regional population level impacts and so the Shetland NHZ would not be adversely affected. Therefore, if the Proposed Project was operational, the available information indicates that conservation status would not likely be affected because (as articulated using three tests SNH (2006) use to consider FCS):

- Shag is likely to maintain itself on a long-term basis as a viable component of its habitat in the Shetland NHZ.
- The natural range of shag in the Shetland NHZ would not be reduced by the Proposed Project, nor would it become likely to be reduced in the foreseeable future.
- There would be (and would continue to be) a sufficiently large habitat area in the Shetland NHZ to maintain the shag population on a long-term basis should the Proposed Project be operated.

Kittiwake

5.8.50 Despite being a common and widespread breeding species throughout coastal Scotland (Forrester and Andrews, 2007) and the most numerous gull species in the world (Mitchell *et al.,* 2004), kittiwake is a Red listed species in the UK and therefore of high conservation importance (Table56.5). The national censuses suggested that the Scottish population increased by 4 % between 1969-70 and 1985-88, but then declined by 21 % by 1998-2002, with the greatest declines in Shetland (Mitchell *et al.,* 2004; Forrester and Andrews, 2007). Although this decline occurred throughout most of the British Isles, there was substantial regional variation in trends. Oceanographic changes (resulting in reduction of their food) and predation of kittiwakes by an expanding great skua population in Shetland are believed to have contributed significantly to the overall decline in kittiwakes in Shetland (Mitchell *et al.,* 2004).

5.8.51 The behavioural sensitivity of the species is considered to be low at the nest (Table 5.7). A study (Dunnet, 1977) to explore the possibility that an increase in air traffic associated with oilfields off the north-east of Scotland was impacting breeding seabirds recorded the reactions of a mixed seabird colony, including kittiwakes, on the Buchan cliffs in relation to aircraft flying within 100 m. Virtually no behavioural reaction was reported as a result of the flyovers to within 100 m of the colony which was conducted during early egg laying and early nestling periods (Appendix 5.2).

5.8.52 The regional, national and international population estimates of this species are known (Table 5.6). The Shetland NHZ kittiwake population estimate is 16,732 AON and based on successive seabird surveys the species is unlikely to be in FCS within Shetland.

5.8.53 The species typically nests colonially on vertical rock cliffs, offshore stacks and, occasionally, on man-made structures (Forrester and Andrews, 2007). The adults feed at sea and carry fish back to the chicks. Consequently, the breeding sites are a relatively predictable 'fixed constraint' insofar as they nest within the same cliff habitats over time.

5.8.54 With a maximum of 55 kittiwake AON within the four kilometre study area, all will be within the range of elevated noise levels associated with the operation of the Proposed Project. Table 5.17 outlines the maximum predicted dB levels on nesting kittiwake. From launch, the noise would rapidly (i.e., a matter of a small number of seconds) build from baseline to maximum, followed by a fairly rapid decrease back to baseline (tens of seconds).

Table 5.17 Maximum Predicted Decibel Levels at Kittiwake Nesting Locations

AON	Pad 1		Pad 2		Pad 3	
Kittiwake	Launch LAmax	Static LAmax	Launch LAmax	Static LAmax	Launch LAmax	Static LAmax
50 AON, 1-2km	100-110dB	90-100dB	100-110dB	100-110dB	90-110dB	90-110dB
5 AON, 3-4km	90-100dB	80-90dB	90-100dB	80-90dB	90-100dB	80-90dB

5.8.55 There is no direct evidence to suggest that the noise at launch would impact on, and adversely affect the success of, breeding kittiwake within the study area and there is also no threshold noise metric against which compare potential effects on kittiwake. Dunnet's (1977) research suggests that kittiwake may have a tolerance for unexpected loud noises. However, the volume of a launch will exceed that of an aircraft flying within 100 m of nesting kittiwake.

5.8.56 Breeding kittiwakes are considered to have low sensitive to human activity (for example, they have bred on buildings and structures along the quayside at the busy Newcastle-Gateshead Quayside on the River Tyne in Northeast England since the 1960s), visual disturbance and sudden noise events at the nest. Whether the pre-launch warning siren, followed by the low frequency rumble of the rocket, building to a maximum, followed by a rapid decrease back to baseline will be sufficient to allow the birds to cope with the noise is currently speculative. Based on the likely launch schedule, up to three launches would take place during the typical 29-day incubation period for kittiwake (Table 5.8). It should be noted that following the NatureScot consultation response (11 March 2021), commitment to a no-launch window whereby no satellite launches or static tests will be carried out between mid-May and the end of June has subsequently been made and this has been reflected in planning conditions for the Proposed Project.

5.8.57 If a worst-case (*not likely*) scenario is assumed (a failure for all study area breeding kittiwake directly related to a launch) then this would constitute an adverse impact on 55 AON out of Shetland's 16,732 AON, i.e., 0.32 % of the regional kittiwake population (Table 5.9). If no such adverse response took place, then 0 % of the regional kittiwake population would be adversely affected. How likely is this worst-case complete breeding failure to occur? Based on Dunnet's (1977) work, it is apparent that kittiwakes can tolerate unexpected loud noises and with none within one kilometre of the launch site and 50 AON within two kilometres, it seems unlikely that such a worst-case scenario would occur. Therefore, were any adverse effect to occur (and there is no direct evidence that it would) it would most likely occur on the 50 AON within two kilometres of the launch sites (ca. 0.3% of the regional population).

5.8.58 Consequently, the potential magnitude of adverse impacts of operational disturbance combined on kittiwake would likely be **negligible**, with **no likely significant effects** predicted. Although kittiwake a species of high conservation importance, the likely effects are judged to be not significant, i.e., there would be no detectable regional population level impacts and so the Shetland NHZ would not be adversely affected. Therefore, if the Proposed Project was operational, the available information indicates that conservation status would not likely be affected because (as articulated using three tests SNH (2006) use to consider FCS):

- Kittiwake is likely to maintain itself on a long-term basis as a viable component of its habitat in the Shetland NHZ.
- The natural range of kittiwake in the Shetland NHZ would not be reduced by the Proposed Project, nor would it become likely to be reduced in the foreseeable future.
- There would be (and would continue to be) a sufficiently large habitat area in the Shetland NHZ to maintain the kittiwake population on a long-term basis should the Proposed Project be operated.

Fulmar

5.8.59 Fulmar is one of the commonest seabirds around Britain (Mitchell *et al.,* 2004) particularly in the Northern Isles and Outer Hebrides, but also breeding in coastal areas throughout Scotland (Forrester and Andrews, 2007). The spectacular growth in fulmar numbers across Britain in the 20th Century is one of the best documented for any bird species (Mitchell *et al.,* 2004). It is the only bird species taken forward for assessment within this EIA Report chapter that is not conservation listed or specially protected, i.e., it is not Amber or Red listed and does not appear on Schedule 1 of the 1981 Wildlife and Countryside Act or Annex 1 of the Birds Directive (Table 5.5) and is therefore of low conservation importance. It was taken forward in this assessment based on the relatively large number of AOS recorded within the study area and because SNH specifically mentioned the species during EIA Scoping (Table 5.1).

5.8.60 The behavioural sensitivity of the species is considered to be low at the nest (Table 5.7). A study (Dunnet, 1977) to explore the possibility that an increase in air traffic associated with oilfields off the north-east of Scotland was impacting breeding seabirds recorded the reactions of a mixed seabird colony, including fulmars, on the Buchan cliffs in relation to aircraft flying within 100 m. Virtually no behavioural reaction was reported as a result of the flyovers to within 100 m of the colony which was conducted during early egg laying and early nestling periods (Appendix 5.2).

5.8.61 The regional, national and international population estimates of this species are known (Table 5.6). The Shetland NHZ fulmar population estimate is 188,544 AOS and the species is likely to be in FCS within Shetland.

5.8.62 The species typically nests on cliffs on islands and open coasts, both on vegetated and bare ledges. It can also nest in dunes and on shorelines on low, mammalian predator free, islands. Occasionally it nests on man-made structures such as bridges and quarries (Forrester and Andrews, 2007). The adults feed at sea and bring food back to the chicks. Consequently, the breeding sites are a relatively predictable 'fixed constraint' insofar as they nest within the same cliff and open coast habitats over time.

5.8.63 With a maximum of 6,987 fulmar AOS within the four kilometre study area, all will be within the range of elevated noise levels associated with the operation of the launch facility. Table 5.18 outlines the maximum predicted dB level on nesting fulmar. From launch, the noise would rapidly (i.e., a matter of a small number of seconds) build from baseline to maximum, followed by a fairly rapid decrease back to baseline (tens of seconds).

Table 5.18 Maximum Predicted Decibel Levels at Fulmar Nesting Locations

AON	Pad 1		Pad 2		Pad 3	
Fulmar	Launch LAmax	Static LAmax	Launch LAmax	Static LAmax	Launch LAmax	Static LAmax
430 AON, 0-0.5km	120-130dB	110-130dB	120-130dB	110-130dB	120-130dB	110-130dB
740 AON, 0.5-1km	110-120dB	100-110dB	110-120dB	100-110dB	100-110dB	100-110dB
1,465 AON, 1-2km	100-110dB	90-100dB	100-110dB	100-110dB	90-110dB	90-110dB
2,645 AON, 2-3km	90-100dB	90-100dB	90-100dB	90-100dB	90-100dB	80-100dB
1,707 AON, 3-4km	90-100dB	80-90dB	90-100dB	80-90dB	90-100dB	80-90dB

5.8.64 There is no direct evidence to suggest that the noise at launch would impact on, and adversely affect the success of, breeding fulmar within the study area and there is also no threshold noise metric against which compare potential effects on fulmar. Dunnet's (1977) research suggests that fulmar may have a tolerance for unexpected loud noises. However, the volume of a launch will exceed that of an aircraft flying within 100 m of nesting fulmar.

5.8.65 Breeding fulmars are considered to have low sensitivity (high tolerance) to human activity, visual disturbance and sudden noise events at the nest. Whether the pre-launch warning siren, followed by the low frequency rumble of the rocket, building to a maximum, followed by a rapid decrease back to baseline will be sufficient to allow the birds to cope with the noise is currently speculative. Based on the likely launch schedule, up to five launches would take place during the typical 51-day incubation period for fulmar (Table 5.8). It should be noted that following the NatureScot consultation response (11 March 2021), commitment to a no-launch window whereby no satellite launches or static tests will be carried out between mid-May and the end of June has subsequently been made and this has been reflected in planning conditions for the Proposed Project.

5.8.66 If a worst-case (*not likely*) scenario is assumed (a failure for all study area breeding fulmar directly related to a launch) then this would constitute an adverse impact on 6,987 AOS out of Shetland's 188,544 AOS, i.e., 3.7 % of the regional fulmar population (Table 5.9). Based on Dunnet's (1977) work, it is apparent that fulmars can tolerate unexpected loud noises and so it seems highly unlikely that such a worst-case scenario would occur. If no such adverse response took place, then 0 % of the regional fulmar population would be adversely affected. However, this is also considered unlikely given the large number of AOS widely spread throughout the four kilometre study area, and with 1,170 AOS within one kilometre of launch facilities (ca. 0.6% of regional population), it is considered likely that some of these fulmars will be adverse affected and some breeding attempts may fail, but it is not known how many, but possibly some of the 430 AON within 0.5 km of the launch pads.

5.8.67 Consequently, the potential magnitude of adverse impacts of operational disturbance combined on fulmar would likely be **negligible** on the regional population, with **no likely significant effects** predicted. Fulmar is not a species of conservation importance and the likely effects are judged to be not significant, i.e., there would be little/no detectable regional population level impacts and so the Shetland NHZ would not be adversely affected. Therefore, if the Proposed Project was operational, the available information indicates that conservation status would not likely be affected because (as articulated using three tests SNH (2006) use to consider FCS):

- Fulmar is likely to maintain itself on a long-term basis as a viable component of its habitat in the Shetland NHZ.
- The natural range of fulmar in the Shetland NHZ would not be reduced by the Proposed Project, nor would it become likely to be reduced in the foreseeable future.

- There would be (and would continue to be) a sufficiently large habitat area in the Shetland NHZ to maintain the fulmar population on a long-term basis should the Proposed Project be operated.

Merlin

5.8.68 Merlin is scarce upland breeding raptor that predominantly nests in heather moorland, usually on sloping ground on hillsides (Forrester and Andrews, 2007). Merlin is an Annex 1, Schedule 1 and Red listed species and therefore is considered to be of High conservation importance (Table 5.5). The behavioural sensitivity of the species is considered High (Table 5.7). The national and international population estimates of this species are known (Table 5.6). The Shetland NHZ merlin population estimate is ca. 30 pairs and without evidence to the contrary the species is likely to be in FCS within Shetland.

5.8.69 The favoured merlin breeding territories tend to be used year after year. Consequently, the breeding sites are relatively predictable, but new sites can and are used in different years. Nesting sites are relatively difficult to find and consequently the species is somewhat under-recorded.

5.8.70 As no merlins nest within the study area, the species is unlikely to be susceptible to disturbance from operational launch activities and **no** likely significant effects are predicted.

5.8.71 Consequently, the potential magnitude of adverse impacts of operational disturbance combined on merlin would equate to **no effect** on the regional population, with **no likely significant effects** predicted. Although merlin is a species of high conservation importance, the likely effects are judged to be not significant, i.e., there would be no detectable regional population level impacts and so the Shetland NHZ would not be adversely affected. Therefore, if the Proposed Project was operational, the available information indicates that conservation status would not likely be affected because (as articulated using three tests SNH (2006) use to consider FCS):

- Merlin is likely to maintain itself on a long-term basis as a viable component of its habitat in the Shetland NHZ.
- The natural range of merlin in the Shetland NHZ would not be reduced by the Proposed Project, nor would it become likely to be reduced in the foreseeable future.
- There would be (and would continue to be) a sufficiently large habitat area in the Shetland NHZ to maintain the merlin population on a long-term basis should the Proposed Project be operated.

Ringed Plover

5.8.72 Ringed plover is a largely coastal wader species, nesting on or above the strandline on open sand and shingle beaches, but can also use sand dunes, grass hinterlands, rocky headlands, maritime heath, small storm beaches and artificial habitats (Forrester and Andrews, 2007). Ringed plover is a Red listed species and therefore of high conservation importance (Table 5.5). The behavioural sensitivity of the species is considered low (Table 5.7). The national and international population estimates of this species are known (Table 5.6). The Shetland NHZ ringed plover population estimate is 800-1,000 pairs and without evidence to the contrary the species is likely to be in FCS within Shetland.

5.8.73 The favoured breeding sites tend to be used year after year and evidence from 2018 and 2019 surveys shows a high degree of overlap in terms of ringed plover territories. Consequently, the breeding sites are a relatively predictable ‘fixed constraint’, but new sites can and are used in different years.

5.8.74 With a maximum of ten pairs of ringed plover within the four kilometre study area, all will be within the range of elevated noise levels associated with the operation of the Proposed Project. Table 5.19 outlines the maximum predicted dB levels on nesting ringed plover. From launch, the noise would rapidly (i.e., a matter of a small number of seconds) build from baseline to maximum, followed by a fairly rapid decrease back to baseline (tens of seconds).

Table 5.19 Maximum Predicted Decibel Levels at Ringed Plover Nesting Locations

Pairs	Pad 1		Pad 2		Pad 3	
Ringed plover	Launch LAmax	Static LAmax	Launch LAmax	Static LAmax	Launch LAmax	Static LAmax
3 pairs, 0-0.5km	120-130dB	110-130dB	120-130dB	110-130dB	120-130dB	110-130dB
4-5 pairs, 1-2km	100-110dB	90-100dB	100-110dB	100-110dB	90-110dB	90-110dB
1-2 pairs, 2-3km	90-100dB	90-100dB	90-100dB	90-100dB	90-100dB	80-100dB
0-1 pair, 3-4km	90-100dB	80-90dB	90-100dB	80-90dB	90-100dB	80-90dB

5.8.75 There is no direct evidence to suggest that the noise at launch would impact on, and adversely affect the success of, all the breeding ringed plover within the study area and there is also no threshold noise metric against which compare potential effects on ringed plover. The literature review (Appendix 5.3) identified studies on two potentially analogous coastal wader species: Wilson's plover (*Charadrius wilsonia*) and snowy plover (*Charadrius nivosus*). The Wilson's plover study reported military flights increased bird's alertness and scanning behaviour, but with no evidence of effect on heart rate or incubation, or direct evidence of this behavioural response reducing reproductive success. The snowy plover study was focused on Titan IV rocket launches (130 dBA) and the birds did not exhibit any adverse reactions to a launch, and monitoring during the breeding season recorded no injury or mortality to adults, young, or eggs following smaller launches and concluded behaviour was not adversely affected by launch noise.

5.8.76 The lack of an adverse response of the analogous snowy plover to rocket launches up to 130 dBA suggests that *Charadrius* plovers maybe relatively robust/tolerant of sudden, very loud noise events and so worst-case scenarios (where all ten breeding pairs fail) within the four kilometre study area are considered unlikely to occur. Nevertheless, one-two pairs are particularly close (<250 m) to the launch pads and so are potentially most likely to be adversely affected by operational disturbance. Whether the pre-launch warning siren, followed by the low frequency rumble of the rocket, building to a maximum, followed by a rapid decrease back to baseline will be sufficient to allow the birds to cope with the noise is currently speculative. Based on the likely launch schedule, up to two-three launches would take place during the typical 24-day incubation period for ringed plover (Table 5.8). It should be noted that following the NatureScot consultation response (11 March 2021), commitment to a no-launch window whereby no satellite launches or static tests will be carried out between mid-May and the end of June has subsequently been made and this has been reflected in planning conditions for the Proposed Project.

5.8.77 If a worst-case (*not likely*) scenario is assumed (a failure for all study area breeding ringed plover directly related to a launch) then this would constitute an adverse impact on 10 pairs out of Shetland's 800-1,000 pairs, i.e., approximately 1 % of the regional ringed plover population (Table 5.9). However, based on the responses of analogous *Charadrius* plovers to rocket launches in the USA, this seems an unlikely scenario. If no such adverse response took place, then 0 % of the regional ringed plover population would be adversely affected. However, this is also considered unlikely given that the territories of one-two pairs in 2018-2019 were located close enough to launch pads (<250 m) to assume that they would likely be adversely affected and possibly fail.

5.8.78 Consequently, the potential magnitude of adverse impacts of operational disturbance combined on ringed plover would likely be **negligible** on the regional population, with **no likely significant effects** predicted. Although ringed plover is a species of high conservation importance, the likely effects are judged to be not significant, i.e., there would be no detectable regional population level impacts and so the Shetland NHZ would not be adversely affected. Therefore, if the Proposed Project was operational, the available information indicates that conservation status would not likely be affected because (as articulated using three tests SNH (2006) use to consider FCS):

- Ringed plover is likely to maintain itself on a long-term basis as a viable component of its habitat in the Shetland NHZ.

- The natural range of ringed plover in the Shetland NHZ would not be reduced by the Proposed Project, nor would it become likely to be reduced in the foreseeable future.
- There would be (and would continue to be) a sufficiently large habitat area in the Shetland NHZ to maintain the ringed plover population on a long-term basis should the Proposed Project be operated.

Golden Plover

5.8.79 Golden plover breeds in semi-natural moorland, dwarf shrub, peatland and arctic alpine heath (Forrester and Andrews, 2007). Golden plover is an Annex 1 wader species and therefore of high conservation importance (Table 5.5), although it is still a quarry species that can legally be shot in season in the UK. The behavioural sensitivity of the species is considered moderate (Table 5.7). The national and international population estimates of this species are known (Table 5.6). The Shetland NHZ golden plover population estimate is 5,665 pairs and without evidence to the contrary the species is likely to be in FCS within Shetland.

5.8.80 There is high annual variation in terms of site occupancy (e.g., with seven breeding pairs recorded in the study area in 2018 and 13 pairs in 2019) and is a feature of many upland golden plover populations Alba Ecology has worked on. Consequently, the breeding sites are considered relatively unpredictable in terms of annual occupancy, although some favoured territories appear to be regularly used.

5.8.81 With a maximum of 13 pairs of golden plover within the four kilometre study area, all will be within the range of elevated noise levels associated with the operation of the Proposed Project. Table 5.20 outlines the maximum predicted dB level on nesting golden plover. From launch, the noise would rapidly (i.e., a matter of a small number of seconds) build from baseline to maximum, followed by a fairly rapid decrease back to baseline (tens of seconds).

Table 5.20 Maximum Predicted Decibel Levels at Golden Plover Nesting Locations

Pairs	Pad 1		Pad 2		Pad 3	
Golden plover	Launch LAmax	Static LAmax	Launch LAmax	Static LAmax	Launch LAmax	Static LAmax
0-1 pair, 0-0.5km	120-130dB	110-130dB	120-130dB	110-130dB	120-130dB	110-130dB
2-3 pairs, 1-2km	100-110dB	90-100dB	100-110dB	100-110dB	90-110dB	90-110dB
1-5 pairs, 2-3km	90-100dB	90-100dB	90-100dB	90-100dB	90-100dB	80-100dB
4 pairs, 3-4km	90-100dB	80-90dB	90-100dB	80-90dB	90-100dB	80-90dB

5.8.82 There is no direct evidence to suggest that the noise at launch would impact on, and adversely affect the success of, all the breeding golden plover within the study area and there is also no threshold noise metric against which compare potential effects on golden plover. The literature review (Appendix 5.2) identified studies on two potentially analogous *Charadrius* species: Wilson's plover and snowy plover. The Wilson's plover study reported military flights increased birds alertness and scanning behaviour, but with no evidence of effect on heart rate or incubation, or direct evidence of this behavioural response reducing reproductive success. The snowy plover study was focused on Titan IV rocket launches (130 dBA) and the birds did not exhibit any adverse reactions to a launch, and monitoring during the breeding season recorded no injury or mortality to adults, young, or eggs following smaller launches and concluded behaviour was not adversely affected by launch noise or vibrations. Furthermore, studies of golden plover breeding on the Otterburn firing range in northern England showed an apparent population increase from 25 pairs in 1994 to 34 pairs in 1998 despite regular loud noise disturbance from live firing and explosions (Appendix 5.2).

5.8.83 The lack of an adverse response of the analogous snowy plover to rocket launches up to 130 dBA and population increases of golden plover in an English live fire range despite explosive noise disturbance suggests that *Charadrius* plovers are relatively robust/tolerant of sudden, very loud noise events and so worst-case scenarios (where all 13 breeding pairs fail) within the four kilometre study area are considered unlikely to occur. Nevertheless, one pair in 2019 was particularly close <250 m) to the launch pads and so would potentially be most likely to be adversely affected by operational disturbance. Whether the pre-launch warning siren, followed by the low frequency rumble of the rocket, building to a maximum, followed by a rapid decrease back to baseline will be sufficient to allow the birds to cope with the noise is currently speculative. Based on the likely launch schedule, up to three launches would take place during the typical 29-day incubation period for golden plover (Table 5.8). It should be noted that following the NatureScot consultation response (11 March 2021), commitment to a no-launch window whereby no satellite launches or static tests will be carried out between mid-May and the end of June has subsequently been made and this has been reflected in planning conditions for the Proposed Project.

5.8.84 If a worst-case scenario (*not likely*) is assumed (a failure for all study area breeding golden plover directly related to a launch) then this would constitute an adverse impact on a maximum of 13 pairs out of Shetland's 5,665 pairs, i.e.,0.23 % of the regional golden plover population (Table 5.9). However, based on the responses of analogous *Charadrius* plovers to rocket launches in the USA and golden plover breeding success at an English live firing range, this seems an unlikely scenario. If no such adverse response took place, then 0 % of the regional golden plover population would be adversely affected. However, this is also considered unlikely given that one territory (if subsequently used) is located close enough to launch pads to assume that they would likely be adversely affected and possibly fail.

5.8.85 Consequently, the potential magnitude of adverse impacts of operational disturbance combined on golden plover would likely be **negligible** on the regional population, with **no likely significant effects** predicted. Although golden plover is a species of high conservation importance, the likely effects are judged to be not significant, i.e., there would be no detectable regional population level impacts and so the Shetland NHZ would not be adversely affected. Therefore, if the Proposed Project was operational, the available information indicates that conservation status would not likely be affected because (as articulated using three tests SNH use to consider FCS):

- Golden plover is likely to maintain itself on a long-term basis as a viable component of its habitat in the Shetland NHZ.
- The natural range of golden plover in the Shetland NHZ would not be reduced by the Proposed Project, nor would it become likely to be reduced in the foreseeable future.
- There would be (and would continue to be) a sufficiently large habitat area in the Shetland NHZ to maintain the golden plover population on a long-term basis should the Proposed Project be operated.

Dunlin

5.8.86 Dunlin breeds on wet upland and montane heath, especially where bog pool systems occur, but also on machair and rarely on salt marsh (Forrester and Andrews, 2007). Dunlin (sub-species *schinzii*, which breeds in Shetland) is an Annex 1 wader species and therefore of high conservation importance (Table 5.5). The behavioural sensitivity of the species is considered moderate (Table 5.7). The national and international population estimates of this species are known (Table 5.6). The Shetland NHZ dunlin population estimate is 2,054 pairs and without evidence to the contrary the species is likely to be in FCS within Shetland.

5.8.87 There is high annual variation in terms of site occupancy (e.g., with five breeding pairs recorded in the study area in 2018 and four pairs in 2019, mostly in different locations). Consequently, the breeding sites are considered relatively unpredictable in terms of annual occupancy, although some favoured territories appear to be regularly used.

5.8.88 With a maximum of five pairs of dunlin within the four kilometre study area, all will be within the range of elevated noise levels associated with the operation of the Proposed Project. Table 5.21 outlines the maximum predicted dB levels on nesting dunlin. From launch, the noise would rapidly (i.e., a matter of a small number of seconds) build from baseline to maximum, followed by a fairly rapid decrease back to baseline (tens of seconds).

Table 5.21 Maximum Predicted Decibel Levels at Dunlin Nesting Locations

Pairs	Pad 1		Pad 2		Pad 3	
Dunlin	Launch LAmax	Static LAmax	Launch LAmax	Static LAmax	Launch LAmax	Static LAmax
0-1 pair, 0-0.5km	120-130dB	110-130dB	120-130dB	110-130dB	120-130dB	110-130dB
2 pairs, 1-2km	100-110dB	90-100dB	100-110dB	100-110dB	90-110dB	90-110dB
0-1 pair, 2-3km	90-100dB	90-100dB	90-100dB	90-100dB	90-100dB	80-100dB
1-2 pairs, 3-4km	90-100dB	80-90dB	90-100dB	80-90dB	90-100dB	80-90dB

5.8.89 There is no direct evidence to suggest that the noise at launch would impact on, and adversely affect the success of, all the breeding dunlin within the study area and there is also no threshold noise metric against which compare potential effects on dunlin. The literature review (Appendix 5.2) did not identify any directly relevant studies on dunlin or potentially analogous wader species. Based on current information it is not possible to predict likely responses of all breeding dunlin to the noise caused by the launches, but it is considered that one territory occupied in 2019 would likely be adversely affected (were it to be subsequently occupied) by operational noise during launches. Whether the pre-launch warning siren, followed by the low frequency rumble of the rocket, building to a maximum, followed by a rapid decrease back to baseline will be sufficient to allow the birds to cope with the noise is currently speculative. Based on the likely launch schedule, up to two launches would take place during the typical 22-day incubation period for dunlin (Table 5.8). It should be noted that following the NatureScot consultation response (11 March 2021), commitment to a no-launch window whereby no satellite launches or static tests will be carried out between mid-May and the end of June has subsequently been made and this has been reflected in planning conditions for the Proposed Project.

5.8.90 If a worst-case scenario (*not likely*) is assumed (a failure for all study area breeding dunlin directly related to a launch) then this would constitute an adverse impact on a maximum of five pairs out of Shetland's 2,054 pairs, i.e., 0.24 % of the regional dunlin population (Table 5.9). However, based on the predicted responses of other waders, this worst-case scenario seems an unlikely scenario. If no such adverse response took place, then 0 % of the regional dunlin population would be adversely affected. However, this is also considered unlikely given that one territory (in 2019) was located close enough to launch pads to assume that they would likely be adversely affected were it to be subsequently occupied.

5.8.91 Consequently, the potential magnitude of adverse impacts of operational disturbance combined on dunlin would likely be **negligible** on the regional population, with **no likely significant effects predicted**. Although dunlin is a species of high conservation importance, the likely effects are judged to be not significant, i.e., there would be no detectable regional population level impacts and so the Shetland NHZ would not be adversely affected. Therefore, if the Proposed Project was operational, the available information indicates that conservation status would not likely be affected because (as articulated using three tests SNH (2006) use to consider FCS):

- Dunlin is likely to maintain itself on a long-term basis as a viable component of its habitat in the Shetland NHZ.
- The natural range of dunlin in the Shetland NHZ would not be reduced by the Proposed Project, nor would it become likely to be reduced in the foreseeable future.
- There would be (and would continue to be) a sufficiently large habitat area in the Shetland NHZ to maintain the dunlin population on a long-term basis should the Proposed Project be operated.

Whimbrel

5.8.92 Within Shetland, whimbrel breed in short vegetation on wet heath, blanket bog and serpentine heath (Grant 1991; Massey *et al.,* 2016). Whimbrel is a Schedule 1 and Red listed wader species and therefore of high conservation importance (Table 5.5). The behavioural sensitivity of the species is considered to be moderate (Table 5.7). The national and international population estimates of this species are known (Table 5.6). The published Shetland NHZ whimbrel population estimate is 290 pairs, but should be increased by 10 % (Digger Jackson, *pers comm.*) to ca. 320 pairs. The current status of the Shetland population is unknown, but detailed monitoring across west and central Shetland suggests it has not substantially changed over the last decade and consequently the species is probably in FCS within Shetland, especially with great skua, believed to be the main culprit in the species' decline (at least in the Northern Isles), now apparently in decline itself. It should be noted that the RSPB quote that the Shetland and Orkney breeding population has been slowly increasing and the UK population estimate to be 400-500 pairs (https://www.rspb.org.uk/birds-and-wildlife/wildlife-guides/bird-a-z/whimbrel/ - accessed August 2020). It is not clear on what the much higher RSPB population data is based, but it is considered misleading and so has not been used within this assessment.

5.8.93 There is a relatively low variation in terms of site occupancy (with five breeding pairs recorded in the study area in 2018 and four pairs in 2019, mostly in similar locations). Consequently, the breeding sites are considered relatively predictable in terms of annual occupancy.

5.8.94 Details of potential impacts on whimbrel have been provided previously to the local planning authority in accordance with SNH (2016) guidance.

Curlew

5.8.95 Curlew is a widespread but declining Scottish breeding bird on farmland and uplands (Forrester and Andrews, 2007). Curlew is a Red listed wader species and therefore of high conservation importance (Table 5.5). The behavioural sensitivity of the species is considered to be moderate (Table 5.7). The national and international population estimates of this species are known (Table 5.6). The Shetland NHZ curlew population estimate is 4,227 pairs and without evidence to the contrary, the species is likely to be in FCS within Shetland.

5.8.96 There is relatively low variation in terms of site occupancy, with many territories occupied in both years of survey (e.g., there were ca. 16 breeding territories in 2018 and ca. 13 in 2019). Consequently, the breeding sites are considered relatively predictable in terms of annual occupancy.

5.8.97 With a maximum of 16 pairs of curlew within the four kilometre study area, all will be within the range of elevated noise levels associated with the operation of the launch facility. Table 5.23 outlines the maximum predicted dB levels on nesting curlew. From launch, the noise would rapidly (i.e., a matter of a small number of seconds) build from baseline to maximum, followed by a fairly rapid decrease back to baseline (tens of seconds).

Table 5.23 Maximum Predicted Decibel Levels at Curlew Nesting Locations

Pairs	Pad 1		Pad 2		Pad 3	
Curlew	Launch LAmax	Static LAmax	Launch LAmax	Static LAmax	Launch LAmax	Static LAmax
0-1 pair, 0-0.5km	120-130dB	110-130dB	120-130dB	110-130dB	120-130dB	110-130dB
2-3 pairs, 1-2km	100-110dB	90-100dB	100-110dB	100-110dB	90-110dB	90-110dB
5 pairs, 2-3km	90-100dB	90-100dB	90-100dB	90-100dB	90-100dB	80-100dB
5-8 pairs, 3-4km	90-100dB	80-90dB	90-100dB	80-90dB	90-100dB	80-90dB

5.8.98 There is no direct evidence to suggest that the noise at launch would impact on, and adversely affect the success of, all the breeding curlew within the study area and there is also no threshold noise metric against which compare potential effects on curlew. The literature review (Appendix 5.2) did not identify any directly relevant noise studies on breeding curlew or potentially analogous wader species (although it did note some evidence of noise disturbance impacts on wintering curlew). Based on current information it is not possible to predict likely responses of all breeding curlew to the noise caused by the launches, but it is considered that one-two regularly occupied territories would likely be adversely affected by operational noise during launches. Whether the pre-launch warning siren, followed by the low frequency rumble of the rocket, building to a maximum, followed by a rapid decrease back to baseline will be sufficient to allow the birds to cope with the noise is currently speculative. Based on the likely launch schedule, up to three launches would take place during the typical 28-day incubation period for curlew (Table 5.8). It should be noted that following the NatureScot consultation response (11 March 2021), commitment to a no-launch window whereby no satellite launches or static tests will be carried out between mid-May and the end of June has subsequently been made and this has been reflected in planning conditions for the Proposed Project.

5.8.99 If a worst-case scenario (*not likely*) is assumed (a failure for all study area breeding curlew directly related to a launch) then this would constitute an adverse impact on a maximum of 16 pairs out of Shetland's 4,227 pairs, i.e.,0.4 % of the regional curlew population (Table 5.9). However, based on the distribution of curlew territories and predicted responses of other waders, this worst-case scenario seems an unlikely scenario. If no such adverse response took place, then 0 % of the regional curlew population would be adversely affected. However, this is also considered unlikely given that one-two territories are located close enough to launch pads to assume that they would likely be adversely affected. Were that scenario to take place, this would constitute an adverse effect (loss) of 0.02-0.05 % of the regional curlew population.

5.8.100 Consequently, the potential magnitude of adverse impacts of operational disturbance combined on curlew would likely be **negligible** on the regional population, with **no likely significant effects** predicted. Although curlew is a species of high conservation importance, the likely effects are judged to be not significant, i.e., there would be no detectable regional population level impacts and so the Shetland NHZ would not be adversely affected. Therefore, if the Proposed Project was operational, the available information indicates that conservation status would not likely be affected because (as articulated using three tests SNH (2006) use to consider FCS):

- Curlew is likely to maintain itself on a long-term basis as a viable component of its habitat in the Shetland NHZ.
- The natural range of curlew in the Shetland NHZ would not be reduced by the Proposed Project, nor would it become likely to be reduced in the foreseeable future.
- There would be (and would continue to be) a sufficiently large habitat area in the Shetland NHZ to maintain the curlew population on a long-term basis should the Proposed Project be operated.

Arctic Tern

5.8.101 Arctic tern is a widespread coastal breeding summer visitor, with strongholds in Orkney and Shetland (Forrester and Andrews, 2007). Arctic tern is an Amber listed species and therefore of moderate conservation importance (Table 5.5). The behavioural sensitivity of the species at the nest is considered to be moderate (Table 5.7). The national and international population estimates of this species are known (Table 5.6). The Shetland NHZ population estimate is 24,716 AON and without evidence to the contrary, the species is likely to be in FCS within Shetland.

5.8.102 There is some variation in terms of site occupancy, with a few small breeding colonies present within the study area, which fluctuate annually in terms of occupancy.

5.8.103 With a maximum of 13 Arctic tern AON within the four kilometre study area, all will be within the range of elevated noise levels associated with the operation of the Proposed Project. Table 5.24 outlines the maximum predicted dB levels on nesting Arctic tern. From launch, the noise would rapidly (i.e., a matter of a small number of seconds) build from baseline to maximum, followed by a fairly rapid decrease back to baseline (tens of seconds).

Table 5.24 Maximum Predicted Decibel Levels at Arctic Tern Nesting Locations

Pairs	Pad 1		Pad 2		Pad 3	
Arctic tern	Launch LAmax	Static LAmax	Launch LAmax	Static LAmax	Launch LAmax	Static LAmax
8-13 pairs, 1-2km	100-110dB	90-100dB	100-110dB	100-110dB	90-110dB	90-110dB
0-1 pair, 2-3km	90-100dB	90-100dB	90-100dB	90-100dB	90-100dB	80-100dB

5.8.104 There is no direct evidence to suggest that the noise at launch would impact on, and adversely affect the success of, all the breeding Arctic tern within the study area and there is also no threshold noise metric against which compare potential adverse effects on Arctic tern. The literature review (Appendix 5.2) found that Arctic tern incubating behaviour is impacted by both fixed-wing aircraft and helicopters, with helicopters causing more disturbance to birds than fixed-wing aircraft, however human presence had a larger effect than aircraft disturbance. Based on current information it is not possible to predict likely responses of all breeding Arctic tern to the noise caused by the launches. Whether the pre-launch warning siren, followed by the low frequency rumble of the rocket, building to a maximum, followed by a rapid decrease back to baseline will be sufficient to allow the birds to cope with the noise is currently speculative. Based on the likely launch schedule, up to two launches would take place during the typical 22-day incubation period for Arctic tern (Table 5.8). It should be noted that following the NatureScot consultation response (11 March 2021), commitment to a no-launch window whereby no satellite launches or static tests will be carried out between mid-May and the end of June has subsequently been made and this has been reflected in planning conditions for the Proposed Project.

5.8.105 If a worst-case scenario (*not likely*) is assumed (a failure for all study area breeding Arctic tern directly related to a launch) then this would constitute an adverse impact on a maximum of 13 AON out of Shetland's 24,716 AON, i.e., 0.05 % of the regional Arctic tern population (Table 5.9). However, given the distance between the small Arctic tern colonies and rocket launch sites, this worst-case scenario seems an unlikely scenario. If no such adverse response took place, then 0 % of the regional Arctic tern population would be adversely affected and this seems most likely.

5.8.106 Consequently, the potential magnitude of adverse impacts of operational disturbance combined on Arctic tern would likely be **negligible** on the regional populations, with **no likely significant effects** predicted. Although Arctic tern is a species of moderate conservation importance, the likely effects are judged to be not significant, i.e., there would be no detectable regional population level impacts and so the Shetland NHZ would not be adversely affected. Therefore, if the Proposed Project was operational, the available information indicates that conservation status would not likely be affected because (as articulated using three tests SNH (2006) use to consider FCS):

- Arctic tern is likely to maintain itself on a long-term basis as a viable component of its habitat in the Shetland NHZ.
- The natural range of Arctic tern in the Shetland NHZ would not be reduced by the Proposed Project, nor would it become likely to be reduced in the foreseeable future.
- There would be (and would continue to be) a sufficiently large habitat area in the Shetland NHZ to maintain the Arctic tern population on a long-term basis should the Proposed Project be operated.

Arctic Skua

5.8.107 Arctic skua is a localised and apparently declining breeding species in Scotland (Forrester and Andrews, 2007). Arctic skua is a Red list species and therefore of high conservation importance (Table 5.5). The behavioural sensitivity of the species is considered to be moderate at the nest

(Table 5.7). The national and international population estimates of this species are known (Table 5.6). The Shetland NHZ population estimate is 516 pairs and without evidence to the contrary, the species is unlikely to be in FCS within Shetland.

5.8.108 There is annual variation in terms of site occupancy, but some territories were occupied in both years of survey (there were five breeding territories in 2018 and 2019). Consequently, some of the breeding sites are relatively predictable in terms of annual occupancy.

5.8.109 With a maximum of five pairs of Arctic skua within the four kilometre study area, all will be within the range of elevated noise levels associated with the operation of the Proposed Project. Table 5.25 outlines the maximum predicted dB levels on nesting Arctic skuas.

Table 5.25 Maximum Predicted Decibel Levels at Arctic Skua Nesting Locations

Pairs	Pad 1		Pad 2		Pad 3	
Arctic skua	Launch LAmax	Static LAmax	Launch LAmax	Static LAmax	Launch LAmax	Static LAmax
1 pair, 0.5-1km	110-120dB	100-110dB	110-120dB	100-110dB	100-110dB	100-110dB
1-2 pairs, 1-2km	100-110dB	90-100dB	100-110dB	100-110dB	90-110dB	90-110dB
2-3 pairs, 2-3km	90-100dB	90-100dB	90-100dB	90-100dB	90-100dB	80-100dB

5.8.110 There is no direct evidence to suggest that the noise at launch would impact on, and adversely affect the success of, all the breeding Arctic skua within the study area and there is also no threshold noise metric against which compare potential effects on Arctic skua. The literature review (Appendix 5.2) did not identify any directly relevant noise studies on breeding Arctic skua or potentially analogous species. Based on current information it is not possible to predict likely responses of all breeding Arctic skua to the noise caused by the launches, but it is considered that one regularly occupied territory (approximately 600 m away from the most westerly launch pad) would likely be adversely affected by operational noise during launches. Whether the pre-launch warning siren, followed by the low frequency rumble of the rocket, building to a maximum, followed by a rapid decrease back to baseline will be sufficient to allow the birds to cope with the noise is currently speculative. Based on the likely launch schedule, up to three launches would take place during the typical 27-day incubation period for Arctic skua (Table 5.8). It should be noted that following the NatureScot consultation response (11 March 2021), commitment to a no-launch window whereby no satellite launches or static tests will be carried out between mid-May and the end of June has subsequently been made and this has been reflected in planning conditions for the Proposed Project.

5.8.111 If a worst-case scenario (*not likely*) is assumed (a failure for all study area breeding Arctic skua directly related to a launch) then this would constitute an adverse impact on a maximum of five pairs out of Shetland's 516 pairs, i.e., 0.97 % of the regional Arctic skua population (Table 5.9). However, given the distance away of some territories, this worst-case scenario seems an unlikely scenario. If no such adverse response took place, then 0 % of the regional Arctic skua population would be adversely affected. However, this is also considered unlikely given that one territory is located close enough to launch pads to assume that they would likely be adversely affected. Were that scenario to take place, this one pair would constitute an adverse effect (loss) on 0.19 % of the regional Arctic skua population.

5.8.112 Consequently, the potential magnitude of adverse impacts of operational disturbance combined on Arctic skua would likely be **negligible** on the regional population, with **no likely significant effects** predicted. Although Arctic skua is a species of high conservation importance, the likely effects are judged to be not significant, i.e., there would be no detectable regional population level impacts and so the Shetland NHZ would not be adversely affected. Therefore, if the Proposed Project was operational, the available information indicates, that the conservation status would not likely be affected because (as articulated using three tests SNH (2006) use to consider FCS):

- Arctic skua is likely to maintain itself on a long-term basis as a viable component of its habitat in the Shetland NHZ.
- The natural range of Arctic skua in the Shetland NHZ would not be reduced by the Proposed Project, nor would it become likely to be reduced in the foreseeable future.
- There would be (and would continue to be) a sufficiently large habitat area in the Shetland NHZ to maintain the Arctic skua population on a long-term basis should the Proposed Project be operated.

Great Skua

5.8.113 Great skua is a localised breeding species in Scotland (Forrester and Andrews, 2007). Great skua is an Amber listed species and therefore of moderate conservation importance (Table 5.5). The behavioural sensitivity of the species is considered to be low at the nest (Table 5.7). The national and international population estimates of this species are known (Table 5.6). The Shetland NHZ population estimate is 6,846 pairs and without evidence to the contrary, the species is likely (in the long-term) to be in FCS within Shetland. A study of abundance data in Scotland from 1992 to 2015 indicated that great skuas increased at most sites, with some very large increases at smaller colonies. However, declines at the two largest colonies (Foula and Hoy) resulted in little overall change in AOTs across all colonies combined (https://jncc.gov.uk/our-work/great-skua-stercorarius-skua/#conservation-status: Accessed August 2020).

5.8.114 The difficulties in distinguishing between non-breeding and breeding pairs holding territory, makes estimates of annual site occupancy challenging (unless undertaken as part of detailed single species monitoring). Consequently, the study area surveys do not provide sufficient information to comment on annual site occupancy in any detail. At best, the study area surveys provide evidence of breeding pairs in the low tens, with breeding mainly concentrated over three kilometres away from the Proposed Project around Saxa Vord hill.

5.8.115 With tens of pairs of great skua within the four kilometre study area, all will be within the range of elevated noise levels associated with the operation of the Proposed Project (Drawing 5.21). Table 5.26 outlines the maximum predicted dB levels on nesting great skuas. From launch, the noise would rapidly (i.e., a matter of a small number of seconds) build from baseline to maximum, followed by a fairly rapid decrease back to baseline (tens of seconds).

Table 5.26 Maximum Predicted Decibel Levels at Great Skua Nesting Locations

Pairs	Pad 1		Pad 2		Pad 3	
Great skua	Launch LAmax	Static LAmax	Launch LAmax	Static LAmax	Launch LAmax	Static LAmax
Low tens of pairs, 3-4km	90-100dB	80-90dB	90-100dB	80-90dB	90-100dB	80-90dB

5.8.116 There is no direct evidence to suggest that the noise at launch would impact on, and adversely affect the success of, all the breeding great skua within the study area and there is also no threshold noise metric against which compare potential effects on great skua. The literature review (Appendix 5.2) did not identify any directly relevant noise studies on great skua or potentially analogous species. Based on current information it is not possible to predict likely responses of all breeding great skua to the noise caused by the launches. Nevertheless, with most of the tens of pairs 3-4 km away from the Proposed Project, few if any breeding pairs would likely be adversely affected by operational noise during launches. Whether the pre-launch warning siren, followed by the low frequency rumble of the rocket, building to a maximum, followed by a rapid decrease back to baseline will be sufficient to allow the birds to cope with the noise is currently speculative. Based on the likely launch schedule, up to three launches would take place during the typical 29-day incubation period for great skua (Table 5.8). It should be noted that following the NatureScot consultation response (11 March 2021), commitment to a no-launch window whereby no satellite launches or static tests will be carried out between mid-May and the end of June has subsequently been made and this has been reflected in planning conditions for the Proposed Project.

5.8.117 If a worst-case scenario (*not likely*) is assumed (a failure for all study area breeding great skua directly related to a launch) then this would constitute an adverse impact on a maximum of low tens of pairs out of Shetland's 6,846 pairs, i.e., <1 % of the regional great skua population (Table 5.9). However, given the large distance away of most breeding territories, this worst-case scenario seems an unlikely scenario. If no such adverse response took place, then 0 % of the regional great skua population would be adversely affected and this seems most likely.

5.8.118 Consequently, the potential magnitude of adverse impacts of operational disturbance combined on great skua would likely be **negligible** on the regional population, with **no likely significant effects** predicted. Although great skua is a species of moderate conservation importance, the likely effects are judged to be not significant, i.e., there would be no detectable regional population level impacts and so the Shetland NHZ would not be adversely affected. Therefore, if the Proposed Project was operational, the available information indicates that conservation status would not likely be affected because (as articulated using three tests SNH use to consider FCS):

- Great skua is likely to maintain itself on a long-term basis as a viable component of its habitat in the Shetland NHZ.
- The natural range of great skua in the Shetland NHZ would not be reduced by the Proposed Project, nor would it become likely to be reduced in the foreseeable future.
- There would be (and would continue to be) a sufficiently large habitat area in the Shetland NHZ to maintain the great skua population on a long-term basis should the Proposed Project be operated.

Natural Capital

5.8.119 Informal discussions with local birdwatchers and whale watchers raised a concern that access to the favoured tip of Lamba Ness might be curtailed by the Proposed Project. As a consequence of this, a new dedicated wildlife watching hide and path too it will be built. Details of the wildlife watching hide are provided in Appendix 5.3 Outline Habitat Management Plan.

5.9 Additional Mitigation

5.9.1 The Outline Habitat Management Plan identifies seven main objectives, three of which are focussed on breeding Schedule 1 bird species. Two of these objectives target mitigation for species likely to be adversely affected by the Proposed Project (one where there is a predicted likely significant effect) and one is better described as a biodiversity enhancement as the objective is for a receptor where no adverse or likely significant effects are predicted.

5.9.2 The details of this mitigation specifically mention Schedule 1 breeding bird nesting locations/territories and so consequently it has been provided separately.

5.10 Residual Effects

5.10.1 No likely significant residual effects are predicted.

5.11 Cumulative Assessment

5.11.1 Cumulative effects can result from individually insignificant but collectively significant actions taking place over a period of time or concentrated in a location (CIEEM, 2018). This guidance goes on to say that "*developments to be included in the cumulative impact assessment should be in accordance with national guidance*".

5.11.2 SNH provides no advice or guidance in relation to the cumulative impacts of a spaceport. CIEEM (2018) state in relation to cumulative assessment that "*Information about developments within the zone(s) of influence may be available in other EcIAs, Local Plan documents, Marine Spatial Plans, Strategic Environmental Assessments (SEAs), Sustainability Appraisals (SAs), Water Framework Directive Assessments (WFDAs), and Habitats Regulations Assessments/Appraisals (HRAs), including 'Natura Impact Statements' (NISs) / 'Natura Impact Reports' (NIRs), 'Information / 'Reports to Inform an Appropriate Assessment', 'Shadow Habitats Regulations Assessments' and, for Nationally Significant Infrastructure Projects, 'Reports on the Implications for European Sites' (RIES)*".

5.11.3 The ornithological study area (out to four kilometres from the Proposed Project) is an equivalent to the potential 'zone of influence' and as there are no existing or proposed developments within that area, no significant issues are considered likely to arise from inter-project additive or cumulative effects.

5.11.4 Intra-project cumulative effects are those where an environmental topic/receptor is affected by more than one impact from the same Proposed Project and the impacts act together. The interactions between noise and ornithology have been identified and assessed within this chapter, and no other environmental topic are considered likely to give rise to potential intra-project cumulative effects.

5.12 Summary

5.12.1 Targeted and licensed breeding bird surveys were undertaken following agreed standardised survey methods between 2018 and 2020 within the ornithological study area. A total of 135 bird species were recorded during breeding bird surveys. There was direct evidence of potentially sensitive and specially protected bird species breeding within, and adjacent to, the Proposed Project boundary.

5.12.2 Ornithological designated site interests on the Hermaness, Saxa Vord and Valla Field SPA (and overlapping Hermaness SSSI and Saxa Vord SSSI) and the following non-designated wider countryside ornithological birds are taken forward for assessment: red-throated diver, merlin, black guillemot, common guillemot, puffin, razorbill, shag, kittiwake, fulmar, ringed plover, golden plover, whimbrel, curlew, dunlin, Arctic tern, Arctic skua, great skua and a confidential Schedule 1 species.

5.12.3 To understand potential impacts of loud, short duration noise events, a background literature review of noise impacts on relevant bird species was undertaken. This literature review looked at how impulsive noise (from various sources including aircraft, fireworks, military ranges and rocket launches) impacted on birds in order to help assess the potential noise impacts of the launches.

5.12.4 Potential impacts have been assessed for the operational phase of the Proposed Project. The magnitude of predicted operational effects is either 'no effect' or 'negligible' for all bird species except one, a confidential Schedule 1 species. For this species, minor magnitude operational effects were considered likely to be significant in the absence of mitigation; however, after mitigation, all residual effects are predicted likely to be not significant.

5.12.5 Confidential bird species information has been submitted to and assessed previously by the local planning authority, as part of the planning process for the Proposed Project.

5.12.6 A summary of the magnitude of predicted effects on target study area wider countryside bird species is provided in Table 5.27.

Table 5.27 Significance of Residual Effects on Target Species

Species	Significance of Residual Effect
Red-throated diver	No likely significant effect
Black guillemot	No likely significant effect
Common guillemot	No likely significant effect

Species	Significance of Residual Effect
Puffin	No likely significant effect
Razorbill	No likely significant effect
Shag	No likely significant effect
Kittiwake	No likely significant effect
Fulmar	No likely significant effect
Merlin	No likely significant effect
Ringed plover	No likely significant effect
Golden plover	No likely significant effect
Dunlin	No likely significant effect
Whimbrel	No likely significant effect
Curlew	No likely significant effect
Confidential Schedule 1 species*	No likely significant effect
Arctic tern	No likely significant effect
Arctic skua	No likely significant effect
Great skua	No likely significant effect

*Minor magnitude operational effects were considered likely to be significant before mitigation. After mitigation applied, effects are predicted likely to be not significant

5.12.7 As regards the existing use of 'Natural Capital' on the site, the Applicant has agreed to provide a purpose built wildlife watching hide within the boundary for locals and visitors to use at the tip of Lamba Ness. The Applicant is willing to consider potential community ownership of the wildlife watching hide and also contribute towards providing an annual maintenance budget for hide repairs and improvements.

5.12.8 After mitigation, all residual effects are predicted likely to be not significant.

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Chapter 6 Ecology

6. Ecology and Biodiversity

6. Ecology and Biodiversity

6.1 Introduction

6.1.1 This AEE Report chapter considers the likely effects of the Proposed Project on ecological receptors at the site and surrounding study areas. This assessment is based upon comprehensive baseline data, comprising specifically targeted ecological surveys of potentially important and legally protected ecological receptors identified during the desk study and consultation feedback. It draws on pre-existing information, where appropriate, survey data and Chartered Institute for Ecology and Environmental Management (CIEEM) best practice guidance. The scope of the ecological assessment excludes potential impacts on birds, which are considered separately in Chapter 5.

6.1.2 Alba Ecology Ltd. led on all aspects of the ecological fieldwork and assessment in association with the Proposed Project. Alba Ecology is a Scottish-based multi-disciplinary ecological consultancy that has worked in the north of Scotland, and Shetland specifically, for many years. Alba Ecology's staff have led on and contributed to all aspects of Ecological Impact Assessment (EcIA) on many large-scale development projects, including the management of Ecological Clerks of Work teams, principal ornithological/ecological surveyors and advisors on planning applications, expert witness advice at Public Local Inquiry and production EcIA Reports, Habitat Regulations Assessments and Habitat Management Plans.

6.1.3 The ecological surveyors used in the study areas between 2018 and 2020 were Dr Peter Cosgrove, Mr Brydon Thomason, Dr Fergus Massey and Dr Kate Massey.

6.1.4 The aforementioned surveyors have extensive ecological field experience of Shetland, and Unst specifically, and have attended regular training events led by experts, covering areas such as species identification, recording data concisely and accurately, navigation techniques and health and safety. Surveyors were trained to carry out surveying and mapping work in a systematic manner, following recognised standardised survey methods. When ecological surveys required working near birds listed in Schedule 1 of the Wildlife and Countryside Act 1981 (and as amended) in the breeding season they were covered by relevant SNH Schedule 1 Bird Licences.

6.1.5 This Chapter is supported by the following documents:

- Appendix 6.1: Natural Heritage Desk Study.
- Appendix 6.2: Phase 1 Habitat, National Vegetation Classification (NVC) and Potential Groundwater dependent Terrestrial Ecosystem (GWDTE) Survey Report.
- Appendix 6.3: Otter Survey Report.
- Appendix 6.4: Freshwater Pearl Mussel Survey Report.
- Appendix 5.3: Outline Habitat Management Plan.

6.1.6 This Chapter should be read alongside other Chapters within the AEE Report, particular Chapters 2, 3, 5, 9, 10 and 12.

6.1.7 The assessment involved the following key stages:

- Reference to relevant legislation, policy and guidance.
- Identification of likely environmental zone of influence (EZI) of the Proposed Project.
- Identification of potentially important ecological receptors likely to be affected (baseline conditions) by the Proposed Project.
- Evaluation of important ecological receptors and features likely to be affected by the Proposed Project.

- Identification of likely impacts and magnitude of the Proposed Project works on important ecological receptors.
- Assessment of the likely significant effects of the Proposed Project, including any mitigation and enhancement measures and definition of any residual significant effects.

6.1.8 The term '*receptor*' is used throughout this AEE process and is defined as the element in the environment affected by a Project (e.g., a species or habitat in the case of ecology). The term '*impact*' is also used commonly throughout the AEE process and is defined as a change experienced by a receptor (this can be beneficial, neutral or adverse). The term '*effect*' is defined as the consequences for the receptor of an impact.

6.2 Legislation, Policy and Guidelines

Legislation

Space Industry Act

6.2.1 The Space Industry Act (2018) regulates all spaceflight activities carried out in the United Kingdom, and associated activities. The Act requires any person or organisation to obtain the relevant licence to:

- launch a launch vehicle from the UK;
- return a launch vehicle launched elsewhere than the UK to the UK landmass or the UK's territorial waters;
- operate a satellite from the UK;
- conduct sub-orbital activities from the UK;
- operate a spaceport in the UK; or
- provide range control services from the UK.

6.2.2 As the Applicant wishes to operate a vertical spaceport (at the SaxaVord Spaceport) and provide range control services (at the Launch and Range Control Centre, LRCC) they are required to apply for a both a spaceport licence and a range control licence. However, AEE is only relevant to applications for spaceport licences.

Space Industry Regulations 2021

6.2.3 The Space Industry Regulations 2021 (the Regulations) set out in more detail the requirements for each licence the Regulators Licensing rules, which specify what information the UK Civil Aviation Authority (CAA), the regulator, requires in support of an application.

Policy Context

6.2.4 Further relevant legislation and best practice guidance documents have been reviewed and taken into account as part of this ecological assessment. The approach used to assess the significance of likely effects of the Proposed Project upon ecological receptors is set in the context of:

- The Wildlife and Countryside Act 1981 (as amended);
- European Commission (EC) (2011) European Biodiversity Strategy;
- European Commission (EC) (2020). European Biodiversity Strategy;
- EC Directive 1992/43/EEC on the conservation of natural habitats and of wild fauna and flora. The so-called 'Habitats Directive';
- The Conservation (Natural Habitats) Regulations 1994. The so-called Habitats Regulations;

- The Conservation of Habitats and Species Regulations 2010;
- The Nature Conservation (Scotland) Act 2004 (as amended);
- Scottish Government PAN 1/2013;
- Scottish Government Planning Circular 1 2017: The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017;
- Guidelines for Ecological Impact Assessment in the UK and Ireland (CIEEM, 2016; 2018);
- Scottish Government. The Scottish Biodiversity List (SBL);
- Scottish Government 2014. Scottish Planning Policy;
- Scottish Government 2020. The Environment Strategy for Scotland: vision and outcomes;
- Biodiversity Net Gain: Good practice principles for development: A practical guide. (CIRIA, CIEEM and IEMA 2019);
- Biodiversity New Gain in Scotland, CIEEM Scotland Policy Group, 2019;
- Strategic Plan for Biodiversity 2011-2020. Convention on Biological Diversity;
- Land-use planning system Scottish Environment Protection Agency (SEPA) Guidance Note 31: Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems. LUPG-GU31 Version 3 (SEPA, 2017);
- The Shetland Local Development Plan (2014);
- The Shetland Local Development Plan Supplementary Guidance (2018); and
- Living Shetland Local Biodiversity Action Plan (LBAP) documents.

6.2.5 Scottish Planning Policy (Scottish Government, 2014) sets out the Scottish Government's national planning policies for the protection of biodiversity through the planning system. This seeks to ensure that projects provide biodiversity benefits where possible, not simply to avoid significant adverse effects. These policies are incorporated into development plans and are a material consideration in the determination of development proposals.

6.2.6 The UK Biodiversity Action Plan (BAP) was the UK Government's 2004 response to the Convention on Biological Diversity, to which the UK was a signatory. Action plans for the most threatened species and habitats (called 'UK BAP species and habitats') were set out to aid recovery. Following the publication of the Convention on Biological Diversity's 'Strategic Plan for Biodiversity 2011–2020' (Convention on Biological Diversity, 2010), its commitment to 20 'Aichi targets', agreed at Nagoya Japan in October 2010, and the launch of the European Biodiversity Strategy in May 2011 the UK Government has changed its strategic thinking.

6.2.7 The Scottish Biodiversity List (SBL) is a list of animals, plants and habitats that Scottish Ministers consider to be of principal importance for biodiversity conservation in Scotland, under the Nature Conservation (Scotland) Act 2004. The SBL therefore supersedes the UK BAP list of species and habitats (CIEEM, 2017). Nevertheless, since most current planning policy and SNH guidance requires consideration of, and makes explicit reference to, UK BAP species and habitats and the definitions of SBL habitats are largely based on UK BAP definitions, these are still referred to where necessary.

6.2.8 The Shetland Local Development Plan (2014) contains policies and objectives to conserve and enhance the habitats and species that contribute to the unique character and heritage of Shetland. It has links to Supplementary Guidance on Local Nature Conservation Sites in Shetland and Supplementary Guidance on Natural Heritage. This guidance is provided to aid planning applicants and their agents when considering development in relation to their biodiversity responsibilities.

6.2.9 Whilst considering a range of potential outcomes that could arise from the Proposed Project, the assessment reports the effects that are considered likely to be significant on the basis of evidence, standard guidance and professional judgement. It is these likely significant effects that the Applicant is obliged to report, and that the decision maker is obliged to consider.

Relevant Guidance

Guidance for the Assessment of Environmental Effects

6.2.10 The CAA, with the UK Space Agency, the Department for Business, Energy and Industrial Strategy and the Department for Transport, issued guidance note 'Guidance for the Assessment of Environmental Effects' in July 2021. The guidance sets out what is required by the regulator regarding assessment of environmental effects as part of a licence application under the Act.

6.2.11 The AEE Guidance requires that potential direct and indirect significant effects of proposed spaceflight activities on environmental features, including ecology, are considered. The guidance further requires that:

- Specific potential effects are identified and, where possible, quantified;
- The focus of the AEE should be on significant effects arising from the proposed activities;
- Applicants for a spaceport licence set an environmental budget, comprising a maximum number of launches per launch vehicle type which can take place over the course of a year that can be carried out in an environmentally sustainable manner, taking into account the cumulative effect of all launches; and
- The AEE must address a range of environmental topics, including ecology and biodiversity.

Guidance to the regulator on environmental objectives relating to the exercise of its functions under the Space Industry Act 2018

6.2.12 The Department for Transport issued its document '*Guidance to the regulator on environmental objectives relating to the exercise of its function under the Space Industry Act 2018*' in 2021, clarifying the government's environmental objectives relating to spaceflight and associated activities in the UK:

The environmental objective for spaceflight are to:

- *Minimise emissions contributing to climate change resulting from spaceflight activities;*
- *Protect human health and the environment from the impacts of emissions on local air quality arising from spaceflight activities;*
- *Protect people and wildlife from the impacts of noise from spaceflight activities; and*
- *Protect the marine environment from the impact of spaceflight activities.*

6.2.13 The objectives presented in the guidance are noted to be consistent with the environmental topics that must be addressed in an AEE.

6.3 Consultation

6.3.1 Extensive statutory consultation on ecology was carried out during preparation and determination of the planning application for the SaxaVord Spaceport, where the Proposed Project will be operated. Where directly relevant to this AEE, consultation responses received during the SaxaVord Spaceport planning application period have been summarised in Table 6.1.

Table 6.1 Consultation relevant to this AEE

Consultee	Summary Ecological Response	Where and How Addressed
Scottish Natural Heritage (SNH; now NatureScot) 16/02/18	Otters "*Otters are protected by law, making it an offence to disturb one in a holt or whilst it is caring for its young, or to destroy, damage or obstruct access to a holt*" SNH provided a link to SNH's standing advice on otters (in May 2020 this was superseded by NatureScot standing advice on otters, which is essentially the same as the previous SNH standing advice). SNH provided standing advice for planning consultation with regard to otter. It states that "*this is standing advice to help planning applicants seeking permission for development that could affect otters, and to assist planning officers and other regulators in their assessment of these applications. It avoids the need for us to advise on individual planning consultations in relation to otters. We will only provide further advice in exceptional circumstances that are not covered by this standing advice*". SNH went on to say that "*in Shetland, otters are predominantly coastal animals, however natal holts (places of shelter where cubs are born and reared) are usually hidden inland and away from watercourses...If a holt is found it may be necessary to submit a species protection plan with your planning application and consider whether a licence might be required for the development*".	Otter surveys are reported in Appendix 6.3 and are considered throughout this Chapter.
SNH (NatureScot) 16/02/18	Plants "*The key plant species, referred to in the Alba Ecology report, are the Shetland endemic Edmondston's chickweed (Cerastium nigrescens) and serpentine dandelion (Taraxacum serpenticola), nationally rare Norwegian sandwort (Arenaria norvegica) and nationally scarce northern rock-cress (Arabis petraea), all of which have very limited distributions in areas with ultrabasic "serpentine" bedrock with natural or semi-natural vegetation. Only the*	The airport is not included in the Planning Application; therefore, no specific rare plant surveys were reported in the EIA Report. A detailed Phase 1 Habitat and NVC survey was conducted during the standard field season. Although this does not constitute a formal floristic survey, or rare plants survey, plant species were recorded where they were encountered. Plants species records are listed in Appendix 7.1

Consultee	Summary Ecological Response	Where and How Addressed
	former RAF camp and Baltasound airport are in serpentine areas, and on the first of these the vegetation has been highly modified so none of these species is likely to be present. Consequently, the proposed rare plant survey can be restricted to the airport".	and are considered in Sections 7.4, 7.5 and 7.7. Habitats and, associated plant species are reported in Appendix 7.2 and considered in Sections 7.3, 7.4, 7.5 and 7.7.
SNH (NatureScot) 16/02/18	Marine mammals "*Noise and vibration from onshore activity close to the coast, such as drilling and blasting (and potentially rocket launching) can affect cetaceans so should not be scoped out at this stage, however there is no need for a survey of marine mammals as the assessment of potential impacts and any necessary mitigation can be generic in nature*."	Marine mammals are considered in Chapter 10.

6.3.2 Given the geographical location and habitats present, and in consultation with SNH, the protected mammal survey focussed on determining the potential presence of otter (*Lutra lutra*). All terrestrial mammal species in Shetland are non-native having been introduced by humans over time (Johnston, 1999). Neither SNH nor CIEEM provide guidance on determining the value of non-native species, so professional judgement and general guidance from the Invasive Non-native Species Framework Strategy for Great Britain has been used (DEFRA, 2015). This suggests that non-native species should not be considered as valuable or important ecological receptors. This approach was also used at the Viking Wind Farm, Beaw Field Wind Farm and Mossy Hill Wind Farm. SNH and SIC agreed with the intention to scope out non–native terrestrial mammal species within a Shetland context, with the exception of otter, which is a European Protected Species (EPS).

6.3.3 Marine mammals are considered separately in Chapter 10.

6.3.4 Consultation and best practice guidance identified key ecological surveys required to consider the potential impacts of the Proposed Project on ecology. These studies included:

- a natural heritage desk study;
- a Phase 1 Habitat survey;
- a National Vegetation Classification (NVC) survey;
- a Groundwater Dependent Terrestrial Ecosystem (GWDTE) survey;
- an otter survey; and,
- a freshwater pearl mussel survey.

6.3.5 Full details of ecological survey methodologies and results can be found in Appendices 6.1 to 6.4 inclusive.

6.4 Assessment Methodology and Significance Criteria

Consultation

6.4.1 In accordance with CIEEM best practice guidance, consultation was undertaken with SNH on the nature and scale of surveys in February 2018.

Study Area

6.4.2 The following geographic definitions are used in this Chapter and associated Appendices (Drawings 6.1 and 6.2 and Table 6.2).

Table 6.2 Site and Study Area Definitions

Term	Definition
The site	This refers to all of the land within the Proposed Project boundary.
The Development Footprint	This refers to the footprint of the infrastructure within the planning application boundary.
The Study Area	The study area equates to the land within the Proposed Project boundary which was considered to have potential for development, plus an appropriate survey buffer. This can be variable depending on the ecological receptor and is described in the relevant appendices. For habitats the study area equates to the site plus a ca. 100 meters (m) or 250 m buffer, excluding private properties and gardens. For otters the study area was the site plus a 500 m buffer. In this Chapter two study areas are referred to: ➢ The Habitats study area, which is the Proposed Project Site at Lamba Ness plus a 250 m buffer, for habitats and vegetation communities. ➢ The Otter study area, which is the Proposed Project Site at Lamba Ness plus a 500 m buffer, for otters. These are shown in Drawing 6.1.

6.4.3 The Proposed Project provides the basic infrastructure for space vehicle launches. The Applicant is looking to achieve a maximum of 30 launch events per year from the Proposed Project. However, in the first year of operation (2022) it is anticipated that there will be up to 10 launches, made up of both orbital and sub-orbital rockets.

6.4.4 The main elements of the Proposed Project which have the potential to impact on ecological receptors during operation are described in Chapter 3 and include:

- Launch Site: located on the Lamba Ness peninsula and comprising three launch pad complexes, each incorporating a launch pad, ground services storage and control, lightning protection masts, liquid and compressed gas storage and water deluge tanks for launch operations;
- Satellite Tracking Station: an area of hardstanding housing satellite tracking, and telemetry devices located on the Lamba Ness peninsula;
- Launch Site Processing Facility (LSPF) hangar buildings (two): located on the Lamba Ness peninsula, a building where the LVs are assembled, and the payload (the satellites) integrated into the LVs;

- Administration Building, Pyrotechnics Store, and Hazardous Materials Store located adjacent to the LSPF on the Lamba Ness peninsula;
- Integration Hangar/TEL building: located on the Lamba Ness peninsula, a forward position building close to the launch pads housing the transporter erector launcher (TEL) and where the final integration activities take place as required;
- Support Infrastructure: located on the Lamba Ness peninsula including access, an internal track system and a series of small temporary buildings;
- Gate House, including a tourist information area, located on the Lamba Ness peninsula; and
- Wildlife Hide: located on the Lamba Ness peninsula.

6.4.5 The 'environmental zone of influence (EZI)' for a project is the area over which ecological receptors may be affected by biophysical changes as a result of the Proposed Project (CIEEM, 2018). The EZI will vary for different ecological receptors depending on their sensitivity to, and nature of, an environmental change. The EZI can extend beyond the site and the study areas, particularly in the context of hydrological connectivity and potential pollution events. However, the study area for each receptor is considered an appropriate zone of influence for the vast majority of ecological receptors.

6.4.6 For habitats, the EZI (study area) is considered to be straight forward and is defined as the Proposed Project site plus a buffer, which equates to the study area. The Proposed Project Site Habitats study area has a 250 m buffer in accordance with SEPA's guidance for GWDTE assessments (SEPA, 2017).

6.4.7 Assessing the potential effects of disturbance on other ecological receptors, such as otters, is a more complex issue which will vary depending on the type of disturbance (e.g., routine/predictable verses unusual/unexpected), topography, vegetation and the behaviour/tolerance of the receptor species and even different individuals within species.

6.4.8 SNH's standing guidance (no date) states that "*otters could be affected by a development proposal anywhere in Scotland close to a water course, wetland, coastline or estuary. An otter survey should be carried out for any proposal within 200 m of these habitats*". Whilst this is in accordance with best practice guidance e.g., Chanin (2003), the potential noise and vibration from the satellite launches could be considerable. Furthermore, at the time of pre-application consultation (2018) and determination of the study area, there was no information on predicted noise levels available. Consequently, this 200 m survey buffer was not necessarily considered an adequate basis on which to determine the size of the otter study area.

6.4.9 There is no standard guidance on potential disturbance (and so survey) distances for satellite launch facilities. At the time of pre-application consultation, it was not possible, based on previous experience or published information, to determine what might be likely in the context of this development and so a precautionary approach to determining the size of the study area was considered and adopted in line with CIEEM (2018) best practice guidance.

6.4.10 Given the lack of any empirical evidence or guidance on the potential impact of satellite launches on otters, it was decided that at least doubling the standing guidance for determining survey area, from a 200 m to a 500 m buffer was a legitimate precautionary basis on which to proceed with otter surveys. Consequently, the size of the otter study areas (Drawing 6.1) was considerably larger than the Proposed Project boundary area and it was centred on indicative launch pad locations provided by the Applicant during pre-application consultation discussions in 2018.

6.4.11 Surveys continued where, in the professional judgement of the surveyor, otter signs may have occurred just outwith the survey buffer in potentially suitable and contiguous habitats e.g., along watercourses.

6.4.12 A plan showing the EZI for both the habitats and otter assessments is included as Drawing 6.1.

Survey Approach

6.4.12 A reconnaissance site visit by Dr Peter Cosgrove in late autumn 2017 determined that the Proposed Project area was predominantly open coastal/upland habitat characterised by peatland, grassland and sea cliffs (plus some buildings and associated hard standings). The principal land use was sheep grazing through crofting and common grazings.

6.4.13 The ecological surveys included a desk study of historical information sources and a series of targeted field surveys of potentially important and/or legally protected ecological receptors. All the ecology field surveys were undertaken by experienced ecological surveyors using recognised survey methods, during suitable times of year and under suitable weather conditions for the habitats and species concerned. Any departures from standard guidance are explicitly stated and reasons for the departure given.

Desk Study

6.4.14 An initial desk study was conducted in 2017 using the SNH's SiteLink website and Shetland Biological Records Centre data held for the Search Area. This was supplemented by existing knowledge of Unst. Given the time gap between 2017 and the current planning submission, the exercise was repeated from the same data providers, alongside up to date information from the National Biodiversity Network (NBN) Atlas; a collaborative partnership created to exchange biodiversity information. This information was then compiled into a technical report (Appendix 6.1).

6.4.15 All known records of potentially important ecological receptors within at least a one kilometre (km) radius of the Proposed Project were identified. All designated sites with ecological qualifying features within a 10 km radius of the Proposed Project were also identified.

Field Surveys

Phase 1 Habitat Survey

6.4.16 A Phase 1 Habitat survey was conducted in July 2018 and updated in July 2020. The vegetation was described and mapped following the methods described in the Joint Nature Conservation Committee (JNCC) Handbook for Phase 1 Habitat surveys (JNCC, 2010), the revised field manual (JNCC, 2012). Details of the survey methodology and results are provided in Appendix 6.2.

National Vegetation Classification (NVC) Survey

6.4.17 A NVC survey was conducted in July 2018 and updated in July 2020. The vegetation was classified and mapped following the methods described in the JNCC National Vegetation Classification User's Handbook (Rodwell, 2006). Details of the survey methodology and results are provided in Appendix 6.2.

Potential Groundwater Dependent Terrestrial Ecosystem (GWDTE) Survey

6.4.18 Wetland habitats were identified in July 2018 and updated in July 2020 as part of the Phase 1 Habitats and NVC vegetation surveys, in accordance with the Functional Wetland Typology (SNIFFER, 2009a, 2009b). Where wetlands were identified, an assessment was made as to whether they were likely to be potential GWDTEs as defined by SEPA (SEPA, 2017). Details of the survey methodology and results are provided in Appendix 6.2.

Peatland Condition Assessment (PCA)

6.4.19 A PCA was undertaken in July 2018 and updated in July 2020 as part of the Phase 1 Habitats and NVC vegetation surveys, in accordance with the Peatland Action Guidance (Peatland Action, 2016). Details of the assessment methodology and results are provided in Appendix 6.2.

Otter Survey

6.4.20 The Proposed Project Site Otter study area was surveyed under SNH licence for otters in 2018 and 2020 by Brydon Thomason, a highly experienced and locally based otter surveyor, with unparalleled practical experience of working on otters on Unst.

6.4.21 A typical/standard otter survey often involves a single survey visit. However, otters are known to be seasonal in their use of certain habitats and so single visits can underestimate occupancy or seasonal use of an area. To ensure that a robust assessment of otter activity was undertaken and the use by otters understood, the Otter study area was surveyed during June and October 2018 and again in July 2020.

6.4.22 The survey methods involve a systematic survey of terrestrial, aquatic and riparian habitats within the study areas looking for places otters use for shelter, resting and protection (such as couches, lying-up sites and holts), or for signs of activity (such as spraints, feeding remains or footprints). The otter surveys took place during suitable weather conditions, so that otter field signs (spraints, slides, sheltering or resting places etc.) would have had time to build up, be relatively visible and would not have been degraded/washed away e.g., after heavy rain. Details of the survey methodology and results are provided in Appendix 6.3.

Freshwater Pearl Mussel Survey

6.4.23 The Burn of Norwick was surveyed by Dr Peter Cosgrove, an experienced and licensed freshwater pearl mussel surveyor in September 2018. Details of the survey methodology and results are provided in Appendix 6.4.

Assessment of Potential Effect Significance

6.4.24 This section defines the criteria that were used to evaluate the significance of predicted likely effects on important ecological receptors due to the operation of the Proposed Project. A level of confidence or likelihood (whether the predicted effect is certain, likely, possible or unlikely) is attached to the predicted effect.

Evaluating Conservation Importance

6.4.25 The ecological receptors identified in the baseline studies were evaluated following best practice guidelines (e.g., CIEEM, 2018). Identifying the importance of potential ecological receptors was the first step of the process, and those considered potentially important and present were then subject to detailed survey and assessment. Those considered sufficiently widespread, unthreatened and resilient to the project impacts were scoped out of further assessment as per best practice EcIA guidance (e.g., CIEEM, 2018).

6.4.26 Ecological receptors can be important for a variety of reasons and the rationale used to define their importance has been explained to demonstrate a robust selection and evaluation process. Importance may relate, for example, to a designated site, to species rarity, to the extent to which they are threatened throughout their range, or to their rate of decline. Various characteristics contribute to the potential importance of ornithological receptors within a study area. Examples include:

- naturalness;
- animal or plant species, sub-species or varieties that are rare or uncommon, either internationally, nationally or more locally, including those that may be seasonally transient;
- ecosystems and their component parts, which provide the habitats required by important species, populations and/or assemblages;
- endemic species or locally distinct sub-populations of a species;
- habitats that are rare or uncommon;

- habitats that are effectively irreplaceable;
- habitat diversity;
- size of habitat or species population;
- habitat connectivity and/or synergistic associations;
- habitats and species in decline;
- rich assemblages of plants and animals;
- large populations of species or concentrations of species considered uncommon or threatened in a wider context;
- plant communities (and their associated animals) that are considered to be typical of valued natural/semi-natural vegetation types, including examples of naturally species-poor communities; and,
- species or habitats on the edge of their range, particularly where their distribution is changing as a result of global trends and climate change.

6.4.27 Guidance on EcIA also sets out categories of ecological or nature conservation importance that relate to a geographical framework (e.g., international through to local) together with criteria and examples of how to place a site or study area (defined by its ecological attributes) into these categories. It is generally straightforward to evaluate sites or species populations designated for their international or national importance (as criteria for defining these exist e.g., SAC and SSSI), but for sites or populations of regional or local importance, criteria may not be easily defined. Where possible, the potential importance of an ecological receptor in the site/study area has been determined within a defined geographical context using criteria outlined in Table 6.3.

Table 6.3 Summary of Geographic Population Importance Criteria Used

Term	Definition
International	For example, >1 % of European Community (EC) population/area of habitat
National	For example, >1 % of United Kingdom (UK/Scotland) population/area of habitat
Regional	For example, <1 % of United Kingdom (UK/Scotland) population/area of habitat, but >1 % of regional resource (Shetland) population/area of habitat
Local	For example, within local area

6.4.28 It should be noted that there is no fundamental biological reason to take 1 % of a population as the threshold level for establishing the level of geographical importance of a site. Nevertheless, this percentage is widely considered to be of value in developing measures that give an appropriate level of protection to populations and has gained acceptance on this basis throughout the world. The criterion was, for example, adopted by parties involved in the Ramsar Convention 1971. Thereafter, the 1 % level of national species totals has been taken as the basis of assessment in various countries, including Britain (Stroud *et al.*, 1990).

6.4.29 To be clear, the ecological importance afforded to a habitat or species within a site or study area, is determined by both the geographical context, as well as the range of ecological characteristics of the habitat or species exhibit (listed above). For example, a habitat in any condition, which is >1 % of the national total could be considered nationally important, whereas a habitat smaller than this, but considered to be of particular high quality (for example, meeting SSSI selection criteria) and/or are connected to/are a stepping-stone between designated sites may also be considered nationally important.

6.4.30 The importance attached to an ecological receptor can also be determined according to legislative status. Some ecological receptors are subject to a general level of legal protection through e.g., the Wildlife and Countryside Act 1981 (as amended), or The Nature Conservation (Scotland) Act 2004 (as amended) and others under Council Directive 1992/43/EEC of 21 May 1992 on the Conservation of Natural Habitats and of Wild Fauna and Flora (the so-called Habitats Directive). There is no clear guidance for conservation importance of ecological receptors other than those of European Protected Species and nationally designated site species and habitats. The importance of other species and habitats is based on professional judgement using the characteristics outlined above. The status of potentially important receptors, such as being on the SBL, is also taken into consideration.

6.4.31 Nevertheless, for the avoidance of doubt, CIEEM EcIA guidance (2018) makes it clear that species which appear on national lists e.g., Schedule 1 of the Wildlife and Countryside Act (1981 as amended) and SBL are not necessarily evaluated as of national importance simply by appearing on such a 'national' list. Importance evaluation must consider the number of individuals of species or area of habitat within a geographical context/scale, i.e. how many of a particular species are likely to be affected by the Proposed Project and what proportion of the local/regional/national population does this constitute. Legal listing/protection is a separate but important consideration.

6.4.32 Once the importance of an ecological receptor has been determined, the potential impacts on that receptor are considered in terms of magnitude, extent, duration, frequency and timing, reversibility, sensitivity and whether the impact would likely be beneficial, adverse or neutral.

Beneficial or Adverse

6.4.33 According to CIEEM (2018) beneficial (positive) and adverse (negative) impacts and effects should be determined according to whether the change is in accordance with nature conservation objectives and policy. In the CIEEM Guidance, the terms positive and negative are used, but in this AEE Report Chapter the equivalent terms beneficial and adverse are used, as synonyms, for consistency between Chapters. These terms are defined as:

- Beneficial – a change that improves the quality of the environment e.g., by increasing species diversity, extending habitat or improving water quality. This may also include halting or slowing an existing decline in the quality of the environment.
- Adverse – a change which reduces the quality of the environment e.g., destruction of habitat, habitat fragmentation, pollution.
- Impacts and effects can also be assessed as neutral.

Extent

6.4.34 According to CIEEM EcIA guidance (2018), extent is the spatial or geographical area over which the predicted impact/effect may occur under a suitably representative range of conditions.

Magnitude

6.4.35 According to CIEEM EcIA guidance (2018), magnitude refers to size, amount, intensity and volume. It should be quantified if possible and expressed in absolute or relative terms e.g., the amount of habitat lost, percentage change to habitat area, percentage decline in a species population. In this assessment there are considered to be four levels of magnitude of impact (Table 6.4) and it is assumed these are adverse, unless otherwise stated.

Table 6.4 Summary of Magnitude Criteria Used

Term	Definition
Major	Total/near total loss of a population/habitat due to mortality or displacement. Total/near total loss of breeding productivity in a population due to disturbance. e.g., ≥50 % of population/habitat affected.

Term	Definition
Moderate	Moderate reduction in the status or productivity of a population/habitat due to mortality or displacement or disturbance. e.g., 10 % to 49 % of population/habitat affected.
Minor	Small but discernible reduction in the status or productivity of a population/habitat due to mortality or displacement or disturbance. e.g., 1 % to 9 % of population/habitat affected.
Negligible	Very slight reduction in the status or productivity of a population/habitat due to mortality or displacement or disturbance. Reduction barely discernible, approximating to the 'no change' situation. e.g., <1 % population/habitat affected.

Duration

6.4.36 According to CIEEM EcIA guidance (2018), duration should be defined in relation to ecological characteristics (such as the life cycle of a species). The duration of an activity may differ from the duration of the resulting effect caused by the activity. Impacts and effects may be described as short, medium or long-term and permanent or temporary and should be defined. In this assessment three timeframes are used: short-term (up to two years), medium-term (two-five years) and long-term (between five years and the lifetime of the Proposed Project).

Frequency and Timing

6.4.37 According to CIEEM EcIA guidance (2018), the number of times an activity occurs may influence the resulting effect. For example, a single person walking a dog will have very limited impact on nearby otters using wetland habitat, but numerous dog walkers will subject the otters to frequent disturbance and could affect breeding/feeding success, leading to displacement and knock-on effects on their ability to survive. The timing of an activity or change may result in an impact if it coincides with critical life-stages or seasons.

Reversibility

6.4.38 According to CIEEM EcIA guidance (2018), an irreversible effect is one from which recovery is not possible within a reasonable timescale or there is no reasonable chance of action being taken to reverse it. A reversible effect is one from which spontaneous recovery is possible or which may be counteracted by mitigation. In some cases, the same activity can cause both reversible and irreversible effects.

Sensitivity

6.4.39 Another factor when assessing potential impacts is the behavioural sensitivity of the ecological receptor under consideration (e.g., high, medium or low) and the zone of influence. Different receptors respond differently to stimuli, making some particularly sensitive to development activities and others less so. Professional judgement is used when assigning sensitivity to an ecological receptor and this is recorded here in a clear and transparent way. Sensitivity criteria vary across the wide range of taxonomic groups considered in an ecological impact assessment and are therefore provided in the receptor descriptions of this Chapter.

6.4.40 By way of example, sensitivity is determined according to species' behaviour, using broad criteria set out in Table 6.5. Behavioural sensitivity can differ between species and between individuals of the same species. Therefore, sensitivity is likely to vary with both the nature and context of the disturbance activity as well as the experience and even 'personality' of the species, in the case of mammals. Sensitivity also depends on the activity the species is undertaking and when it is doing it. For example, a species is likely to be less tolerant of disturbance during the breeding season than at other times of year. Thus, sensitivity changes with both space and time.

Table 6.5 Summary of Sensitivity Criteria Used

Term	Definition
High	Species occupying remote areas away from human activities or exhibiting strong and long-lasting reactions to disturbance events. Habitats that are considered to have a slow recovery time to disturbance.
Medium	Species that appear to be warily tolerant of human activities or exhibiting short-term reactions to disturbance events. Habitats that are considered to have a moderate recovery time to disturbance.
Low	Species occupying areas subject to frequent human activity and exhibiting mild and brief reaction to disturbance events. Habitats that are considered to have a quick recovery time from disturbance.

Likelihood

6.4.41 Finally, a level of confidence (whether the predicted impact is certain, likely, possible or unlikely) can be attached to a predicted effect.

Criteria for Evaluating Significance

6.4.42 Significance is a concept related to the weight that should be attached to predicted effects when decisions are made. A "*significant effect*"" is an effect that either supports or undermines biodiversity conservation objectives for important receptors (CIEEM, 2018). There could be any number of possible impacts on important ecological features arising from a development. However, it is only necessary to describe in detail the impacts that are likely to be significant. Impacts that are either unlikely to occur, or if they did occur are unlikely to be significant, can be scoped out.

6.4.43 In the context of AEE, each likely effect is evaluated and classified as either significant or not significant, using professional judgement, evidence and best practice guidance. In this assessment, a significant effect is defined as "*an impact on the integrity of a defined site or ecosystem and/or the conservation status of habitats or species within a defined geographical area*". Thus, the geographical terms of reference at which a predicted effect may be considered significant must also be defined (e.g., an effect on a species population evaluated to be of regional importance at a given site is likely to be either significant or not at the regional level). Effects can be considered significant at a wide range of scales from international to local.

6.4.44 There is sometimes confusion over geographical context, potentially important receptors and quantifying predicted effects and EcIA best practice guidance has often struggled to articulate this clearly. For example, if a potentially important species appears on a conservation list e.g., the SBL and there is a predicted impact, the geographical context in which the receptor is found must be considered. Therefore, the simple presence of a species on the SBL within an area does not mean that likely effects are significant at the national (Scottish) level. For that to occur, the Proposed Project must have significant effects on its national (Scottish) population.

Requirements for Mitigation

6.4.45 Best practice guidance e.g., CIEEM (2018) identifies a hierarchy of mitigation for potential impacts that seeks to:

- Avoid adverse ecological impacts, especially those that could be significant to important receptors.
- Minimise adverse impacts that could not be avoided.
- Compensate for any remaining significant residual impacts.

6.4.46 CIEEM EcIA guidance (2018) states that "*Avoiding and/or minimising negative impacts is best achieved through consideration of potential impacts of a project from the earliest stages of scheme design and throughout its development*". This approach to avoiding potential adverse impacts within a design layout is sometimes described as embedded mitigation or mitigation by design. "*Mitigation by design is particularly beneficial as there is greater certainty that it will be delivered*" (CIEEM 2018).

6.4.47 This Chapter considers mitigation in the context of CIEEM guidance and also in relation to local planning authority guidance for protected species. The embedded mitigation is considered in the design layout and because of this, it is guaranteed through planning conditions for the Proposed Project. Where likely significant effects are predicted regardless of design layout, further mitigation is separately identified as per CIEEM best practice guidance.

Assessment of Residual Effect Significance

6.4.48 After assessing the potential impacts of the Proposed Project (incorporating embedded mitigation), all attempts were made to further avoid and mitigate predicted adverse ecological impacts. Once measures to avoid and mitigate predicted ecological impacts had been incorporated, assessment of the residual impacts was undertaken to determine the likely significance of their effects on important ecological features.

Limitations to Assessment

6.4.49 Where assumptions within the assessment are made, these are explicitly identified and explained. Similarly, limitations in methods and knowledge of species' ecology are also identified and discussed, particularly where this is likely to affect the outcome of the assessment. As with any environmental assessment there will be elements of uncertainty. Where there is uncertainty, this is identified and reported transparently, along with the measures taken to reduce it, assumptions made, and an explanation as to the likely extent that any uncertainties are likely to affect the conclusions. In circumstances where there is uncertainty; evidence, expert opinion, best practice guidance and professional judgement have been used to evaluate what is biologically likely to occur if the Proposed Project is constructed.

6.4.50 The level of certainty of impact prediction varies depending upon a range of parameters discussed already. For some elements e.g., land-take it is relatively straightforward to assess and quantify the area of habitat that is likely to be lost to development infrastructure and therefore quantify potential impacts of land-take on the habitats present. However, other impacts are less certain because there can be a range of possible scenarios. The main limitations in this assessment are common to most ecological assessments because:

- Baseline surveys undertaken are based on sampling techniques, not absolute censuses. Results give an indication of the numbers of ecological receptors recorded at the particular times that surveys were carried out e.g., summer 2018. Species occurrence changes over time and therefore the results presented in this AEE Report are snapshots in time. Importantly, no information gaps were identified in the baseline survey data that would prevent assessments in line with the requirements of the AEE to be undertaken.
- Putting ecology survey results into a wider geographical context is sometimes challenging because most species and habitats have not been systematically surveyed beyond the study area. Thus, defining a receptor population as locally or regionally important is potentially difficult because local or regional population estimates do not exist for most taxa and habitats. Whenever such uncertainty exists, professional judgement and published evidence is used and populations in the study area or site have been assumed to be at their highest potential level of geographical/ecological importance.

6.5 Baseline Conditions

Desk Study – Designated Sites

6.5.1 A total of 10 designated sites with ecological qualifying features within a 10 km radius of the Proposed Project have been identified (Table 6.6; Drawing 6.3). There are a number of Local Nature Conservation Sites on Unst and these are listed in Table 6.7.

Table 6.6 Biological Designated Sites within 10 km of the Proposed Project.

Designated Site	Designation Type	Area (ha)	Distance (km) and Direction from Proposed Project	Biological Qualifying Features
Hermaness, Saxa Vord and Villa Field	SPA	6,832 ha	1.5 km, northwest	Breeding birds: • Fulmar (*Fulmarus glacialis*) • Gannet (*Morus bassanus*) • Great skua (*Stercorarius skua*) • Guillemot (*Uria aalge*) • Kittiwake (*Rissa tridactyla*) • Puffin (*Fratercula arctica*) • Red-throated diver (*Gavia stellata*) • Shag (*Phalacrocorax aristotelis*) Breeding bird assemblages
Keen of Hamar	SAC	40 ha	4.9 km, south	Upland habitats: • Base rich scree • Dry heath Grasslands on soils rich in heavy metals
Keen of Hamar	SSSI	50 ha	4.7 km, south	Calaminarian grassland and serpentine heath Vascular plant assemblages
Hill of Colvadale and Sobul	SSSI	809 ha	7.9 km, south	Arctic sandwort (*Arenaria norvegica*) Breeding birds: • Arctic skua (*Stercorarius parasiticus*) • Whimbrel (*Numenius phaeopus*) Breeding bird assemblages Calaminarian grassland and serpentine heath
Valla Field	SSSI	629 ha	6.0 km, southwest	Breeding birds: • Great skua Red-throated diver
Crussa Field and Heogs	SSSI	469 ha	4.5 km, south	Breeding birds: • Arctic skua

Designated Site	Designation Type	Area (ha)	Distance (km) and Direction from Proposed Project	Biological Qualifying Features
				• Whimbrel Breeding bird assemblages Vascular plant assemblages Calaminarian grassland and serpentine heath
Hermaness	SSSI	978 ha	3.9 km, west	Breeding birds: • Fulmar • Gannet • Great skua • Guillemot • Puffin Breeding seabird colony
Saxa Vord	SSSI	56 ha	3.0 km, west	Breeding birds: • Fulmar • Guillemot Breeding seabird colony
Norwick Meadows	SSSI	25 ha	0.75 km, southwest	Sand dune habitats Valley fen wetlands
Fetlar to Haroldwick	MPA	216,000 ha	3.0 km, south	Aggregation of breeding birds: • Black guillemot (*Cepphus grylle*) Horse mussel beds Circalittoral sand and coarse sediment communities Kelp and seaweed communities on sublittoral sediment

Table 6.7 Local Nature Conservation Sites on Unst (SIC, 2015).

Local Conservation Sites on Unst	Primary Interest	Justification for Local Conservation Site
Baltasound	Species	Glasswort (*Salicornia europea*) and annual sea-blite (*Suaeda maritima*).
Burn of Mailand	Species	Rare plants. Lesser tussock sedge (*Carex diandra*) and small bur-reed (*Sparganium natans*) are found nowhere else in Shetland. Rich bryophyte flora.
Haroldswick mires	Species	Schedule 1 bird species. The pool at Haroldswick is attractive to migrant birds. The base-rich mire vegetation is unusual in Shetland.
Lochs of Bordastubble and Stourhoull	Species	These water bodies are on the Unst serpentine; they are nutrient rich and support a variety of aquatic species. Breeding Schedule 1 bird species.

Local Conservation Sites on Unst	Primary Interest	Justification for Local Conservation Site
Skeo Taing	Species	The herb-rich turf with base-rich shell sand provides habitat for a diverse range of plants. The nationally rare autumn gentian (*Gentianella amarelle septentrionalis*) is found on site and it is one of only a few sites in Shetland where harebell (*Campanula rotundifolia*) has been recorded.
Wick of Skaw	Geology	Easily identifiable exposure of a granite intrusion contact zone.
Belmont Quarry	Geology	Rock exposures across a major shear zone/ophiolite thrust. Part of the Shetland Ophiolite Suite.
Clibberswick Cross Geo	Geology	Part of the Shetland Ophiolite suite.
Hill of Clibberswick	Species	Two nationally scarce plant species are present on-site, Norwegian sandwort (*Arenaria norvegica*) and northern rock cress (*Arabis petraea*)

Desk Study – Species

6.5.2 Full details of the of the desk study are provided in Appendix 6.1. The desk study demonstrated that there are a large number of records of species of potential interest within vicinity of the site, including legally protected species, SBL species and locally important/rare species. Table 6.8 summaries the results of the desk study for species with potential ecological importance for the site.

Table 6.8 Species Identified as EPS, SBL Species or having Local Importance in the Desk Study

Species name	Common name	Taxa	Listing	Closest Record to the Proposed Project	Year of Record
Lutra lutra	Otter	Mammal	EPS, SBL	>700 m, Norwick	2002-2011
Celaena haworthii	Haworth's minor	Lepidoptera	SBL	One in Saxa Vord, one 150 m away, Houlanbrindy	2017
Eugnorisma glareosa	Autumnal rustic	Lepidoptera	SBL	Within Saxa Vord	2017
Hepialus humuli	Ghost moth	Lepidoptera	SBL	Near Northdale Road	2017
Xanthorhoe decoloraria	Red carpet	Lepidoptera	SBL	Within Saxa Vord	2017
Caloplaca britannica	A lichen	Lichen	SBL	Lamba Ness	2015
Leptogium britannicum	A lichen	Lichen	SBL	Lamba Ness	2015
Opegrapha areniseda	A lichen	Lichen	SBL	Lamba Ness	2015

Species name	Common name	Taxa	Listing	Closest Record to the Proposed Project	Year of Record
Thelenella muscorum var. octospora	A lichen	Lichen	SBL	Lamba Ness	2015
Spergula arvensis	Corn spurry	Vascular plant	Nationally vulnerable	Northdale and near Saxa Vord	2012-2015
Mertensia maritima	Oysterplant	Vascular plant	LBAP. Near Threatened and Nationally Scarce and scarce in Shetland	Inner Skaw	2019

Field Surveys

Habitat Surveys

6.5.3 Full details of the methods and results of the Phase 1 Habitat and NVC surveys can be found in Appendix 6.2 and Drawings 6.3 to 6.7 inclusive. The results are summarised here.

6.5.4 The Habitats study area included distinctive maritime grasslands in the east, on Lamba Ness, which had a range of pools. This transitioned into an area of wet modified bog dominated by purple moor-grass (*Molinia caerulea*). More westerly in the Habitats study area the habitats were made up of wet modified bog/wet heath, which was dominated by heather (*Calluna vulgaris*) and common cottongrass (*Eriophorum angustifolium*), and acid grasslands. To the north-west side of the Habitats study area transitioned into blanket bog habitats.

6.5.5 There were small areas of other habitats, including standing water, marginal vegetation at the edge of pools and saltmarsh perched within the coastal vegetation. The old military buildings and roads and other infrastructure were also mapped across the Habitats study area and often had distinct vegetation around them, enriched from the sheep that sheltered in them.

6.5.6 All the habitats within the Habitats study area had clearly been subject to modification through current and historic management practices including sheep grazing and drainage. Sheep were evident across the Habitats study area and the impacts of fertilisation, grazing and sheep lay-down areas were recorded. Drainage ditches, both very recently cut, and older, were also recorded in wet modified bog and wet modified bog/wet heath habitats. There were areas of naturally occurring haggs, within the blanket bog, which were likely to be exacerbated by sheep and subsequently wind erosion.

6.5.7 The list of Phase 1 habitats mapped and described in the Proposed Project Site Habitats study area along with the total area and the percentage of the study area are displayed in Table 6.9.

Table 6.9 Phase 1 Habitats Described in the Habitats Study Area

Phase 1 Habitats	Area (ha)	% of Habitats Study Area
Wet modified bog/wet heath	30.5	26.1
Wet modified bog	28.2	24.2

Phase 1 Habitats	**Area (ha)**	**% of Habitats Study Area**
Coastal grassland	19.7	16.8
Semi-improved acid grassland	16.3	14.0
Unimproved acid grassland	7.3	6.2
Wet modified bog/wet heath/dry heath	6.5	5.6
Buildings and roads	1.8	1.5
Fen	1.5	1.3
Blanket bog/bare peat	1.5	1.3
Blanket bog	1.1	1.0
Dry dwarf shrub heath	0.7	0.6
Saltmarsh	0.4	0.3
Wet modified bog/wet heath/bare peat	0.3	0.2
Sand dunes	0.3	0.2
Marginal and inundation	0.2	0.2
Wet modified bog/wet heath/acid flush	0.2	0.2
Bare ground	0.1	<0.1
Acid flush	0.1	<0.1
Bare peat	0.1	<0.1
Neutral grassland	0.1	<0.1
Standing water	<0.1	<0.1
Open vegetation	Too small to map separately	N/A
Water courses and drains	Mapped as lines	N/A

6.5.8 The NVC communities found within the Habitats study area were:

- Coastal grasslands
  - MC8d *Festuca rubra – Holcus lanatus* maritime grassland, *Holcus lanatus* sub-community
  - MC10a *Festuca rubra - Plantago spp.* maritime grassland, *Armeria maritima* sub-community
  - MC10b *Festuca rubra - Plantago spp.* maritime grassland, *Carex panacea* sub-community
  - MG11 *Festuca rubra – Agrostis stolonifera – Potentilla anserine* grassland community;
- Saltmarsh
  - SM16b *Festuca rubra* salt-marsh community, *Juncus gerardii* dominant sub-community;

- Sand dunes
  - SD4 *Elytrigia juncea* fore-dune community
  - SD8d *Festuca rubra – Galium verum* fixed dune grassland *Bellis perennis - Ranunculus acris* sub-community;
- Wet modified bog
  - M25b *Molinia caerulea – Potentilla erecta* mire, *Anthoxanthum odoratum* sub-community
  - Mxd *Carex nigra* provisional fen, *Molinia caerulea* sub-community
  - M3x *Eriophorum angustifolium* community;
- Fen
  - Mxd *Carex nigra* provisional fen, *Molinia caerulea* sub-community;
- Semi-improved acid grassland
  - U4b *Festuca ovina – Agrostis capillaris – Galium saxatile* grassland, *Holcus lanatus – Trifolium repens* sub-community;
- Unimproved acid grassland
  - U5a *Nardus stricta – Galium saxatile* grassland, species poor sub-community
  - U5b *Nardus stricta – Galium saxatile* grassland, *Agrostis canina – Polytrichum commune* sub-community
  - U6 *Juncus squarrosus – Festuca ovina* grassland community;
- Neutral grassland
  - MG10a *Holcus lanatus – Juncus effusus* rush-pasture, typical sub-community;
- Wet dwarf shrub heath
  - M15d *Trichophorum cespitosum – Erica tetralix* wet heath, *Vaccinium myrtillus* sub-community
  - M15 *Trichophorum cespitosum – Erica tetralix* wet heath community;
- Blanket bog
  - M2b *Sphagnum cuspidatum/fallax* bog pool, *Sphagnum fallax* sub-community
  - M19 *Calluna vulgaris – Eriophorum vaginatum* blanket mire community;
- Bare peat
  - M3 *Eriophorum angustifolium* bog pool community;
- Dry dwarf shrub heath
  - H10b *Calluna vulgaris – Erica cinerea* heath, *Racomitrium lanuginosum* sub-community;
- Acid flush
  - M6b *Carex echinata – Sphagnum fallax* mire, *Carex nigra – Nardus stricta* sub-community;
- Open vegetation
  - OV25 *Urtica dioica – Cirsium arvense* community; and
- Standing water, water margins and inundation vegetation
  - S19a *Eleocharis palustris swamp, Eleocharis palustris* sub-community;

- A22a *Littorella uniflora - Lobelia dortmanna* community, *Littorella uniflora* sub-community
- A24 *Juncus bulbosus* community
- OV28 *Agrostis stolonifera – Ranunculus repens* community.

GWDTE

6.5.9 Full details of the GWDTE survey and assessment can be found in Appendix 7.2 and Drawing 6.5. NVC communities recorded in the study areas that are considered in the guidance (SEPA, 2017) to be potentially groundwater dependent include:

- M6 *Carex echinata – Sphagnum fallax* mire;
- M15 *Trichophorum cespitosum – Erica tetralix* wet dwarf shrub heath;
- M25 *Molinia caerulea – Potentilla erecta* mire;
- MG9 *Holcus lanatus – Deschampsia cespitosa* grassland;
- MG10 *Holcus lanatus – Juncus effusus* rush-pasture;
- MG11 *Festuca rubra – Agrostis stolonifera – Potentilla anserine* grassland community; and
- U6 *Juncus squarrosus – Festuca ovina* grassland.

6.5.10 Those not in the guidance, that are considered potentially GWDTE (due to their association with similar/related communities that are listed as potentially GWDTE), are:

- Mxd *Carex nigra* provisional fen, *Molinia caerulea* sub-community; and
- M3x *Eriophorum angustifolium* community.

6.5.11 Of these, only M6 is considered to be potentially highly groundwater dependent, depending on the hydrological setting (SEPA, 2017). All the other communities are considered potentially moderately groundwater dependent, depending on the hydrological setting (SEPA, 2017). All mosaics of habitat were allocated their GWDTE category according to the NVC community with the highest potential GWDTE.

6.5.12 The bedrock for the majority of the Habitats study area was the Skaw Intrusion which was describe as a "*Low productivity aquifer*" with "*small amounts of groundwater in near surface weathered zone and secondary fractures; rare springs*" (BGS, 2020). To the far west of the Habitats study area the bedrock is Hevda Phyllite Formation which was also described a "*Low productivity aquifer*" with "*small amounts of groundwater in near surface weathered zone and secondary fractures*" (BGS, 2020). Therefore, the majority of the potentially GWDTE are considered most likely to be present due to waterlogged conditions sustained by high rainfall in the region, rather than groundwater for their maintenance.

6.5.13 The M6 community was located at the transition between the two bedrock types in the Habitats study area. This can be a source location for GWDTE, where groundwater is released at a spring or seepage line (McMullen, 2020). It is therefore considered that the M6 community may be an actual GWDTE.

6.5.14 Detailed geological and hydrological analysis of the site determined that the potential GWDTE were either assessed as not being actual GWDTE or were >250 m from the Proposed Project (Chapter 9).

Peatland Condition

6.5.14 Full details of the PCA can be found in Appendix 6.2. The PCA bases the condition of blanket bog on indicators such as bog-moss cover, extent of bare peat and evidence of grazing and burning (Peatland Action, 2016). Given that the small area of bog habitat within the Habitats study area was clearly grazed and drained and there were patches of bare peat, using PCA terminology, the blanket bog was considered to be modified and some areas drained. Using the PCA Support Tool, the blanket bog would be considered of intermediate condition.

Vascular Plants

6.5.15 Oysterplant, which was recorded in the fore-dune community within the Habitats study area, is an LBAP species and considered Near Threatened and Nationally Scarce and scarce in Shetland.

6.5.16 No other species recorded during field surveys in 2018 were identified as being on the SBL, an LBAP species or in the lists of rare and scarce species for Shetland (Scott *et al*., 2002).

6.5.17 There was no evidence of any notifiable non-native invasive species within the Habitats study area during walkover surveys.

Lower Plants

6.5.18 No lower plant surveys were requested by SNH or conducted as part of this EcIA. Lichen and bryophyte records identified as part of the desk study have been considered. Full details of the desk study are provided in Appendix 6.1. Table 6.8 summaries the results of the desk study and includes four lichen species which are on the SBL and are within the Proposed Project boundary.

Otters

6.5.19 Numerous otter field signs were recorded during targeted surveys in June and October 2018. Based on 2018 survey data, there were eight-ten otter holts within the Otter study area, with six-seven of these within the site (Drawing 6.6).

6.5.20 In 2020, additional otter surveys were undertaken at the Proposed Project Site. Numerous otter signs were recorded (Drawing 6.7). This included eight holts, located in boulder scree and on the boulder beaches, above the high tide mark. The holts were in inaccessible locations, between boulder or going into caves/crevices and were viewed from the cliff tops with binoculars. Scats and regularly used runs were recorded at the holt sites, and otters occasionally seen/heard. One particular holt on Lamba Ness, which had a large build-up of scats, was clearly being used by a female and her young in July 2020.

6.5.21 Scats and footprints, including those of adults and young, were also recorded in the abandoned buildings across Lamba Ness. It was considered likely that some of the buildings were used as lay-ups during poor weather conditions and the predated remains of several fulmars (*Fulmarus glacialis*) were also noted within the buildings.

6.5.22 Otter use of an underpass at HP 671 154 was particularly noticeable. It was considered likely that otters use this underpass as a regular route to cross from the north to south side of Lamba Ness. The route was well delineated on the grassland and rocks showing a well-established run, and so was functionally important to otter use of the Lamba Ness area.

6.5.23 The data indicated that there was one female with young using Lamba Ness as their home territory. Regular sightings of a male indicated that Lamba Ness also formed part of at least one, if not two, dog otter territories.

Freshwater Pearl Mussels

6.5.24 The Burn of Norwick was surveyed, under licence, for freshwater pearl mussels in September 2018. No evidence of freshwater pearl mussels was found in the Burn of Norwick survey reach. No patches of suitable or potentially suitable substrate habitat were recorded in the Burn of Norwick survey reach. There was no evidence of freshwater pearl mussel presence within the Burn of Norwick survey reach. Consequently, the survey evidence suggests that there are no special freshwater pearl mussel sensitivities that need to be considered.

6.6 Receptors Brought Forward for Assessment

Potentially Important Ecological Receptors

6.6.1 Ecological features/receptors can be important for a variety of reasons and the rationale used in evaluation should be explained to demonstrate a robust and transparent selection process (CIEEM, 2018). Based on the results of the desk study, initial site walkover, field surveys, consultation and feedback from the regulators, legal protection and professional judgement, the following potentially important receptors were identified for further consideration:

- designated sites;
- semi-natural habitats; and
- otter.

6.6.2 No other potentially important ecological receptors on which potentially significant effects were likely to occur were identified for further consideration. Other species (such as those identified in the desk study, cited as part of nearby designated areas with similar habitats to the study area or present in the LBAP), were mainly scoped out of further consideration on the basis of:

- recent survey results;
- habitats within the study area (e.g., coastal grassland) compared to the species' preferred habitat; and
- the population size of the potentially important species on a geographical basis.

6.6.3 Table 6.10 summarises the evaluation of potentially important receptor population/feature within the study area.

Table 6.10 Summary Evaluation of Potentially Important Ecological Receptors

Potentially Important Receptor	Evaluation of Potentially Important Receptor Population/Feature within Study Area
Designated sites	Nationally important designated sites <750 m from the study area. Norwick Meadows, is taken forward for assessment.
Otter	Legally protected species. Evidence of regular and frequent use of the study area, with numerus field signs and multiple holts around the Otter study area. Otter use is likely to include at least one male and one female, sometimes with young, around the Otter study area. Otters are considered to have moderate sensitivity to human activities, with resting places and holts considered highly sensitive. However, in Shetland, otters tolerate and utilise a wide variety of human built features, such as buildings, ferry terminals and fish farms. Status: Stable in Scotland. GB population estimate unknown (Mammal Society, 2020). Scottish population considered to be flourishing, with an estimate of ca. 8,000 individuals (JNCC, 2019; SNH, 2020). Shetland population estimate 700-900 (Kruuk *et al.,* 1989) – but note the age of this population estimate data and subsequent national population increase (30 years +). The study area is estimated to hold ca. 0.5 % of the Shetland population. The site population is therefore considered locally important.

Potentially Important Receptor	Evaluation of Potentially Important Receptor Population/Feature within Study Area
	The ecological receptor, otter, is taken forward for assessment.
Semi-natural habitats	Local, regionally, nationally and internationally important habitats present in Shetland. Some of the habitats described within the study area are similar to, or approaching descriptions for, Annex 1 habitats and/or SBL habitats. These include: ➢ coastal grasslands; ➢ saltmarsh; ➢ sand dunes; ➢ wet modified bog; ➢ wet modified bog/blanket bog; ➢ blanket bog; ➢ dry dwarf shrub heath; ➢ acid flush; and ➢ water margin vegetation. Within the study area, the quantity/quality of semi-natural habitats evaluated as locally important, except for some of the water margin vegetation and the sand dune vegetation. For full details of these evaluation refer to Appendix 6.2. These habitats are taken forward for assessment.
GWDTE	Potentially important GWDTE habitats present in the vicinity of the study area. All the potential GWDTE were assessed as not being actual GWDTE and/or were >250 m from the Proposed Project (Chapter 9). Therefore, GWDTE have been scoped out of further consideration.
Freshwater pearl mussels	Legally protected species. Status: Listed as Critically Endangered in Europe by IUCN. Scotland population declining; extinct in 73 rivers, not recruiting in 44 rivers and recruiting in 71 rivers (Cosgrove *et al.,* 2016). Although present in Shetland (Cosgrove and Harvey, 2005), there was no evidence of freshwater pearl mussels, or potentially suitable habitat, in the Burn of Norwick during targeted surveys in 2018. Furthermore, all extant pearl mussel populations in Scotland have headwater lochs/lochan, Burn of Norwick does not have a headwater loch/lochan. Therefore, freshwater pearl mussels have been scoped out of further assessment.
Plants	Oysterplant LBAP species. Considered Near Threatened and Nationally Scarce and scarce in Shetland. Distributed around the coast of northern Britain. Population increased in north, but declined in south (Preston *et al.,* 2002). Only found on gravelly beaches and shingle, and sometimes sand. This species was located on the fore-shore community at Inner Skaw. The dunes and fore-shore

Potentially Important Receptor	Evaluation of Potentially Important Receptor Population/Feature within Study Area
	community at Inner Skaw are being avoided by the design layout. Therefore, this species has been scoped out of further assessment.
Lichens	The desk study identified four species of lichen, which have been recorded within close vicinity of the Proposed Project, that are SBL species ("*watching brief only*" category). *Caloplaca britannica* is considered rare in the UK (SBL, 2013). It is distributed widely around the coast of the UK and is of Least Concern according to the GB Red List (NBN Atlas, 2020) This species "*is found on coastal rocks, in the spray zone and is undoubtedly under-recorded*" (Images of British Lichens, 2013). In Shetland it is known to be located in "*sheltered crevices in landward-facing rock face*"(Dalby and Dalby, 2005). *Leptogium britannicum* is found on coastal rocks (Images of British Lichens, 2013). It is distributed widely on the west coast of the UK and on Shetland and Orkney and is of Least Concern according to the GB Red List (NBN Atlas, 2020). In Shetland it is known to be located within amongst mosses in salt marshes and on cliffs (Dalby and Dalby, 2005). *Opegrapha areniseda* is considered rare in the UK. It is found on "*slightly acid or neutral soft rocks near the seashore (schists) and mainly on old walls, notably of chapels*" (Maritime Lichens, 2020). It is distributed widely around the coast of the UK and is of Least Concern according to the GB Red List (NBN Atlas, 2020). This lichen species was not included in the Lichens of Shetland reference (Dalby and Dalby, 2005). *Thelenella muscorum var. octospora* is considered rare in the UK (SBL, 2013). No information was found on the UK habitat requirements for this lichen and it has limited records in the UK with only 20 records on the NBN Atlas, although these are spread across England, Wales, Ireland and Scotland. This species is considered circumboreal, and is found across western United States, western Canada, UK, Ireland, Scandinavia, Europe and Russia (Christy *et al.,* 2010). The habitat requirements that are reported in the United States are not consistent with the habitats found on Lamba Ness. It is considered that it is an obscure, under recorded and under researched species. The record on Lamba Ness describes the habitat it was found in as "*Coastal rocks, mainly granite, turf edge on cliff top*". This species is not legally protected and is has not been evaluated by the GB Red List (NBN Atlas, 2020). The closely related lichen species *Thelenella muscorum* is distributed widely across the UK. This lichen species was not included in the Lichens of Shetland reference (Dalby and Dalby, 2005). It is considered unlikely that the three common species, which are of Least Concern, are widely distributed in the UK and were not mentioned by SNH in consultation, would be significantly impacted though the Proposed Project because: ➢ the relatively small number of records compared to the wide distribution of their under-recorded UK population; ➢ the study area is not designated or specially protected for these species, or habitats which support these species; ➢ they are located in habitat(s) which appear to be largely or wholly avoided by the design layout (e.g., namely coastal cliffs); and,

Potentially Important Receptor	Evaluation of Potentially Important Receptor Population/Feature within Study Area
	➢ ambient sulphur dioxide levels (the air pollutant which lichens are generally sensitive to) will not be impacted by the operation of the Proposed Project (Chapter 7). Therefore, these species have been scoped out of further assessment. These assessments are likely to also be relevant to the more obscure species *Thelenella muscorum var. octospora*. Additionally, the edge of the cliff, where this species was reported as being situated, is avoided by design. Therefore, it has also been scoped out of further assessment. Nevertheless, it is recognised that the ecological requirements of these poorly known species are not well understood. It should also be recognised that the distribution of some species can be poorly understood, particularly those in less widely known taxonomic groups, such as lichens. Where systematic surveys have not been widely undertaken know distributions may not fully reflect actual distribution and may be associated to where these species have been visited by specialist observers. This is a well know limitation of species distribution data.
Lepidoptera	Four species of Lepidoptera identified as part of the Desk Study which are all SBL species ("*watching brief only*" category). The four species were recorded within the vicinity of the Proposed Project. Haworth's minor (*Celaena haworthii*) is "*mainly a moorland species, occurring most commonly in northern England, Wales and Scotland… Cotton-grass* (Eriphorium spp.) *is the main foodplant, the larvae feeding internally on the stems*" (UK Moths, 2020). Distributed widely across the UK, more common in the north (Hill *et al.,* 2010; Butterfly Conservation, 2020). Considered local (only found in some areas) (Butterfly Conservation, 2020). Resident in Shetland (Nature in Shetland, 2020). Autumnal rustic (*Eugnorisma glareosa*) inhabits "*woodland fringes, moorland and sandy or chalky soils, it is widely distributed, though not always common, throughout Britain. The adults fly in August and September, and the caterpillars are polyphagous, living on a wide variety of plants and grasses*" (UK Moths, 2020). Distributed widely across the UK (Hill *et al.,* 2010). Considered common (NatureSpot, 2020). Resident in Shetland (Nature in Shetland, 2020) Ghost moth (*Hepialus humuli*) is considered a "*common species over much of Britain… The adults fly during June and July. The larvae feed underground on the roots of grasses and small plants"* (UK Moths, 2020) including nettles (*Urtica dioica*) and dock (*Rumex* spp) (Butterfly conservation, 2020). Distributed widely across the UK (Hill *et al.,* 2010; Butterfly conservation, 2020). Considered common (Butterfly Conservation, 2020). Resident in Shetland (Nature in Shetland, 2020). Red carpet (*Xanthorhoe decoloraria*) "*A locally common species in northern Britain, occurring from Shropshire and Staffordshire northwards, into Scotland, where a local subspecies hethlandica occurs on the Shetland Isles… The favoured habitat is rocky moorland, where the larvae feed on lady's mantle Alchemilla spp., possibly also on other low plants"* (UK Moths, 2020). Distributed across northern Britain (Hill *et al.,* 2010). Considered common (Butterfly Conservation, 2020). Resident in Shetland (Nature in Shetland, 2020).

Potentially Important Receptor	Evaluation of Potentially Important Receptor Population/Feature within Study Area
	It is considered unlikely that these, generally common and widespread species, which were not mentioned by SNH in consultation, would be significantly adversely impacted though the Proposed Project because: ➢ the relatively small number of records compared to the wide distribution of their under-recorded UK population; ➢ the study area is not specially designated for these species, or habitats which support these species; and ➢ other than a potentially small (negligible) land-take of possible habitat, no significant impacts are considered likely from the Proposed Project on these species. Therefore, these species have been scoped out of further assessment.

6.7 Standard Mitigation

6.7.1 In line with best practice guidance (CIEEM, 2018), an iterative design approach has been taken and the Proposed Project was amended to avoid or minimise ecological receptors, as far as possible within the parameters of the project. As such, mitigation has been embedded within the project design since Alba Ecology's first involvement in the project in 2017.

6.7.2 The three key mitigation hierarchy principles of EcIA (CIEEM, 2018; CAA, 2021), namely avoidance first, followed by minimisation and finally by compensation, along with enhancement have all been considered and/or used within different iterations of the Proposed Project.

Avoidance

6.7.3 According to CIEEM best practice guidance, adverse effects should be avoided or minimised through mitigation measures, either through the design of the project or subsequent measures that can be guaranteed. For example, through a planning condition. The baseline habitat surveys influenced the project design, avoiding, wherever possible areas of higher ecological sensitivities.

6.7.4 Avoidance of ecological receptors has been achieved in several areas by the proposed design. For example:

- The sand dunes habitat, which was assessed as regionally important, was avoided by the design layout, thus the LBAP species oysterplant has also been avoided by the design layout.
- The small pools, including those dominated by shoreweed (NVC community A22), which were assessed as regionally important, have largely been avoided by the design layout and through micro-siting.
- All the blanket bog habitat has been avoided by the design layout.
- The cliffs have been avoided by the design layout; therefore, the majority of the otter holt locations and preferred lichen habitats will not be impacted.

Minimisation

6.7.5 According to CIEEM best practice guidance, where design layout impacts on important ecological receptors cannot be avoided, they should be minimised. Minimisation takes many forms, with subsequent design iteration being tweaked and amended where possible to reduce potential ecological impacts.

6.7.6 Minimisation has been achieved in several areas by the proposed design. For example:

- The coastal grassland around launch pad 1 and 2 were avoided where possible, and infrastructure on these coastal grasslands minimised for the final design.
- An important under-road culvert, which is regularly used by otters crossing overland from one side of Lamba Ness to the other will be retained and artificial otter holts created nearby.

Compensation

6.7.7 Where there are significant residual adverse ecological effects despite the mitigation proposed, these should, under EcIA guidelines, be offset by appropriate compensatory measures.

Biodiversity Enhancement

6.7.8 There is a growing body of policy and guidance that development plans should not just try to avoid causing likely significant effects. Best practice EcIA guidance recommends seeking to provide net benefits for important biodiversity over and above design requirements for avoidance, minimisation or compensation (e.g., CIEEM, 2018).

6.8 Potential Effects

Impacts to be Assessed

6.8.1 The main elements of the Proposed Project which have the potential to impact on ecological receptors during operation are assessed within this section. For full details of the proposed scheme refer to Chapter 3.

6.8.2 The potential operational impacts on ecology are outlined in Table 6.11. Potential impacts in this table do not imply that they would occur, or that any resultant effects would be significant.

Table 6.11 Summary of Potential Impacts on Ecology

Activity	Potential Ecological Impact
Launch pads in operation	Noise and vibrations resulting in disturbance.
Launch Pad Complex and related buildings	Loss of habitat as a result of ongoingoperations. Potential impacts on hydrology resulting in changes to vegetation.
Tracks and road	Loss of habitat as a result of ongoing operation. Mortality/disturbance from vehicles.

Effects on Designated Sites

6.8.3 There are ten designated ecological sites within ten kilometres of the Proposed Project, as identified in Table 6.6. This is reduced to six when ornithological designations, which are addressed separately in Chapter 5, are excluded. It is further reduced to five designated sites if Marine Protected Areas are excluded. The closest designated ecology site is Norwick Meadows SSSI supporting important sand dune and valley fen habitats. The flora in this designated site is considered "*floristically rich*" with several rare and scares species (NatureScot, 2020). The valley fen is "*one of the best and most extensive examples of mesotrophic (moderately nutrient-rich) marsh in Shetland*" (NatureScot, 2020). Norwick Meadows SSSI is considered nationally important with high sensitivity.

6.8.4 No land-take will take place within this designated site, so no direct habitat loss of the designated site will occur.

6.8.5 When assessing impacts on designated sites it is important to consider whether the Proposed Project is likely to undermine the conservation objectives of the site, the condition of the site, or the conservation status of the species or habitats for which the site is designated (CIEEM, 2018). Consideration should also be given to whether any process or key characteristic will be removed or changed, whether there will be an effect on the nature, extent, structure and function of component habitats and if there is an effect on the average population size and viability of species (CIEEM, 2018).

6.8.6 The conservation objectives for the Norwick Meadows SSSI (taken from Norwick Meadows SSSI Site Management Statement, 2011) are:

- To maintain and enhance the extent and condition of fen and swamp communities.
- To maintain and enhance the extent and condition of open dune and dune grassland habitats.
- To ensure populations of nationally scarce and locally rare species are protected.

6.8.7 As there will be no land-take from the Norwick Meadows designated site, there will be no direct loss to the fen and swamp communities, open dune, or dune grassland and the nationally scarce and locally rare species will not be directly impacted. Therefore, no likely significant direct effects are predicted for Norwick Meadows SSSI.

6.8.8 Potential indirect impacts on the SSSI habitats arise from potential hydrological connectivity and potential pollution pathways. These potential hydrological impacts and pollution pathways are considered in Chapter 9 which take account standard mitigation, in particular implementation of a suitable Operational Environmental Management Plan (OEMP) which will include measures for appropriate storage and management of fuels and chemicals. Indirect effects from the hydrological connectivity on habitats and species in the Norwick Meadows SSSI are considered to be unlikely (given the embedded mitigation), with a potential short-term, intermittent, reversible, effect of a minor-negligible magnitude. Therefore, no likely significant indirect effects are predicted for Norwick Meadows SSSI.

6.8.9 All the other terrestrial designated sites are >1.5 km away from the Proposed Project. Therefore, no land-take or changes to hydrology will take place within these designated sites, so no direct or indirect habitat loss will occur. No other route to impact on designated sites or their features are predicted. Consequently, **no significant effects** on designated sites are predicted.

Effects on Otters

6.8.10 This section describes the predicted effects on otters that could arise from operation of the Proposed Project. Embedded mitigation, including avoidance and minimisation to reduce potential effects are described.

6.8.11 The operation of the Proposed Project has the potential to adversely affect otter directly or indirectly in a number of ways:

- severance;
- damage to watercourses by runoff, pollution and blocking of streams;
- mortality caused by vehicle traffic during operation; and
- disturbance/damage to hearing caused by noise of operation, including launches.

6.8.12 Otters are legally protected species, considered to have moderate sensitivity to human activities, with resting places and holts considered highly sensitive. The population of otters using the Proposed Project Site is considered of local importance.

6.8.13 Baseline otter surveys were completed on multiple occasions, in different seasons and years, and were conducted in a larger study area than is usual for surveys of this nature. Consequently, otter use of the site is relatively well understood.

6.8.14 Numerous otter field signs were recorded including scats, holts, footprints and lay-ups. In the most recent 2020 surveys, eight holts were located in inaccessible boulder scree areas, caves and on the boulder beaches around Lamba Ness. Scats and footprints, including those of adults and young, were also recorded in the abandoned military buildings across the Proposed Project Site. It was considered likely that some of the buildings were used as lay-ups during poor weather conditions.

6.8.15 Otter use of an underpass at HP 671 154 was particularly noticeable. It was considered likely that otters use this underpass as a regular route to cross from the north to south side of Lamba Ness. It appears to be disproportionately and functionally important to continued otter use of Lamba Ness. During poor/rough weather this may be the main route used by otters traversing Lamba Ness.

6.8.16 The survey data collected indicated that there was one female with young regularly using Lamba Ness as their (main) home territory. Regular sightings of a male indicated that Lamba Ness also formed part of at least one dog otter territory. This constitutes ca. 0.5 % of the Shetland otter population.

Severance

6.8.28 Otters mainly use the coast of Lamba Ness. A main route for crossing from the north side to south side is at the underpass at HP 671 154. As discussed above, this route will remain open throughout operation of the Proposed Project so the magnitude of impact on otter habitat as a consequence of severance, at this location, is assessed as negligible. With the embedded mitigation, the impact of severance is considered to be unlikely, never/occasional, reversible and short-term and **no likely significant effects** are predicted (Table 6.15).

Damage to watercourses by runoff, pollution and blocking of streams

6.8.30 In the unlikely event that a serious pollution incident occurs, leading to a sudden pulse of pollutant, and if that was not readily contained, it might enter the aquatic environment and could affect otters directly e.g., by coating fur with oil or indirectly through damage to their prey species. However, taking into account the intended implementation of best practice pollution prevention measures (Chapter 9 and Appendix 3.1), it is considered highly unlikely that a serious pollution incident would occur during operation of the Proposed Project. Therefore, in the unlikely event that a pollution incident did occur, it is very doubtful that pollution would substantially affect otter foraging (as the coastline is very extensive). The magnitude of potential impact caused by a pollution event for otter is assessed as negligible. With the embedded mitigation, the impact caused by a pollution event is considered to be unlikely, intermittent, reversible and short-term (event), with a medium-term recovery and **no likely significant effects** are predicted (Table 6.15).

Mortality caused by vehicle traffic during operation

6.8.31 Vehicular traffic on the site will increase during operation of the Proposed Project, meaning that individual otters will have a slightly increased possibility (albeit still very small) of being injured or killed. However, the existing inbuilt design measures (embedded mitigation) and enforced low vehicle speed limits (10 mph) will greatly reduce the likelihood of injury or death occurring during operation. Otter crossing road signs will be located at the entrance to the site and at the frequently used otter run to further help prevent vehicle traffic mortality during operation. Consequently, the magnitude of impact of direct mortality from operation of the Proposed Project is assessed as negligible. With the embedded mitigation, impact of direct mortality from operation of the Proposed Project is considered to be unlikely, intermittent, irreversible and short-term and **no likely significant effects** are predicted (Table 6.15).

Disturbance caused by noise of operation

6.8.32 There is at least one dog otter and one female otter (sometimes with young), within the range of elevated noise levels associated with the operation of the Satellite Launch Facility. Table 6.12 outlines the maximum predicted dB levels on otter (Chapter 8). The holts on Lamba Ness are in the 0 km to 0.5 km range, the holts located at Saxa's Kettle and Vadna Taing are in the 0.5 km to 1 km range. From launch, the noise will rapidly (i.e., a matter of a small number of seconds) build from baseline to maximum, followed by a fairly rapid decrease back to baseline (tens of seconds).

Table 6.12 Maximum Predicted Decibel (dB) Levels at Otter Holts

Individuals	Pad 1		Pad 2		Pad 3	
Distance from holt	Launch LAmax	Static Lamax	Launch Lamax	Static Lamax	Launch Lamax	Static Lamax
0-0.5 km	120-130 dB	110-130 dB	120-130 dB	110-130 dB	120-130 dB	110-130 dB
0.5-1 km	110-120 dB	100-110 dB	110-120 dB	100-110 dB	100-110 dB	100-110 dB

6.8.33 Otters are considered moderately sensitive to human disturbance. Otters use acoustic communication in both antagonistic (blows, mewing and cries) and social (murmurs and two types of whistles) situations, with new-borns using "*twitters*" to demand care (Gnoli and Prigioni, 1995). Therefore, it can be concluded that hearing is an important sense for otters. A study of otter hearing range demonstrated that at 80 dB, in air hearing ranged from 200 hertz (Hz) to 32 kilohertz (kHz) (Voigt *et al*., 2019). As the satellite launch noise will be concentrated in the low frequencies, the satellite launch noise frequencies will be audible to otters in the vicinity to the Proposed Project. Exposure to loud sounds can result in hearing impairment or loss. Mammals are unable to regenerate damaged auditory (cochlear) hair cells following damage from high levels of noise. Therefore, any potential damage to hearing as a result of the Proposed Project would be considered permanent and non-reversible.

6.8.34 A literature search conducted using freely available sources (e.g., google scholar, researchgate), returned few relevant results regarding the impact of loud noise on otter. Areas of high human disturbance (i.e., not loud noise) has been shown to adversely impact on otter populations (e.g., Cortés *et al*., 1998). This does not necessarily translate to infrequent very loud noises, and otters in Shetland are known to deliberately inhabit areas around ferry terminals and fish farms which have moderate-high levels of human disturbance and noise.

6.8.35 Anecdotal accounts described in the literature suggest loud noise can impact on otter behaviour. Sharp and sudden noises have been reported to cause instant flight to the nearest water. These effects on behaviour may continue after the noise that caused the reaction has ceased (e.g., Jeffries 1985).

6.8.36 There is no direct evidence to suggest that the short-lived noise at launch will impact on, and adversely affect the success of, otters within the study area and there is also no threshold noise metric against which to compare potential effects on otters. The literature search did not identify any directly relevant noise studies on otters or potentially analogous species Whether the pre-launch warning siren, followed by the low frequency rumble of the rocket followed by a rapid decrease back to baseline will be sufficient to allow otters to cope with the noise is currently speculative. Nevertheless, it is considered likely that this warning will give otters warning to swim underwater or find refuge in a holt or shelter where noise levels experienced are likely to be reduced. Therefore, it is considered possible that the operational disturbance of satellite launches could disturb otters within their holts.

6.8.37 If a worst-case scenario is assumed, i.e., mortality of all the otters in the vicinity, this would constitute an adverse impact on a maximum of two to three otters out of the Shetland population of ca. 700 to 900 individuals, i.e. 0.3 % to 0.4 % of the regional population and 0.04 % of the Scottish population. However, based on the likelihood that the pre-launch warning siren would allow otters to find refuge, with a reduction in noise in holts or shelters, this worst-case scenario seems an unlikely scenario. If no such adverse response took place, then 0 % of the regional and Scottish otter population would be adversely affected.

6.8.38 The magnitude of potential impact, in the worst-case scenario, caused by mortality/loss of territory from noise disturbance, is negligible. In the worst-case scenario, the potential impact to otters caused by mortality/loss of territory from noise disturbance is considered to be possible, intermittent, irreversible and short-term and **no likely significant effects** are predicted (Table 6.13).

6.8.39 Mitigation for the non-significant adverse impacts on otters will be achieved by creating additional holts and shelters, many with sound proofing from turfs, allowing many suitable refuge locations.

Table 6.13. Summary of Likely Predicted Impacts on Otter

Parameter	Severance	Pollution	Mortality from Traffic/Activities	Operational Disturbance
Beneficial/adverse/neutral	Adverse	Adverse	Adverse	Adverse
Extent	Potential loss of one run linking north and south of Lamba Ness	Watercourse and coastal region around Lamba Ness	Site-wide	Site-wide
Duration	Short-term	Event = short-term Recovery = medium-term	N/A	Short-term noise level, potential for long term hearing damage
Reversibility	Reversible - the underpass will be maintained, and an additional underpass created, with additional shelters/holts at either side	Reversible – pollution prevention measures and incident kits will be used.	Irreversible	Irreversible
Frequency	Never/occasional	Intermittent	Intermittent	Intermittent
Probability	Unlikely	Unlikely	Unlikely	Possible
Magnitude	Negligible	Negligible	Negligible	Negligible

6.8.40 In summary, with the implementation of the embedded mitigation measures, no likely significant effects are predicted for otters in relation to operation of the Proposed Project (Table 6.13).

6.8.41 As otters are EPS and fully protected under the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended), and this protection extends to their holts; operational activities which may impact on otters, or their holts will require licencing by NatureScot.

Effects on Semi-natural Habitats

6.8.42 The Proposed Project has the potential to adversely impact on habitats directly or indirectly through small but permanent habitat loss during operation, potentially through severance, changes to hydrology and pollution.

6.8.43 Direct impacts from land-take of habitats have been considered by overlaying the Proposed Project layout supplied by the Applicant on to the Phase 1 Habitat map (Drawing 6.3).

6.8.44 Parameters that are 'permanent' for the lifetime of the Proposed Project to facilitate operation are shown in Table 6.14 and are included as the operational loss.

Table 6.14 Summary of Predicted Loss Parameters[1]

Infrastructure/Activity	Operational Loss
Road	Road layout 28,159 m^2
Launch pad 1	All elements within the fenced area at launch pad 1 15,675 m^2
Launch pad 2	All elements within the fenced area at launch pad 2 14,858 m^2
Launch pad 3	All elements within the fenced area at launch pad 3 13,145 m^2
Two Barriers	3,033 m^2
Buildings including four Satellite Tracking Station, LSPF, Administration Building, Stores, Integration hanger/TEL building contractor compound, substation and Gate House	All elements within the fenced areas around buildings' infrastructure 30,553 m^2
Wildlife hide	66 m^2
Track to wildlife hide	900 m^2
Temporary contractor compound and temporary track	N/A
Total	105,699 m^2

6.8.45 The total areas of habitat loss calculated in Table 6.14 are not necessarily the same as the separate metrics combined due to overlap between components which are then merged in GIS. The total shown is the merged total, giving the total land area that will be lost/impacted.

[1] Note that these metrics were correct for the original EIAR which was submitted to SIC in January 2021.

6.8.46 The operational layout was 'clipped' from the Phase 1 Habitat and NVC polygons in GIS. It should also be noted that the habitat boundaries on the Phase 1 Habitat map are indicative only, because there is often a gradation between different habitat types and rarely a distinct boundary. There was a small section at Launch Pad 1 where the design went beyond the edge of the mapped habitats. At this location, the design went onto an area of rock which wasn't surveyed as part of the habitat survey. It is depicted in the calculations as 'rock'.

Effects on Habitats

6.8.47 The approximate direct habitat loss from the buildings required to operate the Proposed Project as a consequence of land-take is provided in Table 6.15. All the land within the Launch Pad fenced compounds and other building compounds were assumed to be lost. Again, this is precautionary as not all of the habitat in this area will actually be lost but, but where possible, some will be retained, but exactly how much and where is unclear.

Table 6.15 Predicted Direct Habitat Loss (land-take) for the Proposed Project[2]

Habitat	Operational Loss in m^2	NVC community	Operational Loss in m^2
Buildings and roads	7,057	Buildings	464
		Roads	6,593
Bare ground	178	Bare ground	162
		Bare sand	16
Coastal grassland	28,486	MC10a	11,529
		MC10a:MC10b	424
		MC10b	3,660
		MC10b:MC10a	100
		MC10b:MC8d	30
		MC8d	2,418
		MC8d:MC10b	8,692
		MG11	1,623
		MG11:U4b:OV25	10
Marginal and inundation	6	A24:S19a:SM16b	2
		S19a:bare ground	4
		S19a	
Wet modified bog	33,335	M25b	17,728
		M25b:M3x	5,627
		M25b:S19a:A24	7,105
		M3x	35
		M3x:M25b	2,840

[2] Note that these metrics were correct for the original EIAR which was submitted to SIC in January 2021. Subsequent alterations were made to the design layout, resulting in small changes in the land-take calculations. These alterations were submitted to SIC in October 2021 are presented in section 7.9.

Habitat	Operational Loss in m^2	NVC community	Operational Loss in m^2
Fen	2,119	Mxd	2,119
Saltmarsh	30	SM16	30
Semi-improved acid grassland	8,356	U4b	4,716
		U4b(MG7)	642
		U4b(MG7):U6:MG10a	264
		U4b:MG10a	858
		U4b:U5b	512
		U4b:U5b:MG10a	302
		U4b:U6	48
		U4b:U6:MG10a	811
		U6:MG10a:U4b	203
Standing water	50		50
Unimproved acid grassland	7,470	U5a	17
		U6	625
		U6:MG10a	347
		U6:U5b	6,481
Wet modified bog/wet heath	17,996	M15:M3x:M15d:U6	11,664
		M15d	6,332
Wet modified bog/wet heath/bare peat	283	M3:M15d	283
Rock	333		333
Total	105,699		105,699

6.8.46 The majority of the habitat predicted lost as a result of operation of the Proposed Project will be wet modified bog (NVC community M25b and mosaics) (Table 6.15). Coastal grassland (MC10, MC8, MG11 and mosaics) has the second highest predicted loss from land-take. Smaller areas of other habitats are predicted to be lost, including semi-improved acid grassland, wet modified bog/wet heath and unimproved acid grassland.

6.8.47 Very small amounts of habitat loss are predicted for marginal and inundation and salt marsh.

6.8.48 Embedded mitigation includes micro-siting which will be used to relocate infrastructure to further avoid any sensitive habitats, such as the marginal and inundation habitat and salt marsh. This will necessarily be carried out on the ground under supervision of the ECoW as part of micro-siting. None of the NVC community A22, which was the particular marginal and inundation community assessed as regionally important was impacted by the land-take because it was deliberately avoided by the design layout.

6.8.49 Several habitat types with conservation listings are predicted to be impacted by the Proposed Project:

- Wet modified bog habitat (M25) is on the SBL. It was assessed as being modified through historic and current land management practices including grazing, drainage and use by military. It was evaluated as being of, at best, local importance.
- Wet modified bog habitat/wet heath (M15) habitat is on the SBL and is listed as an Annex 1 habitat. It was assessed as being modified through historic and current land management practices including grazing, drainage and use by military. It was evaluated as being of, at best, local importance.
- Coastal grassland habitat is on the SBL and is listed as an Annex 1 habitat. The coastal grassland present was evaluated as being of local importance.
- The inundation and marginal vegetation NVC community A22 is on the SBL and is listed as an Annex 1 habitat. The habitat present was evaluated as being of regional importance.
- Saltmarsh habitat is on the SBL and is listed as an Annex 1 habitat. The saltmarsh habitat present was evaluated as being of local importance.
- Unimproved acid grassland habitat is on the SBL and was evaluated as being, at best, of local importance.

6.8.50 Table 6.16 considers the predicted magnitude of change through land-take habitat losses from operation of the Proposed Project as a proportion of the site extent and regional (Shetland) extent and the national (Scottish) extent of these habitat types.

Table 6.16. Summary of Predicted Impacts on Habitats for the Proposed Project[3]

Phase 1 Habitat	Proportional Study Area Loss and Magnitude of Change	Proportional Regional Loss and Magnitude of Change	Proportional National Loss and Magnitude of Change
Wet modified bog habitat	A total of 3.34 ha of wet modified bog habitat, including mosaics, is predicted to be lost from the proposed Vertical Launch Space Port on Lamba Ness out of the total wet modified bog Habitats study area 28.2 ha resource = 12%. Magnitude of predicted change = moderate.	A total of 3.34 ha of wet modified bog habitat, including mosaics, is predicted to be lost from the proposed Vertical Launch Space Port on Lamba Ness out of the total blanket bog Shetland resource of 53,430 ha = 0.006%. Magnitude of predicted change = negligible.	A total of 3.34 ha of wet modified bog habitat, including mosaics, is predicted to be lost from the proposed Vertical Launch Space Port on Lamba Ness out of the total blanket bog Scottish resource of 1,759,000 ha = 0.0002%. Magnitude of predicted change = negligible.
Wet modified bog habitat/wet heath	A total of 1.80 ha of wet modified bog/wet heath habitat (including mosaics with bare peat) is predicted to be lost from the proposed Vertical Launch Space Port on Lamba Ness out of the total wet modified bog/wet heath Habitats study area resource of 37.5 ha = 5%. Magnitude of predicted change = minor.	A total of 1.80 ha of wet modified bog/wet heath habitat (including mosaics with bare peat) is predicted to be lost from the proposed Vertical Launch Space Port on Lamba Ness out of the total blanket bog Shetland resource of 53,430 ha = 0.003%. Magnitude of predicted change = negligible.	A total of 1.80 ha of wet modified bog/wet heath habitat (including mosaics with bare peat) is predicted to be lost from the proposed Vertical Launch Space Port on Lamba Ness out of the total blanket bog Scottish resource of 1,759,000 ha = 0.0001%. Magnitude of predicted change = negligible.
Bog habitats (wet modified bog and wet modified bog/wet heath combined)	A total of 5.14 ha of bog habitat is predicted to be lost from the proposed Vertical Launch Space Port on Lamba Ness out of the total bog (including blanket bog, wet modified bog and wet modified bog/wet heath) Habitats study area resource of 68.3 ha = 8%. Magnitude of predicted change = moderate.	A total of 5.14 ha of bog habitat is predicted to be lost from the proposed Vertical Launch Space Port on Lamba Ness out of the total blanket bog Shetland resource of 53,430 ha = 0.01%. Magnitude of predicted change = negligible.	A total of 5.14 ha of bog habitat is predicted to be lost from the proposed Vertical Launch Space Port on Lamba Ness out of the total blanket bog Scottish resource of 1,759,000 ha = 0.0003%. Magnitude of predicted change = negligible.

[3] Note this assessment has been updated to consider only the operational habitat loss. In the original EIAR submitted to SIC in January 2021 the construction loss (which is bigger) was assessed. However, the overall assessment (magnitude of predicted change) has been kept the same.
Also note subsequent to the original submission alterations were made to the design layout, resulting in small changes in the land-take calculation assessment. These alterations were submitted to SIC in October 2021 are presented in section 6.9.

Phase 1 Habitat	Proportional Study Area Loss and Magnitude of Change	Proportional Regional Loss and Magnitude of Change	Proportional National Loss and Magnitude of Change
Coastal grassland	A total of 2.85 ha of coastal grassland habitat is predicted to be lost from the proposed Vertical Launch Space Port on Lamba Ness out of the total coastal grassland Habitats study area resource of 19.7 ha = 15%. Magnitude of predicted change = moderate.	A total of 2.85 ha of coastal grassland habitat is predicted to be lost from unknown total regional resource. Given the widespread nature of coastal habitats in Shetland the magnitude of predicted change is considered = negligible.	A total of 2.85 ha of coastal grassland habitat plus is predicted to be lost from the proposed Vertical Launch Space Port on Lamba Ness out of the total coastal grassland Scottish resource of 22,138 ha = 0.013%. Magnitude of predicted change = negligible.
Marginal and inundation vegetation	Less than 0.01 ha of marginal and inundation habitat is predicted to be lost from the proposed Vertical Launch Space Port on Lamba Ness out of the total marginal and inundation Habitats study area resource of 0.2 ha = 5%. Magnitude of predicted change = minor.	Less than 0.01 ha of marginal and inundation habitat is predicted to be lost from unknown total regional resource. This habitat type is considered rare therefore the magnitude of predicted change is considered = minor-negligible.	Less than 0.01 ha of marginal and inundation habitat is predicted to be lost from unknown total Scottish resource. This habitat type is considered rare, but at a national scale the magnitude of predicted change is considered = negligible.
Saltmarsh	Less than 0.01 ha of salt marsh habitat is predicted to be lost from the proposed Vertical Launch Space Port on Lamba Ness out of the total saltmarsh Habitats study area resource of 0.4 ha = 2.5%. Magnitude of predicted change = minor.	Less than 0.01 ha of salt marsh habitat is predicted to be lost from unknown total regional resource. This habitat type is considered under-recorded therefore the magnitude of predicted change is considered = negligible.	Less than 0.01 ha of salt marsh habitat is predicted to be lost from unknown total regional resource. This habitat type is considered under-recorded therefore the magnitude of predicted change is considered = negligible.
Unimproved acid grassland	A total of 0.84 ha of unimproved acid grassland habitat is predicted to be lost from the proposed Vertical Launch Space Port on Lamba Ness out of the total unimproved acid grassland habitat Habitats study area resource of 7.3 ha = 12%. Magnitude of predicted change = moderate.	A total 0.84 ha of unimproved acid grassland habitat is predicted to be lost from unknown total regional resource. This habitat type is considered widespread across Unst, Shetland and Scotland. Therefore, the magnitude of predicted change is considered = negligible.	A total 0.84 ha of unimproved acid grassland habitat is predicted to be lost from unknown total national resource. This habitat type is considered widespread across Unst, Shetland and Scotland. Therefore, the magnitude of predicted change is considered = negligible.

6.8.51 Although, there is predicted to be moderate magnitude of change impacts on the bog habitats (including wet modified bog and wet modified bog/wet heath), particularly on the wet modified bog (NVC community M25) at the local, study area level, these habitats are widespread across Unst, Shetland and Scotland. Given the modified nature of the bog habitat to be impacted (through current and historic management practices), and the embedded mitigation in relation to hydrology and drainage, the loss of these habitats is not considered likely to greatly alter the structure or function of the surrounding habitats either at the site or more widely. Embedded mitigation includes preserving the topsoil from the habitat that is lost and laying it over the top of the areas to be reinstated. This will provide a local seed source as well as viable root matter for the areas being reinstated. Therefore, the reinstated vegetation is likely to be similar, if not the same, habitat type as previously present. Mitigation also includes a commitment to reducing grazing pressure, and ditch management (where appropriate) within the bog habitats. With this embedded mitigation, the magnitude of change caused by land-take habitat loss on bog habitat is reduced to minor. With the embedded mitigation, the impact caused by land-take habitat loss on bog habitat is considered likely to be one-off, partly reversible and long-term and **no likely significant effects** are predicted (Table 6.17). There is a further commitment to engage with off-site peatland restoration projects on Unst, which will further compensate for predicted adverse, but non-significant, land-take effects.

6.8.52 There is predicted to be a moderate magnitude of change on the coastal grassland habitats at the study area level. Coastal grassland habitats are considered to be widespread around the coastline of Unst, Shetland and Scotland. The coastal grassland habitat in the Habitats study area has been impacted through current and historic management practices including grazing pressure and military use. Embedded mitigation aimed at reducing the impacts on this habitat type include best practice in relation to preserving the topsoil from the habitat that is lost and laying it over the top of the areas to be reinstated. This will provide a local seed source as well as viable root matter to the areas being reinstated. Therefore, the reinstated vegetation is likely to be similar, if not the same, habitat type as previously present. Mitigation also includes a commitment to reducing grazing pressure and targeting the grazing timing to encourage increased species richness (for details see Appendix 5.3). With this embedded mitigation, the loss of these habitats are not considered likely to greatly alter the structure or function of the surrounding coastal grassland habitats within the study area. Taking these aspects into consideration, with this embedded mitigation, the magnitude of change caused by habitat loss on coastal grassland is reduced to minor-moderate, considered likely to be significant at the local, study area level.

6.8.53 There is predicted to be a minor magnitude of change on the marginal and inundation habitat and the saltmarsh habitat at the study area level. It should be noted that none of the NVC community A22, which is an Annex 1 habitat, is predicted to be lost. The very small amount of predicted loss of marginal and inundation habitat and the saltmarsh habitat (not A22) is only 6 m^2 and 30 m^2 predicted operation loss of two habitats respectively. Embedded mitigation includes micro-siting which will be used to relocate infrastructure to further avoid these habitats. This will necessarily be carried out on the ground under supervision by the ECoW. With this embedded mitigation, the losses of these habitats are considered likely to be reduced to negligible. With the embedded mitigation, the impact caused by habitat loss on marginal and inundation habitat and the saltmarsh habitat is considered to be unlikely (due to micro-siting), one-off, partly reversible and long-term and **no likely significant effects** are predicted (Table 6.17).

6.8.54 There is predicted to be a moderate magnitude of change on the unimproved acid grassland habitats at the local, study area level. Unimproved acid grassland habitats are considered to be widespread across Unst, Shetland and Scotland. The acid grassland habitat in the Habitats study area has been impacted through current and historic management practices including grazing pressure and military uses. Embedded mitigation aimed at reducing the impacts on this habitat type include best practice in relation to preserving the topsoil from the habitat that is lost and laying it over the top of the areas to be reinstated. This will provide local seed source as well as viable root matter for the areas being reinstated. Therefore, the reinstated vegetation is likely to be similar, if not the same, habitat type as previously present. With this embedded mitigation the loss of these habitats is not considered likely to greatly alter the structure or function of the surrounding unimproved acid grassland habitats in the study area. Taking these aspects into consideration, with this embedded mitigation, the magnitude of change caused by habitat loss on acid grassland is reduced to minor. With the embedded mitigation, the impact caused by habitat loss on coastal grassland is considered to be likely, one-off, partly reversible and long-term and **no likely significant effects** are predicted (Table 6.17).

6.8.55 Severance or fragmentation has the potential to adversely affect habitat connectivity for individuals, propagules or gene flow. The Proposed Project on Lamba Ness is set within a mosaic landscape of crofting and common grazings and old military infrastructure. It is considered highly unlikely, given the already fragmented nature of the habitats that the Proposed Project will prevent or inhibit the movement of individuals, propagules or gene flow. The magnitude of change as a consequence of severance is assessed as negligible. The impact caused by severance is considered to be unlikely, one-off, irreversible and long-term and **no likely significant effects** are predicted (Table 6.17).

6.8.56 Potential indirect impacts on the habitats could arise from changes in drainage which can adversely impact on habitats by altering the amount of water a habitat receives or retains. These potential hydrological impacts are considered in Chapter 9 which take into account standard mitigation, in particular implementation of a suitable OEMP and surface water drainage system. With the embedded mitigation, the magnitude of change on habitats as a consequence of changes in drainage is assessed as negligible. The indirect impact on habitats as a consequence of changes in drainage is considered to be unlikely, one-off, temporary and short-term and **no likely significant effects** are predicted (Table 6.17).

6.8.57 Potential indirect impacts on the habitats could arise from pollution events. Pollution prevention measures are considered in Chapter 9 which takes into account standard mitigation, in particular implementation of a suitable OEMP and appropriate storage and management of fuels and chemicals. Therefore, with the embedded mitigation, the magnitude of change on habitats as a consequence of pollution is assessed as negligible. With the embedded mitigation, the indirect impact on habitats as a consequence of pollution is considered to be unlikely, intermittent, temporary and short-term (event) to medium term (recovery) and **no likely significant effects** are predicted (Table 6.17).

Table 6.17. Summary of Predicted Impacts on Habitats for the Proposed Project

Parameter	Habitat Loss (land-take)	Severance	Drainage	Pollution
Adverse/ beneficial/ neutral	Adverse	Adverse	Adverse	Adverse
Extent	Footprint of the Vertical Launch Space Port on Lamba Ness plus cut and fill and 2 m buffer.	Footprint of the Vertical Launch Space Port on Lamba Ness plus cut and fill and 2 m buffer.	Footprint of the Vertical Launch Space Port on Lamba Ness plus cut and fill and 2 m buffer.	Footprint of the Vertical Launch Space Port on Lamba Ness and into watercourses and the sea.
Duration	Long-term.	Long-term.	Short-term.	Short-term (event) – medium-term (recovery).
Reversibility	Partly reversible though reinstatement of habitat.	Irreversible.	Temporary.	Temporary.

Parameter	Habitat Loss (land-take)	Severance	Drainage	Pollution
Frequency	One-off.	One-off.	One-off.	Intermittent.
Probability	Likely.	Unlikely.	Unlikely.	Unlikely.
Magnitude	Moderate to negligible at the Study Area level. Negligible at a regional and national level for all habitat types.	Negligible.	Negligible.	Negligible.

6.9 Amendment to Proposed Project Operational Effects on Habitats

6.9.1 As described above, the operation of the Proposed Project in its original design layout has the potential to adversely impact on habitats directly or indirectly through permanent habitat loss during operation, potentially through severance and changes to hydrology and pollution. The majority of the habitat predicted lost as a result of operation of the Proposed Project is wet modified bog (NVC community M25b and mosaics). Coastal grassland (MC10, MC8, MG11 and mosaics) has the second highest predicted loss from land-take. Very small amounts of loss were predicted for marginal and inundation and salt marsh habitats.

6.9.2 Small changes in the design layout, submitted in to SIC in October 2021, included an altered location of the TEL building. The impacts of this small change on habitats are considered in the following sections.

Coastal Grassland and Wet Modified Bog

6.9.3 On review of the proposed design changes, it was noted that the original TEL building location was largely situated on coastal grassland habitat (NVC community MC8d:MC10b (60:40)) with a small section on wet modified bog (NVC community M25b:S19a:A24 (90:8:2)). The proposed new location is also largely situated on the same habitat types with the majority on coastal grassland (NVC communities MC8d:M10b:A24 (50:25:25)) and a potion on wet modified bog (NVC community M25b).

6.9.4 Therefore, for these coastal grassland and wet modified bog areas, the changes in loss are very small compared to the overall predicted loss. Therefore, the evaluation for these habitat types will not be altered:

- Wet modified bog - with embedded mitigation (e.g., grazing management and ditch blocking), the magnitude of change caused by land-take on wet modified bog habitat was considered minor and no likely significant effects were predicted. There is a further commitment to engage with off-site peatland restoration projects on Unst, which will further mitigate for predicted adverse, but non-significant, land-take effects.

- Coastal grassland - with embedded mitigation (e.g., reinstating vegetation and grazing management), the magnitude of change caused by habitat loss on coastal grassland was minor-moderate. With embedded mitigation, the amount of coastal grassland to be lost will be reduced. Nevertheless, such a loss was considered likely to be **significant effects at the local, study area level**.

Marginal and Inundation Habitat

6.9.5 The adjusted location of the TEL building has a small section on an area mapped as marginal and inundation (NVC community A24:S19a:SM16b (50:45:5)) which includes some salt marsh vegetation, albeit a very small proportion of the habitat type.

6.9.6 For the purposes of this evaluation, the whole marginal/inundation habitat polygon has been assumed to be lost which is likely an overestimation. The loss of the polygon (327m2) increases the loss of marginal and inundation habitat. However, it is noted that the loss could be avoided by micro-siting it further east.

6.9.7 The EIA Report predicted that less than 0.01 ha of marginal and inundation habitat would be lost, out of the total marginal and inundation study area resource of 0.2 ha (5%), therefore resulting in magnitude of predicted change of minor. Embedded mitigation included micro-siting which will be used to relocate infrastructure to further avoid these habitats. This will necessarily be carried out on the ground under supervision by the Ecological Clerk of Works (ECoW). With this embedded mitigation in place, the losses of these habitats were considered likely to be reduced to negligible and **no likely significant effects** are predicted.

6.9.8 Following review of the proposed changes, it is predicted that a maximum of 0.046 ha of marginal and inundation habitat may be lost from the study area resource of 0.2 ha (23%). The magnitude of predicted change is therefore moderate. Embedded mitigation again includes micro-siting which will be used to relocate infrastructure to further avoid these habitats. However, it is unclear how much will be able to be micro-sited away as it is within the development boundary, rather than on the edge.

6.9.9 The habitat type does not have a conservation listing; but may be important as a whimbrel chick feeding habitat. As part of embedded mitigation (for ornithology) the Applicant has agreed to the creation of more whimbrel chick feeding habitat already. To mitigate for the loss of the marginal/inundation vegetation some of these chick feeding habitat should be shallow, allowing for this marginal and inundation vegetation to establish. Therefore, with this embedded mitigation, the loss of this habitat type is reduced to minor-negligible and **no likely significant effects** are predicted.

6.9.10 In summary, a likely significant effect, at the study area/local level, is predicted on coastal grassland habitat in relation to land-take from the operation of the Proposed Project. No other likely significant effects are predicted for semi-natural habitats in relation to the operation of the Proposed Project.

6.10 Additional Mitigation

6.10.1 The Outline Habitat Management Plan (Appendix 5.3) identifies eight main objectives, six of which will have direct ecological benefits to the site and surrounding area. These include peatland restoration, creation of riparian broadleaf tree/scrub cover, coastal grassland management, wetland creation including creating new pools and the creation of artificial otter holts. Whilst the pools and wetland areas are under the auspices of ornithology mitigation, they will none the less have ecological benefits increasing the biodiversity and providing additional habitat for non-avian species e.g., invertebrates thus providing biodiversity enhancement.

6.11 Residual Effects

6.11.1 A likely significant residual effect, at the study area/local level, is predicted on coastal grassland habitat in relation to land-take from operation of the Proposed Project.

6.12 Cumulative Assessment

6.12.1 Cumulative effects can result from individually insignificant but collectively significant actions taking place over a period of time or concentrated in a location (CIEEM, 2018). This guidance goes on to say that "*developments to be included in the cumulative impact assessment should be in accordance with national guidance*". SNH/NatureScot provide no advice or guidance in relation to the cumulative impacts of a spaceport.

6.12.2 CIEEM (2018) also states in relation to cumulative assessment that "*Information about developments within the zone(s) of influence may be available in other EcIAs, Local Plan documents, Marine Spatial Plans, Strategic Environmental Assessments (SEAs), Sustainability Appraisals (SAs), Water Framework Directive Assessments (WFDAs), and Habitats Regulations Assessments/Appraisals (HRAs), including 'Natura Impact Statements' (NISs) / 'Natura Impact Reports' (NIRs), 'Information / 'Reports to Inform an Appropriate Assessment', 'Shadow Habitats Regulations Assessments' and, for Nationally Significant Infrastructure Projects, 'Reports on the Implications for European Sites' (RIES)*".

6.12.3 The ecological study area is an equivalent to the potential 'environmental zone of influence' and as there are no existing or proposed developments within that area, no significant issues are considered likely to arise from inter-project additive or cumulative effects.

6.12.4 Intra-project cumulative effects are those where an environmental topic/receptor is affected by more than one impact from the same Proposed Project and the impacts act together. The interactions between noise and ecology have been identified and assessed within this chapter, and no other environmental topic are considered likely to give rise to potential intra-project cumulative effects.

6.13 Summary

6.13.1 This Ecology Chapter has:

- Established the baseline ecological conditions of the site using a desk-study and targeted ecological surveys (Phase 1 Habitat survey, NVC survey, GWDTE survey, otter survey and freshwater pearl mussel survey).
- Identified the potentially important ecological receptors likely to be affected by the Proposed Project namely designated sites, otters and semi-natural.
- Assessed the ecological importance and sensitivity of designated sites, otters and semi-natural habitats.
- Evaluated the likely magnitude of predicted impact on these ecological receptors from the operation of the Proposed Project.
- Identified mitigation, including avoidance and minimisation of impacts on sensitive ecological receptors and has provided enhancement opportunities.

6.13.2 The assessment predicts one likely significant residual effect, at the study area/local level, on coastal grassland habitat in relation to land-take from operation of the Proposed Project. The assessment does not predict any other likely significant ecological residual effects associated with the Proposed Project.

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Chapter 7 Air Quality

7. Air Quality

Air Quality

7.1 Introduction

7.1.1 This chapter considers the potential effects of the Proposed Project on local air quality. The Proposed Project is described in full detail in Chapter 3, but the elements with the potential to affect local air quality can be summarised as follows:

- Operation of the Proposed Project, located on the Lamba Ness peninsula and comprising three launch sites, associated storage and integration hangars, satellite tracking stations and launch support buildings; and
- Operation of the proposed Launch and Range Control Centre (LRCC) located at the former Valhalla Brewery site in Saxa Vord.

7.1.2 This chapter examines the potential effects of the following:

- potential for emissions from traffic associated with operation of the Proposed Project to cause significant effects at ecological sites and receptors relevant for human health;
- potential for emissions from point sources associated with the Proposed Project to cause significant effects at ecological sites and receptors relevant for human health; and,
- potential for emissions from launches to cause significant effects at receptors relevant for human health. There are no airborne pollutants associated with launch activities considered likely to have any significant adverse effects on important local ecology.

7.1.3 The pollutants considered in this assessment are:

- Vehicle exhaust emissions of oxides of nitrogen (NO_x) and particulate matter (PM_{10} and $PM_{2.5}$); and,
- Carbon monoxide (CO) emissions from launches.

7.1.4 This chapter has been prepared by ITPEnergised and should be read in conjunction with Drawings 7.1 to 7.7 and Technical Appendices 7.1-7.3 in Volumes III and IV respectively.

7.2 Legislation, Policy and Guidelines

Space Industry Act

7.2.1 The Space Industry Act (2018) regulates all spaceflight activities carried out in the United Kingdom, and associated activities. The Act requires any person or organisation to obtain the relevant licence to:

- launch a launch vehicle from the UK;
- return a launch vehicle launched elsewhere than the UK to the UK landmass or the UK's territorial waters;
- operate a satellite from the UK;
- conduct sub-orbital activities from the UK;
- operate a spaceport in the UK; or
- provide range control services from the UK.

7.2.2 As the Applicant wishes to operate a vertical launch spaceport (the SaxaVord Spaceport) and provide range control services (at the Launch and Range Control Centre, LRCC) they are required to apply for both a spaceport licence and a range control licence. However, AEE is only relevant to applications for spaceport licences.

Space Industry Regulations 2021

7.2.3 The Space Industry Regulations 2021 (the Regulations) set out in more detail the requirements for each licence the Regulators Licensing rules, which specify what information the UK Civil Aviation Authority (CAA), the regulator, requires in support of an application.

Air Quality Legislation

7.2.4 The UK's legislation and regulatory regime plays a key role in the prevention, control and minimisation of atmospheric emissions that are potentially harmful to human health and the environment. Air Quality Objectives (AQOs) are quality standards for clean air that are used as assessment criteria for determining the significance of any potential changes in local air quality resulting from development proposals. Relevant legislation and guidance documents have been reviewed and taken into account as part of this AQIA.

European Legislation

7.2.5 The EU has published a Directive on Ambient Air Quality Assessment and Management which came into force in September 1996 (Directive 96/62/EC). This Directive is intended as a strategic framework for tackling air quality consistently, through setting European wide air quality limit values in a series of daughter directives, superseding and extending existing European legislation. The first four daughter directives were placed into national legislation. A new EU air quality directive (Directive 2008/50/EC) came into force in June 2008 and was transposed into The Air Quality Standards Regulations in England, Wales, Scotland and Northern Ireland in June 2010 (H.M Government, 2010). The Directive merged the four daughter directives and one Council decision into a single national directive on air quality.

National Legislation

7.2.6 The Environment Act 1995 (H.M. Government, 1995) required the preparation of a National Air Quality Strategy (NAQS) setting air quality standards and objectives for specified pollutants and outlining measures to be taken by local authorities through the system of Local Air Quality Management (LAQM) and by others to work in pursuit of the achievement of these objectives. The NAQS was published in 1997 and subsequently reviewed and revised in 2000, and an addendum to the Strategy published in 2002. The current Strategy was published in July 2007; (Defra, 2007).

7.2.7 The objectives which are relevant to local air quality management have been set into Regulations namely Air Quality (Scotland) Regulations 2000, Air Quality (Scotland) Amendment Regulations 2002 and Air Quality (Scotland) Amendment Regulations 2016 (Scottish Government, 2016), the latter of which introduces an additional statutory obligation for Scottish Local Authorities to comply with an annual mean objective for $PM_{2.5}$ to align with the World Health Organisation Guideline Value (WHO).

7.2.8 The air quality standards (AQSs) are set for the purpose of protecting human health, vegetation and ecosystems from certain harmful atmospheric pollutants. The Scottish AQSs take account of the EU limit values and are either effectively identical, or more stringent. The AQSs applicable to the pollutants considered in this assessment are shown in Table 7.1.

Table 7.1 Air Quality Standards

Pollutant	Air Quality Standard	
	Concentration (µg/m^3)	Averaging Period
For the Protection of Human Health (Scotland)		
NO_2	200	1-hour mean; not to be exceeded more than 18 times a year
	40	Annual mean
PM_{10}	50	24-hour mean; not to be exceeded more than seven times a year
	18	Annual mean
$PM_{2.5}$	10	Annual mean
CO	10 mg/m^3	Running 8-hour mean
For the Protection of Vegetation and Ecosystems (UK)		
NO_x	30	Annual mean

Local Air Quality Management

7.2.9 Under Section 82 of the Environment Act (1995) (Part IV) Local Authorities (LAs) are required to periodically review and assess air quality within their area of administration under the system LAQM. This review and assessment of air quality involves considering present and likely future air quality against the objectives and reporting to the Scottish Government by means of an Annual Progress Report (Shetland Islands Council, 2020). If it is predicted that levels at sensitive locations where members of the public are regularly present for the relevant averaging period are likely to be exceeded, the LA is required to declare an Air Quality Management Area (AQMA). For each AQMA the LA is required to produce an Air Quality Action Plan (AQAP), the objective of which is to reduce pollutant concentrations in pursuit of the objectives.

7.2.10 There are currently no AQMAs within the Shetland Islands.

Guidance

Guidance to the regulator on environmental objectives relating to the exercise of its functions under the Space Industry Act 2018

7.2.11 The Department for Transport issued its document '*Guidance to the regulator on environmental objectives relating to the exercise of its function under the Space Industry Act 2018*' in2021 (Department for Transport, 2021), clarifying the government's environmental objectives relating to spaceflight and associated activities in the UK:

The environmental objective for spaceflight are to:

- *Minimise emissions contributing to climate change resulting from spaceflight activities*
- *Protect human health and the environment from the impacts of emissions on local air quality arising from spaceflight activities*
- *Protect people and wildlife from the impacts of noise from spaceflight activities*
- *Protect the marine environment from the impact of spaceflight activities.*

Guidance for the Assessment of Environmental Effects

7.2.12 The CAA (July 2021) Guidance for the Assessment of Environmental Effects document explains the process for completing an assessment of environmental effects as part of a licence application under the Space Industry Act.

7.2.13 The AEE Guidance requires that potential direct and indirect significant effects of proposed spaceflight activities on environmental features, including air quality, are considered. The guidance further requires that:

- Specific potential effects are identified and, where possible, quantified;
- The focus of the AEE should be on significant effects arising from the proposed activities;
- Applicants for a spaceport licence set an environmental budget, comprising a maximum number of launches per launch vehicle type which can take place over the course of a year that can be carried out in an environmentally sustainable manner, taking into account the cumulative effect of all launches; and
- The AEE must address a range of environmental topics, including air quality.

Air Quality Guidance

7.2.14 The assessment also uses the guidance documents listed below:

- The Technical Guidance LAQM.TG(16) for Local Air Quality Management, (Defra 2018);
- The Environmental Protection UK (EPUK) and Institute of Air Quality Management (IAQM), Land-Use and Development Control: Planning for Air Quality (Moorcroft and Barrowcliffe et al, 2017);
- IAQM, A Guide to the Assessment of Air Quality Impacts on Designated Nature Conservation Sites, (Holman et al, 2017);
- The IAQM Guidance on the Assessment of Dust from Demolition and Construction (Holman et al, 2014);
- The Environmental Protection Scotland (EPS) and Royal Town Planning Institute (RTPI) Scotland Delivering Cleaner Air for Scotland guidance (EPS and RTPI, 2017); and,
- Civil Aviation Authority (CAA) Airspace Change guidance CAP 1616 (CAA, 2000).

7.3 Consultation

7.3.1 Extensive statutory consultation on air quality was carried out during preparation and determination of the planning application for the SaxaVord Spaceport, where the Proposed Project will be operated. Where directly relevant to this AEE, consultation responses received during the SaxaVord Spaceport planning application period have been summarised in Table 7.2.

Table 7.2 Consultation

Consultee	Summary of Response	Where addressed in Chapter
Air Quality / Ian Taylor assistant EHO, Shetland Islands Council / 26/06/2020	Agreement of parameters and method but reservations about scoping out potential impacts from vehicle movements during the operational phase together with operational point sources.	Appendix 7.1

Consultee	Summary of Response	Where addressed in Chapter
Air Quality / Ian Taylor assistant EHO, Shetland Islands Council / 14/07/2020	Agreement on method to assess impacts of the largest mass emission LV from Launch Pad 3 AND the largest and smaller mass emission LV from Launch Pad 1, closest to the receptors. Agreement on screening approach for transport and point source emissions. Agreement that ambient baseline air quality was not necessary.	Paragraphs 7.4.18 - 7.4.26, 7.4.35 and Appendix 7.3
Air Quality/Peter Cosgrove/Director/Alba Ecology 12/06/2020	Confirmation that there are no airborne pollutants associated with launch emissions considered likely to have any significant adverse effects on important local ecology	Paragraph 7.4.2 and Appendix 7.3

7.4 Assessment Methodology and Significance Criteria

Scope of the Assessment

7.4.1 The scope of the assessment has included the following:

- Consultation with Shetland Islands Council to agree an appropriate method of assessment;
- Identification of the environmental zone of influence (EZI) – equivalent to the study area - and air quality sensitive receptors;
- Collection of baseline pollutant concentrations at the Proposed Project;
- Screening assessment of potential effects of Proposed Project generated point source emissions from heating sources in buildings;
- Detailed assessment of potential effects of Spaceport associated traffic flows in the using the advanced dispersion model ADMS Roads (CERC, 2020);
- Collection of emissions data from two candidate LVs from the manufacturers: Large Mass Emission LV (up to 850 kg payload) and Small Mass Emission LV (up to 350 kg payload);
- Development of representative scenarios: Large Mass Emission LV from Launch Pad 3 (only LV from this pad) and Small and Large Mass Emission LVs from Launch Pad 1 (closest to receptors);
- Development of a time-dependant puff model of a jet release with specified duration for each scenario using the advanced dispersion model ADMS 5 (CERC, 2020) in a range of meteorological conditions and wind directions;
- Development of a time-integrated dose model to predict total concentration at receptors during the lifetime of the puff release in each scenario using ADMS 5 in a range of meteorological conditions and wind directions;
- Conversion of dose concentrations to 8-hour running mean concentrations and comparison with the AQO for CO;

- Contour maps and results tables demonstrating the puff concentration at 5 minute intervals after release for the worst case meteorological condition;
- Mitigation measures required where necessary; and,
- Residual summary of effects.

Effects Scoped Out of the Assessment

7.4.2 There are no airborne pollutants associated with launch events considered likely to have any significant adverse effects on ecological receptors therefore, the effect of emissions from launch events on ecological sites has not been considered further in the assessment.

Environmental Zone of Influence

7.4.3 Maps and aerial images of the Proposed Project and the surrounding area have informed the selection of an appropriate environmental zone of influence ("the study area") for the assessment.

7.4.4 For the potential effects of operational phase vehicle exhaust emissions, a study area of 50 m from affected roads was considered. This is in accordance with IAQM Guidance (Holman et al, 2014) and EPUK & IAQM guidance (Moorcroft and Barrowcliffe et al, 2017). The affected road links considered in the assessment and the respective EZI (study area) are shown in Drawing 7.1.

7.4.5 The closest air quality sensitive receptors in each direction from Launch Pads 1 and 3 were identified, and an EZI up to 4 km from each launch position identified to track the puff release until concentrations returned to ambient background levels under a range of meteorological conditions. The closest occupied sensitive receptor is Banks Cottage at Norwick which is 1840 m from Launch Pad 1 and 2470 m from Launch Pad 3. This is shown as R1 on Drawing 7.2 alongside the wider EZI.

Method of Assessment

7.4.6 Due to the remote location of the Proposed Project, the low baseline traffic movements and a lack of industrial activity in the surrounding area, it was agreed with Shetland Islands Council that no ambient baseline air quality monitoring was necessary. Instead, background air quality concentrations from published Government data have been used and are considered fit for purpose for this assessment.

7.4.7 The potential impacts of emissions to atmosphere from the Proposed Project have been calculated using screening tools and modelling which inherently include a number of robust assumptions.

7.4.8 The emission rate of exhaust gases from each LV will vary with height during the launch event. However, they have been modelled as short-term puff releases from ground level for the duration it takes the LV to reach an altitude of 1000 ft as required by the Civil Aviation Authority. This is considered to represent the maximum potential impact of emissions for identified receptors.

Vehicle Emissions

7.4.9 There is the potential for changes to long-term and short-term mean concentrations of fine particulates (PM_{10}, $PM_{2.5}$) and NO_2 to occur because of predicted changes in road traffic movements on the local road network as a result of the Proposed Project operations.

7.4.10 The maximum daily values during a launch event are predicted to be 70 LGVs and 11 HGVs; significantly below the EPUK and IAQM screening thresholds for detailed assessment. However, in order to satisfy the request from Shetland Islands Council, the potential magnitude of change in air quality due to operational traffic has been assessed.

7.4.11 The magnitude of change at a sensitive roadside receptor has been calculated using the latest version of the atmospheric dispersion model software ADMS Roads Version 5.0.1 (CERC, 2020) with built-in emissions factors, equivalent to those within the Defra emissions factors toolkit EfT 9.0 (2VC) (Defra, 2019). Assuming the construction shift to be limited to an 8-hour shift from 0800-1700 the maximum forecast daily construction vehicle movements have been split into hourly flows during these hours.

7.4.12 The potential magnitude of change in air quality has been assessed by defining an affected road link which all of the maximum daily operational phase traffic is assumed to travel through. This assessment has used a section of the B9087 through Saxa Vord and Norwick where it is considered that maximum exposure to operational phase vehicle emissions is likely due to the number of residential settlements and a SSSI (Norwick Meadows) adjacent to the roadside as shown in Drawing 7.1.

7.4.13 A summary of the modelled road links, traffic speeds and development-generated traffic is shown in Tables 1 and 2 in Volume IV Technical Appendix 7.1.

7.4.14 Pollutant concentrations of NO_x, NO_2, PM_{10} and $PM_{2.5}$ have been predicted at selected receptors using development-generated traffic combined with existing baseline background concentrations in order to compare the total predicted concentration with the relevant AQSs.

7.4.15 The assessment has been undertaken using the most recent year of hourly meteorological data from 2019 for Baltasound Airport on Unst.

7.4.16 Details of general model conditions used in the dispersion model are provided in Table 7.3 below.

Table 7.3- General ADMS Roads Model Conditions

Variables	ADMS Roads Model Input
Surface roughness at source/meteorological site	0.02 m / 0.02 m (Open Grassland)
Minimum Monin-Obukhov length for stable conditions at source/meteorological site	Model-calculated per hourly meteorological condition
Terrain types	Flat Terrain
Receptor location	x, y coordinates determined by Geographic Information System (GIS) z = 1.5 m for ground floor human receptors z = 0 m for ecological receptor
Pollutants	NO_x, PM_{10}, $PM_{2.5}$
Traffic Emissions Factors	Defra EfT9.0 (2 VC) emission factor dataset for 2021
Meteorological data	One year (2019) hourly sequential data from Baltasound Airport meteorological station.
Emission profiles traffic	None

Variables	ADMS Roads Model Input
Receptors	Selected existing receptors (residential) and SSSI
Model output	Long-term annual mean NO_x concentrations Long-term annual mean PM_{10} concentrations Long-term annual mean $PM_{2.5}$ concentrations

Generator Emissions

7.4.17 Until a permanent three phase power supply is secured for the Proposed Project, primary energy demands will be met through the use of mobile diesel generators. The anticipated generator requirement comprises:

- Launch Site Processing Facility (LSPF) - two 275 kVA diesel generators (prime) to provide power requirements for the Administration/Gatehouse/Integration Building/Stores and external lighting.
- Integration Hangar – two 230 kVA diesel generators (prime) to supply the building/services requirements and lighting and small power to the Launch Pads.
- Water Deluge at Launch Pads – two 500 kVA diesel generators (standby) will supply the deluge pumps. These generators will run for a maximum of 30 minutes per launch event and short periods for regular maintenance/testing. The sets will be moved between Launch Pads as required.

7.4.18 When a permanent power supply is achieved it will provide all primary services to the LSPF, Integration Hangar and Launch Pads, and the previous prime generators at the LSPF and Integration Hangar will change to standby configuration. It is anticipated that one of each type of generator will be removed. Launch water deluge pumps will always be supplied with power from the two 500 kVA mobile generators relocated to the active pad as required.

7.4.19 As demonstrated in Drawing 7.2, the closest receptor to the Proposed Project boundary is R1 Banks Cottage at Norwick, more than 900 m from the location of any of the proposed generators. It is therefore unlikely that any perceptible change in air quality will be detected at an area where the AQSs apply and there is relevant exposure. The separation distances between buildings means that the potential for cumulative impacts is considered to be negligible.

7.4.20 In order to satisfy the request from Shetland Islands Council, a screening assessment of the potential impact from generator emissions was calculated using a unit conversion and screening tool (AEA, 2008) based on fuel use data provided in the manufacturer brochures for each proposed type (FG Wilson, 2020) and emissions factors for diesel-fuelled mobile combustion plant from the National Atmospheric Emissions Inventory (NAEI, 2020). The assessment is included in Volume IV Technical Appendix 7.2.

Launch Event Emissions

7.4.21 The Proposed Project includes three launch sites, available for use by multiple launch service providers (LSPs) using a range of different launch vehicle (LV) types. The proposed Launch Pads are designed to accommodate LVs between 13 m and 30 m in height. There is also potential for sub-orbital or sounding rocket launches. These LVs are much smaller, ranging from about 1.5 m to 8 m in height.

7.4.22 Launches will take place in a northerly direction over the sea. Launch events will not occur simultaneously from more than one Launch Pad.

7.4.23 The Applicant is looking to achieve a maximum of 30 launches per year. However, in the first year it is anticipated that there will be up to 10 launches, made up of both orbital and sub-orbital LVs.

7.4.24 Only the largest mass emission LV (approximately 30 m in height and up to 850 kg payload) will launch from Launch Pad 3. All candidate LVs will potentially be launched from Launch Pad 1 (closest to the receptor) or Launch Pad 2.

7.4.25 LVs generally use a mixture of RP-1 (a highly refined form of kerosene similar to jet fuel) and liquid oxygen (LOX) to fuel the first stage. The majority of emissions from burning RP-1 and LOX are nitrogen gas and oxygen gas, alongside much smaller quantities of carbon dioxide (CO_2) and CO. Trace amounts of other NAQS pollutants, such as Volatile organic compounds (VOCs), oxides of nitrogen (NO_x), oxides of sulphur (SO_x) and particulate matter (PM_{10}) could be released, but the total amount of any given release would be negligible per event and recorded as zero.

7.4.26 Launch event greenhouse gas emissions (including CO_2) are quantified in Chapter 11.

7.4.27 The only pollutant that requires assessment with respect to air quality for potential effects on human health is CO.

7.4.28 In order to determine worst case launch event effects at sensitive receptors, and as agreed with Shetland Islands Council as part of the planning application consultation, this assessment considers the following two scenarios:

- Large Mass Emission LV (approximately 30 m in height and up to 850 kg payload) launching from Launch Pad 3; and,
- Large (as above) and Small Mass Emission LV (approximately 13 m height and up to 350 kg payload) launching from Launch Pad 1.

7.4.29 Effects from launch events taking place at Launch Pad 2 are considered to be represented effectively through the Launch Pad 1 scenario. In reality, effects from launch events at Launch Pad 2 will be lower as the launch event will occur at greater distance from any given receptor.

7.4.30 The Civil Aviation Authority (CAA) guidance document CAP1616 "Airspace Change – Guidance on the regulatory process for changing the notified airspace design and planned and permanent redistribution of air traffic, and on providing airspace information", states that assessment of emissions on local air quality is required for any airspace change less than 1000 feet in altitude. It is therefore only necessary for the AQIA to consider emissions from LVs during Stage 1 as subsequent stages occur at significantly higher altitudes. This has been estimated to take a maximum of 30 seconds dependent on LV type.

7.4.31 The "Puff" model in ADMS 5 (CERC, 2020) enables releases of up to one-hour duration to be modelled and concentrations at chosen downwind distances to be predicted at different timesteps (seconds after the start of the emission). It is therefore possible to track the concentration at any point during the whole lifetime of that puff release, for any given meteorological condition, and calculate the total "dose" at each location i.e., the total concentration that a person would be exposed to if they stayed at the same location for the whole time the puff passed overhead. When considering the potential exposure for a human receptor during a launch event, the total dose concentration is the most appropriate.

7.4.32 The assessment has been undertaken for the two launch scenarios and is described in detail in Volume IV Technical Appendix 7.3.

Vehicle Exhaust Emissions and Launch Event Emissions

7.4.33 The change in pollutant concentrations with respect to future baseline concentrations has been described at identified sensitive receptors. The absolute magnitude of pollutant concentrations in the "future with Proposed Project" scenario is described, and this is used to consider the risk of the AQSs being exceeded.

7.4.34 The IAQM has published recommendations for describing the magnitude of impacts and determining the significance of such impacts at individual receptors (Moorcroft & Barrowcliffe et al., 2017). The impact descriptors are summarised in Table 7.4 below. A change of less than 0.5 % of the Air Quality Assessment Level (AQAL) is described as Negligible.

Table 7.4 – Impact Magnitude Descriptors for Individual Receptors

Long Term Average Concentration at Receptor	% Change in concentration relative to Air Quality Assessment Level (AQAL)			
	1 %	2-5 %	6-10 %	>10 %
75 % or less of AQAL	negligible	negligible	slight	moderate
76-94 % of AQAL	negligible	slight	moderate	moderate
95-102 % of AQAL	slight	moderate	moderate	substantial
103-109 % of AQAL	moderate	moderate	substantial	substantial
110 % or more of AQAL	moderate	substantial	substantial	substantial

Overall Assessment of Significance

7.4.35 The reported magnitude impacts for each receptor have been considered for the Proposed Project in overall terms. In addition, the potential for the Proposed Project to contribute to or hinder the successful implementation of policies and strategies for the management of local air quality has been considered. The descriptors used to characterise the overall significance of effects at sensitive receptors are summarised in Table 7.5.

Table 7.5 - Descriptors used for the Overall Assessment of Significance at Sensitive Receptors

Effect Descriptor	Significance
Major	A significant effect that is likely to be a material consideration in its own right.
Moderate	A significant effect that may be a material consideration in combination with other significant effects but is unlikely to be a material consideration in its own right.
Minor	An effect that is not significant but that may be of local concern.
Negligible	An effect that is not significant change.

Requirements for Mitigation

7.4.36 Proposed mitigation measures are presented in Section 7.7.

Assessment of Residual Effect

7.4.37 An assessment of predicted significant residual effects, taking account of committed mitigation measures, is presented in Section 7.9.

7.5 Baseline Conditions

7.5.1 Background concentrations for NO_x, NO_2, PM_{10} and $PM_{2.5}$ have been taken from the 2017 Scottish Air Quality Database (Air Quality in Scotland, 2020) and Defra LAQM background maps (Defra, 2020). The maximum 2020 annual background concentrations in the study area are predicted to be 1.8 µg/m^3, 1.3 µg/m^3, 5.9 µg/m^3, 3.3 µg/m^3 and 0.05 mg/m^3 for NO_x, NO_2, PM_{10}, $PM_{2.5}$ and CO respectively. These are all significantly below the relevant AQSs outlined in Table 7.1.

7.6 Receptors Brought Forward for Assessment

7.6.1 The receptors brought forward for assessment are:

- Two residential properties closest to the roadside along the B9087 road (Saxa Vord Residential and Norwick Residential on Drawing 7.1);
- The closest residential receptor to Launch Pad 1 (R1 on Drawing 7.2); and,
- Norwick Meadows SSSI adjacent to the B9087 (shown on Drawing 7.1).

7.7 Standard Mitigation

Vehicle Emissions

7.7.1 Improvements to the existing public road network and the construction of the New Section of Access Road at Northdale will mitigate against congestion pinch points that can lead to an increase in vehicle emissions due to reduced speed and stop-start behaviour.

7.7.2 A Staff Travel Plan will seek to maximise car sharing. Staff travelling to the Proposed Project will be collected by coach from the ferry terminals avoiding the generation of additional traffic numbers.

7.7.3 The Applicant will use electric vehicles to collect and transport visitors to and around the Proposed Project.

A Spectator Traffic Management Plan has been developed to avoid congestion and encourage sustainable transport choices. The STMP will mitigate against the generation of air pollution from vehicles.

Generator Emissions

7.7.4 Generators proposed for the LSPF will be compliant with EU Stage IIIa emissions limits (FG Wilson, 2020), and all other generators across the Proposed Project will be fuel optimised to minimise NO_x emissions. Generator stack heights will be designed to ensure compliance with the Chimney Height Memorandum as defined in the 1956 Clean Air Act and to ensure effective dispersion and avoidance of potential downwash effects.

7.7.5 In future, the Applicant intends to secure a permanent three phase power supply for the Proposed Project, enabling the number of diesel generators to be reduced significantly to two standby generators and two mobile diesel generators supplying the deluge pump systems used during launch events.

7.8 Potential Effects

Operational Traffic

7.8.1 The assessment of traffic emissions in Volume IV Technical Appendix 7.1 concludes that:

- The magnitude of change in concentration of each pollutant is significantly below 0.5 % of the relevant annual mean AQS at all receptors.

- The maximum predicted total concentration of NO_2 at a sensitive receptor is less than 4 % of the annual mean AQS.
- The maximum predicted total concentration of PM_{10} at a sensitive receptor is less than 33 % of the annual mean AQS.
- The maximum predicted total concentration of $PM_{2.5}$ at a sensitive receptor is less than 34 % of the annual mean AQS.
- There is no predicted risk of exceedance of the annual mean or short-term AQSs at any residential receptor due to the emissions from the forecast peak number of operational vehicles during a launch event.
- The magnitude of change in concentration of each NO_x is significantly below 0.2 % of the relevant annual mean AQS for the protection of vegetation and ecosystems.
- The maximum predicted annual mean NO_x concentration at the Norwick Meadows SSSI is less than seven percent of the annual mean AQS or critical level.
- There is no predicted risk of exceedance of the critical level threshold at a roadside ecological receptor.

7.8.2 The effects of operational phase vehicle emissions at all identified receptors are therefore predicted to be of negligible significance**,** therefore resulting in **no likely significant effect**.

Generator Emissions

7.8.3 The screening assessment of operational generator emissions in Volume IV Technical Appendix 7.2 concluded that effects at the closest sensitive receptor are of negligible significance**,** therefore resulting in **no likely significant effect**.

Launch Event Emissions

7.8.4 The assessment of the potential effects of emission from launch events in Volume IV Appendix 7.3 considered ambient CO concentrations at short term intervals after release. Modelling identifies that the downwind concentration was detectible above background levels following launch for a period of up to 40 minutes from Launch Pad 3, and 30 minutes from Launch Pad 1. After this time, concentrations reverted to background levels.

7.8.5 The maximum predicted concentrations at R1 occurred during the small LV from Launch Pad 1 scenario. While the emissions from Launch Pad 1 LVs are lower than those from Launch Pad 3, Launch Pad 1 is in closer proximity to R1 and the launch of the small LV resulted in a lower exit velocity reducing momentum and rate of dispersion of the modelled release.

7.8.6 The maximum predicted dose at R1 is 44.2 mg/m^3 CO over 30 seconds. This is equivalent to a concentration dose of 38.5 parts per million (ppm). There are no health effects of this level of exposure to CO over periods of 30 minutes. A person would have to be exposed to this dose for six to eight hours of constant exposure to experience headache or dizziness (Goldstein, 2008). For a health effect to arise from 30 – 40 minutes of exposure, the dose would need to be of the order of 800 ppm to 1600 ppm.

7.8.7 The maximum predicted 8-hour concentration of CO at R1 occurred during the small LV from Launch Pad 1 scenario. Dispersion of the jet puff was assessed across a range of representative atmospheric conditions, to ensure all potential meteorological conditions were considered. The maximum concentrations at the closest sensitive receptor R1 were determined and a time-averaged concentration was calculated over the 8-hour period equivalent to the relevant AQS for CO.

7.8.8 The maximum predicted 8-hour concentration of CO at R1 is 2.82 mg/m^3, 28 % of the AQS, when modelled using UK average convective meteorological conditions with wind from the north-east (45°).

7.8.9 On analysis of the meteorological data, a north-east (45°) wind only occurs for approximately 9 % of the year on Unst. There is therefore a high probability that launch events will take place under the local prevailing wind conditions which, over the period 2015-2019, was southerly to westerly. Under prevailing conditions, there is no detectible impact at the closest receptor R1.

7.8.10 The assessment has demonstrated that there is no predicted risk of exceedance of the 8-hour AQS for CO at any sensitive receptor in the vicinity of the Proposed Project, irrespective of the prevailing weather conditions during launch events.

7.8.11 The effect of launch event emissions on all identified receptors is concluded to be of negligible significance**,** therefore resulting in **no likely significant effect**.

7.9 Cumulative Assessment

7.9.1 Cumulative effects can be either inter-project or intra-project effects.

7.9.2 Inter-project cumulative effects are those where an environmental topic/receptor is affected by impacts from more than one project at the same time and the impacts act together. Due to the location of the Proposed Project on the north coast of Unst, the most northerly of the Shetland Islands, it is considered that there are no potential inter-project cumulative effects as there are no other existing or proposed developments in the EZIs for air quality.

7.9.3 Shetland Islands Council was contacted during the planning application stage of the Proposed Project and confirmed that there are no committed development or infrastructure projects on the Island which should be considered in the assessment.

7.9.4 Intra-project cumulative effects are those where an environmental topic/receptor is affected by more than one impact from the same Proposed Project and the impacts act together. Given that none of the other environmental topics considered impact directly on air quality, and the fact that only one launch will occur at any given time and launches will be phased with time enough for the EZI to return fully to its baseline state between launches, it is considered that there is no potential for additive or intra-project cumulative effects.

7.10 Residual Effects

7.10.1 The residual effects on air quality from the construction, operational and decommissioning phases of the Proposed Project are concluded to be of negligible significance, therefore resulting in **no likely significant effect**.

7.11 Summary

7.11.1 An assessment of the potential effects of emissions from the Proposed Project on local air quality has been undertaken. The assessment has considered the operational phase of the Proposed Project.

7.11.2 Proposed project-generated traffic is predicted to have an effect of negligible significance on air quality, therefore resulting in **no likely significant effect**.

7.11.3 Generator emissions are predicted to have no perceptible impact at any identified receptors. The emissions from generators are predicted to have an effect of negligible significance on local air quality**,** therefore resulting in **no likely significant effect**. Emissions are also expected to reduce over the lifetime of the Proposed Project due to the Applicant's intention to secure a permanent three phase power supply in time.

7.11.4 Operational phase launch event emissions are predicted to have no perceptible impact at any identified receptors under prevailing wind directions. The maximum predicted impact at a sensitive receptor is predicted to occur with north-easterly winds which occur typically for less than 10 % of the year. The maximum predicted 8-hour concentration of CO is 28% of the AQS. Emissions from launch events are therefore considered to have an effect of negligible significance on air quality**,** therefore resulting in **no likely significant effect**.

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Chapter 8 Noise and Vibration

8. Noise and Vibration

8. Noise and Vibration

8.1 Introduction

8.1.1 This chapter considers the potential noise and vibration effects associated with the Proposed Project.

Scope of Assessment

8.1.2 The scope of this assessment has comprised the following:

- Baseline noise survey;
- Evaluation of road traffic noise;
- Modelling of engine testing and rocket (LV) launch noise (undertaken by BRRC);
- Evaluation and interpretation of modelling results; and,
- Specification of appropriate mitigation.

8.1.3 Ground-borne vibration effects associated with launches and engine testing will be highly localised and are considered to be negligible at human receptor locations. The evaluation of ground-borne vibration effects has therefore been scoped out of this assessment. However, potential vibration effects at cultural heritage receptors are considered in Chapter 14 of this AEE.

8.1.4 Prediction of noise associated with launch vehicles (LVs), including static engine tests and launches, has been undertaken by Blue Ridge Research and Consulting LLC (BRRC). BRRC is an acoustical engineering consultancy focused on critical noise and vibration challenges for aerospace, aviation, and US Department of Defense projects. With experience from more than 250 civilian and military noise studies, BRRC's team of acoustical engineers is recognised as a trusted advisor to public, private, and academic clients in the space industry around the world.

8.1.5 BRRC's modelling evaluates the potential impacts of LV noise and sonic booms on a cumulative basis in terms of human annoyance. In addition, potential impacts are evaluated on a single-event basis in relation to hearing conservation, sleep disturbance, speech interference, and structural damage. As applicable, model results have then been incorporated into this AEE Report chapter by ITPEnergised.

8.1.6 The BRRC modelling assessment is provided in Volume IV Technical Appendix 8.1. It is recommended that the reader reviews the BRRC report prior to proceeding with this chapter.

8.1.7 With reference to Volume IV Technical Appendix 8.1 Figure 40, the sonic boom from launches will occur 60 km out to sea, away from populated areas, therefore further consideration of air overpressure effects on structures and human receptors has been scoped out of this assessment.

Glossary of Acoustics Terms

8.1.8 Acoustics and vibration are necessarily highly technical disciplines, and as such there are numerous specific terms which are used within this assessment. The terms are defined here to aid the lay reader.

- **Noise** – unwanted sound.
- **A-weighting** – an electronic filter applied to measured sound levels to approximate the hearing response of humans to different frequencies, denoted 'A' in noise indices.
- **Ambient level, $L_{eq,T}$** – the equivalent continuous sound pressure level (L_{eq}) of the totally encompassing sound in a given situation at a given time at the assessment location over a given time interval, T. Denoted $L_{Aeq,T}$ when A-weighted.

- **Background level, $L_{A90,T}$** - the A-weighted sound pressure level that is exceeded for 90 percent of a given time interval, T.
- **Maximum level, L_{Amax}** – the A-weighted maximum instantaneous sound level during a measurement period or noise 'event', recorded during a time interval, T.
- **Day-night noise level, L_{den}** - the A-weighted ambient level over a 24-hour period, with a +10 dB penalty for night-time noise (23:00 – 07:00) and a +5 dB penalty for evening noise (19:00 – 23:00). The L_{den} index is a cumulative yearly average, taking into account all noise 'events' associated with a particular source throughout the year.
- **Sound Exposure Level, SEL** – the SEL (alternatively the Single Event Noise Exposure Level, SENEL) is the one-second long steady level that contains as much sound energy as the varying level over the full event. The SEL is similar to the L_{eq}, however, the SEL uses a reference period of one second, whereas the L_{eq} can be expressed for any time interval.

8.2 Legislation, Policy and Guidelines

8.2.1 A short summary of relevant legislation, policy and guidelines that have been taken into consideration in this assessment is provided below. Where appropriate, detailed summaries of these documents for the lay reader are provided in Volume IV Technical Appendix 8.2.

Legislation

Space Industry Act

8.2.2 The Space Industry Act (2018) regulates all spaceflight activities carried out in the United Kingdom, and associated activities. The Act requires any person or organisation to obtain the relevant licence to:

- launch a launch vehicle from the UK;
- return a launch vehicle launched elsewhere than the UK to the UK landmass or the UK's territorial waters;
- operate a satellite from the UK;
- conduct sub-orbital activities from the UK;
- operate a spaceport in the UK; or
- provide range control services from the UK.

8.2.3 As the Applicant wishes to operate a vertical spaceport (the SaxaVord Spaceport) and provide range control services (at the Launch and Range Control Centre, LRCC) they are required to apply for a both a spaceport licence and a range control licence. However, AEE is only relevant to applications for spaceport licences.

Space Industry Regulations 2021

8.2.4 The Space Industry Regulations 2021 (the Regulations) set out in more detail the requirements for each licence the Regulators Licensing rules, which specify what information the UK Civil Aviation Authority (CAA), the regulator, requires in support of an application.

Control of Noise at Work Regulations, 2005

8.2.5 The Control of Noise at Work Regulations (CoNaW Regs.) seek to protect against hearing damage by controlling the exposure of employees to noise during the course of their working day by providing threshold noise exposure values which trigger particular requirements of employers and employees.

8.2.6 The threshold noise exposure values relate to either daily or weekly personal exposure; the individual 'noise dose' received by an employee during work hours is calculated over the appropriate time period. Where an employee is exposed to noise levels above the thresholds, certain requirements on behalf of the employer and employee are triggered, such that their risk of noise-induced hearing damage is minimised.

8.2.7 The threshold values are as follows:

- **Lower Exposure Action Value (LEAV);**
  - Daily or weekly personal noise exposure of 80 dB(A) and,
  - Peak sound pressure of 135 dB(C);
- **Upper Exposure Action Value (UEAV);**
  - Daily or weekly personal noise exposure of 85 dB(A) and,
  - Peak sound pressure of 137 dB(C);
- **Exposure Limit Value (ELV);**
  - Daily or weekly personal noise exposure of 87 dB(A) and,
  - Peak sound pressure of 140 dB(C);

8.2.8 A weekly value may be used where the exposure of an employee varies markedly from day to day.

8.2.9 The daily exposure is calculated using the following formula:

$$L_{EP,d} = L_{Aeq,Te} + 10\log_{10} (T_e/T_0)$$

8.2.10 Where:

- T_e is the duration of the person's working day in seconds;
- T_0 is 28,800 seconds (8 hours); and,
- $L_{Aeq,T}$ is the equivalent continuous A-weighted sound pressure level that represents the sound the person is exposed to during the working day.

Policy

Consultation Response on UK Airspace Policy: A Framework for balanced decisions on the design and use of airspace

8.2.11 In February 2017 the UK Government put forward proposals to address the noise impact of aviation as part of a consultation on how changes to airspace could be implemented to allow airports to keep up with demand.

8.2.12 The consultation response noted that the UK Government believes that the 54 dB$L_{Aeq,16hr}$ metric remains appropriate, on the basis of a Survey of Noise Attitudes Study (SoNA, 2014) commissioned by the Department for Transport (DfT) which indicated that the degree of annoyance based on percentage of respondents 'highly annoyed' previously occurring at 57 dB$L_{Aeq,16hr}$ now occurs at 54 dB$L_{Aeq,16hr}$.

Shetland Local Development Plan 2014

8.2.13 The Local Development Plan notes that:

- Development should not have a significant adverse effect on existing uses;
- Development should not compromise acceptable health and safety standards or levels; and
- Development should be consistent with National Planning Policy, other Local Development Plan policies and Supplementary Guidance.

Guidance

Guidance for the Assessment of Environmental Effects

8.2.14 The CAA (July 2021) document Guidance for the Assessment of Environmental Effects explains the process for completing an assessment of environmental effects as part of a licence application under the Space Industry Act.

8.2.15 The AEE Guidance requires that potential direct and indirect significant effects of proposed spaceflight activities on environmental features, including noise and vibration, are considered. The guidance further requires that:

- Specific potential effects are identified and, where possible, quantified;
- The focus of the AEE should be on significant effects arising from the proposed activities;
- Applicants for a spaceport licence set an environmental budget, comprising a maximum number of launches per launch vehicle type which can take place over the course of a year that can be carried out in an environmentally sustainable manner, taking into account the cumulative effect of all launches; and
- The AEE must address a range of environmental topics, including noise.

Guidance to the Regulator on Environmental Objectives Relating to the Exercise of its Functions Under the Space Industry Act 2018

8.2.16 The Department for Transport issued its document '*Guidance to the regulator on environmental objectives relating to the exercise of its function under the Space Industry Act 2018*' in 2021, clarifying the government's environmental objectives relating to spaceflight and associated activities in the UK:

The environmental objective for spaceflight are to:

- *Minimise emissions contributing to climate change resulting from spaceflight activities*
- *Protect human health and the environment from the impacts of emissions on local air quality arising from spaceflight activities*
- *Protect people and wildlife from the impacts of noise from spaceflight activities*
- *Protect the marine environment from the impact of spaceflight activities.*

8.2.17 The guidance identifies that noise from spaceflight activities is anticipated to be one of the greatest environmental concerns for impacts to humans and wildlife.

8.2.18 It is further noted that noise generated by spaceflight activities is not covered by WHO guidelines, ISO or BSI assessment methods, however, fixed spaceport activities should be assessed in accordance with BS 4142, as for any other type of industrial noise.

8.2.19 With regard to appropriate indices for the evaluation of rocket noise, the guidance notes the following:

"When assessing distinct and infrequent noise, such as rocket noise, measures of single events such as the maximum noise level (L_{Amax}) and the sound exposure level (SEL or LAE) are most appropriate. Unweighted maximum noise level (L_{max}) may also be appropriate for assessing risk of structural damage to the surrounding buildings and properties. To avoid acute damage to the human inner ear resulting from impulsive sounds, WHO noise guidelines suggest the maximum sound level (L_{Amax}) should never exceed 110 dBL_{ASmax}. To avoid and minimise the risk of structural damage the maximum unweighted noise level (L_{ASmax}) should not exceed 120 dB (unweighted)."

8.2.20 The guidance notes that the regulator must ensure:

- That where the rocket launch noise footprint could result in exposures in excess of 80, 85, 90, 95 and 100 dBL_{ASmax}, that these areas are published on suitable maps and used to communicate with local stakeholders.
- Where a night-time launch has been proposed by an applicant, the regulator should ensure that the applicant has assessed the risks to sleep disturbance in the vicinity around the launch using the following probability of awakening (equation provided in guidance).
- That any noise assessment provided takes into account an assessment of noise under predominant meteorological conditions and favourable weather conditions for launch where they differ.
- That any noise assessment provided clearly identifies the sources of noise and establishes what levels of noise have no observed effect, which have low observed adverse effects, and which have significant observed adverse effects.
- That a range of noise metrics have been assessed in addition to A-weighted measurements when considering a sonic boom. Where sonic booms over land cannot be avoided, the maximum overpressure should not exceed 47.88 pascals (Pa).
- All reasonable steps have been taken by operators to mitigate and minimise the adverse effects of noise events on human health and sensitive wildlife receptors.

8.2.21 The guidance notes that the noise assessment should include noise arising from ground operations and ancillary services, such as increased vehicle movement, generators and on-site equipment, assembly of launch vehicles, propellant loading and static fire testing.

8.2.22 Example mitigation measures are provided, including site selection away from sensitive receptors, applying operational procedures, e.g., restrictions during the night-time, seasonal restrictions, and implementing launch caps.

British Standard BS4142:2014+A1:2019

8.2.23 BS4142 describes methods for rating and assessing sound from industrial or commercial premises at residential receptors by comparison of the rating level due to the noise source with the background level in the absence of noise from the source.

8.2.24 The following evaluation impact significance identifiers are provided in the Standard, in which the difference between the rating level and measured background level are considered:

- The greater the difference, the greater the magnitude of impact;
- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact;
- A difference of around +5 dB is likely to be an indication of an adverse impact;
- The lower the rating level, relative to the measured background level, the less likely that the specific sound source will have an adverse (or significant adverse) impact; and,
- Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact.

Calculation of Road Traffic Noise (CRTN)

8.2.25 CRTN (Department of Transport, 1988) provides a method for the prediction of noise levels due to road traffic based on traffic flows, average speed, road type and geometry.

Converting the UK traffic noise index $L_{A10,18hr}$ to EU noise indices for noise mapping

8.2.26 This report by TRL Ltd. may be used to convert CRTN 10th percentile ($L_{A10,18hr}$) noise index values to equivalent continuous ($L_{Aeq,T}$) index values, including $L_{Aeq,16hr}$, L_{day} and L_{night}.

Design Manual for Roads and Bridges (DMRB)

8.2.27 DMRB provides standards and advice regarding the assessment, design and operation of roads in the UK and provides significance criteria by which the percentage of people adversely affected by traffic noise can be related to the total noise level due to road traffic, or the increase over existing levels.

ISO 9613: Attenuation of sound during propagation outdoors, Part 1 and Part 2

8.2.28 ISO 9613 provides a calculation method for determining the attenuation of sound during propagation outdoors to predict the levels of environmental noise from a variety of sources.

The Environmental Noise (Scotland) Regulations 2006

8.2.29 The Regulations enact European Union Directive 2002/49/EC relating to the assessment and management of environmental noise in Scotland. The Regulations require that noise strategic noise maps are made showing the contribution of road, rail, aircraft and industrial activities. The strategic maps are to be used to develop noise action plans for areas close to major airports and other infrastructure. The Regulations use the noise indices L_{den} and L_{night}.

World Health Organization – Environmental Noise Guidelines for the European Region (WHO ENG)

8.2.30 The World Health Organization (WHO) was requested by the Member States in the European Region to produce noise guidelines that included not only transportation noise sources but also personal electronic devices, toys and wind turbines, which had not yet been considered in existing guidelines. Furthermore, European Union Directive 2002/49/EC relating to the assessment and management of environmental noise (END) and related technical guidance from the European Environment Agency both elaborated on the issue of environmental noise and the importance of up-to-date noise guidelines.

8.2.31 The WHO Regional Office for Europe has therefore developed environmental noise guidelines for the European Region, proposing an updated set of public health recommendations on exposure to environmental noise.

8.2.32 A strong recommendation can be adopted as policy in most situations. The guideline is based on the confidence that the desirable effects of adherence to the recommendation outweigh the undesirable consequences. The quality of evidence for a net benefit – combined with information about the values, preferences and resources – inform this recommendation, which should be implemented in most circumstances.

8.2.33 With regard to aircraft noise, the Guidelines provide the following recommendations:

"For average noise exposure, the Guideline Development Group (GDG) strongly recommends reducing noise levels produced by aircraft below 45 dB Lden, as aircraft noise above this level is associated with adverse health effects. For night noise exposure, the GDG strongly recommends reducing noise levels produced by aircraft during night-time below 40 dB Lnight, as night-time aircraft noise above this level is associated with adverse effects on sleep.

To reduce health effects, the GDG strongly recommends that policy-makers implement suitable measures to reduce noise exposure from aircraft in the population exposed to levels above the guideline values for average and night noise exposure. For specific interventions the GDG recommends implementing suitable changes in infrastructure."

8.2.34 The WHO ENG relies on meta-analysis of studies of the effects of aircraft noise on populations and determined that there was an absolute risk that 10% of a population would be 'highly annoyed' at an aircraft noise exposure level of 45.4 dB L_{den}. The quality of the supporting evidence was reported to be 'moderate'.

8.2.35 The International Civil Aviation Organization (ICAO) 2019 Environmental Report (ICAO. 2019) considers whether aircraft noise annoyance has increased over the last 50 years considered the case presented in the WHO ENG, given that the 45 dB L_{den} recommendation is 10 dB (i.e., an order of magnitude) below the previous recommendation of 55 dB L_{den}. The study concluded that there has been no change in people's response to aircraft noise over the past 50 years, however, there is a substantial spread in the annoyance response, which is attributed to non-acoustic factors, with examples such as noise sensitivity, fear of accidents, mistrust towards airport authorities, maximum noise levels, changes in exposure patterns and the duration of silent periods between noise events listed. On the basis of the ICAO report, this assessment considers the WHO ENG 45 dB L_{den} recommendation to be a highly conservative method for determining potential community annoyance.

World Health Organization –Guidelines for Community Noise (GCN)

8.2.36 The GCN notes the following with regard to sleep disturbance:

If the noise is not continuous, LAmax or SEL are used to indicate the probability of noise induced awakenings. Effects have been observed at individual LAmax exposures of 45 dB or less. Consequently, it is important to limit the number of noise events with a LAmax exceeding 45 dB.

Aircraft noise effect on sleep: application of the results of a large polysomnographic field

8.2.37 With regard to potential sleep disturbance, Basner et al. (2006) noted that a healthy adult briefly awakens around 20 times during an 8-hour night period in environments without external stressors, and there should be less than one additional awakening induced by aircraft noise per night for the avoidance of adverse health effects.

8.3 Consultation

8.3.1 Statutory consultation on noise was carried out during preparation and determination of the planning application for the SaxaVord Spaceport, where the Proposed Project will be operated. Where directly relevant to this AEE, consultation responses received during the SaxaVord Spaceport planning application period have been summarised in Table 8.1.

Table 8.1 Consultation Relevant to AEE

Consultee	Consultation sent/response	Action taken
Shetland Islands Council	Email sent 11th July 2018 Seeking agreement of representative study area and noise sensitive receptors, representative baseline survey locations (based on project footprint at the time).	Shetlands Islands Council confirmed by phone call that Environmental Health Officer (EHO) off sick and unknown when he would return. Noted that a response from Environmental Health unlikely to be issued before survey undertaken. Robust survey undertaken with reference to appropriate UK guidance.

Consultee	Consultation sent/response	Action taken
Shetland Islands Council & SEPA	Email sent 9th June 2020 Outlining ITPE's role in the noise and vibration assessment Seeking agreement on method of evaluation of construction, operational non-launch and launch noise.	-
SEPA	15th June 2020 SEPA email received confirming it is unlikely that a licence under the Pollution Prevention and Control (PPC) regulations was required, therefore the Proposed Project is not within SEPA's remit	No action required
Shetland Islands Council	26th June 2020 email received confirming proposed approach and suggested threshold values are appropriate.	No action required
Shetland Islands Council	26th June 2020 sent further email confirming that ground-borne vibration associated with launches will be negligible, therefore requesting confirmation it may be scoped out of assessment of operational phase.	Ground-borne vibration during launches scoped out of study
Civil Aviation Authority (CAA)	ITPEnergised provided our interpretation of the CAA guidance and described our proposed approach to the assessment. The CAA responded to confirm that it was unable to comment until an application was formally submitted, however, the interpretation of the guidance should be "*proportional and appropriate to the operation*."	Context regarding ITPEnergised's interpretation of the guidance is included within this report

8.4 Assessment Methodology and Significance Criteria

Environmental Zone of Influence

8.4.1 For a new development, a study area or environmental zone of influence (EZI) may be chosen based on the number of receptors at which the development may be audible or has the potential to exceed a particular noise threshold. A sample of the closest or most-affected noise-sensitive receptors (NSRs) is then selected for the detailed evaluation of impacts, with impacts at more distant receptors considered to be lesser. Determining an acceptable level of impact at the closest NSRs is assumed to entail an acceptable level of impact at all receptors within the wider EZI.

8.4.2 The Proposed Project comprises the following principal elements:

- Launch area at Lamba Ness comprising three launch pads, a satellite tracking station, launch vehicle integration buildings, roadways (largely re-using existing roads), fuel storage and ancillary infrastructure.

8.4.3 The environmental zone of influence (EZI) for this assessment has been informed by maps and aerial images of the Proposed Project areas and its surroundings, as well as site visits undertaken during the baseline noise survey. A buffer of five km from the boundary of the Proposed Project has been chosen for the consideration of noise effects. Noise effects may occur beyond this buffer; however, potential effects will be most significant within.

8.4.4 While the AEE guidance notes that the EZI should consider potential effects along the trajectory of launch vehicles, the SaxaVord Spaceport lies at the northernmost tip of the UK and launches will all have a northerly bearing. As such, there will be no permanent human Noise Sensitive Receptors (NSRs) along the trajectory of the launch vehicles, and a circular EZI is sufficient to consider the worst-case noise impacts. There will be no on-land ecological receptors north of launch site and noise impacts will diminish rapidly as the launch vehicle gains altitude, such that consideration of worst-case noise impacts to ecological receptors can be achieved within the five km circular EZI buffer.

8.4.5 A sample of the closest, and therefore potentially worst-affected, Noise Sensitive Receptors (NSRs) to the Proposed Project have been identified and adopted for the evaluation of noise impacts. These are listed in Section 8.6. While vibration impacts have been scoped out of this assessment on the basis that vibration effects will be negligible, we note that the NSRs identified will also be the closest Vibration Sensitive Receptors (VSRs).

8.4.6 NSRs are typically considered to include residential buildings, such as private dwellings, as well as institutional and cultural buildings, such as schools, hospitals, churches and museums. Of these types of potential NSR, only residential buildings have been identified within the adopted EZI.

8.4.7 A plan showing the 5 km study area (EZI) and identified receptors within that is included as Drawing 8.1.

Site Visit and Baseline Noise Survey

8.4.8 ITPEnergised undertook a baseline noise survey in the vicinity of the Proposed Project on 19th and 20th July 2018. More than two years have elapsed since the baseline data was collected, however, given the rural and remote nature of the site setting, this assessment considers that no significant changes will have occurred to the baseline noise environment since the survey was completed. Monitoring was undertaken in accordance with the methods outlined in BS7445 and BS4142.

8.4.9 Measurements were undertaken using a Rion NL-52 Class I sound level meter (SLM). The SLM and calibrator were within their laboratory calibration period, and field calibration checks were performed before and after every measurement. No significant drifts in calibration were noted. A 5-minute averaging period was used for measurements, and the SLM was set to A-weighting and fast averaging. A hand-held anemometer was used to determine the wind speed at each monitoring position.

8.4.10 A single measurement of approximately 30 hours was undertaken at Saxa Vord, and supplementary spot measurements of shorter durations were undertaken at locations representative of residential properties close to proposed infrastructure associated with the Proposed Project, both during the daytime period (07:00 – 23:00) and the night-time period (23:00 – 07:00), as defined in PAN1/2011 TAN. The noise monitoring positions (NMPs) used are shown in Drawing 8.1.

8.4.11 Measurements were undertaken in accordance with the requirements of BS4142, with low wind speeds (<5 m/s) and no rain. Records of the baseline survey are provided in Volume IV Technical Appendix 8.3.

Assessment of Potential Effect Significance

Receptor Sensitivity

8.4.12 The guidance contained within the Technical Advice Note to PAN 1/2011 has been drawn upon in the generation of an appropriate set of significance criteria. The receptor sensitivity criteria are presented within Table 8.2.

Table 8.2 NSR and VSR sensitivity criteria

Receptor Sensitivity	Description	Examples
High	Receptors where people or operations are particularly susceptible to noise and/or vibration.	Residential, quiet outdoor recreational areas, schools and hospitals.
Medium	Receptors moderately sensitive to noise and/or vibration, where it may cause some distraction or disturbance.	Offices and restaurants.
Low	Receptors where distraction or disturbance from noise and/or vibration is minimal.	Buildings not occupied, factories and working environments with existing levels of noise.

Impact Magnitude Criteria

8.4.13 Threshold noise levels have been defined for the operational phase of the Proposed Project. The derivation of threshold levels is described in subsequent sections, however, the general approach to deriving the magnitude of noise impacts for different aspects of the project is provided below.

Road traffic

8.4.14 A previous version to the current iteration of DMRB states that *"In the period following a change in traffic flow, people may find benefits or disadvantages when the noise changes are as small as 1 dB(A) – equivalent to an increase in traffic flow of 25% or a decrease in flow of 20%. These effects last for a number of years"*, whilst PAN1/2011 advises that a change of three dB(A) is the minimum perceptible under normal conditions.

8.4.15 CRTN provides a procedure for calculating road traffic noise for links with low flows, defined as between 50 and 200 vehicle movements per hour, or 1,000 to 4,000 vehicle movements per day, and notes that calculations of noise level for traffic flows below these ranges are unreliable, recommending that measurements be undertaken when evaluating such cases.

8.4.16 Using these principles, the noise impact magnitude has been determined according to the criteria provided in Table 8.3.

Table 8.3 Road traffic noise impact magnitude criteria

Increase (i) over existing road traffic noise level due to project-generated traffic flows, dB	Impact magnitude
i ≥+5	High
+3 ≤ i < +5	Medium
+1 ≤ i < +3	Low
0 ≤ i < +1	Negligible

Noise from engine testing and launches

8.4.17 No standard UK or Scottish guidance exists upon which the magnitude of noise impacts associated with LV engine testing or launches is available. This assessment has therefore considered as a robust basis of assessment, the potential for adverse health effects on the local population by reference to guidelines for aircraft noise provided by the WHO and the EU with regard to potential annoyance, and to the CoNaW Regs with regard to the potential for hearing damage.

8.4.18 Guidance relating to aircraft noise is a useful point of reference with regard to potential annoyance and sleep disturbance, however, it is noted that the character, duration and level of noise associated with LV launches will differ from that associated with conventional civilian or military airfields.

8.4.19 Given the nature of operational noise from static engine tests and launches, with high levels of noise occurring over a relatively short duration, two metrics have been considered for the determination of noise impact magnitude as follows:

- Firstly, the L_{den} noise level has been used to determine the potential for community annoyance; and,
- Secondly, instantaneous L_{Amax} noise levels have been considered with regard to potential adverse health/discomfort impacts.

8.4.20 This two-tier approach seeks to set in context the L_{den} levels generated by short-duration noisy events averaged over a year.

8.4.21 The threshold criteria for the L_{Amax} index adopt the CoNaW Regs thresholds, and robustly assume that the highest predicted $L_{Amax,1sec}$ level occurs at each NSR for the full duration of the noise 'event'. By way of context, sustained noise levels above 110 dB may cause discomfort and levels of 120 dB and above are considered the threshold of pain, therefore the CoNaW Regs thresholds are substantially below noise levels which may cause instantaneous discomfort to nearby residents. The impact magnitude criteria are presented in Table 8.4.

Table 8.4 Operational noise impact magnitude criteria matrix – static engine testing and launches – likelihood of annoyance (L_{den}) and noise exposure ($L_{EP,d}$)

Likelihood of annoyance threshold, dB L_{den}	Noise exposure, $dBL_{EP,d}$	Rationale	Impact magnitude
>45	≥85	Above threshold of community annoyance and above UEAV	High
	≥80, <85	Above threshold of community annoyance and below UEAV	Medium
	<80	Above threshold of community annoyance and below LEAV	Low
<45	<80	Below threshold of community annoyance and below LEAV	Negligible

8.4.22 At all NSRs where the predicted L_{den} is below the threshold for community annoyance *and* the $L_{EP,d}$ derived from predicted $L_{Amax,1sec}$ values is below the daily LEAV, the impact magnitude will be 'negligible'.

8.4.23 At all NSRs where the 45 dBL_{den} threshold for community annoyance is exceeded, the impact magnitude will be greater than 'negligible', and the impact magnitude will be determined by the $L_{EP,d}$ relative to the CoNaW threshold values.

8.4.24 Further consideration has been given to the number of additional potential awakening events, with regard to the findings of the aircraft noise effect on sleep study (Basner, 2006), with potential for night-time sleep disturbance determined by SEL values above 90 dB (BRRC) and L_{Amax} values above 45 dB.

Noise from non-launch activities and plant

8.4.25 For noise from fixed plant and non-launch activities such as assembly, maintenance and control buildings and activities, significance criteria have been derived based on the guidance contained within BS4142, i.e., by consideration of the difference between the rating level from the plant noise and the prevailing background sound levels, but also with respect to context and the resulting sound levels in absolute terms.

8.4.26 The impact magnitude scale for noise associated with fixed plant and non-launch activities has been derived based on the PAN1/2011 and BS4142 guidance and is presented in Table 8.5.

Table 8.5 Non-launch plant and activity noise impact magnitude criteria

Difference (d) between predicted operational noise level and applicable noise limit, dB	Impact magnitude
d ≥+5	High
0 ≤ d < +5	Medium
-10 ≤ d < 0	Low
<-10	Negligible

Vibration from engine tests and launches

8.4.27 Airborne vibration (air overpressure) associated with launches is considered with reference to predicted noise levels in the BRRC report, which notes that "*one damage claim in 100 households exposed is expected at an average continuous sound level of 120 dB (unweighted), and one in 1,000 households at 111 dB (unweighted)*". These levels match the criterion in the CAA guidance whereby "*…the maximum unweighted noise level (L_{ASmax})[1] should not exceed 120 dB (unweighted)*". Vibration criteria are provided for the determination of effect significance in Table 8.6.

Table 8.6 Operational vibration (air overpressure) impact magnitude criteria matrix – static engine testing and launches – likelihood of structural damage

Likelihood of structural damage threshold, dBL_{max}	Rationale	Impact magnitude
≥120	Likelihood of damage complaints greater than 1 in 100 households	Medium / High
≤111, <120	Likelihood of damage complaints lesser than 1 in 100 households, greater than 1 in 1,000 households	Low
<111	Likelihood of damage complaints lesser than 1 in 1,000 households	Negligible

[1] We note that the CAA guidance refers to "L_{ASmax}" values, however, we assume that the L_{max} (i.e. unweighted) value is intended here.

Effect significance

8.4.28 This assessment determines the significance of effects drawing on the example criteria provided in PAN1/2011 (refer to Table 1 in Appendix 8.2). The adopted criteria are provided for a range of NSR sensitivities in Table 8.7.

Table 8.7 Effect significance criteria

Impact magnitude	Effect significance		
	Low	Medium	High
High	Slight / Moderate	Moderate / Large	Large
Medium	Slight	Slight / Moderate	Moderate
Low	Neutral / Slight	Slight	Slight
Negligible	Neutral	Neutral	Neutral

8.4.29 This assessment considers effects with a significance of 'moderate' and above are significant and effects with a significance of 'slight' or below are considered not significant.

8.4.30 All noise sensitive receptors (NSRs) considered in this assessment are considered to have a high sensitivity to noise and vibration.

Limitations to Assessment

8.4.31 This assessment relies on information provided by BRRC. Launch data has been provided by the Launch Service Providers (LSPs) to BRRC, who undertook verification and predictions of rocket engine testing and rocket launch events using proprietary methods as described in their report, *Noise Study for Launch Vehicle Operations at Shetland Space Centre* included in Volume IV as Technical Appendix 8.1.

8.4.32 The assessment considers 30 launches of the largest type of launch vehicle intended for launch as part of the Proposed Project and, as such, represents the worst-case. Smaller launch vehicles will result in lesser noise effects.

8.4.33 This assessment considers the methods and models developed by BRRC to be appropriate and notes their routine use in the United States of America to evaluate noise from similar launch facilities, including for NASA and SpaceX. Further details of BRRC's capability and experience are given in the document *BRRC Shetland Space Centre Data Call* included for reference in Volume IV as Technical Appendix 1.2.

8.5 Baseline Conditions

8.5.1 During the baseline survey, the baseline noise environment was determined to be consistent between all monitoring locations. There was little anthropogenic noise, and natural sources such as bird calls, wind and wind-induced rustling of vegetation were the primary contributors to overall noise levels. Very infrequent vehicle movements were a lesser contributor, with traffic typically slow-moving and fewer than five movements per hour. A summary of the measured noise levels is provided in Table 8.8. Full details of the survey are provided in Volume IV Technical Appendix 8.3.

Table 8.8 Summary of measured baseline noise levels

Monitoring position / period	Monitoring duration, T	Measured level, dB(A)			
		Ambient, $L_{Aeq,T}$	Background, $L_{A90,T}$	Maximum, $L_{Amax,T}$	10th percentile, $L_{A10,T}$
NMP1 (day)	1 hr	38	27	57	39
NMP1 (night)	35 min	38	19	53	32
NMP2 (day)	1.5 hr	40	33	53	42
NMP2 (night)	40 min	27	18	45	25
NMP3	30 hrs	45	22	51	34
NMP3 (day)	5 hrs	42	21	55	36
NMP4 (day)	15 min	41	31	61	39
NMP5 (day)	1.5 hr	39	28	57	39

8.5.2 With reference to the measured levels presented in Table 8.8 above, time-event plots provided for each NMP in Volume IV Technical Appendix 8.3 and field notes, the following observations may be drawn regarding the baseline noise environment:

- Noise levels across the EZI are very low, representative of a remote, rural area with little or no influence from anthropogenic noise sources such as road traffic, air traffic, industry or power generation.
- The primary contributors to the noise environment are natural sources, such as bird calls and the wind, and agricultural sources, such as livestock.
- There is very little temporal variation in noise levels between the daytime and the night-time periods. This is particularly evident in the background (L_{A90}) trace for the 30-hour measurement at Saxa Vord, which ranges from <20 dB up to a maximum of 34 dB at 05:00, attributed to dawn chorus.
- There is very little spatial variation in noise levels between monitoring positions, with the main control on noise levels being the level of wildlife activity and atmospheric conditions.
- Throughout the daytime and the night-time period noise levels lower than the 'noise floor' of the SLM (the threshold below which accurate measurements cannot be obtained due to electrical 'noise' within the circuitry) were recorded at most of the NMPs.

8.5.3 Note that the higher noise levels recorded at NMP4 preceded a squall which required the measurement to be abandoned, therefore this measurement is not considered suitably representative of the noise environment and is provided for information only.

8.6 Receptors Brought Forward for Assessment

8.6.1 NSRs considered in this assessment comprise a representative sample of the closest inhabited dwellings to the Proposed Project. These are shown in Drawing 8.1 and listed in Table 8.9 below.

Table 8.9 NSRs considered in assessment

NSR ID	NSR Name	Rationale for selection
NSR1	Booths	Representative of closest dwellings to the Proposed Project
NSR2	Valie	Representative of dwellings to the north-west of Norwick
NSR3	Norwick	Representative of dwellings within Norwick
NSR4	Millfield	Representative of slightly elevated dwellings to the east of Norwick
NSR5	Virse	Representative of dwellings to the south of Norwick
NSR6	Northdale	Representative of dwellings in Northdale
NSR7	Haroldswick	Representative of dwellings in Haroldswick

8.7 Standard Mitigation

8.7.1 The design and operation of the Proposed Project will incorporate the following standard mitigation:

- Fixed plant will be specified such that it meets appropriate noise limits at NSRs;
- Where necessary, attenuation such as acoustic enclosures will be specified to enable noise limits to be met;
- Where possible, noisy items of plant will be situated such that project infrastructure provides screening (e.g., fans and air handling plant will be situated on the opposite side of buildings from the closest NSRs); and,
- The Applicant will seek to minimise additional vehicle journeys by providing local accommodation for site workers.

8.7.2 No mitigation is possible to reduce instantaneous noise levels associated with launches; however, the following community engagement protocols will be followed to seek to minimise the potential for annoyance:

- The timing of launches will be advertised well in advance, in local media and online, such that local residents can avoid launch noise if they choose. Predicted noise levels inside the closest dwellings will be substantially below the level at which discomfort or hearing damage would occur and residents wanting to minimise their noise exposure may choose to remain indoors when a launch is scheduled;
- The Applicant proposes to engage with the local community to support local jobs and increase employment, increase tourism to the area and connect with local schools and colleges to aid teaching of science and technology subjects. Further details of proposed community engagement and expected local benefits are provided in Chapter 4. Such measures are expected to make the local community feel engaged with the Proposed Project and reduce the likelihood of non-acoustic factors contributing to annoyance associated with noise from launches (refer to para. 8.2.35 above).
- Suggestions for appropriate community liaison are provided below:
  - Establish Liaison Group Forum;
  - Produce project update newsletter;
  - Media, website update, social media;

- Briefings with site neighbours, landowners, community representatives, interest groups and other key stakeholders;
- Produce leaflet detailing upcoming activities;
- Send letters to stakeholders likely to be immediately affected;
- Hold public open days / exhibitions;
- Manage community helpline and general email contact;
- Attend community council meetings quarterly; and,
- Manage complaints procedure.

8.8 Potential Effects

Noise from engine testing and launches

8.8.1 As noted above, this assessment relies on predicted noise levels associated with static engine tests and launches provided by BRRC. Full details of the modelling undertaken are provided in Volume IV Technical Appendix 8.1, which should be read in conjunction with this AEE chapter.

8.8.2 The BRRC report notes that the predicted noise levels consider the most likely scenario with regard to meteorological conditions, rather than those specifically likely to be favourable for launches or favourable to propagation.

8.8.3 The predicted L_{den} values from all launch-related activities at the Proposed Project, comprising launches from all three launch pads and static engine tests, are provided in Table 8.10. The predicted L_{den} values are shown as contours at five dB intervals in Drawing 8.2. Where NSRs lie between contours an interval of values has been reported.

Table 8.10 Predicted L_{den} values at NSRs

NSR ID	Predicted level, dBL_{den}
NSR1	<60, >55
NSR2	<60, >55
NSR3	<60, >55
NSR4	<60, >55
NSR5	≥55
NSR6	<55, >45
NSR7	<50, >45

8.8.4 To provide context to the lay reader, it is noted that normal conversation may register a typical noise level of 60 dB, while ambient noise levels within a quiet office may range from 40 – 50 dB.

8.8.5 Predicted L_{den} values at all of the representative NSRs considered are greater than 45 dB, therefore the impact magnitude exceeds ‘negligible’ at all NSRs. As discussed above, this assumes that noise from a space centre will generate similar levels of annoyance to noise from airports. This assessment considers that the very short duration and infrequent occurrence of noise from launches is likely to generate lower levels of annoyance than aircraft noise, which is far more frequent and regular and varies little from day to day. Launches will offer substantially greater periods of respite for nearby residents than an equivalent airport, and residents will be given warning in advance of each launch, such that they can plan accordingly to avoid the noise if they choose.

8.8.6 The predicted $L_{Amax,1sec}$ values for static engine tests and for launches are provided in Drawing 8.3a-c and Drawing 8.4a-c, respectively.

8.8.7 The predicted duration for which specific noise levels will be exceeded at NSR1 (the closest receptor to the Proposed Project) are provided in Table 8.11.

Table 8.11 Time above durations at 2 km

Level / rationale for use of level	Static engine test – time above level (seconds)	Launch – time above level (seconds)
22 dB – representative 24-hour background level in Norwick.	5	340
45 dB – representative 24-hour ambient level in Norwick and also the external level which corresponds to the internal level of 30 dB via open-window transmission, above which sleep disturbance may occur.	5	190
66 dB – level above which speech intelligibility reduces; used to evaluate potential adverse effects of rocket noise within national parks in the USA.	5	70
89 dB – representative of maximum level during overflight by an oil rig shuttle helicopter, as occurs occasionally within the EZI.	0	45

8.8.8 A time-history chart, showing how the predicted noise level changes at the closest NSR throughout a launch is provided in Figure 8.1.

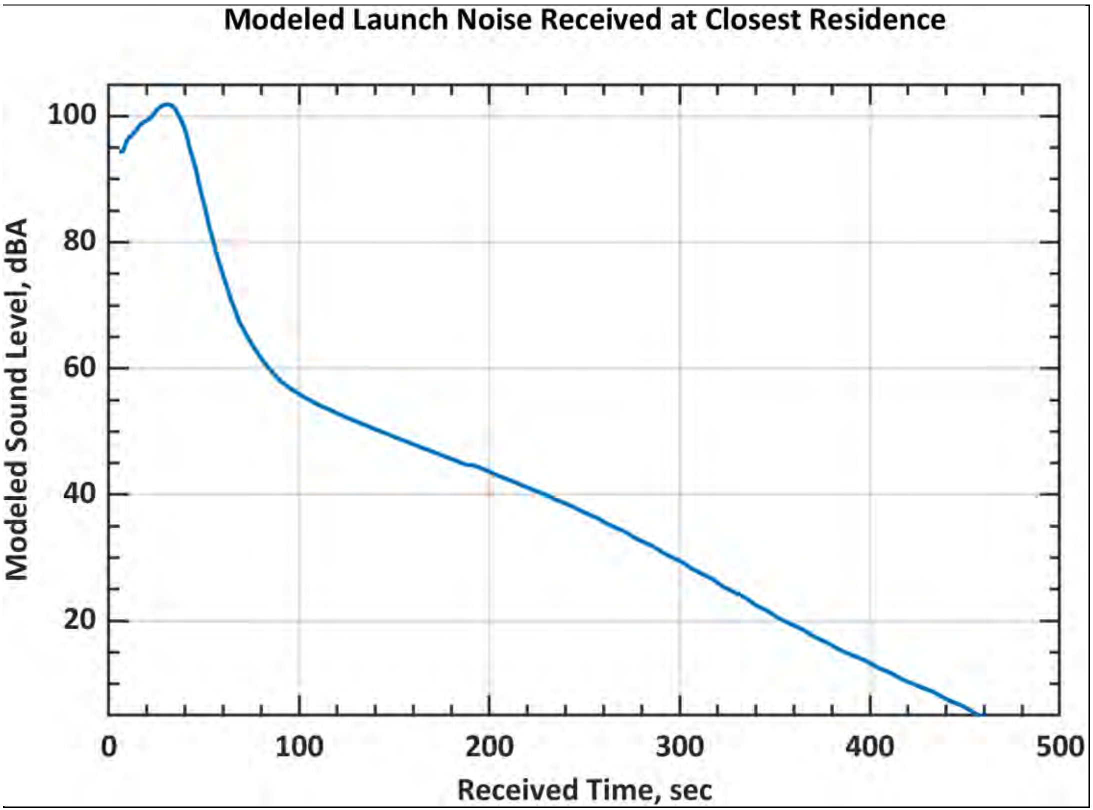

Figure 8.1 Time-history chart of launch noise

8.8.9 The noise levels at the closest NSR show a short-duration (approx. 50 seconds) peak where noise levels are in the range 80 – 100 dB(A), followed by a rapid decline to approx. 55 dB by 100 seconds. Figure 8.1 shows that the noise level drops to 45 dB, representative of the baseline ambient level, within 200 seconds. Table 8.11 above shows that the noise level drops below 22 dB, representative of the baseline background level and below which noise from the launch will trend towards being inaudible, within 340 seconds. The maximum duration of launch events in terms of noise will therefore be approximately 340 seconds, or just under six minutes.

8.8.10 The BRRC report (Volume IV Technical Appendix 8.1) considers an upper limit level of 115 dBL_{Amax} to protect human hearing from noise-induced hearing loss (NIHL), and notes that there are no dwellings within the 115 dB noise contour for operational noise associated with launches or engine tests.

8.8.11 With reference to Drawing 8.3, showing the predicted L_{Amax} contours for static engine tests from all three pads of the Proposed Project, the highest predicted level occurs at NSR1, which lies on the 87 dB contour. Given an engine test duration of five seconds, and using the equation provided in para. 8.2.9 above, the resultant $L_{EP,d}$ is 49 dB. This is substantially below the LEAV and the impact magnitude at this worst affected NSR is therefore low.

8.8.12 At all other NSRs the predicted L_{Amax} levels are lower than at NSR1, therefore the resultant $L_{EP,d}$ will be lower, and the impact magnitude is low.

8.8.13 With reference to Table 8.7 above, the resultant effect significance for noise from static engine tests at high sensitivity receptors is slight. Noise effects associated with static engine tests are therefore not significant, resulting in **no likely significant effect.**.

8.8.14 With reference to Drawing 8.4, showing the predicted L_{Amax} contours for launches from all three pads of the Proposed Project, the highest predicted level occurs at NSR1 during launches from Pad 1, with a predicted level of 102 dBL_{Amax}. With reference to Table 8.11 and Figure 8.1, the predicted noise level at NSR1 is below 60 dB after approximately 80 seconds.

8.8.15 In a highly conservative assumption, the $L_{EP,d}$ has been calculated assuming that the 102 dB noise level occurs throughout the 80 second period. Using the equation provided in para. 8.2.9 above, the resultant $L_{EP,d}$ is 76 dB. This is substantially below the LEAV and the impact magnitude at this worst affected NSR is therefore **low**.

8.8.16 With reference to Table 8.7 above, the resultant effect significance for high sensitivity receptors is slight. Noise effects associated with launches are therefore not significant, resulting in **no likely significant effect**.

8.8.17 When considering potential increased sensitivity to noise during the night-time period, it is noted that the BRRC report states SEL values greater than 90 dB generally lead to sleep disturbance. Further, given a predicted 102 dBL_{Amax} level at NSR1, and assuming a reduction of approximately 30 dB to external levels provided by the building envelope, it is highly likely that launches during the night-time period will result in internal noise levels above 45 dBL_{Amax} with resultant potential awakening of sleeping population at all NSRs within the EZI, as per GCN guidance.

8.8.18 Of the proposed 30 launches per year, when taking into account the no-launch window agreed between mid-May to the end of June, the Applicant anticipates that in any one month there may be three-four launches. Given the proposed frequency of launches and the short duration of the noise events associated with launches, and with reference to the 2006 Basner study which states that restricting additional awakenings due to aircraft noise to a maximum of one event per night is anticipated to have no adverse effect on human health, adverse effects associated with sleep disturbance due to night-time launches are considered to be minimal. This is considered to further reduce the likely effect significance of launch noise during the night-time period and place short-duration, high intensity noise events into context.

Noise from non-launch activities and plant

8.8.19 The Applicant has committed to meeting boundary noise limits for fixed plant, such that appropriate noise limits derived using BS4142 will be met at all NSRs. The detailed list of fixed plant associated with the Proposed Project has yet to be finalised, however, it is anticipated that the largest and potentially noisiest items of plant will be generators which will provide power to the facility. The generators will be sited within an enclosure and will have internally mounted exhaust silencers. Other potentially significant noise sources will comprise air handling units for the clean rooms, as well as condensers and pumps at the assembly buildings. Lifting equipment, such as cranes, will only operate within the assembly buildings and not outside, and will therefore not be a significant source of noise. LVs will be transported to the launch pads using a Transporter Erector Launch (TEL) vehicle.

8.8.20 A simple noise model has been run assuming two generators operating simultaneously at each pad (i.e., six in total), with no acoustic enclosure. In reality this situation will never occur. It is simply to consider the worst-case noise level at the closest NSRs arising from fixed plant associated with the Proposed Project. The noise model also includes a source representative of the TEL vehicle, which has been modelled with a source level equivalent to a large lorry and been assumed to be operating in close proximity to the assembly buildings for a duration of 30 minutes.

8.8.21 The resultant worst-case predicted specific noise level at the closest receptor, NSR1, is 24 dB. In accordance with the BS4142 method, noise from fixed plant is not anticipated to include audible tonal, intermittent or impulsive characteristics, therefore the rating level is equal to the specific level, 24 dB.

8.8.22 With reference to Section 8.5 (above), the typical background noise level in the vicinity of the Proposed Project is 22 dB. This level is representative of both the daytime period and the night-time period and is objectively a very low background level. In accordance with BS4142, whereby a rating noise level of less than five dB above the background level is indicative of a low impact, the noise limit for fixed and mobile plant at NSR1 is 27 dB.

8.8.23 The predicted worst-case rating level for fixed and mobile plant of 24 dB is three dB below the derived noise limit. With reference to Table 8.5 above, the impact magnitude is therefore low. With reference to Table 8.7 above, the resultant effect significance is slight. At more distant NSRs the rating level will be lower, and the result effect significance will be similar or lower than at NSR1. Noise effects associated with fixed and mobile plant at NSR1 are therefore not significant, resulting in **no likely significant effect**.

Road traffic noise

8.8.24 Projected traffic flows associated with the Proposed Project total 81 vehicle movements per day, based on an average of monthly traffic movements.

8.8.25 Noting that:

- The 2019 estimated flow at the closest Department for Transport (DfT) monitoring location to the Proposed Project, located on the A968 near the centre of Unst, is 494 (details of the DfT data are provided in Volume IV Technical Appendix 8.4);
- This is below the 1,000 vehicle movements per day minimum threshold for the calculation of noise for low traffic flow roads provided in CRTN. Baseline traffic flows are therefore considered to be 'very low';
- An increase of 81 vehicle movements per day represents an increase of 16% over baseline flows and corresponds to an increase in road traffic noise of approximately 1 dB or lower.

8.8.26 Referring to Table 8.3 the impact magnitude of operational road traffic noise is negligible, and the resultant effect significance is neutral. Road traffic noise effects during the operational phase are therefore not significant, resulting in **no likely significant effect.**

Vibration from engine tests and launches

8.8.27 Predicted unweighted L_{max} noise contours associated with static engine tests and launches are provided in Drawing 8.5 and Drawing 8.6, respectively. With reference to these drawings there are no NSRs within the 120 dBL_{max} contour, a small number of NSRs (five representative NSRs, approximately 10 properties in total) within the 111 dB contour, with the remainder of NSRs lying outside the 111 dB contour. With reference to Table 8.6 (above) the impact magnitude ranges from negligible to low. Referring to Table 8.7 the resultant significance of effect ranges from neutral to slight and is therefore not significant, resulting in **no likely significant effect.**

8.9 Additional Mitigation

8.9.1 No additional mitigation is proposed.

8.10 Residual Effects

8.10.1 No additional mitigation is proposed, beyond the committed standard mitigation measures. Residual effects associated with operations remain unchanged resulting in no **likely significant effect**.

8.11 Cumulative Assessment

8.11.1 Cumulative effects can be either inter-project or intra-project effects.

8.11.2 Inter-project cumulative effects are those where an environmental topic/receptor is affected by impacts from more than one project at the same time and the impacts act together. Due to the location of the Proposed Project on the north coast of Unst, the most northerly of the Shetland

Islands, it is considered that there are no potential inter-project cumulative effects as there are no other existing or proposed developments in the EZI for noise.

8.11.3 Shetland Islands Council was contacted during the planning application stage of the Proposed Project and confirmed that there are no committed development or infrastructure projects on the Island which should be considered in the assessment.

8.11.4 Intra-project cumulative effects are those where an environmental topic/receptor is affected by more than one impact from the same Proposed Project and the impacts act together. Given that none of the other environmental topics considered impact directly on noise levels, and the fact that only one launch will occur at any given time and launches will be phased with time enough for the EZI to return fully to its baseline state between launches, it is considered that there is no potential for additive or intra-project cumulative noise effects.

8.11.5 It is noted that noise effects are likely to have an impact on the ornithological and ecological response to launch events and as such noise is considered as an intra-project cumulative effect in these assessments. Whilst no significant effects relating to noise have been identified for either ecology or ornithological receptors, the Applicant is committed to undertaking further noise monitoring of launches to inform the ecological monitoring required by the planning conditions for the Proposed Project. More detail on this is provided in Chapter 5 Ornithology and related appendices.

8.12 Summary

8.12.1 Potential noise and vibration effects associated with the Proposed Project have been robustly assessed with regard to static engine tests, launches and non-launch activities.

8.12.2 The assessment of noise and vibration associated with static engine tests and launches relies primarily on modelling and calculations undertaken by BRRC.

8.12.3 Noise effects associated with road traffic and non-launch activities have been assessed as not significant, resulting in **no likely significant effect**.

8.12.4 Noise during engine tests and launches will be audible at NSRs within and beyond the EZI and levels will exceed the criterion for community annoyance associated with aircraft noise. Instantaneous noise levels will be below the threshold at which damage to hearing may occur. The short duration of audible noise ‘events’ associated with engine tests and launches, and their infrequent occurrence, will reduce the associated levels of annoyance to below that which may be associated with aircraft noise from conventional airports. Accordingly, adverse health effects are not anticipated. Noise at NSRs associated with launches is below the level at which the potential for cosmetic damage to structures is likely. Noise effects associated with engine tests and launches have therefore been assessed as not significant, resulting in **no likely significant effect**.

8.12.5 Vibration (air overpressure) associated with static engine tests and launch events has been evaluated and found to result in a low likelihood of damage complaints and has therefore been determined to be not significant, resulting in **no likely significant effect**.

8.12.6 Standard mitigation has been considered in the derivation of effect significance. Committed mitigation measures include a commitment to meeting noise limits for fixed and mobile plant items and maintaining good communications with the local community with regard to all activities of the Proposed Project.

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Chapter 9 Water

9. Water

9. Water

9.1 Introduction

9.1.1 This chapter provides an assessment of the effects of the Proposed Project on hydrological and hydrogeological resources.

9.1.2 The Proposed Project comprises operation of a vertical launch Spaceport located on the Lamba Ness peninsula and comprising three launch complexes, associated storage and integration hangars, satellite tracking stations and launch support buildings. Full details of the Proposed Project are provided in Chapter 3.

9.1.3 An assessment of the potential significant effects of the operation of the Proposed Project on the water environment has been undertaken, together with an assessment of the potential for any long-term or permanent alterations to the hydrological and hydrogeological regime.

9.1.4 For the purposes of this assessment, watercourses have been identified as those which appear on 1:25,000 scale Ordnance Survey mapping (Volume III Drawing 9.1). However, reconnaissance and survey work by the project civil engineers and ecologists has been undertaken and observations of watercourses and field drains have been made and taken into account in the detailed design and mitigation measures drawn up for the Proposed Project.

9.2 Legislation, Policy and Guidelines

Legislation

Space Industry Act

9.2.1 The Space Industry Act (2018) regulates all spaceflight activities carried out in the United Kingdom, and associated activities. The Act requires any person or organisation to obtain the relevant licence to:

- launch a launch vehicle from the UK;
- return a launch vehicle launched elsewhere than the UK to the UK landmass or the UK's territorial waters;
- operate a satellite from the UK;
- conduct sub-orbital activities from the UK;
- operate a spaceport in the UK; or
- provide range control services from the UK.

9.2.2 As the Applicant wishes to operate a vertical launch spaceport (the SaxaVord Spaceport) and provide range control services (at the Launch and Range Control Centre, LRCC) they are required to apply for a both a spaceport licence and a range control licence. However, AEE is only relevant to applications for spaceport licences.

Space Industry Regulations 2021

9.2.3 The Space Industry Regulations 2021 (the Regulations) set out in more detail the requirements for each licence the Regulators Licensing rules, which specify what information the UK Civil Aviation Authority (CAA), the regulator, requires in support of an application.

Additional Legislation

9.2.4 With regard to hydrology, management of water-borne pollution and protection of natural heritage areas, the Scottish Environment Protection Agency (SEPA) has statutory obligations in terms of the management and control of pollution into water resources in Scotland. Where careful design has avoided sensitive receptors, it is reasonable to assume that the adoption of the SEPA's Good Practice Guidelines will, in general, prevent pollution to acceptable standards and make the majority of any 'significant' effects unlikely.

9.2.5 There is a range of environmental legislation that the Proposed Project must adhere to throughout its life cycle. Relevant legislation and guidance documents have been reviewed and taken into account as part of this hydrogeological and hydrological assessment. Key legislative drivers relating to the water environment which have been considered within this assessment are listed below:

- Control of Pollution Act 1974;
- Environmental Protection Act 1990;
- Environment Act 1995;
- Water Framework Directive 2000/60/EC;
- Groundwater Daughter Directive 2006/118/EC;
- Water Environment and Water Services (Scotland) Act (WEWSA) 2003;
- Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended in 2018) (CAR);
- The Water Intended for Human Consumption (Private Supplies) (Scotland) Regulations 2017 (amends and revokes the Private Water Supplies (Scotland) Regulations 2006);
- The Flood Risk Management (Scotland) Act 2009; and,
- The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017.

9.2.6 The Water Framework Directive has been implemented in Scotland through WESWA and CAR. The primary objective of the Directive is for all surface and coastal water bodies to achieve good chemical and ecological status, and ground water bodies to achieve good quantitative and chemical status, by 2015 or 2021. This required assessment of a much wider set of water quality parameters than had previously been used. SEPA has published River Basin Management Plans (RBMPs) which detail the current and target status of water bodies, and the means of achieving these targets.

Policy

9.2.7 Scottish Planning Policy (SPP) (Scottish Government, 2014) identifies the range of considerations likely to be relevant to the determination of developments of the nature of the Proposed Project. These include effects on hydrology, the water environment and flood risk.

9.2.8 It also states that the planning system should '*promote protection and improvement of the water environment, including rivers, lochs, estuaries, wetlands, coastal waters and groundwater, in a sustainable and co-ordinated way*' (paragraph 194); and '*Development management decisions should take account of potential effects on landscapes and the natural and water environment, including cumulative effects*' (paragraph 202).

9.2.9 With respect to flooding, SPP paragraph 255 promotes a precautionary approach to flood risk from all sources and states that the planning system should prevent development which would have a significant probability of being affected by flooding or would increase the probability of flooding elsewhere. Paragraph 264 sets out aspects to be taken account for development management, in respect of flood risk. This includes consideration of the design and use of the Proposed Project. Paragraph 266 notes that Flood Risk Assessments should be required for development in the medium to high category of flood risk (annual probability of coastal or watercourse flooding is greater than 0.5% or 1:200 years).

9.2.10 The following Planning Advice Notes, issued by the then Scottish Executive, are also relevant to the assessments made in this chapter:

- Planning Advice Note 61: Planning and Sustainable Urban Drainage Systems, 2001; and,
- Planning Advice Note 79: Water and Drainage, 2006.

9.2.11 The Shetland Local Development Plan (Shetland Islands Council, 2014), identifies considerations relevant to the Proposed Project including:

- WD1 Flooding Avoidance;
- WD2 Waste Water;
- WD3 Sustainable Drainage Systems;
- NH1 International and National Designations; and
- NH7 Water Environment.

Guidance

Guidance to the regulator on environmental objectives relating to the exercise of its functions under the Space Industry Act 2018

9.2.12 The Department for Transport issued its document '*Guidance to the regulator on environmental objectives relating to the exercise of its function under the Space Industry Act 2018*' in 2021, clarifying the government's environmental objectives relating to spaceflight and associated activities in the UK:

The environmental objective for spaceflight are to:

- *Minimise emissions contributing to climate change resulting from spaceflight activities*
- *Protect human health and the environment from the impacts of emissions on local air quality arising from spaceflight activities*
- *Protect people and wildlife from the impacts of noise from spaceflight activities*
- *Protect the marine environment from the impact of spaceflight activities.*

Guidance for the Assessment of Environmental Effects

9.2.13 The CAA (July 2021) document Guidance for the Assessment of Environmental Effects (AEE) explains the process for completing an assessment of environmental effects as part of a licence application under the Space Industry Act.

9.2.14 The AEE Guidance requires that potential direct and indirect significant effects of proposed spaceflight activities on environmental features, including water, are considered. The guidance further requires that:

- Specific potential effects are identified and, where possible, quantified;
- The focus of the AEE should be on significant effects arising from the proposed activities;
- Applicants for a spaceport licence set an environmental budget, comprising a maximum number of launches per launch vehicle type which can take place over the course of a year that can be carried out in an environmentally sustainable manner, taking into account the cumulative effect of all launches; and
- The AEE must address a range of environmental topics, including water.

Pollution Prevention Guidance documents

9.2.15 A review plan for Pollution Prevention Guidance documents (PPGs) is currently underway by Natural Resources Wales (NRW), the Northern Ireland Environment Agency (NIEA) and the Scottish Environment Protection Agency (SEPA), replacing them with a replacement guidance series: Guidance for Pollution Prevention (GPPs). GPPs provide environmental good practice guidance for the whole UK, and environmental regulatory guidance directly to Northern Ireland, Scotland and Wales only.

9.2.16 The PPGs and GPPs include the documents referred to below, which are the principal documents used for guidance on preventing contamination of surface water. Those relevant to the Proposed Project include:

- PPG1: General guide to the prevention of pollution (EA, SEPA & EHSNI, 2013);
- GPP2: Above ground oil storage tanks (EA, SEPA & EHSNI, January 2018);
- GPP21: Pollution incidence response planning (EA, SEPA & EHSNI, 2017).

9.2.17 The following SEPA Guidelines are also relevant:

- Flood Risk and Planning Briefing Note (SEPA, 2014);
- Position Statement: The role of SEPA in natural flood management (SEPA, Feb, 2012);
- Technical flood risk guidance for stakeholders, version 12 (SEPA, May 2019);
- Land Use Planning System Guidance Note 31 (LUPS-GU31) - Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems (SEPA, October 2014);
- The Water Environment (Controlled Activities) (Scotland) Regulations 2011 as amended in 2018 - A practical guide (SEPA, 2011 as amended in 2019);
- Environmental Quality Standards and Standards for Discharges to Surface Waters, Supporting Guidance (WAT-SG-53) (SEPA, 2020);
- Development of a groundwater vulnerability screening methodology for the Water Framework Directive, Project WFD28 Final Report (SEPA 2004); and,
- The River Basin Planning Strategy for the Scotland River Basin District (SEPA, 2009/2015).

9.2.18 Other relevant guidance includes:

- Private Water Supplies: Technical Manual, Scottish Executive, 2006; and
- UK Technical Advisory Group on the WFD (Water Transport Directive), UK Environmental Standards and Conditions Final Report, November 2013.

9.3 Consultation

9.3.1 Extensive statutory consultation in relation to the water environment was carried out during preparation and determination of the planning application for the SaxaVord Spaceport, where the Proposed Project will be operated. Where directly relevant to this AEE, consultation responses received during the SaxaVord Spaceport planning application period have been summarised in Table 9.1.

Table 9.1 Consultation Relevant to AEE

Consultee	Notes
Shetland Islands Council Environmental Health	Shetland Islands Council Environmental Health was consulted for information on any known private water supplies within 1 km of any of the Proposed Project boundaries. Shetland Islands Council confirmed that it holds no records of any private water supplies within this study area.
SEPA	SEPA was not directly consulted, however a database of regulatory information including water quality classifications, flood risk, historical landfill sites, waste sites, and authorised industrial process was obtained by AECOM (the project civil engineer) and has been reviewed.

9.4 Assessment Methodology and Significance Criteria

9.4.1 The following section sets out the approach that was followed to collect relevant baseline information and the methodology for assessing impacts and the significance of effects.

Environmental Zone of Influence

9.4.2 The Environmental Zone of Influence (EZI) incorporates the areas within the Proposed Project boundary, alongside consideration of hydrological effects up to 1 km away. Consideration has also been given to the presence of any known private water supplies within one kilometre of the Proposed Project.

9.4.3 The criteria for defining the EZI with regard to hydrological resources have been established based on professional judgement and experience with regard to likely access and working areas, reference to SEPA guidance, and with due consideration to other relevant guidance on hydrological assessment.

9.4.4 The extent of the hydrology study area or EZI is shown on Drawing 9.1.

Desk Study

9.4.5 Baseline conditions have been established primarily via desk-based research and has included the following:

- consultation with relevant regulatory authorities as described in Table 9.1 above;
- identification of the locations and characteristics of catchments and principal watercourses and waterbodies as shown on 1:25,000 scale OS mapping which may be affected by the Proposed Project;
- identification of SEPA/WFD watercourse and water body classifications;
- review of online SEPA flood mapping;
- review and collation of pertinent information on surface hydrology, flooding, climate etc.;
- review of geological mapping of the area, British Geological Survey, Geology of Britain Viewer, 1:50,000 scale;
- review of hydrogeological characteristics and groundwater resource;
- review of Private Water Supply records held by the Drinking Water Quality Regulator for Scotland (DWQR) and Shetland Islands Council;

- AECOM project drawing 0065 – Existing Watercourses & Drainage Ditches; and,
- AECOM report *Shetland Space Centre, Desk Study and Site Appraisal* (AECOM, 2019), which is included as Volume IV Technical Appendix 9.1 to this AEE Report.

9.4.6 Details of the Proposed Project relevant to the water environment have been provided by the project team, principally AECOM as the project civil engineer. Specifically, this includes the following:

- AECOM project drawings:
  - 0037(S) – Launch Site Layout
  - 0054(B) – Launch Pad 1 Drainage Strategy
  - 0056(C) – Transport Holding Building Drainage Strategy
  - 0057(C) – Assembly & Storage Area Proposed Drainage Strategy
  - 0060(C) – Launch Pad 3 Drainage Strategy
  - 0066(A) – Satellite Tracking Area Drainage Strategy
- AECOM report *Shetland Space Centre, Drainage Strategy Rev.4* (AECOM, 2020a), which is included as Volume IV Technical Appendix 9.2 to this AEE Report.

Site Visit and Surveys

9.4.7 As part of AECOM's site appraisal (as reported in the above-noted desk study and site appraisal report), AECOM staff undertook a detailed site walkover of the Proposed Project in November 2019. Photographs were taken and are included in the report with descriptions. Observations were made of extant buildings, other relic infrastructure, and former quarries. Ground conditions were also observed where possible, including along the sea cliffs and at the quarries, where the soil profile was reported to be clearly exposed. The presence and nature of watercourses and drainage ditches was also noted.

9.4.8 Subsequently, in October and November 2020, AECOM undertook a preliminary ground investigation at the Proposed Project, to determine the depth of peat, where present, and the nature of underlying deposits and depth to bedrock. This investigation comprised excavation of 42 trial pits and advancing 304 peat probes. Information from this investigation is included and referred to as appropriate within this chapter. Full details are provided in the AECOM report *Shetland Space Centre, Preliminary Ground Investigation – Factual Report* (AECOM, 2020b) which is included as Volume IV Technical Appendix 9.3 to this AEE Report.

9.4.9 As part of the ecological assessment for the Proposed Project, Alba Ecology undertook field surveys in July 2018, updated in July 2020. These included an extended Phase 1 Habitat survey, a National Vegetation Classification (NVC) survey, and protected species surveys. Alba undertook an assessment of potential Groundwater Dependent Terrestrial Ecosystems (GWDTE) as part of this work, as reported in Appendix 6.2.

9.4.10 No water quality monitoring has been undertaken, although this is not considered to be warranted at this stage and is not considered to materially affect the impact assessment.

Assessment of Potential Effect Significance

9.4.11 The characterisation of hydrological and hydrogeological sensitivities has been guided by the matrix presented in Table 9.2 below which lists the characterisation criteria.

Table 9.2 Hydrological and Hydrogeological Sensitivity

Sensitivity	Description
High	Areas containing hydrological features considered to be of international or national interest, for example Aquatic Natura 2000 sites, SACs (Special Areas of Conservation), SSSIs (Site of Special Scientific Interest). Highly permeable superficial deposits allowing free transport of contaminants to groundwater and surrounding surface waters. Wetland/watercourse of High or Good Ecological Potential. High risk of flooding.
Medium	Moderately permeable superficial deposits allowing some limited transport of contaminants to groundwater and surrounding surface waters. Wetland/watercourse of Moderate Ecological Potential. Moderate risk of flooding.
Low	Low permeability superficial deposits likely to inhibit the transport of contaminants. Wetland/watercourse of Poor or Bad Ecological Potential or no WFD classification. Low risk of flooding.

9.4.12 The criteria for sensitivity have been developed based on a hierarchy of factors relating to quality of the aquatic environment including international and national designations, water quality information, watercourse status from the WFD review work undertaken to date by SEPA, consultations, site reconnaissance and the professional judgement of the assessment team.

9.4.13 The prediction and assessment of effects on hydrology and hydrogeology has been undertaken using a series of tables to document the various potential impacts from operation of the Proposed Project. Effects have been predicted for the Proposed Project based on the guideline criteria for impact magnitudes set out in Table 9.3 below.

Table 9.3 Impact Magnitude

Impact Magnitude	Guideline Criteria
High	Total loss of, or alteration to, key features of the baseline resource such that characteristics or quality would be fundamentally and irreversibly changed e.g. watercourse realignment.
Medium	Loss of, or alteration to, key features of the baseline resource such that characteristics or quality would be partially changed e.g., instream permanent bridge supports.
Low	Small changes to the baseline resource, which are detectable, but the underlying characteristics or quality of the baseline

Impact Magnitude	Guideline Criteria
	situation would be similar e.g. culverting of very small watercourses/drains.
Negligible	A very slight change from baseline conditions, which is barely distinguishable, and approximates to the 'no-change' situation.

9.4.14 The significance of the predicted effects has been assessed in relation to the sensitivities of the baseline resource and magnitude of predicted impacts. A matrix of significance has been developed to provide a consistent framework for evaluation and is presented in Table 9.4 below. Guideline criteria for the various categories of effect are included in Table 9.5 below.

Table 9.4 Effect Significance Matrix

	Sensitivity			
Magnitude	**High**	**Medium**	**Low**	**Not Sensitive**
High	Major	Major	Moderate	Minor
Medium	Major	Moderate	Minor	Negligible
Low	Moderate	Minor	Minor	Negligible
Negligible	Minor	Negligible	Negligible	Negligible

Table 9.5 Effect Significance Categories

Significance	Definition	Guideline Criteria
Major	A fundamental change to the environment.	Changes in water quality or quantity affecting widespread catchments or groundwater reserves of strategic significance.
Moderate	A larger, but non-fundamental change to the environment.	Changes in water quality or quantity affecting part of a catchment or groundwaters of moderate vulnerability.
Minor	A small but detectable change to the environment.	Localised changes resulting in minor and reversible effects on surface and groundwater quality or habitats.
Negligible	No detectable change to the environment.	No effects on drainage patterns, surface and groundwater quality or aquatic habitat.

9.4.15 In the above classification, fundamental changes are those which are permanent, either adverse or beneficial, and would result in widespread change to the baseline environment. For the purposes of this assessment, those effects identified as being major or moderate have been evaluated as significant environmental effects.

9.4.16 These matrices have been used to guide the assessment, although they have been applied with a degree of flexibility, since the evaluation of effects will always be subject to location-specific characteristics which must be taken into account. For this reason, the evaluation of the significance of effects in particular will not always correlate exactly with the cells in the relevant matrix, especially where professional judgement and knowledge of local conditions may result in a slightly different interpretation of the impact concerned. Additionally, effects may be assessed as having a significance level between those noted above, i.e., Minor to Moderate, or Moderate to Major.

9.4.17 Cumulative effects have been accounted for through the prediction and evaluation of effects cumulatively with those which could arise as a result of operation of other developments (operational, consented or in planning) within the EZI.

Requirements for Mitigation

9.4.18 Proposed mitigation measures are presented within this chapter (Sections 9.7 and 9.9 below) where the potential to affect sensitive hydrological or hydrogeological receptors has been predicted.

Assessment of Residual Effect Significance

9.4.19 An assessment of any predicted significant residual effects on sensitive hydrological or hydrogeological receptors, taking account of committed mitigation measures, is presented within this chapter (Section 9.11).

9.5 Baseline Conditions

Geography and Topography

9.5.1 The Proposed Project is located on the peninsula known as Lamba Ness, on the north-east coast of the Island of Unst. The coastline which forms the north, east and south boundaries comprises high, rocky cliffs, rising from sea level to approximately 10 to 20 m Above Ordnance Datum (AOD) along the north and east of the site, and as high as 50 m AOD in the south.

9.5.2 The Proposed Project site is generally flat, with a very gentle overall rise towards the west across the main body, steepening towards the west end (the western edge being at approximately 65 m AOD). A small, low hill feature (31 m AOD) is located towards the east end of the peninsula.

Designated Sites

9.5.3 There are no statutorily designated sites relevant to hydrology or hydrogeology within the boundaries of the Proposed Project.

9.5.4 No internationally designated sites relevant to hydrology or hydrogeology (i.e. Special Areas of Conservation) are located within the EZI.

9.5.5 There is one relevant nationally designated site within the EZI:

- The Norwick Meadows SSSI is approximately 800 m south-west of the Proposed Project and is designated for sand dunes and valley fen.

9.5.6 There is no hydrological continuity between the Proposed Project and the Norwick Meadows SSSI, therefore potential impacts on this designated site arising from operation are scoped out of further assessment.

Hydrology

9.5.7 There are no major surface watercourses within the Proposed Project boundary.

9.5.8 A minor, unnamed watercourse rises in the central part of the Proposed Project site (west of The Garths) and flows north/north-east to the sea west of Skaw Banks. A small pond feature appears to be present along the course of this burn.

9.5.9 Three further drains/minor burns flow from the western part of the northern boundary, north/north-east to the sea at Sand of Inner Shaw. Another drain flows north to south across the far west end of the site. Several small ponds are located off-site to the north of the far west end, with map markings indicating these may be water-filled former quarries.

9.5.10 A small water body is present in the south-east of the Proposed Project site, called Loch of Lamba Ness. A second, unnamed pond is located approximately 300 m west of this. These ponds have no evident connection with any surface watercourses, so may be rainwater fed.

9.5.11 In addition to the above watercourses and water bodies identified from 1:25,000 scale OS mapping (as shown on Drawing 9.1), AECOM identifies a number of drainage ditches cut into the Proposed Project site, as shown in Figure 9-1 below. These are largely in the central part of the site, draining from south to north, with a small number draining southward to the sea.

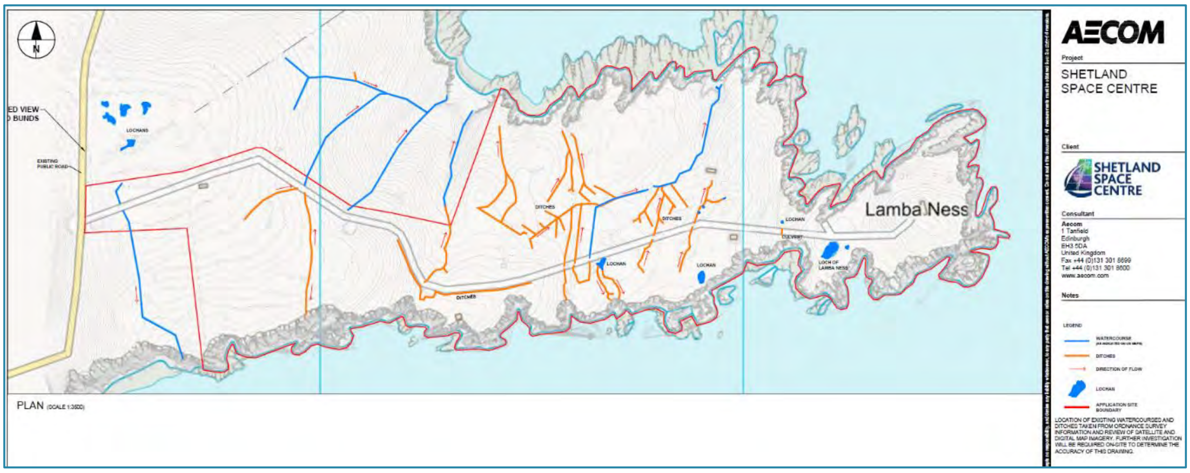

Figure 9-1 Existing watercourses and drainage ditches

9.5.12 Figure 9-1 also shows several additional small lochans, in the south-central part of the Proposed Project site.

9.5.13 Additional watercourses within 1 km of the Proposed Project are all up-stream/up-gradient and are therefore unlikely to be impacted by operation of the Proposed Project.

9.5.14 None of the above-noted watercourses have WFD classifications.

Summary

9.5.15 Although there are a number of drains and small watercourses within and near to the Proposed Project, these are all minor watercourses with no WFD classifications. Furthermore, they all drain to the sea, therefore the potential for any localised impact on surface water is minimal given the scale of the receiving coastal water body. The overall sensitivity of the hydrological (surface water) resource in the Proposed Project EZI is assessed as low.

Hydrogeology

Aquifer Status

9.5.16 The Hydrogeology Map of the UK indicates that the rock formations underlying the Proposed Project are classified as a low productivity aquifer, with flow virtually all through fractures and other discontinuities. Small amounts of groundwater may be present in the near-surface weathered zone.

9.5.17 SEPA identifies the groundwater body at the Proposed Project site as the Unst Groundwater (ID 150594), designated an overall status of '*Good*' in 2018.

Private Water Supplies

9.5.18 No springs or wells are marked on OS mapping within the boundary of the Proposed Project. A well is shown at the mouth of the Burn of Skaw, approximately 650 m north of the western part of the Proposed Project.

9.5.19 The DWQR online map shows no recorded private water supplies within 1 km of the Proposed Project. Shetland Islands Council has been consulted for any information it holds on private water supplies within 1 km of the Proposed Project. A response was received during the planning application stage indicating that Shetland Islands Council holds no records of private water supplies within the EZI.

Groundwater Dependent Terrestrial Ecosystems (GWDTE)

9.5.20 National Vegetation Classification (NVC) survey work undertaken by Alba Ecology (refer to Chapter 5) recorded several NVC communities indicative of potential groundwater dependence. Much of the Proposed Project area was recorded as wet modified bog and wet modified bog/wet heath transitional habitat, suggesting potentially moderate groundwater dependence.

9.5.21 Bedrock across the Proposed Project site comprises a low productivity aquifer (Skaw Intrusion), considered unlikely to contain any substantial groundwater at shallow depth. Groundwater is indicated to flow virtually all through fractures and other discontinuities. Therefore, the pattern of modified bog/wet heath being widespread across much of the site area is not indicative of potential groundwater presence along fissures or discontinuities. Rather, it is considered likely that these habitats are fed by rainwater forming waterlogged ground conditions.

9.5.22 An area of acid flush observed by Alba Ecology to the west of the Proposed Project site was identified as being potentially highly groundwater dependent. This area is within the Saxa Vord Pelite Formation, also a low permeability aquifer with minimal groundwater anticipated to be present at shallow depth. The localised occurrence of this habitat, near the edge of the Skaw Intrusion, suggests potential for it to be at a fissure or spring feature, and actually fed by groundwater. However, this location is up-gradient, and more than 250 m from any proposed infrastructure (the distance identified by SEPA as being a suitable buffer between GWDTE and even deep excavations).

Summary

9.5.23 Superficial geological deposits in the area are likely to be variable and potentially conducive to transmission of groundwater at least locally. However, the regional bedrock has low permeability and is likely to inhibit migration of groundwater and reduce its susceptibility to impact beyond a limited zone of influence. The only area of potential GWDTE considered to be actually fed by groundwater is more than 250 m from any proposed infrastructure.

9.5.24 The sensitivity of groundwater at the Proposed Project site is assessed as low.

Flood Risk

9.5.25 SEPA online flood risk mapping identifies no risk of fluvial or coastal flooding at the Proposed Project site. Potential surface water flood risk areas are limited to actual water bodies i.e., the Loch of Lamba Ness.

9.5.26 Given the absence of identified flood risk, the sensitivity of the Proposed Project to flood risk is assessed as low.

9.6 Receptors Brought Forward for Assessment

9.6.1 Following review and analysis of the hydrological and hydrogeological baseline as reported above, the following features/receptors have been taken forward for assessment:

- Local surface water including watercourses within the Proposed Project boundary.

9.7 Standard Mitigation

9.7.1 The following standard, or embedded, mitigation measures are applicable to operation of the Proposed Project.

9.7.2 The AECOM Drainage Strategy report and associated drawings provide full details of the proposed arrangements for the management of drainage throughout the Proposed Project.

Surface Water

9.7.3 Each launch pad will comprise a concrete slab with a launch pit sunk into it, and a flame deflection culvert. The concrete slab will be surrounded on three sides by a wall to contain any deluge water, if required. The slab will fall towards the launch pit, such that any surface and deluge water will run-off into the launch pit. The launch pit is connected to a culvert via a manhole with a penstock valve permitting water to be diverted to an interceptor/storage tank (for collection and removal for off-site treatment) during fuelling and launch activities.

9.7.4 When no launch activities are in operation, the penstock valve on the launch pit will be maintained open such that rain water run-off from the launch pit will discharge into a filter trench prior to sea outfall.

9.7.5 Launch pad fuel storage areas, which will store mainly RP-1 Kerosene, will have a contained concrete surface with run-off into channels which will discharge into a full-retention alarmed interceptor, before discharging into either a filter drain or drainage ditch. The interceptor will be appropriately sized to accommodate a tanker cell burst.

9.7.6 Drainage from roofs (other than the Gate House and Integration Building), roads, hardstanding area and the satellite tracking area concrete pads will discharge into filter trench systems to provide Sustainable Drainage Systems (SuDS) treatment, prior to discharging into the existing ditch drainage system or newly created ditches to tie into the existing sea outfalls.

Foul Drainage

9.7.7 Permanent welfare facilities will be provided at the Gate House, Launch Site Processing Facility and Integration Hangars. Foul drainage from these facilities will be collected through a small drainage network into a sewerage storage tank which will be emptied as required. Given the relatively infrequent use of the facilities (only during launch cycles and in preparation for them), AECOM notes that it is not considered feasible to use septic tanks or small treatment works. In future, as and when launch frequency increases such that there are consistent foul drainage flows, a septic tank is proposed to be added, with filter distribution pipework and final discharge to existing drainage ditches.

9.7.8 Temporary welfare facilities will be provided at each launch pad when in use (i.e. portable cabins, with tanks emptied as required).

Fuel Storage

9.7.9 Fuels and gases will not be permanently stored at the Proposed Project, rather they will be brought to the launch pads from external storage, via road haulage, as required.

9.7.10 Large volume fuel and gas containers will remain on their trailers for fuelling and de-fuelling. Small volumes of fuels and oils in containers will be off-loaded to the ground within the control areas of the launch pads, to facilitate electrical and mechanical support during launches. These will be stored in accordance with best practice procedures, including being kept within a designated storage site in appropriate impermeable bunded containers/areas.

Water Abstraction

9.7.11 No new on-site water abstraction is proposed. The volumes of water required for site operation are approximately 5,000 litres per launch/test, and it is proposed that water is either sourced from a nearby MoD reservoir west/north-west of the Proposed Project site (subject to further assessment and appropriate authorisation), or tankered onto site as required. Rainwater harvesting is also being considered and will be used where available but is unlikely to reliably provide the volumes required for all functions. Very little potable water will be required for site operation, and due to the intermittent requirement, bottled water will be used.

9.8 Potential Effects

9.8.1 New structures and hardstanding at the Proposed Project have the potential to result in increased and concentrated surface water run-off, impacting on the water quality and flow rate of local drainage ditches and watercourses.

9.8.2 Taking account of the standard mitigation, in particular implementation of a suitable site drainage design as described in Paragraphs 9.7.3 to 9.7.8 above, the potential impact magnitude is considered to be low, on a low sensitivity receptor. Therefore, there are **no significant effects** predicted.

9.9 Additional Mitigation

9.9.1 When taking account of the standard mitigation measures, potential effects have been assessed as not significant, with no additional mitigation therefore required.

9.10 Cumulative Assessment

9.10.1 Cumulative effects can be either inter-project or intra-project effects.

9.10.2 Inter-project cumulative effects are those where an environmental topic/receptor is affected by impacts from more than one project at the same time and the impacts act together. No consented or proposed (in planning) developments with the potential to create cumulative effects on water have been identified in the EZI.

9.10.3 Intra-project cumulative effects are those where an environmental topic/receptor is affected by more than one impact from the same Proposed Project and the impacts act together. Given that none of the other environmental topics considered impact directly on water and the fact that containment will be in place during launches, it is considered that there is no potential for additive or intra-project cumulative effects.

9.11 Residual Effects

9.11.1 No additional mitigation is proposed therefore, residual effects are as per the potential effects described in Section 9.8 above. All residual effects considered in this assessment are assessed as being minor adverse and therefore there are considered to be **no significant effects**.

9.12 Summary

9.12.1 The Proposed Project comprises three launch pads and ancillary buildings and access infrastructure. The site is a relatively flat area on the Lamba Ness peninsula with high, rocky cliffs forming the north, east and south boundaries.

9.12.2 There are no statutorily designated sites relevant to hydrology or hydrogeology within Proposed Project boundary. The Norwick Meadows SSSI is approximately 800 m south-west of the Proposed Project and is designated for sand dunes and valley fen.

9.12.3 There is no hydrological continuity between the Proposed Project and the Norwick Meadows SSSI.

9.12.4 There are a number of drains and small watercourses within and near to the Proposed Project site, all of which drain into the sea.

9.12.5 Habitats indicative of potential moderate groundwater dependency have been identified across much of the Proposed Project site, although based on the site geology and the distribution of these habitats, they are interpreted as being surface water or rainwater fed. The only area of potential GWDTE considered to be actually fed by groundwater is more than 250 m from any proposed infrastructure.

9.12.6 Likely operational effects include sedimentation or pollution of the water environment from surface runoff and fuel/chemical leaks and spills, and effects on the local groundwater quality and flow regime.

9.12.7 Standard/embedded mitigation measures include no bulk storage of fuels at the Proposed Project and appropriate spill control procedures alongside a suitable Drainage Strategy to control and treat surface and foul drainage.

9.12.8 No new on-site water abstraction is proposed. Water required for site operation will be sourced from a nearby MoD reservoir or tankered onto site as required.

9.12.9 The likely effects on hydrological and hydrogeological receptors, taking account of the standard mitigation measures, have been assessed as minor and **no significant effects**.

9.12.10 The significance of residual effects on hydrological and hydrogeological receptors is considered to be minor and **no significant effects**.

9.12.11 No cumulative effects on hydrology or hydrogeology are predicted.

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Chapter 10 Marine and Transboundary Effects

10. Marine & Transboundary Effects

10. Marine & Transboundary Effects

10.1 Introduction

10.1.1 This chapter considers the marine and transboundary effects from operations at the Proposed Project.

10.1.2 Transboundary effects of the Proposed Project are significant environmental effects that may arise in a different country as a consequence of the Proposed Project.

10.1.3 The majority of the potential environmental effects of the Proposed Project are expected at or near the Proposed Project site. However, sub-orbital and orbital launch vehicles (LVs) may splashdown further away in Scottish or international waters and potentially interact with the marine environment.

10.1.4 For the purposes of the AEE and to provide a conservative approach, it has been assumed that there is no recovery of orbital LV components. The scope of the transboundary effects assessment for orbital LVs is therefore concerned with assessment of the marine environmental effects of returning LVs, stages and debris arising. The UK Government has consulted with the governments of countries where the LVs are predicted to land, specifically Norway, Faroe, Greenland and Iceland, to come to an agreement to allow stages to fall in their waters (Applicant, 2020).

10.1.5 Following consultation with launch service providers, it is considered more likely that sub-orbital LVs will be recovered, and so the scope of the marine effects assessment for sub-orbital LVs considers returning LVs, stages and debris arising as well as impacts from the recovery vessels.

10.2 Legislation, Policy and Guidelines

Legislation and Guidance

10.2.1 This Assessment of Environmental Effects has been produced under the following the Space Industry Act 2018, as transposed into The Space Industry Regulations 2021. It has been informed using:

- Guidance to the Regulator on Environmental Objectives Relating to the Exercise of its Functions under the Space Industry Act 2018; and
- Guidance for the Assessment of Environmental Effects 2021.

Planning Policy

10.2.2 The launch aspect of Scotland's space sector is emergent in nature. As such developments occur only on land, the space sector has not been considered in marine planning policy such as Scotland's National Marine Plan (Scottish Government, 2015). Despite not being considered as a specific activity in Scotland's National Marine Plan (the Plan), policies are included in the Plan that may need consideration when assessing the Proposed Project. In order to address this potential, the Plan policies have been reviewed (Appendix 10.1) and screened to determine which of the policies are of relevance to the Proposed Project. Where policies are considered relevant, the related sections of the AEE have been signposted to ensure that the content of the AEE demonstrates due consideration of the issues highlighted by the Plan policies.

10.2.3 The screening of policies for relevance to the Proposed Project considered if the Plan policies were sector specific and therefore not relevant, or if the Plan policies related to a specific geographic location and were therefore not relevant to the Proposed Project. The reason for not including policies in the process is noted in the summary table presented in Appendix 10.1.

10.2.4 The results of the Plan policy review and screening process indicate that the following policies are of relevance to the marine environment and the Proposed Project:

- GEN 1 General planning principle;
- GEN 2 Economic benefit;
- GEN 3 Social benefit;
- GEN 4 Co-existence;
- GEN 5 Climate change;
- GEN 6 Historic environment;
- GEN 7 Landscape/seascape;
- GEN 8 Coastal process and flooding;
- GEN 9 Natural heritage;
- GEN 10 Invasive non-native species;
- GEN 11 Marine litter;
- GEN 12 Water quality and resource;
- GEN 13 Noise;
- GEN 14 Air quality;
- GEN 15 Planning alignment A;
- GEN 16 Planning alignment B;
- GEN 17 Fairness;
- GEN 18 Engagement;
- GEN 19 Sound evidence;
- GEN 20 Adaptive management;
- GEN 21 Cumulative impacts;
- FISHERIES 1, 2 and 3;
- AQUACULTURE 1 and 2;
- WILDFISH 1;
- OIL & GAS 4, 5, and 6;
- CCS 2;
- REC & TOURISM 1, 2, 3, 4, 5 & 6;
- TRANSPORT 1, 3 & 6; and
- AGGREGATES 1.

10.2.5 **Error! Reference source not found.** lists these Plan policies and indicates the section of the AEE w here information is presented to account for the requirements of the policy.

Table 10.1 Scotland National Marine Plan policies and cross-reference to where information is presented to account for the requirements of the policies

Policy ID	Policy Text	Relevant Section of AEE Report
GEN 1	*There is a presumption in favour of sustainable development and use of the marine environment when consistent with the policies and objectives of this Plan.*	Section 10
GEN 2	*Sustainable development and use which provides economic benefit to Scottish communities is encouraged when consistent with the objectives and policies of this Plan.*	Section 10
GEN 3	*Sustainable development and use which provides social benefits is encouraged when consistent with the objectives and policies of this Plan.*	Section 10
GEN 4	*Proposals which enable coexistence with other development sectors and activities within the Scottish marine area are encouraged in planning and decision making processes, when consistent with policies and objectives of this Plan.*	Section 10
GEN 5	*Marine planners and decision makers must act in the way best calculated to mitigate, and adapt to, climate change.*	Section 10.12
GEN 6	*Development and use of the marine environment should protect and, where appropriate, enhance heritage assets in a manner proportionate to their significance.*	Section 10.12, Sections 10.10.109 - 10.10.117
GEN 7	*Marine planners and decision makers should ensure that development and use of the marine environment take seascape, landscape and visual impacts into account.*	Section 10.12
GEN 8	*Developments and activities in the marine environment should be resilient to coastal change and flooding, and not have unacceptable adverse impact on coastal processes or contribute to coastal flooding.*	Section 10.12
GEN 9	*"Development and use of the marine environment must:*	Section 10.12
GEN 10	*(a) Comply with legal requirements for protected areas and protected species.*	Section 10.12
GEN 11	*(b) Not result in significant impact on the national status of Priority Marine Features.*	Section 10.12
GEN 12	*(c) Protect and, where appropriate, enhance the health of the marine area."*	Section 10.12

Policy ID	Policy Text	Relevant Section of AEE Report
GEN 13	*Opportunities to reduce the introduction of invasive non-native species to a minimum or proactively improve the practice of existing activity should be taken when decisions are being made.*	Section 10.12
GEN 14	*Developers, users and those accessing the marine environment must take measures to address marine litter where appropriate. Reduction of litter must be taken into account by decision makers.*	Section 10.12
GEN 15	*Developments and activities should not result in a deterioration of the quality of waters to which the Water Framework Directive, Marine Strategy Framework Directive or other related Directives apply.*	Section 10
GEN 16	*Development and use in the marine environment should avoid significant adverse effects of man-made noise and vibration, especially on species sensitive to such effects.*	Section 10
GEN 17	*Development and use of the marine environment should not result in the deterioration of air quality and should not breach any statutory air quality limits.*	Section 10
GEN 18	*Marine and terrestrial plans should align to support marine and land-based components required by development and seek to facilitate appropriate access to the shore and sea.*	Section 10.3.1
GEN 19	*Marine plans should align and comply where possible with other statutory plans and should consider objectives and policies of relevant non-statutory plans where appropriate to do so. <applies to inshore waters only>*	Section 10
GEN 21	*Cumulative impacts affecting the ecosystem of the marine plan area should be addressed in decision making and plan implementation.*	Section 10.13

Policy ID	Policy Text	Relevant Section of AEE Report
FISHERIES 1	*Taking account of the EU's Common Fisheries Policy, Habitats Directive, Birds Directive and Marine Strategy Framework Directive, marine planners and decision makers should aim to ensure:* - *Existing fishing opportunities and activities are safeguarded wherever possible.* - *An ecosystem-based approach to the management of fishing which ensures sustainable and resilient fish stocks and avoids damage to fragile habitats.* - *Protection for vulnerable stocks (in particular for juvenile and spawning stocks through continuation of sea area closures where appropriate).* - *Improved protection of the seabed and historical and archaeological remains requiring protection through effective identification of high-risk areas and management measures to mitigate the impacts of fishing, where appropriate.* - *That other sectors take into account the need to protect fish stocks and sustain healthy fisheries for both economic and conservation reasons.* - *Delivery of Scotland's international commitments in fisheries, including the ban on discards.* - *Mechanisms for managing conflicts between fishermen and/or between the fishing sector and other users of the marine environment.*	Section 10.10.151
FISHERIES 2	*The following key factors should be taken into account when deciding on uses of the marine environment and the potential impact on fishing:* - *The cultural and economic importance of fishing, in particular to vulnerable coastal communities.* - *The potential impact (positive and negative) of marine developments on the sustainability of fish and shellfish stocks and resultant fishing opportunities in any given area.* - *The environmental impact on fishing grounds (such as nursery, spawning areas), commercially fished species, habitats and species more generally.* - *The potential effect of displacement on: fish stocks; the wider environment; use of fuel; socio-economic costs to fishers and their communities and other marine users.*	Section 10.10.151

Policy ID	Policy Text	Relevant Section of AEE Report
FISHERIES 3	*Where existing fishing opportunities or activity cannot be safeguarded, a Fisheries Management and Mitigation Strategy should be prepared by the proposer of development or use, involving full engagement with local fishing interests (and other interests as appropriate) in the development of the Strategy. All efforts should be made to agree the Strategy with those interests. Those interests should also undertake to engage with the proposer and provide transparent and accurate information and data to help complete the Strategy. The Strategy should be drawn up as part of the discharge of conditions of permissions granted.* *The content of the Strategy should be relevant to the particular circumstances and could include:* - *An assessment of the potential impact of the development or use on the affected fishery or fisheries, both in socio-economic terms and in terms of environmental sustainability.* - *A recognition that the disruption to existing fishing opportunities/activity should be minimised as far as possible.* - *Reasonable measures to mitigate any constraints which the Proposed Project or use may place on existing or proposed fishing activity.* - *Reasonable measures to mitigate any potential impacts on sustainability of fish stocks (e.g., impacts on spawning grounds or areas of fish or shellfish abundance) and any socio-economic impacts.* *Where it does not prove possible to agree the Strategy with all interests, the reasons for any divergence of views between the parties should be fully explained in the Strategy and dissenting views should be given a platform within the Strategy to make their case.*	Section 10.10.151
WILD FISH 1	*The impact of development and use of the marine environment on diadromous fish species should be considered in marine planning and decision making processes. Where evidence of impacts on salmon and other diadromous species is inconclusive, mitigation should be adopted where possible and information on impacts on diadromous species from monitoring of developments should be used to inform subsequent marine decision making.*	Section 10.10.151

Policy ID	Policy Text	Relevant Section of AEE Report
OIL & GAS 4	*All oil and gas platforms will be subject to 9 nautical mile consultation zones in line with Civil Aviation Authority guidance.*	Sections 10.10.81 - 10.10.88
OIL & GAS 5	*Consenting and licensing authorities should have regard to the potential risks, both now and under future climates, to oil and gas operations in Scottish waters, and be satisfied that installations are appropriately sited and designed to take account of current and future conditions.*	Sections 10.10.81 - 10.10.88
OIL & GAS 6	*Consenting and licensing authorities should be satisfied that adequate risk reduction measures are in place, and that operators should have sufficient emergency response and contingency strategies in place that are compatible with the National Contingency Plan and the Offshore Safety Directive.*	Sections 10.10.81 - 10.10.88
REC & TOURISM 1	*Opportunities to promote sustainable development of marine recreation and tourism should be supported.*	Sections 10.10.169 - 10.10.177
REC & TOURISM 2	*The following key factors should be taken into account when deciding on uses of the marine environment and the potential impact on recreation and tourism:* - *The extent to which the proposal is likely to adversely affect the qualities important to recreational users, including the extent to which proposals may interfere with the physical infrastructure that underpins a recreational activity.* - *The extent to which any proposal interferes with access to and along the shore, to the water, use of the resource for recreation or tourism purposes and existing navigational routes or navigational safety.* - *Where significant impacts are likely, whether reasonable alternatives can be identified for the proposed activity or development.* - *Where significant impacts are likely and there are no reasonable alternatives, whether mitigation, through recognised and effective measures, can be achieved at no significant cost to the marine recreation or tourism sector interests.*	Sections 10.10.169 - 10.10.177

Policy ID	Policy Text	Relevant Section of AEE Report
REC & TOURISM 3	*Regional marine plans should identify areas that are of recreational and tourism value and identify where prospects for significant development exist, including opportunities to link to the National Long Distance Walking and Cycle Routes, and more localised and/or bespoke recreational opportunities and visitor attractions.*	Sections 10.10.169 - 10.10.177
REC & TOURISM 4	*Marine and terrestrial planners, marine decision makers and developers should give consideration to the facility requirements of marine recreation and tourism activities, including a focus on support for participation and development in sport. Co-operation and sharing infrastructure and/or facilities, where appropriate, with complementary sectors should be supported as should provision of low carbon transport options.*	Sections 10.10.169 - 10.10.177
REC & TOURISM 5	*Marine planners and decision makers should support enhancement to the aesthetic qualities, coastal character and wildlife experience of Scotland's marine and coastal areas, to the mutual benefit of the natural environment, human quality of life and the recreation and tourism sectors.*	Sections 10.10.169 - 10.10.177
REC & TOURISM 6	*Codes of practice for invasive non-native species and Marine Wildlife Watching should be complied with.*	Sections 10.10.169 - 10.10.177
TRANSPORT 1	*Navigational safety in relevant areas used by shipping now and in the future will be protected, adhering to the rights of innocent passage and freedom of navigation contained in UN Convention on the Law of the Sea (UNCLOS). The following factors will be taken into account when reaching decisions regarding development and use:* - *The extent to which the locational decision interferes with existing or planned routes used by shipping, access to ports and harbours and navigational safety. This includes commercial anchorages and defined approaches to ports.* - *Where interference is likely, whether reasonable alternatives can be identified.* - *Where there are no reasonable alternatives, whether mitigation through measures adopted in accordance with the principles and procedures established by the International Maritime Organization can be achieved at no significant cost to the shipping or ports sector.*	Sections 10.10.169 - 10.10.177

Policy ID	Policy Text	Relevant Section of AEE Report
TRANSPORT 3	*Ferry routes and maritime transport to island and remote mainland areas provide essential connections and should be safeguarded from inappropriate marine development and use that would significantly interfere with their operation. Developments will not be consented where they will unacceptably interfere with lifeline ferry services.*	Sections 10.10.99 - 10.10.108, Sections 10.10.159 - 10.10.168
TRANSPORT 6	*Marine planners and decision makers and developers should ensure displacement of shipping is avoided where possible to mitigate against potential increased journey lengths (and associated fuel costs, emissions and impact on journey frequency) and potential impacts on other users and ecologically sensitive areas.*	Sections 10.10.99 - 10.10.108, Sections 10.10.159 - 10.10.168

10.2.6 In addition to the policies in Scotland's National Marine Plan, the Shetland Local Development Plan (the Shetland Plan) (Shetland Islands Council, 2014) has also been reviewed to determine if any policies exist that may be relevant to the Proposed Project. The Shetland Plan outlines several policies that must be considered in applications for new development. The policies that are of relevance to the marine environment and the Proposed Project include:

- GP 1 Sustainable Development;
- GP2 General Requirements for All Development;
- GP 3 All Development: Layout and Design
- NH1 International and National Designations;
- NH2 Protected Species;
- NH3 Furthering the Conservation of Biodiversity;
- NH4 Local Designations;
- NH 6 Geodiversity;
- NH 7 Water Environment;
- NH 1 Historic Environment;
- HE4 Archaeology; and,
- CST1 Coastal Development.

10.2.7 Table 10.2 lists these Shetland Plan policies and indicates the section of the AEE where information is presented to account for the requirements of the policy.

Table 10.2 Shetland Local Development Plan policies and cross-reference to where information is presented to account for the requirements of the policies

Policy ID	Policy Text	Relevant Section of the AEE Report
GP 1	*"Development will be planned to meet the economic and social needs of Shetland in a manner that does not compromise the ability of future generations to meet their own needs and to enjoy the area's high quality environment. Tackling climate change and associated risks is a major consideration for all development proposals.* *New residential, employment, cultural, educational and community developments should be in or adjacent to existing settlements that have basic services and infrastructure in order to enhance their viability and vitality and facilitate ease of access for all. This will be achieved through Allocations, Sites with Development Potential and Areas of Best Fit."*	Section 10
GP 2	*"Applications for new buildings or for the conversion of existing buildings should meet all of the following General Requirements:* *a. Developments should not adversely affect the integrity or viability of sites designated for their landscape and natural heritage value.* *b. Development should not occur any lower than 5 metres Above Ordnance Datum (Newlyn) unless the development meets the requirements of Policy WD1;* *c. Development should be located, constructed and designed so as to minimise the use of energy and to adapt to impacts arising from climate change, such as the increased probability of flooding; water stress, such as water supply; health or community impacts as a result of extreme climatic events; and a change in richness of biodiversity.* *d. Suitable water, waste water and surface water drainage must be provided;* *e. All new buildings shall avoid a specified and rising proportion of the projected greenhouse gas emissions from their use, through the installation and operation of low and zero-carbon generating technologies (LZCGT). The proportion of such emissions shall be specified in the council's Supplementary Guidance – Design. That guidance will also set out the approach to existing buildings which are being altered or extended, including historic buildings, and the approach to applications where*	Section 10

Policy ID	Policy Text	Relevant Section of the AEE Report
	developers are able to demonstrate that there are significant technical constraints to using on-site low and zero carbon generating technologies. *f. Suitable access, car parking and turning should be provided;* *g. Development should not adversely affect areas, buildings or structures of archaeological, architectural or historic interest;* *h. Development should not sterilise mineral reserves;* *i. Development should not sterilise allocated sites as identified within the Shetland Local Development Plan;* *j. Development should not have a significant adverse effect on existing uses;* *k. Development should not compromise acceptable health and safety standards or levels;* *l. Development should be consistent with National Planning Policy, other Local Development Plan policies and Supplementary Guidance."*	
GP 3	*"All new development should be sited and designed to respect the character and local distinctiveness of the site and its surroundings.* *The Proposed Project should make a positive contribution to:* *• maintaining identity and character* *• ensuring a safe and pleasant space* *• ensuring ease of movement and access for all* *• a sense of welcome* *• long term adaptability, and* *• good use of resources* *The Planning Authority may request a Masterplan and/ or Design and Access Statement in support of development proposals.* *A Masterplan should be submitted with applications where Major Development is proposed; Major Development is defined in the Town and Country Planning (Hierarchy of Developments) (Scotland) Regulations 2009, Reg 2 (1). Further details for these requirements are set out in Supplementary Guidance."*	Section 10

Policy ID	Policy Text	Relevant Section of the AEE Report
NH 1	*"Any development proposal that is likely to have a significant effect on an internationally important site, (Special Area of Conservation (SAC), Special Protection Areas (SPA) or Ramsar Sites) and is not directly connected with or necessary to the conservation management of that site will be subject to an assessment of the implications for the site's conservation objectives. Development that could have a significant effect on a site will only be permitted where:* • *An appropriate assessment has demonstrated that it will not adversely affect the integrity of the site, or* • *There are no alternative solutions, and* • *There are imperative reasons of over-riding public interest that may, for sites not hosting a priority habitat type and/or priority species, be of a social or economic nature.* *Development that affects a National Scenic Area (NSA), National Nature Reserve (NNR) or a Site of Special Scientific Interest (SSSI) will only be permitted where:* • *It will not adversely affect the integrity of the area or the qualities or protected features for which it has been designated, or* • *Any such adverse effects are clearly outweighed by social, environmental or economic benefits of national importance. "*	Section 10.12
NH 2	*"Where there is good reason to suggest that a species protected under the Wildlife and Countryside Act 1981 (as amended), Annex IV of the Habitats Directive or Annex 1 of the Birds Directive is present on site, or may be affected by a Proposed Project, the Council will require any such presence to be established. If such a species is present, a plan should be provided to avoid or mitigate any adverse impacts on the species, prior to determining the application.* *Planning permission will not be granted for development that would be likely to have an adverse effect on a European Protected Species unless the Council is satisfied that:* • *The development is required for preserving public health or public safety or for other imperative reasons of overriding public interest including those of a social or*	*Section 10.12*

Policy ID	Policy Text	Relevant Section of the AEE Report
	economic nature and beneficial consequences of primary importance for the environment; and • *There is no satisfactory alternative; and* • *The development will not be detrimental to the maintenance of the population of the European Protected Species concerned at a favourable conservation status in their natural range.* *Planning permission will not be granted for development that would be likely to have an adverse effect on a species protected under Schedule 5 (animals) or 8 (plants) of the Wildlife and Countryside Act 1981 (as amended) unless the Council is satisfied that:* • *Undertaking the development will give rise to, or contribute towards the achievement of, a significant social, economic or environmental benefit; and* • *There is no satisfactory solution.* *Planning permission will not be granted for development that would be likely to have an adverse effect on a species protected under Schedules 1, 1A or A1 (birds) of the Wildlife and Countryside Act 1981 (as amended), unless the Council is satisfied that:* *o The development is required for preserving public health or public safety; and* *o There is no other satisfactory solution.* *Applicants should submit supporting evidence for any development meeting these criteria, demonstrating both the need for the development and that a full range of possible alternative courses of action have been properly examined and none found to acceptably meet the need identified.* *The Council will apply the precautionary principle where the impacts of a Proposed Project on natural heritage are uncertain but potentially significant. Where development is constrained on the grounds of uncertainty, the potential for research, surveys or assessments to remove or reduce uncertainty should be considered. "*	

Policy ID	Policy Text	Relevant Section of the AEE Report
NH 3	*"Development will be considered against the Council's obligation to further the conservation of biodiversity and the ecosystem services it delivers. The extent of these measures should be relevant and proportionate to the scale of the development.* *Proposals for development that would have a significant adverse effect on habitats or species identified in the Shetland Local Biodiversity Action Plan, Scottish Biodiversity List, UK Biodiversity Action Plan, Annexes I and II of the Habitats Directive, Annex I of the Birds Directive (if not included in Schedule 1 of the Wildlife and Countryside Act) or on the ecosystem services of biodiversity, including any cumulative impact, will only be permitted where it has been demonstrated by the developer that;* • *The development will have benefits of overriding public interest including those of a social or economic nature that outweigh the local, national or international contribution of the affected area in terms of habitat or populations of species; and* • *Any harm or disturbance to the ecosystem services, continuity and integrity of the habitats or species is avoided or reduced to acceptable levels by mitigation."*	*Section 10.12*
NH 4	*"Development that affects a Local Nature Conservation Site or Local Landscape Area will only be permitted where:* • *It will not adversely affect the integrity of the area or the qualities for which it has been identified; or* • *Any such effects are clearly outweighed by social, environmental or economic benefits. "*	*Section 10.12*

Policy ID	Policy Text	Relevant Section of the AEE Report
NH 6	*"Development will only be permitted where appropriate measures are taken to protect and/or enhance important geological and geomorphological resources and sites, including those of educational or research value.* *Proposals that will have an unavoidable effect on geodiversity will only be permitted where it has been demonstrated that:* • *The development will have benefits of overriding public interest including those of a social or economic nature that outweigh the local, national or international contribution of the affected area in terms of its geo-diversity;* • *Any loss of geodiversity is reduced to acceptable levels by mitigation, and a record is made prior to any loss.* *For certain scales of development where a soil management plan is required, reference should also be made to geodiversity on site."*	*Section 10.12*
NH 7	*"Development will only be permitted where appropriate measures are taken to protect the marine and freshwater environments to an extent that is relevant and proportionate to the scale of development. Development adjacent to a watercourse or water body must be accompanied by sufficient information to enable a full assessment of the likely effects.* *Where there is potential for the development to have an adverse impact the applicant/developer must demonstrate that:* • *There will be no deterioration in the ecological status of the watercourse or water body;* • *It does not encroach on any existing buffer strips and that access to these buffer strips has been maintained; and* • *Both during the construction phase and after completion it would not significantly affect:* *o Water quality flows in adjacent watercourses or areas downstream* *o Natural flow patterns and sediment transport processes in all water bodies or watercourses."*	*Section 10.12*

Policy ID	Policy Text	Relevant Section of the AEE Report
HE 1	*The Council should presume in favour of the protection, conservation and enhancement of all elements of Shetland's historic environment, which includes buildings, monuments, landscapes and areas.*	Section 10.12, Sections 10.10.109 - 10.10.117
HE 4	*"Scheduled monuments, designated wrecks and other identified nationally important archaeological resources should be preserved in situ, and within an appropriate setting. Developments that have an adverse effect on scheduled monuments and designated wrecks or the integrity of their settings should not be permitted unless there are exceptional circumstances.* *All other significant archaeological resources should be preserved in situ wherever feasible. Where preservation in situ is not possible the planning authority should ensure that developers undertake appropriate archaeological excavation, recording, analysis, publication and archiving in advance of and/ or during development."*	Section 10.12, Sections 10.10.109 - 10.10.117
CST 1	*"Proposals for developments and infrastructure in the coastal zone (above Mean Low Water Mark of Ordinary Spring Tides) will only be permitted where the proposal can demonstrate that:* • *It will not have a significant impact, either individually or cumulatively, on the natural, built environment and cultural heritage resources either in the sea or on land;* • *The location, scale and design are such that it will not have a significant adverse impact.* • *It does not result in any deterioration in ecological status or potential for any water body or prevent it from achieving good ecological status in the future;* • *There is no significant adverse impact on other users of marine resources, and/or neighbouring land.* *Proposals for marine aquaculture developments or amendments to existing fish farm developments will require to have regard to the foregoing criteria and will be assessed against the Supplementary Guidance Policy for Aquaculture.* *All proposals will be assessed against the Shetland Islands Marine Spatial Plan that sets out a spatial strategy and policy framework to guide marine developments in the coastal waters around Shetland. The Marine Spatial Plan identifies the constraints developers are required to consider when contemplating development in the coastal area and will form supplementary guidance to this plan."*	Section 10.12

10.3 Consultation

10.3.1 Consultation was undertaken with various interested parties on the scope of the Marine Environmental Risk Assessment (MERA). A consultation email was sent, outlining the intended approach to the MERA, and requesting feedback from the consultee. Table 10.3 below summarises the consultation responses regarding the MERA and how/where they have been addressed.

Table 10.3 Summary of consultation responses

Consultee and Date	Issue Raised	Response/Action Taken
Marine Scotland 28/05/2020	The Marine Scotland Licensing Operations Team do not have anything to add in relation to the planning or construction aspects of the Space Centre, nor are we suitably placed to inform you as to what should or should not be scoped into your MERA. However, you should ensure we are contacted regarding marine licensing requirements of launch activities taking place at the Space Centre. We would also recommend that you consult with the MMO (Marine Management Organisation) to confirm whether or not there are any further UK licensing requirements.	A response was provided by email to assure that marine licensing requirements had already been discussed and addressed, and that these did not fall within the scope of the MERA. The MMO were consulted with (see below).
Scottish Environmental Protection Agency (SEPA) 17/06/2020	The information provided suggest that marine issues appear to be further away offshore and is therefore not within SEPA's remit to provide advice. Following your statement in the email below; it is unfortunate that the proposals seem to be one that would be polluting the marine environment especially the Arctic as it is stated that, it is not expected that any part of the launch vehicles will be retrieved. In regard to the impact on the marine environment, it appears the four bullet points that have been scoped out would need to be considered because planned launches which go wrong may end up landing in the waters close to Marine Protected Areas (MPA) and offshore oil platforms rather than in the arctic.	Acknowledged. As assessed in the MERA, the impact is predicted to be **minor** at worst. The 4 bullet points to which the email refers (offshore marine protected areas; offshore renewable developments; offshore oil and gas platforms; aggregated extraction areas) were characterised as part of the baseline for the study areas in Section 10.6. Both study areas encompass the launch site, so as to be precautionary about where the impact zones will be.
Royal Society for the Protection of Birds (RSPB) 03/06/2020	We feel that consideration of the assessment approach required for the return of parts of launch vehicles to the marine environment is somewhat outwith our expertise. However, in general terms, looking at the receptors that you intend to scope in, my opinion would be that you seem to be covering all relevant factors. Also, the receptors being scoped out seem acceptable.	Acknowledged; no further action required.

Consultee and Date	Issue Raised	Response/Action Taken
Maritime and Coastguard Agency (MCA) [Offshore Renewables Advisor] 03/06/2020 and 04/06/2020 [via phone discussion]	A series of clarification queries were raised by the MCA via return email. Issues raised in relation to the MERA included: Have the scoped-out receptors been checked with current datasets?	Clarification was provided via a phone call on 04/06/2020. The scoped-out receptors were characterised as part of the baseline for the study areas in Section 10.6.
	Will 'Shipping Activities' cover all vessel types; recreational, fishing, commercial and other offshore users including oil and gas, and dredging? Has vessel traffic been assessed in the study area to make this conclusion [that in-combination effects can be ruled out]?	Shipping activities, characterised in Section 10.6, have assessed all vessel types. Vessel traffic has been described in Section 10.6 and assessed in Section 10.10. Effects on shipping and navigation have been considered in the cumulative assessment in Section 10.13. With regards to Study Area B, vessel traffic has been assessed as part of the Navigation Risk Assessment, the results of which have been utilised in the MERA.
09/09/2020 [via email]	Based on [the further information provided in response to previous questions], I believe (at this point) that the impact on shipping and navigation should be suitably addressed through your approach to the MERA. I can only respond within the MCA's remit and you will of course need to consult with other interested parties to ensure nothing has been omitted from the approach.	Acknowledged, no further action required.
Marine Management Organisation (MMO) 29/05/2020 [via phone discussion]	Enquiries with regards to marine licensing should be submitted through our online marine licensing portal the Marine Case Management System (MCMS).	A response was provided by email to assure that marine licensing requirements had already been discussed and addressed, and that these did not fall within the scope of the MERA

10.4 Scope of Assessment

Environmental Zones of Influence

10.4.1 There are two types of launches which are proposed to occur from the Proposed Project; orbital and sub-orbital. The trajectories and likely impact zones for returning material from these launches is spatially distinct, therefore there is a need to have two EZIs, one for orbital launches (Study Area A) and one for sub-orbital launches (Study Area B).

Orbital Launches

10.4.2 Potential Launch Service Providers (LSPs) wishing to undertake orbital launches have provided information on the proposed trajectories and impact zones for all stages of their LVs, and this information has been utilised to devise the study area for orbital launches. The exact trajectories and impact zones of the LVs will vary depending on the requirements of the clients utilising the Proposed Project and will be provided to the CAA separately within the Launch Operator Flight Safety Analysis submitted in support of future associated LO licence applications.

10.4.3 The proposed trajectories of the LVs will have an overall northerly direction. The number of impact zones arising from a launch will depend on the number of stages in the LV, which may be one or two. Taking into account the impact zone for the payload fairing, up to 3 impact zones are expected per launch (Stage 1, Stage 2 and the payload fairing). The impact zones are expected to occur at a minimum distance of 200 km from the launch site, and up to a maximum distance of 1,100 km. The indicative locations of impact zones have been provided by the LSPs, and a precautionary 200 km buffer has been drawn around them to ensure that the study area is large enough to capture all reasonably foreseeable locations where the LVs will return. The resultant environmental zone of influence (EZI) for orbital launches, termed Study Area A, is presented in Drawing 10.1.

10.4.4 Study Area A falls within the jurisdiction of several countries including Scotland, Norway, Faroe Islands (Denmark), Iceland, and Greenland (Denmark). It also falls within areas beyond national jurisdiction. The northern part of Study Area A lies within the Arctic Circle, of which the southern limit is at a latitude of 66˚N. Study Area A lies mostly within OSPAR Region 1: Arctic Waters, with the waters up to 200 km north of Shetland falling within Region II: Greater North Sea (OSPAR, 2020).

Sub-orbital Launches

10.4.5 Sub-orbital LVs will comprise single-stage sounding rockets. Within this assessment it has been assumed that all sub-orbital activities will comprise sounding rockets that reach 47 km altitude as a worst case scenario. In reality, many sub-orbital launches will not reach that altitude and will therefore not be subject to regulation under the Space Act 2018.

10.4.6 Sounding rockets will have a launch range of approximately 60 km from the Proposed Project and will have a northerly trajectory. For precautionary purposes, the launch range assumes a maximum variation of 22.5˚ degrees either side of the predicted trajectory. The sounding rocket launch safety area encompasses a ~5 km buffer around the launch range, thereby extending to 70 km from the launch site. In order to encompass both operational areas, an EZI boundary of 90 km radius from the Proposed Project has been selected, hereafter referred to as Study Area B (Drawing 10.2), which lies wholly within Scottish waters. For figures showing the operational ranges of the two sub-orbital launch types, please see the Navigational Risk Assessment (NRA) (ABPmer, 2020).

10.4.7 In addition, weather balloons will also be launched from the Proposed Project as part of LV launch sequences to assess meteorological conditions prior to launch. Weather balloon operations will have a maximum drop radius of 80 km from the Proposed Project. Balloon launches will only be conducted when conditions ensure that the balloon will not enter areas of interest such as Sullom Voe Harbour, Oil/Gas Terminals, and Sumburgh Airport (i.e., Shetland), therefore the operation window of balloon launches will be in a 'window' from approximately 270˚ (i.e., 90˚ west of North) through to 160˚ of the launch site.

10.4.8 The resultant EZI for sub-orbital launches, termed Study Area B, is presented in Drawing 10.2.

Desk Study

10.4.9 This assessment comprises a desk study. The primary resources used to inform this chapter include:

- OSPAR resources;
- Conservation of Arctic Flora and Fauna (CAFF) 2017 State of the Arctic Marine Biodiversity Report;
- National Oceanic and Atmospheric Administration (NOAA) resources;
- European Marine Observation and Data network (EMODnet);
- ICES landings data;
- National Biodiversity Network (NBN) Atlas;
- NatureScot resources;
- Marine Scotland resources, including the National Marine Plan interactive viewer;
- Consultation responses;
- Project-specific Navigational Risk Assessment; and,
- Published and unpublished literature.

10.5 Assessment Methodology

10.5.1 To assess the level of potential impact (likely significant effects) resulting from launch events at the Proposed Project, a methodology has been developed to establish the level of environmental risk of the Proposed Project to a range of receptors. This takes account of the sensitivity of the receptor, the exposure of the receptor to effects and the magnitude of the effects over and above the baseline condition. Therefore, for the purposes of this assessment, the term 'risk assessment' can be used interchangeably for 'impact assessment'.

10.5.2 More information on the criteria considered when determining levels of sensitivity, exposure and magnitude is provided below. In all cases, the assessment considers impacts, over and above those that may have already occurred, to determine whether the proposal constitutes a significant risk (likely significant effect) to the water quality, biodiversity or human and human activity environment in the vicinity of the study areas. It should also be noted that where receptors are grouped together, or where a wide range of scores exists, the worst-case scores of sensitivity (comprising worst case scores of tolerance, adaptability and recoverability), exposure and magnitude are taken for each of the individual receptors.

Criteria Employed to Determine Levels of Sensitivity, Exposure and Magnitude

Sensitivity

10.5.3 The sensitivity assessment used is an assessment of the relative sensitivity of the receptor features within the impact zone to effects associated with returning LVs. In relation to this assessment, sensitivity has been defined in terms of the receptor's value (importance, quality and rarity), and as a product of tolerance, adaptability and recoverability to a pressure/effect:

- Tolerance is the susceptibility (ability to be affected or unaffected) of a receptor from an external factor;
- Adaptability relates to the ability of the receptor to adapt to, or avoid, an external factor; and,
- Recoverability is the ability of a receptor to return to a state close to that which existed before the activity or event caused change within a specified period of time.

10.5.4 For each receptor, consideration is given to each of these component parts of the sensitivity assessment, with overall sensitivity being governed by the combined scores for each part. The scores for each element range from 0-3 (Negligible to High) and are determined based on consideration of the available evidence.

10.5.5 The sensitivity assessments of the receptors (grouped or their component sub-features) are based upon a series of scientific review documents. These include Tyler-Walters and Hiscock (2005) and the Marine Habitats Reviews (Jones et al., 2000). Further detailed consideration of sensitivity (specifically in the context of benthic receptors but also more widely applicable) is provided at the MarLIN website. (MarLIN, 2019).

10.5.6 A combination of screening against sensitivity criteria per receptor/grouped receptors and expert judgement, based upon supporting statements within the baseline, have then been used to deliver the sensitivity assessment component of the risk assessment.

10.5.7 Where grouped receptors have been used (e.g., for some parts of the benthic ecology assessment), then the receptor with the known highest sensitivity (greatest intolerance) to the pressure assessed has been used as the benchmark. This has allowed a conservative/precautionary assessment process for sensitivity to feed into the risk assessment matrix.

10.5.8 In practice, to determine the sensitivity of a receptor each characteristic (value, adaptability, tolerance and recoverability) is scored from 0-3. In most cases, 0 represents a negligible score whereas 3 will indicate a high value for the characteristic. In the case of recoverability, adaptability, and tolerance, a low score indicates that the receptor is capable of withstanding the impact pressure and should reduce the sensitivity score, whereas a high score for these characteristics will lead to a high sensitivity. The following limits have subsequently been used to determine whether the sensitivity of the receptor is negligible, low, medium or high.

Table 10.4 Receptor Sensitivity Scoring

Combined Score	Sensitivity
0-3	Negligible (0)
4-6	Low (1)
7-9	Medium (2)
10-12	High (3)

Exposure

10.5.9 Exposure is defined in terms of how the impacts affect a receptor, including the spatial extent of the impact, its longevity above baseline levels and the frequency at which the impact occurs.

10.5.10 In practice, to determine the exposure of a receptor to a particular impact, each characteristic (spatial extent, longevity and frequency) is scored from 0-3. The combined scores are then used to determine the level of exposure that a receptor will experience. The following limits have subsequently been used to determine whether the exposure to the impact is negligible, low, medium or high.

Table 10.5 Receptor Exposure Scoring

Combined Score	Exposure
0	Negligible (0)
1-4	Low (1)
5-7	Medium (2)
8-9	High (3)

Magnitude

10.5.11 Magnitude is defined in terms of the level of the impact above background conditions and natural variability by whatever parameters are measurable.

10.5.12 In practice, to determine the magnitude of an impact, each characteristic (level above background, level in the context of natural variability) is scored from 0-3. The combined scores are then used to determine the level of exposure that a receptor will experience.

10.5.13 The following limits have subsequently been used to determine whether the magnitude of the impact is negligible, low, medium or high.

Table 10.6 Magnitude

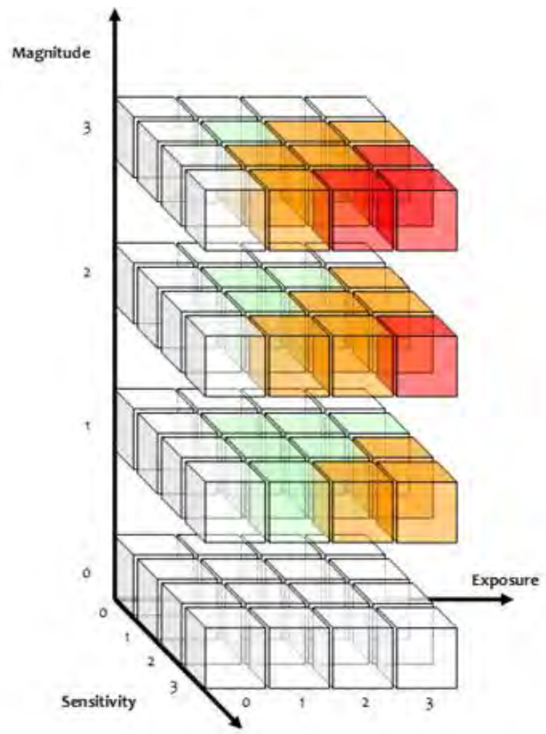
Combined Score	Magnitude
0	Negligible (0)
1-2	Low (1)
3-4	Medium (2)
5-6	High (3)

Summary of Methodology Used to Determine Level of Environmental Risk

10.5.14 As noted, the methodology adopted for this assessment utilises three elements: receptor sensitivity, exposure to impact and the magnitude of impact. As described, limits have been defined to assist in ascribing relevant values to these elements for all the receptors and potential impacts considered. The parameters adopted to ascribe values to the level of sensitivity, exposure, and risk (impact) have been adjusted according to the nature of the receptor and the impact.

Environmental Risk Assessment Matrix

10.5.15 An environmental risk assessment matrix has been developed to determine the risk posed by a range of impacts to a range of receptors. The matrix is illustrated in Figure 10.1 below. In practice, to determine the level of risk posed by an impact to a receptor, the scores resulting from the assessment outlined above are multiplied to determine the level of risk.



For the purposes of this assessment, the following limits have been set.

Score		Risk Value
0	=	Negligible
1-5.99	=	Low
6-17.99	=	Medium
18-27	=	High

Figure 10.1 The risk assessment matrix

10.5.16 Table 10.7 below presents the transposition of the risk values into the terminology used in the wider AEE Report.

Table 10.7 Risk assessment values and transposition into wider AEE Report terminology

Risk Value	AEE terminology	Potential Significant Effect
Negligible	Negligible	No Likely Significant Effect
Low	Minor	No Likely Significant Effect
Medium	Moderate	Likely Significant Effect
High	Major	Likely Significant Effect

10.5.17 It should be noted that broad receptor groups e.g., benthic habitats, are made up of a range of individual receptors e.g., bivalves, polychaetes, corals, sponges etc. As such, the risk assessment has been undertaken to account for the most sensitive elements of the broad receptor groups, with an overall risk summary for each broad group presented in the document.

Requirements for Mitigation

10.5.18 For the purposes of this assessment, risk scores of <6 (Low or Negligible Risk) are considered insignificant, and mitigation is unnecessary as no likely significant effects arise.

10.5.19 Risk scores of 6-17.99 (Medium Risk) are considered to result in likely significant effects. Where mitigation can be applied impacts may be reduced to Low or Negligible Risk resulting in residual effects equating to no likely significant effect. If specific mitigation measures are not applied likely significant effects will remain.

10.5.20 Risk scores ≥18 (High Risk) are considered to result in likely significant effects and impacts are likely to be mitigated only through application of specifically targeted measures and/or acquisition of further environmental information to better determine impact significance. If specific mitigation measures are not applied significant effects will remain.

Assessment of Residual Effect Significance

10.5.21 Where mitigation practices are required to reduce the level of risk to no likely significant effect, these measures are presented along with a subsequent assessment of likely residual effect.

Limitations to Assessment

10.5.22 Following the risk assessment, a consideration of the confidence of the assessment has been undertaken based on the nature of evidence used, and the application of the evidence, to determine the risk of the proposals.

10.6 Baseline Conditions

10.6.1 The baseline conditions are described in terms of their water quality, biodiversity and humans/human activities for the two study areas A and B. Parameters included in the assessment are water quality, biodiversity and human activities which are discussed in detail in Appendix 10.2.

10.7 Receptors Brought Forward for Assessment

10.7.1 Following characterisation of the baseline, certain receptors have been screened out due to a lack of presence in the study areas and/or pathway of effect.

10.7.2 Physical features have been screened out for both study areas due to a lack of pathway of effect.

10.7.3 It is noted that during the consultation for the NRA, the Oil and Gas Authority confirmed that there was negligible risk to the oil and gas surface infrastructure present to the west and north-east of Shetland. Accordingly, oil and gas surface infrastructure are scoped out of the assessment, for both study areas.

10.7.4 The LVs from sub-orbital launches are anticipated to be recovered, therefore several of the effect pathways will not be applicable to sub-orbital launches. Specifically, effects in relation to water quality, plankton, and seabed receptors (benthic habitats, marine archaeology, cables and pipelines) will not be affected.

10.7.5 As described in the baseline environment, there is negligible presence of other sea users and socio-economics/tourism in Study Area A. There is negligible presence of military activity in Study Area B. Accordingly, these human activities have been scoped out for the respective study areas.

10.7.6 Details of which features/receptors are being taken forward for assessment are presented in Table 10.8 below.

Table 10.8 Receptors taken forward in the assessment for the two study areas

Receptor	Taken Forward For Study Area A	Taken Forward For Study Area B
Water and Sediment quality		
Contaminants	Yes	No
Microplastics	Yes	No
Biodiversity		
Physical features	No	No
Plankton	Yes	No

Receptor	Taken Forward For Study Area A	Taken Forward For Study Area B
Benthic species	Yes	No
Fish and shellfish	Yes	Yes
Marine ornithology	Yes	Yes
Marine megafauna	Yes	Yes
Marine protected area	Yes	Yes
Human/human activities		
Shipping and navigation	Yes	Yes
Oil and gas infrastructure	No	No
Cables and pipelines	Yes	No
Military	Yes	No
Other sea users	No	Yes
Socioeconomics/tourism	No	Yes
Marine archaeology	Yes	No
Commercial fisheries	Yes	Yes

10.8 Assessment Envelope

10.8.1 As per the AEE Regulations, the impact assessment should be based on the worst-case parameters, known as the Rochdale envelope.

10.8.2 Certain worst-case scenarios, such as the maximum number of launches, are already known and have been set as limits as part of the project design.

10.8.3 At the time of writing, the potential clients interested in launching from the Proposed Project have not been fully determined. Therefore, this assessment has been made on the information provided to date which is considered to be representative of the Proposed Project.

10.8.4 A full description of the proposal is provided in Chapter 3 Description of Proposed Project. For completeness, this assessment envelope presents a subset of the project description that is relevant to this chapter.

Orbital launch vehicles

10.8.5 The effects of the returning stages of orbital LVs on the marine environment will depend on the physical properties of the LVs as well as the marine environmental receptor at the specific impact zone. The physical properties of the returning LV which may influence the level of effect include aspects such as the amount of residual fuel, the materials present and their reaction in the marine environment, and the dimensions of the stages of the LVs. The number of stages and the potential impact zones of the stages will vary depending on the LV specification.

10.8.6 The frequency of operations is also relevant to the magnitude of effects. It is noted that there will be 10 launches in the first year, rising to a maximum of 30 per year thereafter.

Physical properties

10.8.7 The maximum height of the LV to be used is 30 m. Rockets will likely comprise two stages.

10.8.8 A set of parameters for a representative and limiting-case orbital LV is summarised in Table 10.9 below. Using dimensions of a representative and limiting-case LV is suitably precautionary and likely to be representative of the limiting scenario in terms of size and amount of materials that return to the marine environment.

Table 10.9 Approximate parameters associated with a representative and limiting case LV

Parameter	Stage 1	Stage 2	Payload Fairing
Maximum height (m)	20.0	6.0	6.0
Maximum diameter (m)	2.0	2.0	2.5
Gross lift off weight (kg)	56,000		
Payload weight (kg)	Up to 1,000		
Dry mass (kg)	3,000	1,000	1,250
Potential elements contained within	LOX tank Avionics Helium tanks Fuel tank 4 × engines	LOX tank Avionics Fuel tank Helium tank 1 × engine	Fairing materials Payload
Indicative materials present	Lightweight carbon-fibre composite material Lithium polymer batteries Aluminium liner Copper thrust chambers Plastics[1]	Lightweight carbon-fibre composite material Lithium polymer batteries Aluminium liner Copper thrust chambers Plastics[1]	Carbon composite structure
Propellant (oxidizer and fuel)	Liquid oxygen (LOX) Rocket Propellant 1 (RP1)	LOX RP1	n/a
Amount of propellant left upon re-entry	It is assumed that the worst-case amount of propellant to be used for launch will not exceed 17,000 litres. This value is quoted in the corporate literature for one of the larger LVs (see Chapter 15). The amount of propellant in the LV at launch will be precisely measured so that the minimum amount is used to meet the launch requirements. All fuel is expected to be used during the launch. However, there is the possibility that some fuel will remain upon re-entry of the stage(s). A worst-case scenario of 1% of fuel remaining, i.e., 170 L, has been determined to be appropriate for the purposes of this assessment.		
Likely fate	Stage 1 is jettisoned first at a height of up to 75 km. Ignition of the Stage 2 engine occurs, followed by fairing separation and jettison. Once this has occurred Stage 2 will continue into orbital phase to for payload deployment. In most cases the Stage 2 would remain in orbit and undertake passivation. The different components are expected to return separately. Depending on the height that a stage or fairing is jettisoned, it may burn up on re-entering the atmosphere. It is broadly anticipated that Stage 1 will remain intact upon returning to Earth and entering the marine environment, whereas the fairing will break-up upon re-entry and lead to debris entering the marine environment.		

Parameter	Stage 1	Stage 2	Payload Fairing
	The worst-case scenario would be to assume that the LV parts do not burn up and instead enter the marine environment.		
Indicative impact zone	See section below		

Indicative Impact Zones

10.8.9 Drawing 10.3 presents the representative impact points of the different stages in Study Area A. These have been based on example trajectories provided by potential clients interested in the Proposed Project. It is acknowledged that information has not been provided for the impact zones of rockets that comprise three stages.

Sub-orbital launch vehicles

10.8.10 As well as orbital LVs, the Applicant is proposing to launch sub-orbital LVs from the Proposed Project. Sub-orbital launches are usually designed and required for data collection to inform the baseline that is vital for the next stages of launch clients' launch plans (i.e., orbital launches). Occasionally, sub-orbital launches may be carried out independently of an associated orbital launch.

10.8.11 Within this assessment it has been assumed that all sub-orbital activities will comprise sounding rockets that reach 47 km altitude as a worst case scenario. In reality, many sub-orbital launches will not reach that altitude and will therefore not be subject to regulation under the Space Act 2018.

10.8.12 In addition, weather balloons will also be launched from the Proposed Project as part of LV launch sequences to assess meteorological conditions prior to launch.

Equipment

10.8.13 The two types of sub-orbital LVs are single-stage sounding rockets and stratospheric weather balloons (Table 10.10).

10.8.14 Single stage sounding rockets consists of two main components: the fuselage, and the nosecone. The fuselage contains solid fuel, liquid fuel, or a hybrid of both, which is entirely burnt during launch, and the nosecone contains scientific equipment. The total mass of the rocket pre-launch is 230 kg, which is reduced by over 50 % upon burning of all the rocket fuel. A parachute is also built into the nosecone, allowing a controlled return of the rocket to return to sea level. The parachute deploys at an altitude of approximately 1 km. Once back at sea level, the sounding rocket can be collected by a recovery vessel.

10.8.15 Stratospheric weather balloons consist of a weather balloon weighing approximately 1.5 kg, with a ground-level diameter of 7 m, which expands to 20 m with altitude as atmospheric pressure decreases. The balloons will be filled with either hydrogen (H) or helium (He), depending on the flight pattern, required altitude, and weather conditions.

Table 10.10 Approximate parameters of a representative and limiting-case sub-orbital LV

Parameter	Single-stage Sounding Rocket	Weather Balloon
Maximum height (m)	1.5 - 8.0	7
Maximum diameter (m)	2.0	7 (ground-level) / 20 (expanded)
Gross lift off weight (kg)	230.0	<10.0
Payload weight (kg)	<5.0	
Dry mass (kg)	115.0	1.5

Parameter	Single-stage Sounding Rocket	Weather Balloon
Potential elements contained within	LOx tank Avionics Fuel tank 1 × engine	Balloon Attachment materials Radiosonde
Indicative materials present	Lightweight carbon-fibre composite material Lithium polymer batteries Aluminium liner Copper thrust chambers Plastics	Latex, rubber or neoprene balloon Attachment rope/wire Helium
Propellant (oxidizer and fuel)	Liquid oxygen (LOx) Liquid/solid/hybrid fuel	n/a
Likely fate	See Launch and Recovery section below	
Indicative impact zone	See Indicative Impact Zones section below	

10.8.16 The assessment of environmental effects from sub-orbital LVs within this AEE considers the effects of single-stage sounding rockets as the effects from weather balloons on the marine environment are considered to be much less significant.

Launch and Recovery

10.8.17 The flight path and landing location of the sub-orbital LV will be predicted using the weather conditions and modelling. During launch, a recovery/security vessel will be deployed to maintain a clear launch range to protect mariners operating in the area. The guard vessel will monitor radar and issue security notices over VHF radio. If the payload is to be recovered, the vessel will move to the impact location and recover the payload to ensure navigational safety.

10.8.18 The payload will be fitted with a Global Positioning System (GPS) receiver, and a frequency tracker as a backup, to enable tracking and locating of the payload in near real-time. As per International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) guidelines, the payload will be painted in high-visual yellow paint and will carry a flashing yellow light.

10.8.19 When recovery of the sub-orbital LV and/or payload is required by the LSP, a recovery/patrol vessel will be used for recovery, subcontracted to local maritime companies. The vessel will be of specific standards to ensure it can withstand the conditions off the coast of the Shetland Islands. The vessel crew will be required to be certified and appropriately trained to reduce unnecessary risk.

Indicative Impact Zones

10.8.20 The impact zone differs marginally for the stratospheric weather balloons and the sub-orbital sounding rockets (See Figure 10.2 and Figure 10.3 respectively). A precautionary 90 km radius from the Proposed Project site has been used to ensure the full extent of potential effects is covered appropriately.

10.8.21 As observed in Figure 10.2, the maximum extent of impact does not cover a full 360° from the launch point, but instead encompasses an area from west of the Proposed Project clockwise round to the south-east. This is because balloon launches will only proceed if the desired trajectory is met and the predictions show that the balloon will not travel in a south to south-west direction, to ensure that Sullom Voe and Shetland's commercial airspace are avoided.

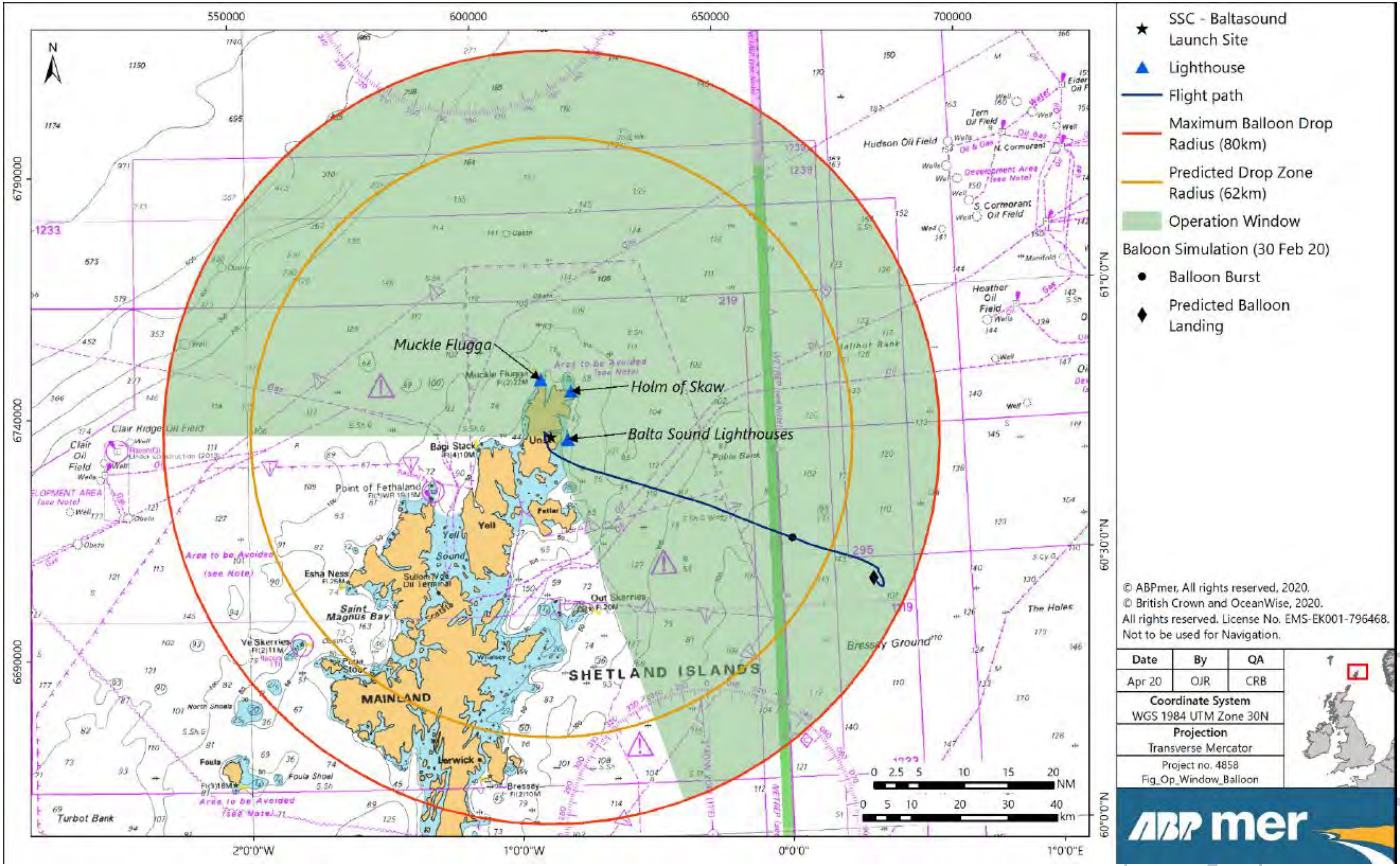


Figure 10.2: Indicative impact zone and example flight path for a stratospheric weather balloon launch (From: ABPmer, 2020)

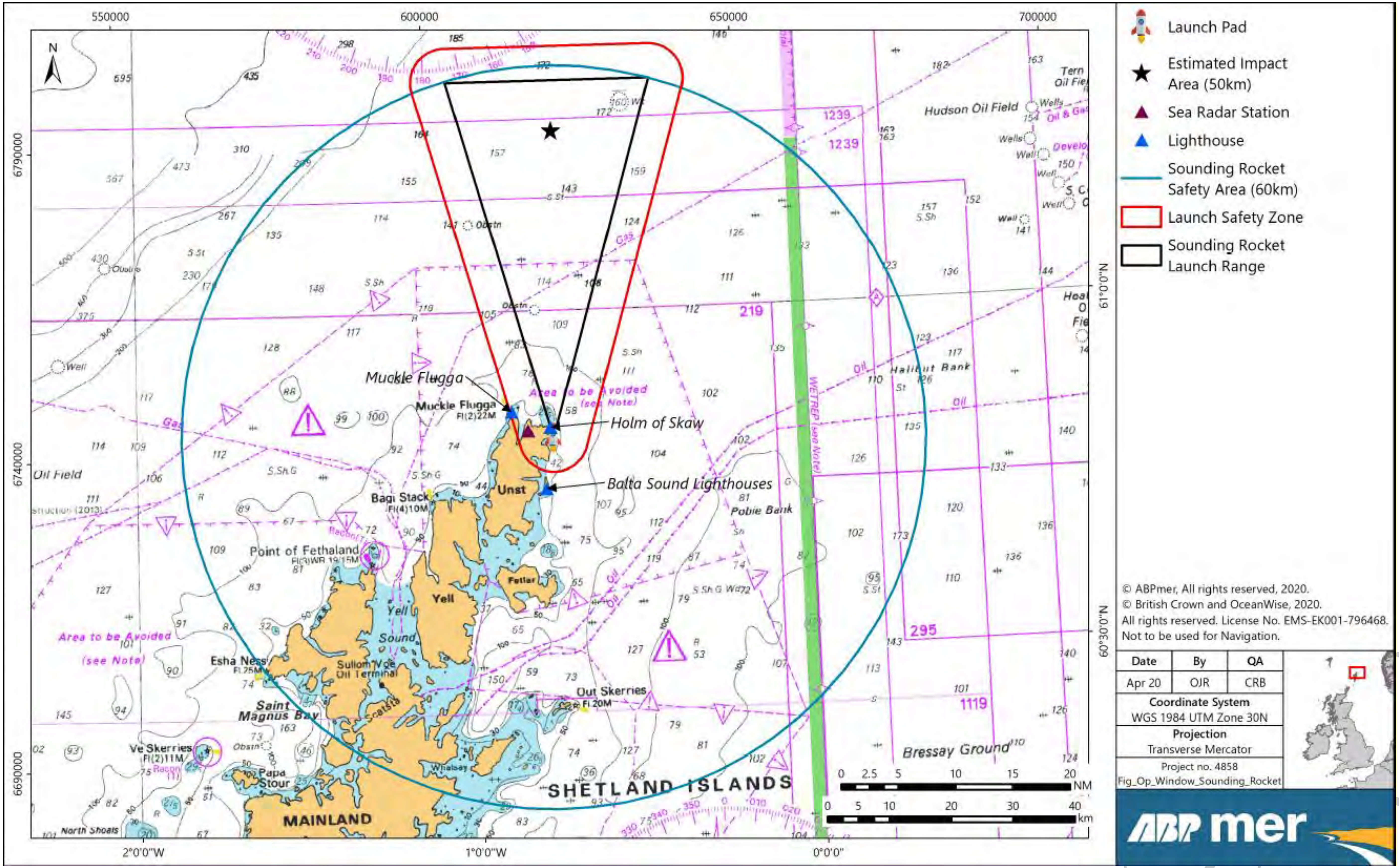


Figure 10.3: Indicative impact zone and example flight path for a single stage sub-orbital rocket launch (From: ABPmer, 2020)

10.9 Standard Mitigation

Orbital launches

10.9.1 The Federal Aviation Administration (FAA) methodology will be applied to define an exclusion zone, which will apply to sea and air. Using FAA defined exclusion zones ensures a precautionary approach, as these are larger than UK exclusion zones. The direction from land will vary with the launch azimuth, with bearings currently projected to range from 330 to 030 True. The exclusion zone will fan between the aforementioned bearings and will extend outwards from the Proposed Project to at least 3.3 nautical miles. Once an exclusion zone has been identified, the area will be registered on Marine Charts and will be activated via a Notice to Mariners.

10.9.2 An exclusion zone is not anticipated to be required for the stages and fairings. For these, a Notice to Mariners will be published, with the exact areas dependent upon individual launches/rockets.

Sub-orbital launches

10.9.3 Sounding rockets will use the FAA defined exclusion zone approach described above. Operational areas (nearshore of the rocket launch and the calculated drop zone) will be clearly marked and promulgated through Notice to Mariners if required by the Maritime and Coastguard Agency. If the zones are expected to be active for extended time periods, consultation with the UK Hydrographic Office will determine whether the zones need to be marked on Admiralty paper and electronic charts.

10.9.4 Prior to launch, a Notice to Mariners will be published, and NAVTEX warnings and Sécurité messages will be broadcast over Very High Frequency (VHF) radio. This will ensure that other maritime users are aware of the launch and potential recovery operations and will assist in the implementation of temporary exclusion zones. In addition, continuous monitoring of AIS and radar will be carried out from land to ensure navigational safety at all times in the indicative impact zone. NAVTEX warnings will be provided at least five days in advance of launches.

10.9.5 When recovery of the sub-orbital LV and/or payload is required by the LSP, the recovery/patrol vessel will be present in the calculated drop zone throughout the launch of the sub-orbital (stratospheric weather balloon or single stage rocket). The vessel will monitor launches and the trajectory of the sub-orbital payload, receiving continuous real-time updates from land and the GPS receiver and tracker on the payload. The payload will also be monitoring visually, from land and from the vessel, using observers with binoculars. This will enable the recovery/patrol vessel to inform nearby and approaching vessels of the impending payload drop and recovery.

10.9.6 In order to increase visibility, the Applicant will ensure that payloads are marked with bright yellow tape/paint and will affix a flashing beacon light.

10.10 Potential Effects

10.10.1 A series of effect pathways on the marine environment have been identified as a result of the return of LVs to Earth. Table 10.11 below summarises the effect pathways to be considered for orbital and sub-orbital launches from the Proposed Project.

10.10.2 The effects of direct strike on vessels has been screened out. There is no pathway for effect due to the standard operating procedure of implementing an exclusion zone around the returning LV and associated vessel (where applicable).

Table 10.11 Impacts considered for the impact assessment of orbital and sub-orbital launches.

Key: ✓ = Impact present; × = Impact not present

Impact	Orbital Launches	Sub-orbital Launches
Effects on Water and Sediment Quality, and Ecological Receptors from Fuel Spillage	✓	×
Effects on Water and Sediment Quality, and Ecological Receptors from Metal Corrosion and Toxic Contamination	✓	×
Effects on Water and Sediment Quality, and Ecological Receptors from Debris and Microplastics (Including Ingestion)	✓	×
Smothering of Marine Organisms, Habitat Alteration (Including Reef Effects) and Habitat Loss via Deposition of Material on the Seabed	✓	×
Direct Strike	✓	✓
Acoustic Disturbance (including Underwater Noise) from the Impact of the Jettisoned Objects Hitting the Sea Surface	✓	✓
Toxic Contaminants from Jettisoned Objects	✓	✓
Thermal Effects of Jettisoned Objects	✓	✓
Visual Disturbance	✓	✓
Displacement of Fish	✓	✓
Damage to Human Infrastructure (Subsea Cables/Pipelines)	✓	×
Interference with Military Exercise Areas	✓	×
Impacts to Vessel Navigation Including Floating Debris, Changes to Topography and Re-routing of Vessel Traffic	✓	✓
Interference with Marine and Coastal Tourism Activities/Industry	×	✓

10.10.3 The risk assessment matrices that correspond to the written description of the environmental effects in the sections below are provided in:

- Appendix 10.3 – water quality risk matrix (Volume IV Technical Appendix 10.3);
- Appendix 10.4 – biodiversity risk matrix (Volume IV Technical Appendix 10.4); and,
- Appendix 10.5 –human activity risk matrix (Volume IV Technical Appendix 10.5).

Study Area A – Orbital launches

Effects on Water and Sediment Quality and Ecological Receptors from Fuel Spillage

10.10.4 As detailed in Table 10.9 above, it has been assumed that the worst-case scenario of residual propellant in the LVs upon re-entry would be 170 L. This nominal amount would be split across the two stages, therefore the amount of propellant at each impact zone would be less than this.

10.10.5 The propellent will comprise RP1, which is a subset of kerosene. NOAA (2019) has provided a description of the effects of kerosene in the marine environment. Kerosene-type oils spread very quickly on water to form a thin film, which may be less than 0.01 mm thick. When forming this film, approximately 1,000 gallons is present per square nautical mile of coverage. Taking into account the total amount of kerosene (170 L, or 45 gallons), the maximum size of the surface film from 170 L of kerosene would be approximately 1/20th of a square nautical mile, equivalent to ~0.17 km2. Kerosene has a low boiling point and viscosity, meaning that, when spilled on water, most of the oil will evaporate or naturally disperse within a day or less. Kerosene that is dispersed in the water column can adhere to sediment and be transported to the sea bottom, however this is highly unlikely in Study Area A given the low sediment load. As stated by NOAA (2019), this process is not likely to result in measurable sediment contamination for small spills like those potentially associated with this assessment. Small spills of kerosene that reach the shoreline would be expected to quickly penetrate the sediment and/or be washed off. Kerosene can be completely degraded in the marine environment on the timescale of 1-2 months.

10.10.6 Liquid oxygen (LOX) has a boiling point of -183°C (Air Products, 2015) and so would be expected to evaporate upon entering Earth's atmosphere, thereby not entering the marine environment.

10.10.7 It is anticipated that any residual propellant in the returning stages will be expelled upon impact on the sea surface. Due to the nature of kerosene-like fuels, only the very surface of the water column is anticipated to be within the zone of effect from RP1 release. The marine biodiversity receptors that have the potential to be in this zone of effect for a non-negligible period of time are plankton. All other marine biodiversity receptors are present in the surface waters on a transient basis and so would not be exposed to potential residual propellants for any notable period of time.

10.10.8 It is possible that aquatic organisms that come into direct contact with naturally dispersed and entrained propellant will be killed (NOAA, 2019). However, given the small area of effect and the abundance and turnover of plankton, this is not anticipated to cause significant changes to the marine community.

10.10.9 Though effects to marine organisms higher up the food web have been excluded, it is worth noting that NOAA (2019) confirms that fish kills are unlikely to occur as a result of jet fuel spills in the open ocean due to evaporation and therefore concentrations are below lethal effects. This is expected to be applicable to other marine megafauna too.

10.10.10 The water quality and biodiversity of Study Area A has an important environmental value. The biodiversity receptor which may be impacted by hydrocarbons, plankton, may experience lethal effects as a result of exposure to hydrocarbons. Hydrocarbons are anticipated to remain at the sea surface, over a small area, and be present over a short timescale (1-2 months). Given this and the abundance and turnover of plankton, the sensitivity of these receptors is moderate.

10.10.11 Water quality and biodiversity receptors may be exposed to the effects of contaminants over an extensive period of time i.e., the full duration of the Proposed Project operations. Within this timeframe, launches are anticipated to occur up to a maximum of 30 times per year. It is noted that, due to the large spatial extent over which the LVs could return, it is extremely unlikely that the receptors would be exposed to multiple LVs, further reducing the frequency at which they could be exposed to hydrocarbon spills. It is also noted that the event of a hydrocarbon spill is unlikely as in most cases there will be no residual fuel. The zone of effect of hydrocarbon spills is anticipated to be spatially limited, to the immediate vicinity (<0.5 km2) of the LVs. Therefore, overall exposure of the receptors to the effect is low.

10.10.12 Direct effects on the hydrocarbon concentration of the sea water is likely to be measurable above natural variability, as there are limited other sources of hydrocarbons in the marine environment. Similarly, potential impact to the water quality is likely to be measurable above the baseline in that the hydrocarbon concentration will be elevated. However only a small percentage change above the baseline or natural variation is predicted due to the small amount and rapid evaporation/dispersion of kerosene in the marine environment. The magnitude of the impact is therefore low.

10.10.13 Moderate sensitivity, combined with low exposure and low magnitude, means that the risk to these receptors is low, which is equivalent to minor risk. No likely significant effect.

10.10.14 Effects on Water and Sediment Quality and Ecological Receptors from Metal Corrosion and Toxic Contamination

10.10.15 As detailed in Table 10.9 above, the metals that have the potential to enter the marine environment are lithium (from the batteries), aluminium (from the helium tank liner), and copper (from the thrust tanks). These are all present in Stages 1 and 2 but not the fairing (Table 10.9). The marine environment of Study Area A is therefore described in terms of these specific metals.

10.10.16 Lithium (Li) in the open ocean is present in low concentrations in seawater (typically 1 ppm) (SAMCO, 2018). The main input of lithium to the ocean is weathering of continental crust, though there has been a reported increase in anthropogenic inputs near populated areas (e.g., Choi et al., 2019). Lithium is a non-essential nutrient to marine biota (Campbell et al., 2005). Campbell et al. (2005) reported that, for Arctic waters, lithium is present in high concentrations in zooplankton as a result of bioconcentration from seawater. The concentration in zooplankton was several orders of magnitude lower than in seals, fish, and birds, which indicates that lithium decreases trophically through the food web (Campbell et al., 2005). Lithium therefore only has the potential to affect the zooplankton and such lower levels in the food chain. The lithium that may be introduced to the environment will only come from one set of batteries per impact zone, therefore it is predicted to be a small amount that will only lead to localised increases. Given that only a small proportion of the food web (zooplankton) has the potential to be affected, and that zooplankton are abundant and have high turnover, the effects are expected to be negligible.

10.10.17 Aluminium (Al) is one of the most resistant metals to corrosion in the marine environment, and so is used widely in the shipping industry (Almet-Marine, 2020).The primary natural input of aluminium to the marine environment is from aeolian sources, though this input is limited in Arctic waters. Here, aluminium is low in surface waters and increases with depth (Wong et al., 1983). Aluminium is present in seawater in trace levels, ranging from 5-20 nmol/L, and is non-essential to marine life (Wong et al., 1983; Gilmore, 2014). The low number of studies on species' sensitivity to aluminium has shown there is great interspecies variability (Gilmore, 2014). So far, it has been reported that species of urchin, coral and macroalgae are tolerant, whereas some species of molluscs and phytoplankton show toxicity responses to lower concentrations of aluminium (Gilmore, 2014). The potential effects of elevated aluminium on marine life is therefore highly variable and species-specific. Nevertheless, it is unlikely that the introduction of aluminium as a result of the presence of the LV stages would increase aluminium concentration to levels where a toxic effect occurred, except in the immediate vicinity of LV stage.

10.10.18 In the Atlantic Ocean, copper (Cu) concentration increases with depth and latitude (Pohl et al., 1993). Copper concentration is higher near the shelf due to dissolution from shelf sediments and higher inputs from freshwater sources (Pohl et al., 1993). There is no interannual variation in copper levels in the Atlantic and Arctic oceans (Pohl et al., 1993). The input of copper into the marine environment has increased four-fold since the start of the industrial era (Lopez et al., 2019). Most copper it deposited through the atmosphere into the surface layer (Lopez et al., 2019). Of the total copper that is inputted to the surface layers, only a fraction is soluble and so able to be used by marine life (Lopez et al., 2019). Copper is an essential nutrient in the marine environment; hence it is typically present in high concentrations in all marine life across all trophic levels and does not bioaccumulate (Campbell et al., 2005). At high concentrations in seawater copper can be toxic to phytoplankton, though this is typically in areas subject to heavy anthropogenic emissions (Lopez et al., 2019). It is unlikely that the copper concentrations in Study Area A are sufficiently high as to be toxic, as it is away from most anthropogenic inputs. As copper in Study Area A is not predicted to be present in toxic levels, and is an essential nutrient, a small, localised increase in copper concentrations in seawater is not likely to be detrimental to marine life.

10.10.19 The water quality and biodiversity of Study Area A has an important environmental value, with certain biodiversity features also having an important cultural value. The most sensitive receptor is expected to be slightly tolerant and adaptable to increase in the contaminant levels. The source of contaminants (stages of the LVs) will pass through the water column and then rest on the seabed. Biodiversity receptors will be exposed to increased contaminants as the LV passes through the area of the water column that they occupy. Water quality will be affected throughout the LVs' passage. Given the predicted small increase in concentration of contaminants, it is anticipated that biodiversity and water quality receptors will be able to recover within short timescales (<1 year). The sensitivity of these receptors is therefore low.

10.10.20 Water quality and biodiversity receptors may be exposed to the effects of contaminants over an extensive period of time i.e., the full duration of the Proposed Project operations. Within this timeframe, launches are anticipated to occur up to a maximum of 30 times per year. It is noted that, due to the large spatial extent over which the LVs could return, it is extremely unlikely that the receptors would be exposed to multiple LVs, further reducing the frequency at which they could be exposed. The zone of effect of contaminants is anticipated to be highly spatially limited, to the immediate vicinity (i.e., metres) of the LVs. Therefore, overall exposure of the receptors to the effect is low.

10.10.21 Any impact is likely to be small and slightly above the range of natural variation in the marine environment. This is suitably precautionary as little is known about the fine-scale variation of contaminant concentration in the marine environment of Study Area A. Potential effects on the water quality are expected to be measurable above the present baseline, though for biodiversity it is anticipated that potential effects will not affect the baseline. The magnitude of the impact is therefore low.

10.10.22 Low sensitivity, combined with low exposure and low magnitude, means that the risk to these receptors is low, which is equivalent to minor risk. **No likely significant effect.**

Effects on Water Quality and Sediment and Ecological Receptors from Debris and Microplastics (Including Ingestion)

10.10.23 As detailed in Table 10.9 above, there is the potential for plastic to enter the marine environment as plastic is sometimes used for liners of the propellant tanks. Plastic may be present in Stages 1 and 2 but not the fairing (Table 10.9).

10.10.24 The plastic class that would be used for liners has not been specified. One example of a plastic type used for propellant tanks is Mylar, which is a family of plastic sheet products made from the resin polyethylene terephthalate (PET) (Frischmuth, 1966; Grafix Plastics, 2020). For the purposes of the assessment, it is assumed that PET is representative of the plastics potentially present in returning LVs.

10.10.25 PET is already present in the baseline of the marine environment as it is a type of plastic commonly found in marine litter, specifically plastic beverage bottles (Andrady, 2011). PET has been reported in the Arctic and given that the Arctic is a hotspot for plastics, it is likely that PET is already present in notable concentrations in Study Area A (Obbard et al., 2014). PET has a specific gravity of 1.37, greater than the 1.025 of seawater, indicating that it sinks in the marine environment (Andrady, 2011). PET can remain robust in the marine environment for approximately 15 years before significant breakdown (Ioakeimidis et al., 2016). It is anticipated that any plastic present in the returning stages would be large (>5 mm), and so classified as macroplastics at the point of entry (NOAA, 2020a), but would breakdown over a period of time during which microplastics (<5 mm) would be emitted.

10.10.26 Microplastics are readily ingested by marine organisms either through direct ingestion or indirectly by trophic transfer from contaminated prey (Nelms et al., 2018). There are records of microplastic polyethylene ingestion in a range of holoplankton and meroplankton, including ichthyoplankton, though the recorded taxa are likely an underestimation due to the frequency of not reporting plastic class (Botterell et al., 2019). As summarised by the review of Nelms et al. (2018), there has been many inference of trophic transfer of microplastics due to the recorded presence of microplastics in the faeces and stomach contents of species groups at higher trophic levels including fish, birds and marine mammals.

10.10.27 Studies on the biological effects of microplastics in the field are rare (Botterell et al., 2019). In smaller organisms, microplastic ingestion has been shown to cause detrimental physiological impacts such as reducing feeding capacity, energy reserves, and reproductive output (Nelms et al., 2018). The effects on higher marine organisms are not well known. A few studies have shown that microplastics can be excreted after some days in the stomach, indicating a lower likelihood of the more severe physiological effects seen in small organisms (Nelms et al., 2018).

10.10.28 Debris, which would primarily comprise carbon composite, may also enter the environment from either the stages or the fairing of an LV (Table 10.9). The exact composition and structure of the composite material are likely to be unique to the rocket manufacturer, therefore for the purpose of this assessment a generalisation of the material is required. An example of carbon composite used as part of a LV is a composite structure consisting of an aluminium honeycomb core surrounded by carbon fibre face sheet piles. It has not been possible to find any evidence on how such unique composite material might break down in the marine environment, and in turn how the subsequent contaminants present may affect marine life. When returning to earth, the stages and fairing will hit the ocean at high velocity and therefore incur mechanical damage upon impact. The carbon composite is likely to sink upon entry into the marine environment, as has been recorded for other returning rocket stages. The rocket components are designed to withstand the extreme conditions of launch and travel; therefore, it is considered likely that any corrosion would be limited and only occur over long timeframes. To illustrate, the thrust chamber of one of the first stage F-1 rocket engines to launch the Saturn V rocket over 50 years ago has been recently detected on the seafloor, intact, and has been recovered (Space.com, 2013) (noting that these were made from aluminium and not a composite structure). The worst-case scenario, of a limited amount of corrosion of the composite material, may result in an increase in various contaminants in the marine environment, however due to the large quantity available for dilution of relatively small parts, toxic concentrations are not likely to occur.

10.10.29 The water quality and biodiversity of Study Area A has an important environmental value, with certain biodiversity features also having an important cultural value. The most sensitive receptor, plankton, is expected to be slightly tolerant to low levels of microplastic ingestion which could potentially occur as a result of plastic from the LV entering the marine environment. As a result of this potential ingestion and subsequent change plankton could be noticeably affected. The source of microplastics (plastic liners in the stages of the LVs) will be of unknown size upon entering the marine environment, though it is hypothesized that they will enter as macroplastics and will sink through the water column and then rest on the seabed. Biodiversity and water quality receptors will be exposed to increased microplastics as the LV breaks down on passage through the area of the water column that they occupy. Given the predicted small increase in concentration of microplastics, the high turnover and abundance of the most sensitive receptor (plankton), and the potentially short residence time in the gut of larger marine organisms, it is anticipated that biodiversity and water quality receptors will be able to recover within short timescales (<1 year). The sensitivity of these receptors is therefore moderate.

10.10.30 Water quality and biodiversity receptors may be exposed to the effects of microplastic over an extensive period of time i.e., the full duration of the Proposed Project operations. Within this timeframe, launches are anticipated to occur up to a maximum of 30 times per year. It is noted that there are two factors which reduce the frequency of exposure to an individual, the large spatial extent over which the LVs could return, and that plastics will not necessarily be used in all LVs launched. The zone of effect of microplastics is anticipated to be spatially limited, with concentrations of microplastics decreasing to below effect levels outside of the immediate vicinity of the LVs. Therefore, overall exposure of the receptors to the effect is moderate.

10.10.31 Any increase in microplastics is likely to be small and slightly above the range of natural variation in the marine environment. This is suitably precautionary as there is minimal information on natural variation, though background levels are predicted to be high in the Arctic waters that overlap Study Area A. The impact on water quality is expected to be measurable above the present baseline, at a local scale, though for biodiversity it is anticipated that potential impacts will not affect the baseline. The magnitude of the impact is therefore low.

10.10.32 Moderate sensitivity, combined with moderate exposure and low magnitude, means that the risk to these receptors is low, which is equivalent to minor risk. **No likely significant effect.**

10.10.33 It is noted that there are elements of uncertainty in the overall impact assessment of debris and microplastics, particularly with regards to the assessment envelope. However, the conclusions of the assessment concurs with the conclusion of the Draft Environmental Impact Statement for the Mars 2020 Mission (NASA, 2020) for impact of contaminants on the local marine environment, which assessed significantly larger rockets than proposed to be launched from the Proposed Project.

Smothering of Marine Organisms, Habitat Alteration (Including Reef Effects) and Habitat Loss via Deposition of Material on the Seabed

10.10.34 Study Area A is poorly understood in terms of its benthic habitats, as described in Appendix 10.1. It is likely that the most species rich group is arthropods, followed by polychaetes and molluscs. Vulnerable Marine Ecosystems (VMEs) are also present in Study Area A. VMEs are sensitive to benthic pressures, though protection measures from these pressures are only applicable where they arise from fishing. There are a few MPAs in the region that have designated benthic habitat features, therefore, the benthic habitats receptor is considered to have a high value.

10.10.35 The landing of the stages of the LVs at the seabed may directly impact benthic habitats in Study Area A. If the stage lands in/on a sensitive benthic habitat, it would likely be intolerant of the change and unable to adapt, with potentially lethal or destructive effects. It is anticipated that the LV stages will sink through the water column and come to rest at a single place at the seabed, and not move once at the seabed, thereby only impacting the habitat directly within the LV footprint (maximum of <20 m by ~2 m, with a volume of 62.8 m3). The footprint of the impact is likely to be smaller than the full extent of the benthic habitat in a given area. Therefore, it is likely that once the LV stage has fully broken down, the surrounding benthic habitat will enable the impacted zone to be recolonised, though this can only happen over a long timescale. There is also the possibility that the novel infrastructure surface could be colonised whilst intact on the seabed i.e., act like an artificial reef, though this is not confirmed. The introduction of artificial habitats into an environment are known to have a number of impacts on the local environment. The addition of hard substrate may allow for the colonisation of species that would otherwise be unable to exist in the local environment. Fish aggregating device effects may also result from the addition of hard substrate within the environment, causing a localised increase in species richness and abundance, and potentially decreasing these measures in the surrounding area. Further, increased biological activity surrounding the debris may result in an increased level of local nutrient levels through increased deposition flow of organic material. All of these effects are however likely to be confined to the close vicinity of any debris. For the purposes of this assessment, a 30-year operational lifetime of the Project has been assumed; equivalent to 880 launches, resulting in a total debris volume of approximately 55,264 m^3 [1]. When compared to the total volume of the study area, this potential reef volume is likely to have a negligible impact on the marine environment. It is also likely that larger bits of debris will break up with time, further reducing the total volume of potential reef. In conclusion, the most sensitive benthic habitats have a low tolerance or adaptability, though the habitat may recover on a long timescale.

10.10.36 Due to the high value, low tolerance, adaptability, and recoverability, benthic habitats are considered to have high sensitivity to direct loss of seabed habitat via deposition of material on the seabed.

10.10.37 For the purposes of this AEE an operational period of 30 years has been assumed, with an initial plan of 10 launches per year, increasing to a maximum of 30 per year. Although the operational phase of the Proposed Project is considered to have high longevity, the likelihood of the LV stage impacting the same area of benthic habitat is extremely low, considering the total extent over which the LV could enter the marine environment. Therefore, the longevity of the impact has been reduced to low to reflect this short time period per impact.

[1] This is the approximate volume of 22 Olympic sized swimming pools.

10.10.38 Vulnerable Marine Ecosystems (VMEs) are numerous in Study Area A, particularly around the coasts of landmasses. There are only a few MPAs with benthic features, though these are typically large in extent. The impact zone around an LV stage is extremely small in comparison to the areas of sensitive and/or protected benthic habitats. Therefore, the spatial extent of the impact is low.

10.10.39 An overall low longevity and spatial extent result in a low exposure of benthic habitats to direct loss caused by the returning LV.

10.10.40 Any potential impact to benthic habitats is likely to result in a small measurable change to the baseline in the immediate vicinity of the LV stage. This change is likely to be measurable above natural variability, as sensitive benthic habitats such as VMEs are long-lived and there are few other sources of direct loss. Therefore, the magnitude of impact in terms of baseline and natural variability is low.

10.10.41 High sensitivity, combined with low exposure and low magnitude, mean that the risk to benthic habitats from direct loss caused by the returning LVs is minor. **No likely significant effect.**

Direct Strike

10.10.42 Marine ecological receptors that have the potential to be present at, above, or just below the sea surface, concurrent with a returning LV, include seabirds and marine megafauna. Many species of these ecological receptor groups are protected under various nature conservation legislation and constitute and essential part of the ecosystem. Accordingly, the receptors that may be affected by this impact pathway have been ascribed a high value.

10.10.43 The maximum i.e., worst-case mass of a returning LV stage is anticipated to not exceed approximately 3,500 kg, calculated from the maximum dry mass of a single stage plus the assumed amount of residual fuel. The returning LV stage will be travelling at considerable speed at the point of entry into the marine environment. Based on other, larger rockets, it is anticipated that the return speed will not exceed 1,000 m/s (The Conservation, 2016).

10.10.44 The return of the LV stages through the Earth's atmosphere and into the marine environment has potential to cause injury and/or death to marine ecological receptors which are in the return flightpath. The LV stage may collide with species that spend time at, above, or just below, the sea's surface. The ecological receptors and their specific behaviours which may lead to them being affected by a returning LV stage include:

- Foraging or migrating seabird species, which may be flying above the water;
- Foraging or loafing seabird species, which may be floating on the water surface;
- Pinniped species, which may be at or just below the water surface;
- Cetacean species, which may be at or just below the water surface;
- Basking shark and sunfish, which may be at or just below the water surface; and,
- Designated seabird features of MPAs, behaving as described above.

10.10.45 Given the size of the stages and the speed at which they are predicted to return, it is anticipated that any receptors struck by the returning LV would experience mortality. Larger animals such as baleen whales may experience serious physical injury if not directly struck, however this is also considered likely to lead to mortality, albeit indirectly. Individual marine ecological receptors are not tolerant, adaptable, or able to recover from mortality events.

10.10.46 A high ecological and cultural value, combined with no tolerance, adaptability, and recoverability, results in the aforementioned ecological receptors having a high sensitivity to direct strike from returning LVs within Study Area A.

10.10.47 For the purposes of this AEE an operational period of 30 years has been assumed, with an initial plan of 10 launches per year, increasing to a maximum of 30 per year. Although the longevity of the operational phase of the Proposed Project is high, the frequency of the impact is low. This is further reduced when it is considered that a single individual is only likely to exposed to this impact up to once in a lifetime. The returning LV will only impact the area directly where it lands, which, compared to the total available habitat within Study Area A (including the entire water column below the surface layers and total air space for flying birds), is low.

10.10.48 A low frequency and spatial extent, combined with a high longevity, result in a low exposure of ecological receptors to direct strike from the returning payload.

10.10.49 The likelihood of such an impact occurring is considered to be very low. Should it occur, it is expected that only single individuals would be affected. Collisions between these ecological receptor groups and vessels (in water) or anthropogenic infrastructure (in air) is not an uncommon occurrence. Similarly, the natural level of mortality in these species would mean that the additional mortality of a limited number of individuals would not affect the population baseline nor be detectable above the natural variability of populations which fluctuates on a range of timescales. Therefore, the magnitude of effect is negligible.

10.10.50 A high sensitivity, combined with a low exposure, and negligible magnitude, mean that the risk to ecological receptor populations (seabirds, marine megafauna, and MPAs) in Study Area A from direct strike by the returning LV is negligible. **No likely significant effect**.

Acoustic Disturbance (Including Underwater Noise) from the Impact of the Jettisoned Objects Hitting the Sea Surface

10.10.51 The occurrence of excessive noise input into the ocean can elicit a range of responses in marine ecological receptors, such as mortality, physiological injury, auditory injury (either permanent or temporary), disturbance, and masking. The magnitude of the response is dependent on the properties of the sound source, such as the loudness, frequency, and duration, as well as the state of the receiving individual. The marine ecological receptor groups with demonstrated sensitivity to noise include plankton, fish, and marine megafauna. Benthic habitats are also known to be sensitive to noise but given the probable water depths at the point of LV return, it is unlikely that the received noise at the seabed will be above the threshold to cause a response. Seabirds have limited sensitivity to underwater noise and are also highly unlikely to be present in the water in the immediate vicinity of the LV when the noise occurs, therefore these are not considered further.

10.10.52 The characteristics of the acoustic emission produced by the LV stage hitting the water is not known. Taking into consideration the speed at which the LV stage will be travelling (up to 1,000 m/s; The Conversation, 2016), the maximum size (20 m × 2 m), and the weight (<3,500 kg), it is likely that the sound will comprise a single pulse, of high intensity and short duration (impulsive). These acoustic properties are similar to the sound produced by explosive detonation in the marine environment. As considerably more is known about the sound emissions of explosives, this source has been used a proxy for the sound emitted by returning LVs in this assessment.

10.10.53 Explosive noise is characterised as broadband i.e., occurs across a wide frequency range, with a peak energy content in the low frequency bands of 63-500 Hz (Paro et al., 2015). It has a high peak sound pressure level that can exceed 200 dB re 1µPa at distances around 200-300 m distance from the source (Paro et al., 2015).

10.10.54 Due to the high intensity of the noise, it is possible that marine receptors in the immediate vicinity (i.e., metres) of the impact would experience physiological trauma and therefore experience a mortality effect. At increased distances, the severity of the response will decrease.

10.10.55 As explosive noise is broadband, with peak content in the low frequency band, it falls within the hearing range of many marine ecological receptor groups. All fish species have a hearing range that overlaps this low frequency band, including hearing specialists (such as Atlantic herring) and hearing generalists (such as basking sharks). All marine mammal hearing groups, including low-, mid- and high- frequency cetaceans, and pinnipeds in water, would be able to detect the noise produced as it falls within the lower end of their hearing range (NOAA, 2018). Zooplankton have been shown to be sensitive to low frequency underwater noise from seismic sources which produce sound in a similar frequency range to explosions (McCauley et al., 2017).

10.10.56 The potential impact ranges for the different receptors are as follows. The assessment of impact ranges has been based on an environmental assessment of drilling and blasting by National Grid (2018). In this assessment, the maximum injury ranges were as follows: 104 m for low-frequency cetaceans; 43 m for mid-frequency cetaceans; 171 m for high-frequency cetaceans; 65 m for phocid pinnipeds; and 14 m for fish. The maximum disturbance ranges were: 139 m for low-frequency cetaceans; 57 m for mid-frequency cetaceans; 227 m for high-frequency cetaceans; and 87 m for phocid pinnipeds (fish were not assessed for disturbance). With regards to zooplankton, McCauley et al. (2017) reported that, for seismic airguns, impacts were reported out to the maximum 1.2 km sampled.

10.10.57 For the purposes of this AEE an operational period of 30 years has been assumed, with an initial plan of 10 launches per year increasing to a maximum of 30 launches per year. Although the operational phase of the Proposed Project is considered to have high longevity, the frequency of the impact is low. The returning LV will create an impact zone with a radius of tens of metres for seabirds, 14 m for fish, 277 m for marine mammals, 1.2 km for plankton. The spatial extent of these impact zones is low when compared to the total available habitat within Study Area A for these marine ecological receptors.

10.10.58 A low frequency and spatial extent, combined with a high longevity, result in a moderate exposure of ecological receptors to direct strike from the returning payload.

10.10.59 The likelihood of a severe disturbance impact occurring is considered to be very low. Should it occur, it is expected that only a low proportion of the population would be affected (in the region of <0.01%). The proportion of the population that could experience a minor disturbance effect could be an order of magnitude greater, as the impact zones for such effects are typically larger, but this would still be a small proportion in the context of the population. As such, it is considered that the impact of disturbance from the LV stage returning would not affect the baseline nor be detectable above the natural variability. Therefore, the magnitude of effect is negligible.

10.10.60 A high sensitivity, combined with moderate exposure, and negligible magnitude, mean that the risk to ecological receptors (plankton, fish, marine megafauna, seabirds) in Study Area A from disturbance by the returning LV is negligible. **No likely significant effect.**

Thermal Effects of Jettisoned Objects

10.10.61 While it is likely that the LV stage will have associated thermal energy, any heating of the marine environment will be highly localised. Tidal and wind driven currents will allow for heated water to dissipate into the surrounding waters rapidly. It is highly unlikely that any marine receptors will be impacted as a result of these temporary heating events. Due to heating being highly localised and temporary, thermal effects are likely to have a footprint similar to those determined for Direct Strike effects. Thermal effects are therefore considered negligible. **No likely significant effect.**

Visual Disturbance

10.10.62 Once the LV stage has impacted the surface of the marine environment, it will likely remain at the water surface for some time before sinking through the water column. Whilst it is at the surface or in the water column there is the potential for visual disturbance to marine ecological receptors. The LV stage will be stationary once in the water, moved only by the ocean movements. In essence, it is anticipated to behave like a large item of marine litter. The size of the LV stage will be a maximum of 20 m × 2 m.

10.10.63 In general, fish species are not considered sensitive to visual disturbance (Natural England, 2017). Though basking shark has been observed to show visual disturbance from moving craft, they are unlikely to show a response to a stationary object (Natural England, 2017). Fish are therefore not considered sensitive to potential visual disturbance from the LV stage in the water. Marine mammals have been observed showing behavioural response to non-motorised craft, which is almost certainly due to visual disturbance as opposed to noise disturbance (Natural England, 2017). However, the likelihood of a behavioural response occurring is variable. To illustrate, only half of common bottlenose dolphin encounters with kayaks in Cardigan Bay resulted in the dolphins moving away (Natural England, 2017). It is considered highly unlikely that the stationary presence of an LV stage would cause any impacts, therefore marine mammals are also not considered further for visual disturbance.

10.10.64 Seabirds have been reported as showing visual disturbance to vessels whilst in air and also on water (Natural England, 2017). Similarly, certain species of seabird have been reported to avoid large anthropogenic structures in the marine environment such as wind farms, though these cover a much larger extent than the proposed LV stages. The distance at which birds typically initiate a flight response and flush from an area as a result of visual disturbance is typically <40 m (Natural England, 2017). This disturbance distance is applicable to the scenario of the LV stage floating towards seabirds loafing on the sea surface. The most sensitive seabirds have been assumed to show a visual disturbance effect up to 4 km from large marine infrastructure such as windfarms. As windfarms are several orders of magnitude larger than the size of an LV stage, with an associated high degree of visibility/sightlines above relative sea level, it is anticipated that the disturbance zone for the LV stage would be several orders of magnitude smaller than this i.e., in the tens of metres.

10.10.65 The marine ecological receptor groups that have the potential to are either commercially, environmentally and/or culturally important and therefore for the purpose of this assessment have been ascribed a high value.

10.10.66 Given the predicted noise produced by the LV hitting the sea surface, there is the potential for injury to occur in individuals in the immediate vicinity (up to 227 m for the most sensitive marine mammal hearing group). At greater distances from the impact source, the effect experienced by marine mammals and fish will comprise disturbance. Zooplankton may be lethally impacted up to 1.2 km from the source. Individual marine ecological receptors are not tolerant, adaptable, or able to recover from mortality events. Seabirds are predicted to experience a disturbance effect only within 10s of metres from the source, with no associated mortality. To this they are adaptable.

10.10.67 A high ecological and cultural value, combined with no tolerance, adaptability, and recoverability, results in the aforementioned ecological receptors having a high sensitivity to disturbance effects from returning LVs within Study Area A.

10.10.68 For the purposes of this AEE an operational period of 30 years has been assumed, with an initial plan of 10 launches per year increasing to a maximum of 30 launches per year. Although the operational phase of the Proposed Project is considered to have high longevity, the frequency of the impact is moderate. The returning LV will create an impact zone with a radius of tens of metres for seabirds, 14 m for fish, 277 m for marine mammals, 1.2 km for plankton. The spatial extent of these impact zones is low when compared to the total available habitat within Study Area A for these marine ecological receptors.

10.10.69 A low frequency and spatial extent, combined with a high longevity, result in a moderate exposure of ecological receptors to direct strike from the returning payload.

10.10.70 The likelihood of a severe disturbance impact occurring is considered to be very low. Should it occur, it is expected that only a low proportion of the population would be affected (in the region of <0.01%). The proportion of the population that could experience a minor disturbance effect could be an order of magnitude greater, as the impact zones for such effects are typically larger, but this would still be a small proportion in the context of the population. As such, it is considered that the impact of disturbance from the LV stage returning would not affect the baseline nor be detectable above the natural variability. Therefore, the magnitude of effect is negligible.

10.10.71 A high sensitivity, combined with moderate exposure, and negligible magnitude, mean that the risk to ecological receptors (plankton, fish, marine megafauna, seabirds) in Study Area A from disturbance by the returning LV is negligible. **No likely significant effect.**

Displacement of Fish

10.10.72 The commercial fishing activity in Study Area A is described in Appendix 10.1. Study Area A comprises an important area for commercial fisheries from several different nations, with primarily benthopelagic and pelagic fish targeted. Figure A10.7 displays commercial fishing vessel activity, as recorded by AIS transmission, showing that most AIS datapoints are located in the southern portion of Study Area A, with decreasing effort with distance north. As the fisheries industry in Study Area A is valuable and culturally important to several countries, the receptor is considered to have a high value.

10.10.73 The landing of the stages of the LVs on the sea surface may indirectly impact commercial fisheries. If the stage lands in a productive fishing ground, target fish species may be disturbed and displaced from the location, thus reducing the productivity of said fishing ground. Whilst displacement can be considered a negative impact, it is possible that this impact will act as mitigation against the displacement of fishing vessels. If the landing of the stage displaces target fish species from the impact zone, the abundance of fish in other fishing grounds may increase. As fish species are highly mobile, they have a high tolerance and adaptability to displacement.

10.10.74 Due to their mobility, and the short period of impact and low magnitude of disturbance, fish species will be able in return to the impact zone within a short timescale of the stage passing through. Therefore, the recoverability of fish stocks is high.

10.10.75 Despite the high value, a high tolerance, adaptability, and recoverability result in fish stocks having a low sensitivity to displacement caused by the stage entering the marine environment.

10.10.76 For the purposes of this AEE an operational period of 30 years has been assumed, with an initial plan of 10 launches per year increasing to a maximum of 30 launches per year. Although the operational phase of the Proposed Project is considered to have high longevity, the frequency of the impact is low. As such displacement to fishing stock is predicted to happen only on a short-term scale whilst the LV is present in that specific area. Therefore, the longevity of the impact has been reduced to low to reflect this short time period per impact.

10.10.77 As evidenced by the AIS data (displayed in Figure A10.7), fishing grounds in Study Area A are wide-spread and of high spatial extent. The impact zone around an LV is extremely small in comparison to the fishing grounds. Therefore, the spatial extent of the impact is low.

10.10.78 A low frequency, longevity, and spatial extent result in a low exposure of fish stocks to displacement caused by the returning LV.

10.10.79 Fish are highly mobile and often make use of a range of habitats and rarely remain in one specific location for extended periods. As the displacement caused by the returning LVs is of small spatial and temporal scale, the magnitude of impact in terms of baseline and natural variability is negligible.

10.10.80 Low sensitivity, combined with low exposure and negligible magnitude, mean that the risk to fish stocks from displacement caused by the returning LVs is negligible. **No likely significant effect.**

Damage to Human Infrastructure (Subsea Cables/Pipelines)

10.10.81 As described in Appendix 10.1 there are several subsea cables and pipelines in Study Area A, concentrated in the southern portion of the area. The subsea cables are operated by companies of several different nationalities and are of significant commercial and communications value to the countries where cable landfall is made. The oil and gas pipelines in Study Area A supply nearby countries with hydrocarbons, and so is also of significant value. Accordingly, subsea cables and pipelines in Study Area A as a whole has been ascribed a high value.

10.10.82 The landing of the stages of the LVs at the seabed may directly impact subsea cables and pipelines in Study Area A. If the stage lands on such infrastructure, there is a possibility that the integrity of the cable or pipeline would be compromised, and significant structural damage could occur. The likelihood of this is reduced where such infrastructure is buried, however for the purpose of this assessment it is assumed that they are not buried. If a subsea cable or pipeline was compromised it would not be possible to tolerate, adapt, or recover from the impact (without anthropogenic intervention).

10.10.83 Due to the high value, and lack of tolerance, adaptability, and recoverability from the worst-case scenario effects, subsea cables and pipelines are considered to have high sensitivity to direct impact via deposition of material on the seabed.

10.10.84 For the purposes of this AEE an operational period of 30 years has been assumed, with an initial plan of 10 launches per year increasing to a maximum of 30 launches per year. Although the operational phase of the Proposed Project is considered to have high longevity, with a high combined number of launches, the likelihood of the LV stage impacting the same subsea cable or pipeline is extremely low, considering the total extent over which the LV could enter the marine environment. Therefore, the frequency of the impact has been reduced to low to reflect this.

10.10.85 Subsea cables and pipelines are restricted in their distribution in Study Area A. It is anticipated that the maximum size of any single stage that comes to rest on the seabed will be a maximum 20 m × 2 m, to which the footprint of the impact will be limited. The receptor will therefore be impact over a low spatial scale.

10.10.86 An overall low longevity and spatial extent result in a low exposure of benthic habitats to direct loss caused by the returning LV.

10.10.87 There is no natural variation in subsea cables and pipelines as they are a constant presence on the seabed. Any potential impact to subsea cables or pipelines would cause a measurable change to the baseline, though this change would be temporary as it would require reparation. In addition, it is noted that, considering the small footprint of the impact, and the total area over which the LV may return, the likelihood of the impact occurring is negligible. Therefore, the magnitude of impact is low.

10.10.88 High sensitivity, combined with low exposure and low magnitude, mean that the risk to subsea cables and pipelines from direct impact of returning LVs is minor. **No likely significant effect.**

Interference with Military Exercise Areas

10.10.89 As described Appendix 10.1, Study Area A is utilised for military exercises by a variety of nations on an intermittent basis. Military activities are of significant financial and defence importance, and therefore have been assigned a high value.

10.10.90 Any military activity that occurs in Study Area A concurrently with the return of LV stages has the potential to be affected. It is anticipated that, to ensure navigational safety, an exclusion zone will be implemented around the predicted landing position of the returning LV stage. As the return to Earth of the LV stage is monitored, communication with vessels operating nearby will be maintained to provide updates on the location and predicted impact zone of the stage.

10.10.91 If the impact zone of an LV is within an operational military exercise area, any vessels in the location would be temporarily displaced/excluded. Displacement or exclusion of military vessels whilst on transit could result in increased expenditure on fuel and sundries, and increased time for vessels to reach their destination due to having to take alternative routes/detours. Displacement of military vessels whilst on exercise would perhaps cause them to relocate the exercise, but this is unlikely to cause significant issues as the exercises are not location-specific (at the fine-scale of several kilometres). Therefore, with standard safety and communications in place, military activities are considered to have a high tolerance and adaptability to displacement, as military vessels are mobile and can easily adjust their course and positioning as required.

10.10.92 Once the LV and associated exclusion zone has passed, military vessels would be able to return to the area immediately. Therefore, military vessels have a high recoverability to displacement effects.

10.10.93 A high value, and high tolerance, adaptability, and recoverability, mean the sensitivity of military exercises within Study Area A to displacement from returning LVs is low.

10.10.94 For the purposes of this AEE an operational period of 30 years has been assumed, with an initial plan of 10 launches per year increasing to a maximum of 30 launches per year. Although the operational phase of the Proposed Project is considered to have high longevity, the exclusion zones will only be in place for the duration of the return of the LV, and therefore the longevity of the impact has been reduced to low to reflect this short time period per launch. Furthermore, to our knowledge, military exercises are not regular and only occur on an intermittent basis in Study Area A and so the frequency of exposure is further reduced.

10.10.95 Representative impact points are displayed in Drawing 10.3. However, in order to be precautionary, it is assumed that LV stages could return anywhere within Study Area A. There is therefore the potential that the LVs could return in an area of military exercise. However, it is noted that such exercises are not spatially restricted in Study Area A, and indeed could occur over large areas. The small spatial extent of the exclusion zone, which will be limited to the immediate vicinity of the LV return, will therefore affect a small proportion of the total area that could be used by military activity. Therefore, the spatial extent of the impact is low.

10.10.96 A low frequency, high longevity, and low spatial extent result in a low exposure of military activity to displacement from returning LVs.

10.10.97 Vessels are mobile and are often required to relocate for a variety of reasons, including adverse weather and displacement from other vessels. As the displacement caused by returning LVs of small spatial and temporal scale, the magnitude of impact in terms of baseline and variability is negligible.

10.10.98 Low sensitivity, combined with low exposure and negligible magnitude, mean that the risk to military activities from interference arising from potential recovery of LVs is negligible. **No likely significant effect**..

Impacts to Vessel Navigation Including Floating Debris, Changes to Topography and Re-routing of Vessel Traffic

10.10.99 As described in Appendix 10.1, shipping and commercial fishing activity within Study Area A is relatively high. In particular the southern portion of Study Area A, which has considerable fishing effort (Drawing A10.7) and is a main area of vessel traffic (Figure A10.5) and shipping density (Figure A10.6). Due to this level of activity, it is possible for returning LVs and the associated exclusion zone to have an impact on shipping and commercial fishing vessels. The high level of activity indicates the financial importance of the area to the surrounding countries; therefore, the value of the receptor is high.

10.10.100 It is anticipated that, to ensure navigational safety, an exclusion zone will be implemented around the predicted landing position of the returning LV stage. At the time of writing, it is not expected that any LV stages will be recovered. As the return of the LV stage is monitored, communication with vessels operating nearby will be maintained to provide updates on the location and predicted impact zone of the stage.

10.10.101 If the impact zone of an LV is within fishing grounds or along vessel transit routes, any vessels in the location would be temporarily displaced. Displacement of vessels or interruptions to transit routes can result in increased expenditure on fuel and increased time for vessels to reach their destination due to having to take alternative routes/detours. Displacement of fishing vessels from fishing grounds can result in loss of income as catch per unit effort is likely to be reduced if alternative productive fishing grounds cannot be exploited whilst the temporary exclusion zone is in place. The majority of Study Area A is offshore therefore it is anticipated that most fishing vessels and shipping in the area will be large and so able to adapt their movements. Therefore, with standard safety and communications in place, shipping and commercial fishing activities have high tolerance and adaptability, as vessels are mobile and can easily react to adjust their course and positioning as required.

10.10.102 Once the LV has entered the marine environment, exclusion zones can be removed and therefore transiting vessels and active fishing vessels can return to normal operation immediately. The recoverability is therefore considered high.

10.10.103 A high value, and high tolerance, adaptability, and recoverability, mean the sensitivity of shipping and commercial fishing activities within Study Area A to displacement from returning LVs is low.

10.10.104 For the purposes of this AEE an operational period of 30 years has been assumed, with an initial plan of 10 launches per year increasing to a maximum of 30 launches per year. Although the operational phase of the Proposed Project is considered to have high longevity, the exclusion zones will only be in place for the duration of the return of the LV, and therefore the longevity of the impact has been reduced to moderate to reflect this short time period per launch.

10.10.105 Representative impact points are displayed in Drawing 10.3. However, in order to be precautionary, it is assumed that LV stages could return anywhere within Study Area A. There is therefore the potential that the LVs could return in an area of high shipping density such as near the coast of a landmass, or in a key fishing area. However, it is noted that such areas of high fishing and shipping activity are widespread in Study Area A. The small spatial extent of the exclusion zone, which will be limited to the immediate vicinity of the LV return, will therefore affect a small proportion of the total area used highly by shipping and fishing vessels. Therefore, the spatial extent of the impact is low.

10.10.106 A low frequency, moderate longevity, and low spatial extent result in a low exposure of shipping and commercial fishing activity to displacement from returning LVs.

10.10.107 Vessels are mobile and are often required to take alternative routes or use other fishing grounds for a variety of reasons, including adverse weather and displacement from other vessels. As the displacement caused by returning LVs of small spatial and temporal scale, the magnitude of impact in terms of baseline and variability is negligible.

10.10.108 Low sensitivity, combined with low exposure and negligible magnitude, mean that the risk to shipping and commercial fishing activities from interference arising from orbital launches and potential recovery operations is negligible. **No likely significant effect**.

Damage to Marine Archaeology/Shipwrecks

10.10.109 As described in Appendix 10.1, it has not been possible to determine the extent of the presence of marine archaeological features in most of Study Area A. For the purpose of this assessment, however, it is assumed that marine archaeological features are present and so have the potential to be impacted by the proposed operations.

10.10.110 The value of marine archaeological features can vary depending on the feature type and level of preservation. As a worst-case scenario, it is assumed that any given marine archaeological feature in Study Area A has a high value, due to its cultural and historical significance.

10.10.111 The landing of the stages of the LVs at the seabed may directly impact marine archaeological features in Study Area A. If the stage lands on such a feature, there is a possibility that the integrity would be compromised, and significant structural damage could occur. The likelihood of this is reduced where such infrastructure is buried, however for the purpose of this assessment it is assumed that they are not buried. If a marine archaeological feature were compromised it would not be possible to tolerant, adapt, or recover from the impact.

10.10.112 Due to the high value, and lack of tolerance, adaptability, and recoverability from the worst-case scenario effects, marine archaeological features are considered to have high sensitivity to direct impact via deposition of material on the seabed.

10.10.113 For the purposes of this AEE an operational period of 30 years has been assumed, with an initial plan of 10 launches per year increasing to a maximum of 30 launches per year. Although the operational phase of the Proposed Project is considered to have high longevity, the likelihood of the LV stage impacting the same marine archaeological features is negligible considering the total extent over which the LV could enter the marine environment. Therefore, the frequency of the impact has been reduced to low to reflect this.

10.10.114 It is anticipated that the maximum size of any single stage that comes to rest on the seabed will be a maximum 20 m × 2 m, to which the footprint of the impact will be limited. The LV stages is expected to sink through the water column and come to rest at a single place at the seabed, and not move once at the seabed, thereby only impacting the features directly within the LV footprint the receptor will therefore be impact over a low spatial scale.

10.10.115 An overall high longevity, low frequency and low spatial extent result in a low exposure of marine archaeological features to direct loss caused by the returning LV.

10.10.116 There is no natural variation in the presence of marine archaeological features although the amount of coverage by sediment may vary with time. Any potential impact to marine archaeological features would cause a measurable change to the baseline, though it is noted that there may not be a record of this change the eventual location of the LV stage will not be monitored. In addition, it is noted that, considering the small footprint of the impact, and the total area over which the LV may return, the likelihood of the impact occurring is extremely low. Therefore, the magnitude of impact is low.

10.10.117 High sensitivity, combined with low exposure and low magnitude, mean that the risk to marine archaeological features from direct impact of returning LVs is minor. **No likely significant effect**.

Study Area B – Sub-orbital launches

Direct Strike

10.10.118 For the purpose of this assessment, ecological receptors that may be sensitive to direct strike from the returning payload have been ascribed a high value as although not all, many are protected under various nature conservation legislation and constitute an essential part of the ecosystem.

10.10.119 The maximum mass of the stratospheric weather balloon will be 1.5 kg, and the maximum mass of the single-stage sounding rocket upon returning to sea level will be 115 kg, as all fuel will be burnt. In both cases, the payload will have an attached parachute to prevent damage, which will also lessen the impact upon landing in the sea; and as required payloads will be designed to float for easy retrieval by the recovery vessel.

10.10.120 The following assessment refers to the 115 kg single stage rocket payload to take a worst-case scenario into account; in the case of the weather balloon payload, the effects are expected to be far less significant in terms of damage caused in the event of a collision and are likely to impact only the most fragile receptors, e.g., seabirds.

10.10.121 Objects, such as these, weighing over 100 kg falling into the sea have potential to cause injury and/or death to marine ecological receptors. The payload may collide with species that spend time at, very near, or flying above the surface of the sea. Ecological receptors that may be sensitive to collision with the returning payload include:

- Foraging or migrating seabird species, which may be flying above the water;
- Foraging or loafing seabird species, which may be floating on the sea surface;
- Grey or harbour seal, which may be at or just below the sea surface;
- Cetacean species, which may be at or just below the sea surface;
- Basking shark and sunfish, which may be at or just below the water surface; and,
- MPAs with features of conservation interest that fall within the categories above.

10.10.122 If the payload were to collide with smaller receptors, such as seabirds, mortality is likely to occur. Larger species may survive the initial impact, however, are likely to suffer physiological damage, which may lead to mortality or result in long-term injury. Individual seabirds and marine mammals have a Low tolerance and adaptability to direct strike. Recoverability is also expected to be low as it is impossible for an individual to recover from mortality or permanent damage, and substantial injuries will have long recovery periods.

10.10.123 A high ecological and cultural value, combined with low tolerance, adaptability, and recoverability, results in the aforementioned ecological receptors having a high sensitivity to direct strike from return payloads within Study Area B.

10.10.124 For the purposes of this AEE an operational period of 30 years has been assumed, with an initial plan of 10 launches per year increasing to a maximum of 30 launches per year. Although the operational phase of the Proposed Project is considered to have high longevity, the frequency of the impact is low and this can be further reduced when it is considered that a single individual is only likely to exposed to this impact up to once in a lifetime.

10.10.125 A low frequency and spatial extent, combined with a high longevity, result in a low exposure of ecological receptors to direct strike from the returning payload.

10.10.126 As the likelihood of impact occurring is very low, only a limited number of individuals will be affected. Collisions between marine mammals or seabirds and man-made infrastructure or vehicles is not an uncommon occurrence, therefore the potential addition of a very small number of collisions with returning payloads will be negligible in terms of the baseline environment. Injury and death to seabirds and marine mammals also occurs naturally, and as with all species, the rates fluctuate monthly and annually. It is proposed that any additional mortalities or injuries resulting from collision with the returning payload will be negligible against the natural mortality rate of the aforementioned ecological receptors and especially at the population-level. Therefore, the magnitude of effect is negligible.

10.10.127 A high sensitivity, combined with a low exposure, and negligible magnitude, mean that the risk to populations of ecological receptors (seabirds, marine mammals, and MPAs) in Study Area B from direct strike with the returning payload is negligible. **No likely significant effect**.

Protected Areas

10.10.128 Single-stage sounding rocket launches are not predicted to impact any Marine Protected Areas (MPAs) in the region. For stratospheric weather balloons, standard mitigation measures will be in place (see Section 10.4.7) to avoid launches where atmospheric conditions would drive the weather balloon towards any of the coasts of the Shetland Islands south or west of Unst, including protected areas. Furthermore, as weather balloons will be required to be retrieved by the LSPs, their interaction with the marine environment is predicted to be limited to surface layers. There is one offshore MPA (Faroe-Shetland Sponge Belt) and one Special Area of Conservation (SAC) (Pobie Bank Reef; UK0030385) within the indicative impact zone for weather balloons in Study Area B. Due to the small size, low speed of impact, measures for mitigation, and the requirement for its retrieval, the impact of weather balloons on MPAs is considered negligible. No likely significant effect.

Acoustic Disturbance (Including Underwater Noise) from the Impact of the Jettisoned Objects Hitting the Sea Surface

10.10.129 Underwater noise can lead to varied direct effects on marine mammals and fish, including mortality, physiological injury, and auditory injury, the latter of which can be classified as permanent threshold shift (PTS) or temporary threshold shift (TTS) (Todd *et al.*, 2015). There is also potential for indirect effects, such as masking of communication signals (Todd *et al.*, 2015). Individuals that are being disturbed by underwater noise may also leave the area of disturbance, which can lead to displacement effects. The level of effect is related to the frequency, sound levels, and duration of the noise, as well as variation in the individual receptor.

10.10.130 Different fish species are known to have varying sensitivities to noise emissions (Popper and Fay, 1999; Popper *et al.*, 2003; Popper *et al.*, 2014). Previously, fish species have been categorised into and assessed based on two broad categories regarding their sensitivity to noise pressures: hearing generalists and hearing specialists (Popper and Fay, 1999; Popper *et al.*, 2003). Studies carried out by Popper and Fay (1999) and Popper *et al.* (2003) concluded that species able to hear sounds ranging 100-400 Hz, and that have a swim bladder uncoupled with the inner ear or entirely absent, are hearing generalists; whereas hearing specialists were determined to be able to hear sounds from 300-1,000 Hz and have a swim bladder connected to the inner ear (Popper *et al.*, 2003).

10.10.131 Recent research (Popper *et al.*, 2014) has resulted in more detailed categorisation of fish hearing sensitivities: fishes with no swim bladder or other gas chamber, which are less susceptible to the effects of noise and vibration; fishes with a swim bladder that is not connected to the ear, which are susceptible to the effects of noise and vibration; fishes that have the inner ear connected to the swim bladder, which are susceptible to the effects of noise and vibration; and, fish eggs and larvae.

10.10.132 As Study Area B does not constitute major spawning grounds for fish species, there is no pressure-receptor pathway for noise and vibration to impact fish eggs and larvae, therefore no further consideration is made in this assessment. Of the fish species detailed in Table A10.7, the species that are considered susceptible to the effects of noise and vibration are: Atlantic cod, Atlantic herring, saithe/pollock, and haddock. These species all have a swim bladder that is connected to the inner ear.

10.10.133 Fish species have been shown to display strong behavioural avoidance up to 4 m and mild behavioural avoidance up to 30 m from the source of vessel noise (EMU Ltd, 2012). Continuous exposure to vessel engine noise (up to 1,000 Hz) for 30 minutes has been shown to increase the level of cortisol in fish species, showing a stress response (Wysocki *et al.*, 2006). TTS has been associated with continuous exposure for periods greater than 2 hours (Scholik and Yan, 2001; Vasconcelos *et al.*, 2007). Vessel engine noise has been associated with avoidance behaviour by Atlantic herring, including diving and altering swim direction to avoid the vessel (Mitson and Knudsen, 2003). It is, however, unclear if the effects are entirely due to vessel noise, as research vessels designed to reduce noise emissions can cause greater disturbance than regular vessels (Ona *et al.*, 2007). Physiological effects or fish mortality have been linked to pile driving. However, no such effects have been associated with vessel engine noise emissions (BOEM, 2014).

10.10.134 A number of marine mammals are sensitive to underwater noise emissions, for example harbour seal has a hearing range of 0.5-40 kHz (Kastelein *et al.*, 2009), grey seal 0.1-30 kHz (Chen *et al.*, 2016), harbour porpoise 1-180 kHz (Southall *et al.*, 2007), and common bottlenose dolphin *Tursiops truncatus* 150 Hz-160 kHz (Southall *et al.*, 2007). As vessel noise is up to 1 kHz, the majority of marine mammals present in Study Area B are able to hear and therefore may be affected by noise emissions from the recovery vessel.

10.10.135 The noise produced by small vessel engines, such as those of the recovery vessel, are lower than the threshold required to cause physiological injury or mortality (Southall *et al.*, 2019) and therefore any the impacts will be limited to disturbance within close vicinity to the vessel. Todd *et al.* (2015) concluded that the level of vessel noise expected to be created by the recovery vessel caused no signs of disturbance or adverse reactions in pinniped species. Heinis *et al.* (2013) determined that for TTS to be exceeded, an individual seal would be required to remain within 90 m of the vessel for a 24-hour period, which far exceeds the time the vessel will be present for each launch (45 minutes). Similarly, for cetacean species, the TTS is not expected to be exceeded (Thomsen *et al.*, 2009), however disturbance and avoidance behaviour in the vicinity of the recovery vessel may be exhibited.

10.10.136 The low levels of noise associated with the recovery vessel is not expected to be of concern for seabird species.

10.10.137 A low frequency, longevity, and spatial extent result in a low exposure of marine ecological receptors to displacement and disturbance caused by the sub-orbital payload and recovery vessel.

10.10.138 Low sensitivity, exposure, and magnitude mean that the risk to ecological receptors (seabirds, fish, and marine mammals) from disturbance and displacement caused by the recovery of the payload is negligible. **No likely significant effect**.

Thermal Effects of Jettisoned Objects

10.10.139 While it is likely that the returning payload will have associated thermal energy, any heating of the marine environment will be highly localised. Further, it is likely that cooling will have occurred during the parachute-aided decent. Tidal and wind driven currents will allow for heated water to dissipate into the surrounding waters rapidly. It is highly unlikely that any marine receptors will be impacted as a result of these temporary heating events. Due to heating being highly localised and temporary, thermal effects are likely to have a footprint similar to those determined for Direct Strike effects. Thermal effects are therefore considered negligible. **No likely significant effect**.

Visual Disturbance

10.10.140 Recovery of the payload has potential to disturb a number of ecological receptors in two ways: the presence of the recovery vessel can cause visual and noise disturbance to seabirds, marine mammals, and fish species; and the presence of the payload and attached parachute falling to the sea can disturb seabird species. All three receptor groups are either commercially, ecologically and/or culturally important in the region and therefore, for the purpose of this assessment, have been ascribed a high value.

10.10.141 Different receptor groups are sensitive to disturbance in different manners. Fish and marine mammals will not be disturbed by the presence of the payload itself, however, are likely to be disturbed by the presence of the recovery vessel and/or the vessel engine noise. Seabird species are only likely to be disturbed by the visual presence of above-water objects, i.e. the payload and attached parachute, and the recovery vessel. Vessel noise is generally around 100-1,000 Hz, however high frequency (10-96 kHz) noise has been associated with commercial shipping vessels (Veirs *et al.*, 2016). As the recovery vessel will be relatively small, the noise emissions are expected to be at the lower end of the frequency range.

10.10.142 Disturbance to seabirds can occur through two pathways, the presence of the recovery vessel on the sea surface and the presence of the payload and attached parachute falling to sea level. The low levels of noise associated with the recovery vessel is not expected to be of concern for seabird species.

10.10.143 Seabirds species have differing sensitivities to vessels (Fliessbach *et al.*, 2019) and to anthropogenic objects in the air (Barr *et al.*, 2020; Brisson-Curadeau *et al.*, 2017). Seabirds are known to display a range of responses to sources of disturbance, such as escaping via changing flight direction or swimming if birds are loafing on the water surface (Fliessbach *et al.*, 2019), and mobbing objects in the sky (Albores-Barajas *et al.*, 2018). Displacement, interruption of flight paths, mobbing, and evasive action are all responses that are likely to result in increased energy expenditure (Weimerskirch *et al.*, 2002; Carey, 2009) and may result in decreased survival. If the payload is expected to land within a seabird foraging area, it is possible that individuals will be displaced. Displacement from a foraging area can result in reduced food intake, which may also impact on the survival rate of individuals.

10.10.144 Within Study Area B, there is a wide extent of habitat available for utilisation by fish, marine mammals, and seabirds, and therefore all three have high adaptability to the effects of noise and vibration and visual disturbance as they are able to temporarily relocate. Tolerance is considered moderate, as individuals will likely exhibit avoidance behaviours, however, will not suffer physiological damage. Recoverability is very high as fish and marine mammals will be able to return to the area immediately following retrieval of the payload and departure of the recovery vessel.

10.10.145 A high value and adaptability, moderate tolerance and very high recoverability mean the overall sensitivity of ecological receptors to disturbance and displacement caused by the recovery of the payload is low; especially at the population-level.

10.10.146 For the purposes of this AEE an operational period of 30 years has been assumed, with an initial plan of 10 launches per year increasing to a maximum of 30 launches per year. Although the operational phase of the Proposed Project is considered to have high longevity, the frequency of the impact is low. As it is anticipated that the payload will be retrieved almost immediately after landing, and the recovery vessel and payload will only be present for the duration of the launch (45 minutes, or up to a maximum of 11.25 days over the assumed 30-year operational term), the longevity of the impact has been reduced to **low** to reflect this short time period per launch.

10.10.147 Marine mammals, fish and bird species all have a wide spatial extent of habitat and foraging grounds available for use within Study Area B. The payload and recovery vessel have an extremely small footprint in comparison to this, and the sound emitted from the vessel is not expected to increase the footprint by a substantial margin. Therefore, the spatial extent of the impact is low.

10.10.148 A low frequency, longevity, and spatial extent result in a low exposure of marine ecological receptors to displacement and disturbance caused by the sub-orbital payload and recovery vessel.

10.10.149 The addition of one vessel for a 45-minute period a few times per month will not be noticeable above the background levels of vessel activity in Study Area B, therefore the magnitude of impact in terms of the baseline conditions is negligible. There is a variety of sources of noise in the marine environment, both natural and anthropogenic, and with the small spatial footprint of disturbance created by the recovery of the payload, the additional disturbance caused is likely to be negligible in terms of natural variation. Therefore, the magnitude of the impact is negligible.

10.10.150 Low sensitivity, exposure, and magnitude mean that the risk to ecological receptors (seabirds, fish, and marine mammals) from disturbance and displacement caused by the recovery of the payload is negligible. **No likely significant effect.**

Displacement of Fish

10.10.151 Appendix 10.1 describes the commercial fishing activity around the Shetland Islands and within Study Area B. As observed in Figure A10.18, the Shetland Islands and surround seas constitute a national hotspot for pelagic and demersal fish landings in the UK. Commercial fishing vessel activity, as recorded by AIS transmission, shows that most AIS datapoints are located to the east and southeast of Study Area B, although there are distinct transit tracks to the northwest, associated with the Faroe-Shetland Channel, and to the northeast. As the seafood industry provides a substantial £300 million per year to Shetland’s economy, the receptor is considered to have a high value.

10.10.152 The landing of the sub-orbital payload on the sea surface may indirectly impact commercial fisheries. If the payload lands in a productive fishing ground, target fish species may be disturbed and displaced from the location, thus reducing the productivity of said fishing ground. Whilst displacement can be considered a negative impact, it is possible that this impact will act as mitigation against the displacement of fishing vessels. If the presence of the recovery vessel or the landing of the payload displaces target fish species from the drop zone, the abundance of fish in other fishing grounds may increase. As fish species are highly mobile, they have a high tolerance and adaptability to displacement.

10.10.153 Due to their mobility, and the short period of impact and low magnitude of disturbance, fish species will be able in instantly return to the drop zone once the payload has landed, been collected, and the recovery vessel has vacated the area. Therefore, the recoverability of fish stocks is very high.

10.10.154 Despite the very high value, a high tolerance, adaptability, and recoverability result in fish stocks having a low sensitivity to displacement caused by the payload and recovery vessel.

10.10.155 For the purposes of this AEE an operational period of 30 years has been assumed, with an initial plan of 10 launches per year increasing to a maximum of 30 launches per year. Although the operational phase of the Proposed Project is considered to have high longevity, the frequency of the impact is low. As it is assumed that the payload will be retrieved almost immediately after landing, and the recovery vessel will only be present for the duration of the launch (45 minutes, or up to a maximum of 11.25 days over the assumed 30-year operational term), the longevity of the impact has been reduced to low to reflect this short time period per launch.

10.10.156 As evidenced by the AIS data fishing grounds around the Shetland Islands are wide-spread and of high spatial extent. The payload and recovery vessel have an extremely small footprint in comparison to the fishing grounds. Therefore, the spatial extent of the impact is low.

10.10.157 A low frequency, longevity, and spatial extent result in a low exposure of fish stocks to displacement caused by the sub-orbital payload and recovery vessel.

10.10.158 Fish are highly mobile and often make use of a range of habitats and rarely remain in one specific location for extended periods. As the displacement caused by the payload and recovery vessel are of small spatial and temporal scale, the magnitude of impact in terms of baseline and natural variability is negligible.

Low sensitivity, combined with Low exposure and negligible magnitude, mean that the risk to fish stocks from displacement caused by the payload and recovery vessel is negligible. **No likely significant effect.**

Impacts to Vessel Navigation Including Floating Debris, Changes to Topography and Re-routing of Vessel Traffic

10.10.159 As described in Appendix 10.1, within the indicative impact zone for sub-orbital launches (Study Area B), shipping and commercial fishing activity is relatively high, especially around the coasts and ports of the Shetland Islands. Due to this level of activity, it is possible for the operations during the flight and recovery of sub-orbital LVs to have an impact on shipping and commercial fishing vessels. Much of Shetland's economy is supported by the seafood industry (Shetland Islands Council, 2019b), and commercial shipping is of high national and international importance, therefore the value of the receptor is high.

10.10.160 Modelling and present weather conditions will be used to determine the flight path and expected landing position of the payload for each launch. To ensure navigational safety, an exclusion zone will be implemented around the launch site and the recovery/patrol vessel will be present in the drop zone for the duration of the launch. The recovery vessel will quickly intercept and retrieve the payload once it has reached sea level. If the flight path alters from that originally modelled, updates will be provided to the recovery vessel and may result in changing of the extent and/or location of the drop zone. Throughout the process, communication with vessels operating nearby will be maintained to provide updates on the location and predicted drop zone of the payload. Therefore, with standard safety and communications in place, shipping and navigation are considered to have high tolerance and adaptability to potential displacement, as vessels are mobile and can easily react to adjust their course and positioning as required.

10.10.161 If the expected or actual touchdown position of the payload is within fishing grounds or along vessel transit routes, any vessels in the location would be temporarily displaced. Displacement of vessels or interruptions to transit routes can result in increased expenditure on fuel and increased time for vessels to reach their destination due to having to take alternative routes/detours. Displacement of fishing vessels from fishing grounds can result in loss of income as catch per unit effort is likely to be reduced if alternative productive fishing grounds cannot be exploited whilst the temporary exclusion zone is in place.

10.10.162 Once the payload has landed and been recovered, exclusion zones can be removed and therefore transiting and active fishing vessels can return to normal operation immediately. The recoverability is therefore considered extremely high.

10.10.163 A high value, and high tolerance, adaptability, and recoverability, mean the sensitivity of shipping and commercial fishing activities within Study Area B to interference caused by sub-orbital launches and payload recovery is low.

10.10.164 For the purposes of this AEE an operational period of 30 years has been assumed, with an initial plan of 10 launches per year increasing to a maximum of 30 launches per year. Although the operational phase of the Proposed Project is considered to have high longevity, the frequency of the impact is low. As the exclusion zones will only be in place for the duration of each launch (approximately 45 minutes, or up to a maximum of 11.25 days over the 30-year operational term the longevity of the impact has been reduced to low to reflect this short time period per launch.

10.10.165 As presented in Figure 10.2 and Figure 10.3 above, the indicative impact zone for sub-orbital LVs does not cover any of the coasts of the Shetland Islands south or west of Unst, and therefore does not overlap with the areas of highest vessel density and transit routes. It should be noted that the exclusion zone will be of small spatial extent (limited to the immediate vicinity of the touchdown location and the Launch Site). Therefore, the spatial extent of the impact is low.

10.10.166 A low frequency, longevity, and spatial extent result in a low exposure of shipping and commercial fishing activity to interference from sub-orbital launches and payload recovery.

10.10.167 Vessels are mobile and are often required to take alternative routes or use other fishing grounds for a variety of reasons, including adverse weather and displacement from other vessels. As the displacement caused by sub-orbital launches and payload recovery are of small spatial and temporal scale, the magnitude of impact in terms of baseline variability is negligible.

10.10.168 Low sensitivity, combined with low exposure and negligible magnitude, mean that the risk to shipping and commercial fishing activities from interference arising from sub-orbital launches and payload recovery is negligible. **No likely significant effect.**

Interference with Marine and Coastal Tourism Activities/Industry

10.10.169 The tourist industry of the Shetland Islands is substantial, with visitors arriving in the islands year-round, peaking in the summer months. As the tourist industry provides essential income to the Shetland Islands and is socially important, it has a high value in terms of this assessment.

10.10.170 The tourist industry may be affected by the sub-orbital launch operations at the Proposed Project, mainly via displacement of coastal activities around the launch site and displacement of recreational vessels in the payload drop zone due to the implementation of temporary exclusion zones. Tourism receptors include recreational diving, surfing, 'Keep Scotland Beautiful' beaches, marinas, and recreational boating activity. Although there are two dive sites relatively near to the Proposed Project site, these are outside the indicative impact zone presented in Figure 10.2 and Figure 10.3. However, recreational boating activity overlaps with the impact zone, to the south-south-west and the west. Recreational vessels have a high mobility and can relocate to different spots if required. Therefore, tourism is considered to have a high adaptability and tolerance to the effects of displacement.

10.10.171 As soon as the launch is completed and the payload recovered, exclusion zones will no longer apply, and therefore recreational vessels can immediately return to the area, resulting in a high recoverability.

10.10.172 A high value, combined with a high tolerance, adaptability, and recoverability mean that marine and coastal tourism has a low sensitivity to displacement and disturbance.

10.10.173 For the purposes of this AEE an operational period of 30 years has been assumed, with an initial plan of 10 launches per year increasing to a maximum of 30 launches per year. Although the operational phase of the Proposed Project is considered to have high longevity, the frequency of the impact is low. As the exclusion zones will only be in place for the duration of each launch (approximately 45 minutes, or up to a maximum of 11.25 days over the assumed 30-year operational term), the longevity of the impact has been reduced to low to reflect this short time period per launch.

10.10.174 As presented in Figure 10.2 and Figure 10.3 above, the indicative impact zone for sub-orbital LVs does not cover any of the coasts of the Shetland Islands south or west of Unst, and therefore does not overlap any coastal tourism activity. It should be noted that the exclusion zone will be of small spatial extent (limited to the immediate vicinity of the touchdown location and the launch site). It is also important to note that there is minimal overlap with areas of very low tourism activity and the indicative impact zone. Therefore, the spatial extent of the impact is extremely low.

10.10.175 A low frequency, longevity, and spatial extent result in a low exposure of marine and coastal tourism to displacement caused by the implementation of temporary exclusion zones.

10.10.176 The number of tourists and associated income fluctuates by month and by year. The impact upon tourism is not expected to result in a decrease that will be noticeable above these baseline fluctuations, and therefore the magnitude of impact is negligible.

10.10.177 Low sensitivity, combined with low exposure and negligible magnitude, mean that the risk to marine and coastal tourism from displacement due to the implementation of temporary exclusion zones is negligible. **No likely significant effect.**

Accidental Aeronautical Events - Failure During Flight

10.10.178 Chapter 16 Major Accidents and Disasters of this AEE considers major accidents that could occur during the project life cycle, in terms of those with serious effects on the environment. One type of accidental event would be the failure of the LV during flight. The predicted magnitude of effects of such an event are not considered 'major', therefore an assessment of the effects of failure during flight has been considered in this chapter, rather than Chapter 16.

10.10.179 There is the potential for failure of the LV during flight. The worst-case scenario would be the loss of the entire LV before any of the routine separation phases, as this would lead to the maximum quantity of LV material potentially entering the marine environment at a single location, i.e., impact zone.

10.10.180 It was predicted that the impact zones of standard orbital launches would occur at a minimum distance of 200 km from the launch site. However, in the case of failure during flight, there is potential for part or all of the LV to land within 200 km of the launch site, which would be within Scotland's EEZ. Due to northerly trajectory, LVs do not pass over land once they have left the Proposed Project, therefore it is assumed that any such failure would result in the LV entering the marine environment rather than coming down over land. The receiving marine environment of any flight failures (i.e., the marine environment within 200 km north of the launch site) is described in Appendix 10.1.

10.10.181 A summary of the approximate parameters associated with a representative and limiting-case LV is provided in Table 10.4. The worst-case scenario is to assume that the LV parts do not burn up, and instead enter the marine environment whole. This is similar to the worst-case scenario of a failure during flight, except that in a failure during flight the entire LV may enter the marine environment at a single impact zone, rather than several impact zones associated with the separate return of the stages and fairings. Nonetheless, the impact pathways that may arise can be considered as the sum of the impacts at the separate impact zones.

10.10.182 The assessment is based on the return of Stage 1 to the marine environment, as it comprises the largest single part of the LV infrastructure and is assumed to be intact upon entering the marine environment. The addition of the remainder of the LV infrastructure does not greatly add to the total infrastructure entering the marine environment. To illustrate, Stage 1 comprises over 50% of the total length and mass of a representative and limiting-case LV and contains all the indicative materials present in the LV. Therefore, it is considered that the results of the impact assessment undertaken for Stage 1 entering the marine environment is applicable to the event of the entire LV entering. The conclusion of negligible or minor risk of likely significant effect on the receptors is considered applicable. **No likely significant effect**.

10.10.183 There is one difference to the impact assessment of the full LV compared to Stage 1; consideration of propellant left upon re-entry. In the case of a failure during flight, it is possible that the vast majority of the propellant will be unused and therefore could enter the marine environment. This would be the worst-case scenario in terms of potential hydrocarbon pollution to the marine environment. Assuming that the amount of propellant at launch remains upon entry, there is the potential for a surface film of up to 4.5 square nautical miles or 15 km^2 to form in the marine environment. Though this area is larger than the area of surface film predicted for routine events, the duration of the film will remain low (a day or less). The environmental effects are still predicted to be low (as per the assessment of this pathway, underpinned by NOAA (2019)), therefore there is predicted to be minor risk to the environment as a result of fuel release due to LV flight failure.

10.11 Additional Mitigation

10.11.1 No additional mitigation has been proposed to mitigate the effects from the aforementioned pathways.

10.12 Residual Effects

Study Area A – Orbital launches

Effects on Water and Sediment Quality and, Ecological Receptors from Fuel Spillage

10.12.1 As stated above, no additional mitigation is required to mitigate this impact. The residual risk of the impact pathway is minor. **No likely significant effect**.

Effects on Water and Sediment Quality, and Ecological Receptors from Metal Corrosion and Toxic Contamination

10.12.2 As stated above, no additional mitigation is required to mitigate this impact. The residual risk of the impact pathway is minor. **No likely significant effect**.

Effects on Water and Sediment Quality, and Ecological Receptors from Debris and Microplastics (Including Ingestion)

10.12.3 As stated above, no additional mitigation is required to mitigate this impact. The residual risk of the impact pathway is minor. **No likely significant effect**.

Smothering of Marine Organisms, Habitat Alteration (Including Reef Effects) and Habitat Loss via Deposition of Material on the Seabed

10.12.4 As stated above, no additional mitigation is required to mitigate this impact. The residual risk of the impact pathway is minor. **No likely significant effect**.

Direct Strike

10.12.5 As stated above, no additional mitigation is required to mitigate this impact. The residual risk of the impact pathway is negligible. **No likely significant effect**.

Acoustic Disturbance (Including Underwater Noise) from the Impact of the Jettisoned Objects Hitting the Sea Surface

10.12.6 As stated above, no additional mitigation is required to mitigate this impact. The residual risk of the impact pathway is negligible. **No likely significant effect**.

Toxic Contaminants from Jettisoned Objects

10.12.7 As stated above, no additional mitigation is required to mitigate this impact. The residual risk of the impact pathway is negligible. **No likely significant effect**.

Thermal Effects from Jettisoned Objects

10.12.8 As stated above, no additional mitigation is required to mitigate this impact. The residual risk of the impact pathway is negligible. **No likely significant effect**.

Visual Disturbance

10.12.9 As stated above, no additional mitigation is required to mitigate this impact. The residual risk of the impact pathway is negligible. **No likely significant effect**.

Displacement of Fish

10.12.10 As stated above, no additional mitigation is required to mitigate this impact. The residual risk of the impact pathway is negligible. **No likely significant effect**.

Damage to Human Infrastructure (Subsea Cables/Pipelines)

10.12.11 As stated above, no additional mitigation is required to mitigate this impact. The residual risk of the impact pathway is minor. **No likely significant effect**.

Interference with Military Exercise Areas

10.12.12 As stated above, no additional mitigation is required to mitigate this impact. The residual risk of the impact pathway is negligible. **No likely significant effect**.

Impacts to Vessel Navigation Including Floating Debris, Changes to Topography and Re-routing of Vessel Traffic

10.12.13 As stated above, no additional mitigation is required to mitigate this impact. The residual risk of the impact pathway is negligible. **No likely significant effect**.

Damage to Marine Archaeology/Shipwrecks

10.12.14 As stated above, no additional mitigation is required to mitigate this impact. The residual risk of the impact pathway is minor. **No likely significant effect**.

Study Area B – Sub-orbital launches

Direct Strike

10.12.15 As stated above, no additional mitigation is required to mitigate this impact. The residual risk of the impact pathway is negligible. **No likely significant effect**.

Acoustic Disturbance (including Underwater Noise) from the Impact of the Jettisoned Objects Hitting the Sea Surface

10.12.16 As stated above, no additional mitigation is required to mitigate this impact. The residual risk of the impact pathway is negligible. **No likely significant effect**.

Toxic Contaminants from Jettisoned Objects

10.12.17 As stated above, no additional mitigation is required to mitigate this impact. The residual risk of the impact pathway is negligible. **No likely significant effect**.

Thermal Effects from Jettisoned Objects

10.12.18 As stated above, no additional mitigation is required to mitigate this impact. The residual risk of the impact pathway is negligible. **No likely significant effect**.

Visual Disturbance

10.12.19 As stated above, no additional mitigation is required to mitigate this impact. The residual risk of the impact pathway is negligible. **No likely significant effect**.

Displacement of Fish

10.12.20 As stated above, no additional mitigation is required to mitigate this impact. The residual risk of the impact pathway is negligible. **No likely significant effect**.

Impacts to Vessel Navigation Including Floating Debris, Changes to Topography and Re-routing of Vessel Traffic

10.12.21 As stated above, no additional mitigation is required to mitigate this impact. The residual risk of the impact pathway is negligible. **No likely significant effect**.

Interference with Marine and Coastal Tourism Activities/Industry

10.12.22 As stated above, no additional mitigation is required to mitigate this impact. The residual risk of the impact pathway is negligible. **No likely significant effect**.

Accidental Aeronautical Events - Failure during Flight

10.12.23 As stated above, no additional mitigation is required to mitigate this impact. The likelihood of an accidental aeronautical event is extremely low due to the embedded safety procedures, and any effects will also be mitigated through the standard mitigation (detailed in Section 10.9). The residual risk of the impact pathway is negligible. **No likely significant effect**.

10.13 Cumulative Assessment

10.13.1 Cumulative effects can be either inter-project or intra-project effects.

10.13.2 Inter-project cumulative effects are those where an environmental topic/receptor is affected by impacts from more than one project at the same time and the impacts act together. Reasonably foreseeable projects can comprise projects that are planned but not yet operational, be they under construction, or under approval for construction. Projects and plans that are fully implemented and in operation are not considered under the cumulative assessment as they will have been considered under the baseline environment.

10.13.3 Intra-project cumulative effects are those where an environmental topic/receptor is affected by more than one impact from the same Proposed Project and the impacts act together. Although there is no significant interaction between environmental disciplines that could generate intra-project effects in the marine and transboundary assessment, it is acknowledged that multiple launches through time may give rise to additive effects (e.g., multiple landings in the same location). The potential for such additive interactions has already been discussed in this chapter and as such is not repeated in this section.

Identification of Projects and Plans

10.13.4 The key sources utilised to provide a long list of reasonably foreseeable plans and projects are:

- 4C Offshore Global Offshore Wind Map;
- Scotwind Leasing Round;
- Submarine Cable Map;
- KIS-ORCA Offshore Renewables and Cables Awareness;
- Marine Scotland’s National Marine Plan interactive site;
- The Crown Estate Scotland maps;
- UK Oil and Gas Authority;
- Norwegian Petroleum Directorate;
- NATO exercises website (https://shape.nato.int/nato-exercises); and,
- Shetland Islands Draft Regional Marine Plan.

10.13.5 All reasonably foreseeable plans and projects that have the potential to act cumulatively with the marine effect pathways associated with the Proposed Project are presented in Table 10.12 below. Plans and projects have been identified for offshore wind, marine renewables, oil and gas, and subsea cables. With regard to the sectors of military, recreation and tourism, and disposal sites, no proposed plans or projects have been identified.

10.13.6 Shipping and navigation, commercial and recreational fishing, and tourism, have not been considered as future projects and plans for the purposes of this cumulative assessment. Although it is understood that these sectors may increase over time in the study areas, this is not as part of any specific plan or project. The potential impacts to these receptors as a result of cumulative effects has been considered.

10.13.7 Table 10.13 below details which of the effect pathways included in the assessment are applicable to each of the projects or plans. The pathways which have the potential to act cumulatively between the Proposed Project and the reasonably foreseeable projects and plans have been taken forward in the assessment.

Table 10.12 All reasonably foreseeable plans and projects in Study Areas A and B

Plan/Project	Description	Location	Stage	Source
Hywind Tampen Floating Offshore Wind Farm	The Hywind Tampen is being developed by Equinor ASA in Norwegian waters. The windfarm capacity is 88 MW and will comprise floating turbines.	Norway, adjacent to the south-east corner of Study Area A	Pre-construction	4COffshore (2020)
Celtic Norse Subsea Cable	The Celtic Norse cable will be ready for service in 2022. It connects Grindavik, Iceland, Killala, Ireland, Caithness, Scotland, and Øysanden, Norway. It is approximately 2,000 km in length and is owned by Eidsiva Energi, NTE, and TrønderEnergi.	Norway, Iceland, Scotland, crossing the southern part of Study Area A	Pre-construction	Submarine Cable Map (2020)
UK Offshore Licensing Round for Oil and Gas	There have been several UK Offshore Licensing rounds for Oil and Gas in recent years, most recently the 32nd Offshore Licensing Round in 2019. These licensing rounds have included blocks and part-blocks in Study Areas A and B. It is likely that a proportion of these recently licensed blocks will be developed, either by drilling exploration wells, undertaking seismic surveys, or field development planning.	West of Shetland, Faroe-Shetland Basin, East Shetland Platform	Exploration and Pre-development	Oil and Gas Authority (2020)
Norway Offshore Licensing Round for Oil and Gas	Similar to the UK, Norway also undertakes licensing for its offshore oil and gas blocks. The latest announcement of new blocks up for award in pre-defined areas was in June 2020. Blocks awarded in previous rounds may be developed in the future	Norwegian waters of Study Area A. Examples of overlapping blocks are Licence 933 and 993	Exploration and Pre-development	Offshore Mag (2020) Norwegian Petroleum Directorate (2020)
Faroese Licensing Round for Oil and Gas	Similar to the UK, the Faroe Islands also undertakes licensing rounds for its offshore oil and gas blocks. In 2019 the 5th Faroese Licensing Round occurred, in conjunction with the UK's 32nd Licensing Round. The blocks on offer were near to the boundary of the UKCS. There is therefore potential for future oil and gas exploration and production in these blocks.	Faroese waters of Study Area A, specifically in the south-west of Study Area A near the border with the UKCS	Exploration and Pre-development	Jardfeingi (2019)

Plan/Project	Description	Location	Stage	Source
Jan Mayen oil exploration	There has been interest in the potential oil and gas reserves of Jan Mayen. Although there have been no recent updates on progress (in the last five years), there is the potential that exploration and production activities could occur in the future.	Jan Mayen EEZ of Study Area A	Exploration and Pre-development	Reuters (2013)
Faroe Islands marine renewable energy	Minesto have signed an agreement to install two tidal kites in Faroese waters. Site development is in progress; installation of the first kite happened in Q2 2020, with the second unit also planned for 2020.	Faroese coastal waters, just outside Study Area A	Pre-construction	Minesto (2020)
ScotWind 2019 Leasing Site: NE1	A total of 16 potential leasing sites have been identified around the coasts of Scotland, including a 775.6 km^2 Draft Plan Option site located southeast of the Shetland Islands (NE1). The leasing round aims to increase Scotland's offshore wind capacity by 8-10 GW to 15-17 GB by 2030. Many of the sites are in water depths exceeding 60 m and therefore are likely to appeal to floating offshore wind projects. Any development within the NE1 site will be required to consider cumulative effects with the Shetland Space Centre project.	South-east of Study Area B	Pre-application	Marine Scotland (2020); Offshore Wind Scotland (2020)
Shetland Tidal Array extension	The Shetland Tidal Array, developed by Nova Innovation Ltd, was installed in March 2016-August 2017 was the first tidal array in Scotland. Nova Innovation Ltd aim to expand the current three turbine generators to six under the European Union's Enabling Future Arrays in Tidal project. The project is already in operation and has been considered in the baseline, however the expansion is currently pre-construction, having been approved by the European Commission and granted the lease by Crown Estate Scotland.	Bluemull Sound, south-west of the centre of Study Area B	Pre-construction	Nova Innovation Ltd (2018a-b; 2020)
Tidal and wave energy Development Plan Options 2013	In 2013, Draft Sectoral Marine Plans for offshore tidal and wave energy developments in Scotland were published. The plans identified potential future sites for commercial-scale developments, however, were never formally adopted by Scottish ministers. Regardless, the draft plans remain included in the National Marine Plan for Scotland, and therefore are considered here.	North and south Unst, in the centre of Study Area B; and south and south-west Shetland, in the south of Study Area B	Pre-application	Marine Scotland (2020)

Table 10.13 Screening exercise assessing which of the pressures relevant to the Proposed Project apply to other projects screened in for cumulative assessment

Key: ✓ = pressure applied to both projects; × = no exposure pathway for this pressure from the other project

Plan/Project	Fuel Spillage	Metal Corrosion	Microplastics	Disturbance/ Displacement/ Interference	Impact At Seabed	Direct Strike
Hywind Tampen Floating Offshore Wind Farm	×	✓	×	✓	✓	×
Celtic Norse Subsea Cable	×	×	✓	✓	✓	×
UK Offshore Licensing Round for Oil and Gas	✓	✓	✓	✓	✓	×
Norway Offshore Licensing Round for Oil and Gas	✓	✓	✓	✓	✓	×
Faroese Licensing Round for Oil and Gas	✓	✓	✓	✓	✓	×
Jan Mayen oil exploration	✓	✓	✓	✓	✓	×
Faroe Islands marine renewable energy	×	✓	×	✓	✓	×
ScotWind 2019 Leasing Site: NE1	×	✓	×	✓	✓	×
Shetland Tidal Array extension	×	✓	×	✓	✓	✓
Tidal and wave energy Development Plan Options 2013	×	✓	×	✓	✓	✓

Methodology

10.13.8 The potential cumulative effects of the plans and projects listed in Table 10.12 above are considered on individual receptors in the subsequent sections. It should be noted that there is limited information on the plans and projects that are less progressed, and therefore less certainty on the potential cumulative effects of the projects.

10.13.9 As part of the AEE Report, the effect upon a receptor may be concluded as negligible or minor risk. However, an effect that has negligible or minor risk from the project alone cannot be ruled out from the cumulative assessment as there is the potential for an increased risk as effects may accumulate with other plans or projects. Therefore, all effects for which there are pathways with the receptors have been considered.

10.13.10 The assessment of cumulative effects between the project and the associated study areas and other plans and projects takes into account the:

- Potential for project/plan effect envelopes to overlap temporally and spatially with a specific receptor;
- Magnitude of cumulative effect (where known or possible to deduce); and,
- Receptor-specific sensitivity (including their value), as determined as part of the AEE Report process.

Assessment

10.13.11 In recognition of the level of information availability regarding the projects screened into this assessment, a detailed matrix-based risk (impact) assessment (see methodology detailed in Section 10.4) is not feasible. Expert judgment is used to consider all information available and determine the potential for combination of effects to cause increased effects on regional fish and shellfish populations.

Water Quality

10.13.12 Sections 10.9.5,10.9.16 and 10.9.23 above provide a risk assessment of the potential impacts on the water quality environment from the Proposed Project. The potential effects on water quality are the increase in hydrocarbons from fuel spills, metal from corrosion, and microplastics.

10.13.13 The projects and plans detailed in Table 10.13 above all comprise construction in the marine environment. The primary material used for construction will be metals for most projects (such as oil and gas, offshore wind etc), with subsea cables comprising plastic (on the outer layer) and metal. All infrastructure placed in the marine environment as part of these projects will have been designed to have a long lifespan with minimal breakdown as this would impact infrastructure integrity. Therefore, the combined input of metals and microplastics as a result of project infrastructure in combination with the Proposed Project is negligible. **No likely significant effect**.

10.13.14 Microplastics may enter the marine environment from offshore platforms as part of the waste produced e.g., wastewater. However, this is controlled by international regulations and standard operating procedures to minimise the input (Press and Journal, 2018), therefore this input of microplastics alongside the Proposed Project is considered negligible. **No likely significant effect**.

10.13.15 Of the additional plans and projects, the input of hydrocarbons will likely only arise from oil and gas operations. Hydrocarbons can enter the marine environment through accidental events such as spills or intentional means such as through the deposition of drill cuttings at the seabed. The oil and gas sector is governed by international regulations on drill cuttings (OSPAR Decision 2000/3 and Recommendation 2006/5) and has standard operating procedures to reduce the likelihood and severity of oil spills, thereby minimising the potential for hydrocarbon input into the marine environment. Taking into account the low likelihood and severity of hydrocarbon input from oil and gas projects, as well as the proposed launches, the in-combination risk is considered negligible. **No likely significant effect**.

Biodiversity Receptors

10.13.16 The potential effects on biodiversity receptors are the increase in contaminants (hydrocarbons, metal, microplastic), direct strike from LV stage parts, disturbance and displacement from LV stage parts, payloads and vessels, and direct loss of seabed habitat.

10.13.17 The results of the assessment of cumulative effects on water quality as a result of contaminant pathways is directly applicable to the biodiversity receptors within the marine environment. Accordingly, there is negligible risk of cumulative effects on biodiversity receptors as a result of contaminants from the Proposed Project in-combination with other reasonably foreseeable plans and projects. **No likely significant effect**.

10.13.18 The other projects and plans that also have the potential to result in direct strike of marine ecological receptors are tidal arrays. Historically, the risk of collision from tidal array has been of concern during developments and has resulted in significant pre-construction modelling and post-construction monitoring. At present there is still poor understanding of the real-life level of collision risk for marine ecological receptors. It is noted that, with regards to marine mammals, there have been no reports of collisions as the animals have been shown to instead display an avoidance response (NERC, 2013). Even though there is limited information, it is likely that the number of individuals lost from a population as a result of tidal turbines is low. To illustrate, collision risk modelling for MeyGen, Pentland Firth, Scotland, concluded that up to 243 salmon would collide with an array of 200 turbines per year. The number of individuals from other receptor groups that may be affected is likely to be much smaller (it is high in fish due to shoaling behaviour). In addition, the number of individuals affected is further reduced as it is highly unlikely that any tidal arrays in the study areas would comprises such a large array of turbines. The subsequent low number of affected individuals is anticipated to comprise a negligible proportion of the marine ecological receptor populations in the study areas. Therefore, it is considered that the risk of mortality as a result of direct strike from the Proposed Project in combination with other projects is negligible. **No likely significant effect**.

10.13.19 The projects and plans detailed in Table 10.12 above have the potential to disturb marine ecological receptors through either visual pathways, i.e. physical presence of the infrastructure and associated vessel traffic, or acoustic pathways i.e. through underwater noise emitted. The area of displacement associated with these projects is anticipated to be similar in scale to the displacement for the proposed project i.e., no more than several kilometres around the disturbance source. Perhaps one type of activity which could lead to larger areas of disturbance is piling, which can be used for fixing infrastructure to the seabed such as offshore wind or tidal devices, however it is not known if piling will be used for the additional projects. It is considered highly unlikely that the area of disturbance around a project or plan will overlap with the area of disturbance around a returning LV or payload, due to the safety issue of being nearby a returning LV or payload. Therefore, the area of displacement is unlikely to increase due to two potential sources of effects within a single disturbance zone. There is the potential that the disturbance zones around projects in the study areas will be additive, increasing the total amount of area from which a marine ecological receptor is displaced. However, given the total habitat available to marine ecological receptors across the study areas, this is determined to have negligible risk at the population-level. **No likely significant effect**.

10.13.20 The benthic habitat in Study Area A comprises predominantly deep-sea habitats that are expected to be homogeneous. Also present in Study Area A are sensitive benthic habitats, VMEs and MPA features, however these are widespread and large in spatial extent, respectively. The majority of projects and plans detailed in Table 10.12 above will have a limited seabed footprint as they comprise single infrastructure or a series of single infrastructure. The exception is the Celtic Norse subsea cable, which will have a considerably larger seabed footprint. All these projects will be required to undertake an assessment of the seabed conditions prior to development, including an assessment of benthic habitats with focus on any protected species or habitats. Should protected habitats be discovered, it is anticipated that the project location will be amended to minimise effects, as per international regulations and best practice. Therefore, due to the minimised effect from the proposed projects and plans, in conjunction with the extremely low likelihood of effect from the Proposed Project, the cumulative risk is considered negligible. **No likely significant effect**.

Human and Human Activities

10.13.21 The potential effects on humans and human activities are direct impact from LV stage parts at the seabed and disturbance and displacement from LV stage parts, payloads and vessels.

10.13.22 The two human activities which may be affected by pathways at the seabed are subsea cables and pipelines and marine archaeology. All of the proposed projects and plans detailed in Table 10.12 above will result in some level of seabed disturbance due to emplacement of infrastructure. However, as the existing infrastructure at the seabed described in the baseline are already known, they will form part of the baseline assessment of future projects, prior to construction at the seabed. Therefore, avoidance of infrastructure should occur and negate the possibility that future projects and plans will affect pre-existing infrastructure at the seabed, such as subsea cables. Therefore, there is no pathway for these projects to act cumulatively with effects from launch operations as a result of Proposed Project. Similarly, future projects and plans will have to undertake an assessment of the presence of marine archaeological features in the project footprint and minimise effects to these features through amending the location. Therefore, the likelihood that the proposed plans and project detailed in Table 10.12 above will affect the marine archaeological features that have the potential to interact with the launch operations from the Proposed Project is mitigated through accepted best practice planning procedures and assessments.

10.13.23 The human and human activities in the study areas that utilise vessels have the potential to be affected via disturbance. Disturbance from the Proposed Project can arise during the return of orbital LV stages, and the return and retrieval of sub-orbital payloads as undertaken by a vessel. It is anticipated that an exclusion zone will be implemented around returning launch items, thereby excluding other human activities from the area on a temporary basis (the exact duration is not yet known). It is likely that future infrastructure projects (except subsea cables) will also implement an exclusion zone around the infrastructure, to ensure safety to navigation in their immediate vicinity (noting that subsea cable installation vessels also implement safety exclusion zones whilst installing the cables). In the case of oil and gas offshore platforms, such safety zones are typically 500 m (Step Change in Safety, 2017). The spatial extent of the area from which vessels are excluded will therefore be added to by each infrastructure project and associated exclusion zone. The cumulative area of exclusion is anticipated to be small in the context of the total area of navigation available to vessels. In the case of commercial fishing vessels, cumulative displacement from fishing grounds can result in loss of income as catch per unit effort is likely to be reduced. However, the exclusion zones around other future infrastructure will be permanent, as opposed to the temporary exclusion zone for the Proposed Project, therefore the fishers will have already modified their fishing areas to accommodate these zones. It is considered that the small size of the area of exclusion in the context of total area available to navigation, or the area available for fishing, will result in a negligible cumulative risk of the Proposed Project with other projects and plans. **No likely significant effect**.

Conclusion

10.13.24 Negligible risk has been determined for all receptors screened into this assessment for in combination effects from the Proposed Project with reasonably foreseeable plans and projects. **No likely significant effect**.

10.14 Summary

10.14.1 This chapter considers the marine and transboundary effects from the proposed operations at the Proposed Project, from both orbital and sub-orbital launches. Effects on the marine environment will arise from the return to earth of LVs, and their associated recovery (in the case of sub-orbital launches). Such marine effects may occur in Scottish waters or in the waters of other countries (i.e., transboundary effects), specifically Denmark (Faroe Islands, Greenland), Iceland, and Norway (including Jan Mayen).

10.14.2 Two study areas have been defined for the purpose of this chapter: the orbital study area (Study Area A), which encompasses an area between the Proposed Project and approximately 1,100 km north of the Proposed Project and, the sub-orbital study area (Study Area B), which encompasses a 90 km radius from the proposed Launch Site. The study areas encompass the expected impact zones for the return of orbital LVs and sub-orbital payloads.

10.14.3 Study Area A comprises mostly deep water with a small amount of continental shelf and many bathymetric features. Study Area B comprises the continental shelf waters around the Shetland Islands. The water quality of these study areas is high, in that they do not have significant local input of anthropogenic contaminants such as metals, microplastics, and hydrocarbons. The study areas support numerous marine biota such as plankton, benthic habitats, fish and shellfish, seabirds, and marine mammals. Study Area A has few marine protected areas (Drawing 10.4) whereas there are more in Study Area B (Drawing 10.5).

10.14.4 In Study Area A, human activities are concentrated in the southern portion (as far as the Faroe Islands to the north). This includes shipping and navigation, oil and gas cables and pipelines, and commercial fishing (Drawing 10.6). There is occasional use of the area for military activities. Marine archaeology is poorly known and so assumed to be present. In Study Area B, vessel density is mostly low with small areas of increased density. Active and transiting fishing vessels are widespread in Study Area B. There is presence of oil and gas infrastructure, subsea cables and pipelines, marine renewable energy, dredge disposal sites, tourism, and marine archaeological features as shown on Drawings 10.7 – 10.9.

10.14.5 Several standard operating procedures are included as part of the project design which reduce the risk to human receptors from the proposed operations. It is anticipated that an exclusion zone will be implemented around the precited returning LV impact zones (and the recovery vessel, in the case of sub-orbital launches). Communications to other maritime users of the location of LV impact zones will comprise Notice to Mariners, NAVTEX warnings and Sécurité messages.

10.14.6 For Study Area A, the orbital launches have the potential to affect the aforementioned water quality, biodiversity and human activities. The pathways of effect have been identified: impacts from the presence of the LV and associated materials, such as metals, microplastics, and hydrocarbons; impacts from direct strike; impacts from disturbance/displacement associated with presence of the LV/recovery vessels and associated exclusion zones; and impact at the seabed from when the LV comes to rest.

10.14.7 As sub-orbital LVs are expected to be recovered, the effect pathways associated with the input of contaminants from LVs, and the impacts at the seabed, have been scoped out for Study Area B. Impacts from disturbance/displacement and direct strike have been considered for Study Area B.

10.14.8 The potential impacts on water quality, biodiversity, and human activities in the study areas have been assessed. All pathways have a negligible or minor risk of a likely significant effect on the receptors. **No likely significant effect**.

10.14.9 Because the risk is negligible or minor there is no requirement to apply mitigation in order to reduce the risk further. Accordingly, the residual effects to the receptors is also negligible or minor. **No likely significant effect**.

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Chapter 11 Climate Change

11. Climate Change

11. Climate Change

11.1 Introduction

11.1.1 This chapter evaluates the potential impact on climate change of operating the Proposed Project due to its greenhouse gas emissions (GHG), as well as assessing the vulnerability of the Proposed Project to climate change and the need for adaptation measures.

11.1.2 The climate adaptation part of the chapter considers the impact of climatic variables such as wind speed, precipitation and temperature on the site, and considers significant climate change risks on the operation of the Proposed Project over its expected lifespan.

11.1.3 The Proposed Project will have an impact on climate change due to GHG emissions resulting from transportation, and electricity and fuel consumption. A reasonable worst-case scenario for carbon emissions associated with the Proposed Project has been quantified as part of a greenhouse gas (GHG) assessment.

11.1.4 Following the identification of potential effects, suitable mitigation measures have been proposed, and an assessment of residual effects on environmental receptors sensitive to climate change has been undertaken.

11.2 Legislation, Policy and Guidelines

Space Industry Act

11.2.1 The Space Industry Act (2018) regulates all spaceflight activities carried out in the United Kingdom, and associated activities. The Act requires any person or organisation to obtain the relevant licence to:

- launch a launch vehicle from the UK;
- return a launch vehicle launched elsewhere than the UK to the UK landmass or the UK's territorial waters;
- operate a satellite from the UK;
- conduct sub-orbital activities from the UK;
- operate a spaceport in the UK; or
- provide range control services from the UK.

11.2.2 As the Applicant wishes to operate a vertical spaceport (at the SaxaVord Spaceport) and provide range control services (at the Launch and Range Control Centre, LRCC) they are required to apply for a both a spaceport licence and a range control licence.

Space Industry Regulations 2021

11.2.3 The Space Industry Regulations 2021 (the Regulations) set out in more detail the requirements for each licence the Regulators Licensing rules, which specify what information the UK Civil Aviation Authority (CAA), the regulator, requires in support of an application.

Additional Legislation

11.2.4 Relevant legislation and guidance documents have been reviewed as part of this climate change assessment. Of particular relevance are:

- The Climate Change (Scotland) Act 2009 which required ministers to establish Scotland's programme for climate change adaptation (Scottish Government, 2009);

- The Paris Agreement 2015 which sets a target for net zero global carbon emissions in the second half of the 21st century to limit the global temperature increase to less than 2°C above pre-industrial levels. A key aim of this agreement is to strengthen national responses to combat climate change and adapt to its effects. The Paris Agreement was ratified by the UK in 2016 (UNFCCC, 2015);
- Climate Change (Emissions Reduction Targets) (Scotland) Act 2019 which sets Scottish targets for the reduction of GHG emissions to deliver on the Paris Agreement, and makes provision about advice, plans and reports in relation to those targets. The Act sets an interim 56% reduction target for 2020 and a Net Zero target for 2045 (Scottish Government, 2019); and,
- Scottish Government Climate Change Plan (CCP) (2018-2032) which is a roadmap for Scotland to transition to a low carbon economy. The plan sets out how Scotland will reduce emissions by 66% over the period to 2032 (Scottish Government, 2018).

Planning Policy

11.2.5 The following policies have been taken into consideration:

- Scottish Government Climate Change Plan (CCP) (2018-2032) sets out how Scotland will continue to improve resilience to climate change and reduce emissions over the period to 2032 (Scottish Government, 2018);
- Shetland Islands Council Carbon Management Plan 2015-2020 (still extant) outlines a five-year implementation plan for achieving its desired carbon emissions reduction target of 42% by 2020 (SIC, 2015); and,
- Shetland Islands Local Development Plan 2014 policies GP1 (Sustainable Development) and GP2 (General Requirements for All Development).

Guidance

11.2.6 Best practice guidance for assessing climate change effects in an AEE has been taken into account:

- Guidance for the Assessment of Environmental Effects (CAA, 2021)
- 2015 IEMA guidance on Climate Resilience and Adaptation in EIA (amended in 2020) provides a framework for the effective consideration of climate change resilience and adaptation through EIA procedures. It includes case studies of EIAs which have considered climate adaptation and resilience issues, reflecting legislative developments and evolving practice (IEMA, 2015).
- Guidance to the Regulator on Environmental Objectives relating to the exercise of its functions under the Space Industry Act 2018 (Department for Transport, 2021)

Considerations noted in the DfT guidance for the regulator

11.2.7 The DfT guidance notes several subject areas which are recommended for consideration by the regulator when assessing AEE reports. Discussions between SaxaVord and the CAA on the exact treatment of these areas are ongoing. For completeness, the provisional approaches summarised below.

Alternative fuels

11.2.8 Calculated emissions per launch in this AEE are indicative and assume that RP-1 is the fuel of choice in each case. Emissions per launch using other liquid or solid hydrocarbon fuels will be of a similar magnitude. As the site operator SaxaVord will have limited influence in stipulating the use of low or zero carbon fuels. SaxaVord has suggested to the CAA that the role of operator will be to calculate and collect GHG emissions data from the various operators and report these data in a consistent and regular way to the regulator.

Efficiency savings

11.2.9 Data from launch vehicle (LV) operators on proposed future mitigation of GHGs by fuel switching or increased fuel efficiency through design iterations are expected to be a matter for the LV operators and the relevant regulators; as with fuel selection, SaxaVord as a commercial site operator cannot set targets for customers.

Ozone depletion

11.2.10 Stratospheric ozone depletion by the reaction with RP-1 rocket fuel exhaust compounds is reported to be related to the action of black carbon caused by the incomplete combustion of hydrocarbons in the RP-1 blend. Black carbon increases radiative forcing in the stratosphere, which leads in turn to warming in that atmospheric layer and an increase in the rate of reactions which contribute to ozone depletion. The most effective mitigation against black carbon will be the sectoral transition to carbon-free fuels. Whilst it is possible that emissions from non-carbon fuels such as hydrogen and hydrazine will also lead to the formation of ozone-depleting chemical species, they are likely to be more reactive than black carbon and hence possess a shorter atmospheric residence time. The decarbonisation of the launch vehicle sector, which as discussed previously must have its own policy drivers rather than advocacy by SaxaVord, will be the most effective route to mitigating stratospheric ozone depletion. Most if not all rocket fuels will have at least a temporary and reversible effect on stratospheric ozone depletion from free radical formation.

Meteorology

11.2.11 Local meteorological conditions are not considered a relevant consideration in the context of the climate effects of this Project but are considered by the Air Quality assessment.

Offsetting

11.2.12 Offsetting is not currently under consideration as a mitigation strategy. The most impactful decreases in operational GHG emissions will be from the electrification of the on-site power supply and decarbonisation of logistics and transport contributions under emerging UK policies. The focus will remain on managing emissions within the direct influence of SaxaVord; offsetting may be considered in due course once the actual residual emissions directly attributable to the spaceport have been estimated and recorded over an appropriate timescale.

11.3 Consultation

11.3.1 Shetland Islands Council was approached to consult on the proposed scope and methodology for the Climate Change Environmental Impact Assessment. No formal response was given.

11.4 Assessment Methodology and Significance Criteria

11.4.1 The following assessments have been undertaken as part of this chapter:

- a GHG assessment to evaluate the potential effects of the Proposed Project on climate change;
- an assessment of potentially significant climate change variables on the Proposed Project; and,
- an assessment of the residual effects on environmental receptors sensitive to climate change.

Environmental Zone of Influence

11.4.2 The scope of the GHG assessment includes operational emissions of the Proposed Project includes emissions from on-site activities associated with office use, launch campaigns and on-site power generation, as well as relevant off-site transportation.

11.4.3 The Environmental Zone of Influence (EZI) for the assessment of the potential adverse climate change effects on the Proposed Project is restricted to the Proposed Project boundary and the transport network utilised for the transport of materials and personnel.

Desk Study

11.4.4 An assessment has been undertaken of current and future climate trends in the EZI, including mean air temperature, wind speed and precipitation rate. The following sources were used to characterise existing or future baseline conditions:

- Met Office UK Climate Averages (Met Office, 2020a);
- UKCP18 Climate Projections (Met Office, 2020b); and,
- UK local authority and regional carbon dioxide emissions national statistics (BEIS, 2019).

Assessment of Potential Effect Significance

11.4.5 For the purposes of this chapter, two assessments of potential effect significance have been carried out, a GHG assessment to evaluate the potential effects of the Proposed Project on climate change and an assessment of potentially significant climate change impacts on the Proposed Project.

11.4.6 The sensitivity of the receptor has been evaluated, along with the significance of effect and the magnitude of the impact, based on the subjective judgement of the assessor. The terminology used has been defined below.

Sensitivity

11.4.7 An evaluation of the sensitivity of the Proposed Project in terms of climate change and the sensitivity of the global atmospheric environment as the receiving body for GHG emissions, was undertaken using the following terminology:

- High Sensitivity - Absolutely reliant on specific climate/global atmospheric conditions prevailing.
- Medium Sensitivity - Affected by changes in climate/global atmospheric conditions but not dependent on specific conditions.
- Low Sensitivity - Hardly influenced by climate/global atmospheric conditions at all.

Magnitude of impact

11.4.8 The magnitude of the impacts on baseline conditions has been assessed, and the following terminology has been used to define magnitude:

- High - A fundamental change (positive or negative) to the baseline condition of the receptor, leading to total loss or major alteration of character. An impact on regional GHG emissions which causes a large net increase;
- Medium - A material change (positive or negative) leading to partial loss or alteration of character. An impact on regional GHG emissions which causes an appreciable net increase;
- Low - A slight, detectable, alteration of the baseline condition which may be positive or negative. An impact on regional GHG emissions which causes a measurable net increase;

- Negligible - A barely distinguishable change from baseline conditions. Changes in GHG emissions so low as to not be practically measurable.

Significance of effect

11.4.9 Based on the sensitivity of receptors and magnitude of impact, the significance of effect has been professionally evaluated. Under environmental impact assessment legislation, major and moderate impacts are to be considered as significant:

- Major - A significant effect that is likely to be a material consideration in its own right. GHG emissions which represent a major proportion of regional totals;
- Moderate - A significant effect that may be a material consideration in combination with other significant effects but is unlikely to be a material consideration in its own right. GHG emissions which represent a recognisable change in regional totals;
- Minor - An effect that is not significant but may be of local concern. GHG emissions which though measurable do not materially affect regional totals; and
- Negligible - An effect that would result in no change to the existing environment.

Requirements for Mitigation

11.4.10 Standard mitigation measures must be implemented to lessen the impact of potentially significant climate effects on the Proposed Project, these have been outlined in Section 15.7.

11.4.11 IEMA best practice guidance considers all GHG emissions to be significant due to their contribution towards climate change; however, to assign any GHG emissions which are additive to the prevailing baseline as being of major significance is to ignore local context, which is why the magnitude and significance descriptors above have been developed.

11.4.12 To mitigate against potential significant effects, a baseline carbon footprint is calculated and then used as a basis to reduce emissions.

Limitations to Assessment

11.4.13 The principal sources of uncertainty are:

- Natural climate variability resulting from natural external influences on climate or changes in the energy received from the sun;
- Climate models represent an incomplete understanding of Earth system processes; and,
- Uncertainty in future GHG emissions resulting from the Proposed Project.

11.5 Baseline Conditions

Current baseline – climatic conditions

11.5.1 A local climate baseline is provided by Met Office Historic Climate Data which presents a set of 30-year averages, covering the period 1981-2010 for a range of parameters. The nearest meteorological Met Office data station to the site is Baltasound No. 2, which is located approximately 8 km to the south-west (60.749, -0.854). The data available for the Baltasound No. 2 data station comprises a representative baseline for the Proposed Project due to its close proximity, comparable altitude of 15 m above mean sea level, and the similar maritime setting on the east coast of Unst, Northern Shetland. The data is presented in Table 11.1 and summarised below:

- The Baltasound No. 2 data station recorded an average annual maximum temperature of 10.2°C, 0.5°C lower than the average annual minimum temperature for Scotland.
- The average annual minimum temperature of 5.4°C was 1.2°C warmer than the average annual minimum temperature for Scotland (4.2°C).
- An annual average of 1,108.1 mm of rain was recorded by the Baltasound No. 2 data station. This is significantly less than the average annual rainfall for Scotland between 1981-2010 which stands at 1,570.9 mm.
- The monthly mean wind speed at 10m on Unst is 13.4 knots, with the highest average wind speed recorded in the month of January, an average of 16.7 knots.

Table 11.1 Climate averages 1981-2010 recorded by Baltasound No. 2 Station

Month	Maximum temperature (°C)	Minimum temperature (°C)	Days of air frost (days)	Rainfall (mm)	Days of rainfall ≥1 mm (days)	Monthly mean wind speed at 10 m (knots)
January	6.4	2	7.8	123	22	16.7
February	6	1.3	7.7	95.7	17.5	15.7
March	7.1	2.1	6.3	107.4	20.1	15.3
April	8.9	3.7	3.5	64.7	13.7	13.1
May	11	5.6	0.5	52.3	11.8	11.4
June	13.1	8	0	56.6	11	10.9
July	15	10.2	0	59.9	12	10.3
August	15.2	10.4	0	82.1	13.4	10.5
September	13.4	8.8	0.1	96	16.7	12.6
October	10.7	6.5	0.5	122.6	20.6	14.4
November	8.2	3.8	3.6	128	20.5	15
December	6.8	2.1	7.8	119.8	20.7	14.5
Annual	10.2	5.4	37.7	1108.1	200	13.4

Current baseline – GHG emissions

11.5.2 Local and regional CO_2 emissions data tables published by the UK Government contain historic emissions data for the period 2005 - 2019 for all UK local authorities and councils. The total emissions and emissions per capita in the Shetland Islands for the reported period are reproduced in Table 11.2 below and include all fossil fuel and land use / land use change factor (LULUCF) related GHG emissions. Between 2005 and 2019, CO_2 emissions per capita in the Shetland Islands have decreased consistently.

Table 11.2 Shetland Islands Local Authority CO2 emissions estimates 2005-2019 (kilotons CO2)

Year	Kilotons CO_2	Population ('000s)	Per Capita Emissions (tonnes)
2005	621.4	22.3	27.9
2006	618.4	22.2	27.8
2007	610.2	22.4	27.3
2008	594.3	22.5	26.4
2009	576.1	22.8	25.3
2010	581.2	23.1	25.2
2011	567.9	23.2	24.4
2012	564.0	23.2	24.3
2013	555.5	23.2	23.9
2014	545.8	23.2	23.5
2015	532.4	23.2	22.9
2016	516.0	23.2	22.2
2017	506.8	23.1	22.0
2018	502.2	23.0	21.8
2019	495.5	22.9	21.6

Future baseline

11.5.3 Climate projections for the periods 2020-2048 and 2050-2078 have been analysed to account for changing conditions over the proposed 50-year maximum design life of the built assets at the Proposed Project.

11.5.4 Representative Concentration Pathway 8.5 (RCP8.5) was utilised to capture the worst-case scenario future trends. RCP8.5 represents a pathway in which global population doubles to 12 billion, technology development and GDP growth is slow, and high fossil fuel consumption is sustained. This scenario assumes a culmination in radiative forcing levels of 8.5 W/m^2 by 2100.

11.5.5 The climate variables considered relevant to this assessment are mean air temperature, maximum air temperature, wind speed and precipitation.

11.5.6 The future baseline data is presented as a series of 12 thumbnail maps each representing a "member". Each member represents a plausible future climate scenario, with the ensemble members differing due to natural climate variability and uncertainty in global model physics. The 12 members therefore display the range of uncertainty in climate projections.

11.5.7 In general, the trends become more pronounced over time with more extreme trends arising by 2080.

Mean Air Temperature

11.5.8 Throughout the Proposed Project's design life, there is predicted to be an increase in mean air temperature in Unst. For the period 2020 - 48, the annual mean air temperature at Unst is projected to be 1°C -2°C higher than the 1981-2010 average. This rises to 2-3°C above baseline levels for the 2050 - 2078 timescale, according to 75% of member scenarios.

11.5.9 An identical trend is predicted for the maximum air temperature anomaly. However, there is greater uncertainty in predictions for the annual average minimum air temperature anomaly, this variable is projected to rise by between 1°C - 4°C above baseline levels under the RCP8.5 scenario.

11.5.10 The baseline maximum temperature recorded at Baltasound, Unst is 15.2°C for the month of August (see Table 11.1), and the highest temperature ever recorded by this weather station is 25°C in July 1958. The average maximum temperature in Unst over the baseline period is significantly lower than the UK average maximum temperature of 19.4°C for the month of July. As such, despite the projected warming, temperatures in Unst will remain comparatively low.

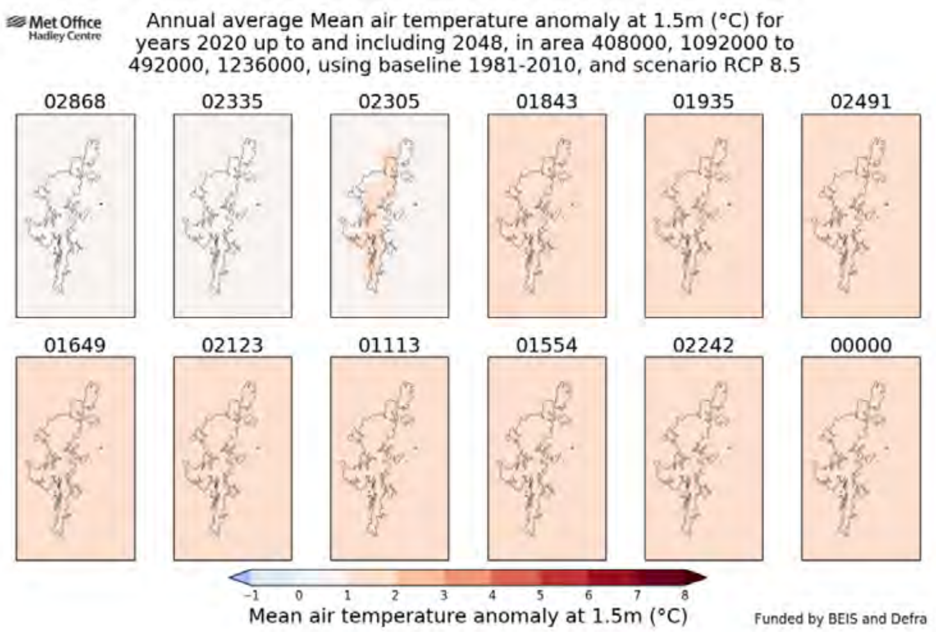

Figure 11.1 Annual Average Mean Air Temperature Variation 2020-2048

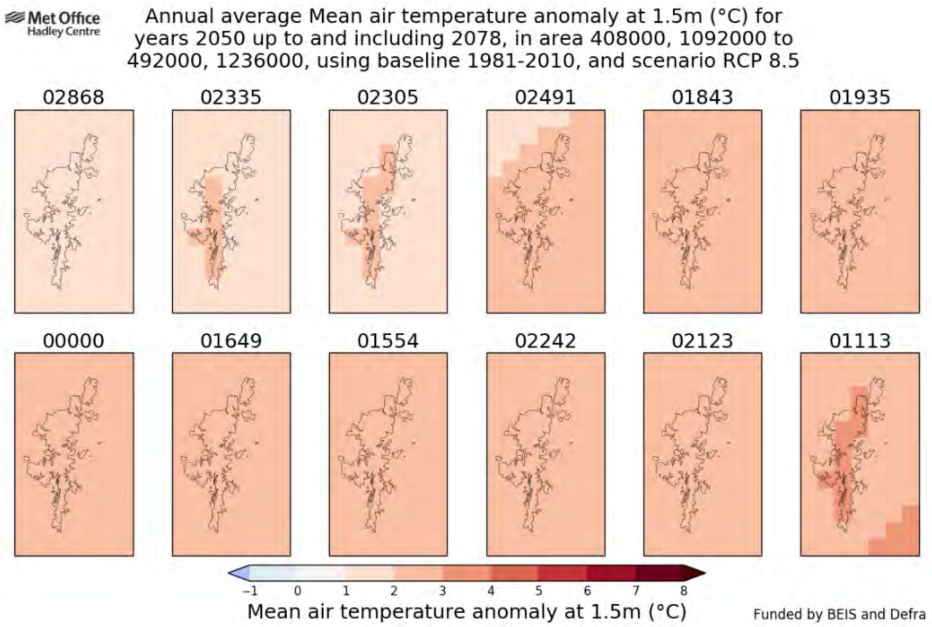

Figure 11.2 Annual Average Mean Air Temperature Variation 2050-2078

Wind Speed

11.5.11 In all member scenarios covering the 2020-2048 and 2050-78 periods, the annual average wind speed is predicted to be between 0-0.5 m/s lower than the 1981-2010 baseline levels. This minor decrease in wind speed applies to all seasons.

11.5.12 The baseline monthly mean wind speed at 10 m in Unst is 13.4 knots (6.89 m/s), which is higher than the UK average. Therefore, average wind speed in Unst will remain comparatively high, despite the projected reduction.

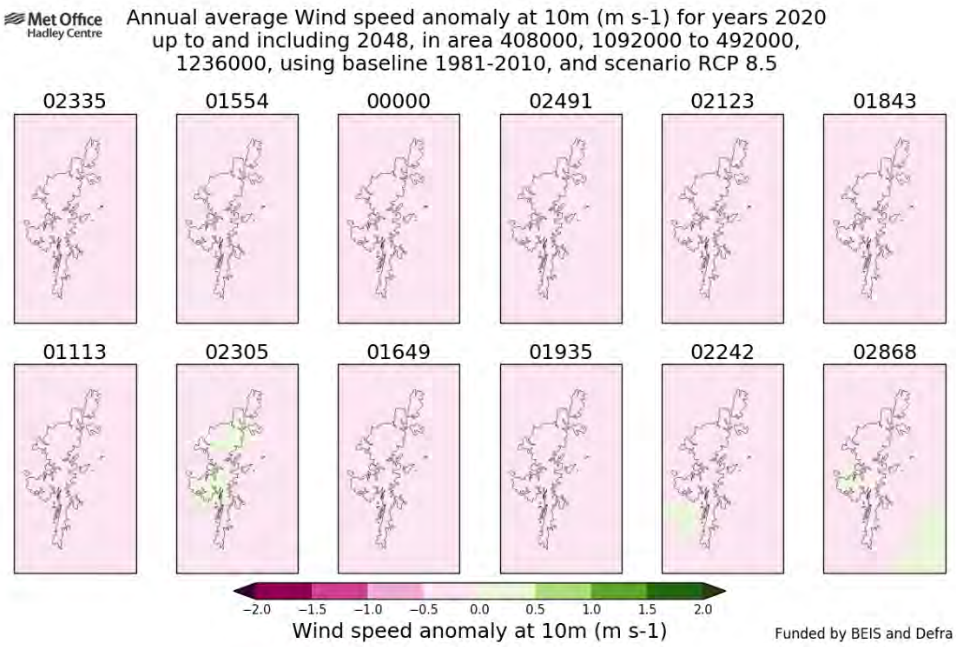

Figure 11.3 Annual Average Wind Speed Variation 2020-2048

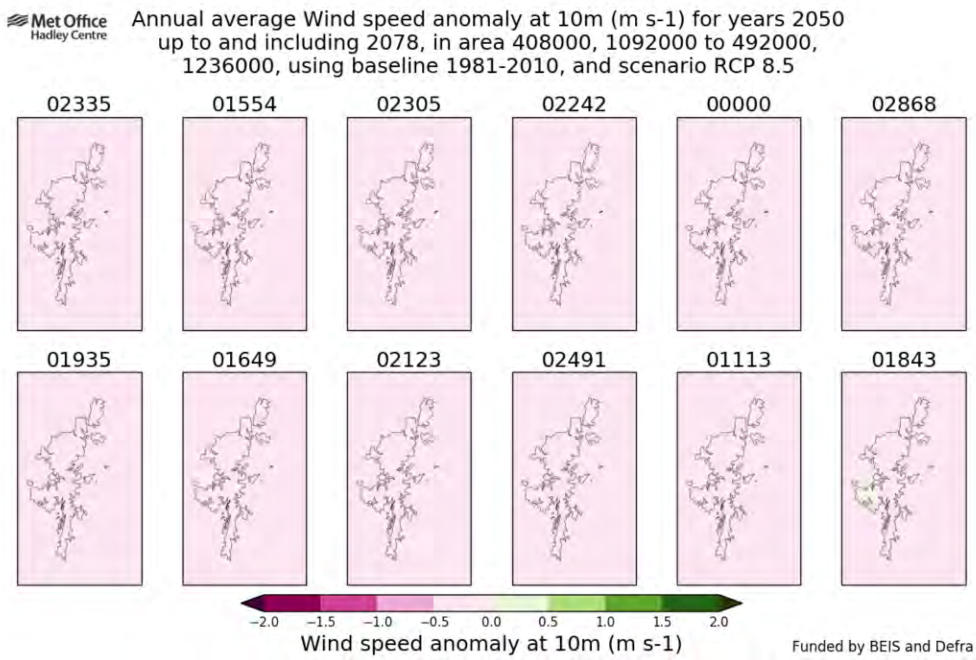

Figure 11.4 Annual Average Wind Speed Variation 2050-2078

Precipitation rate

11.5.13 A slight increase in the annual average precipitation rate is expected during the lifetime of the Proposed Project. Throughout both the 2020 - 2048 and 2050 - 2078 periods, 66.66% of member scenarios predict a 0-10% increase in the annual average precipitation rate in Unst compared to baseline levels.

11.5.14 Seasonal variation is predicted, with summer months expected to experience a slight decrease in the average precipitation rate, whilst winter months will see an increase.

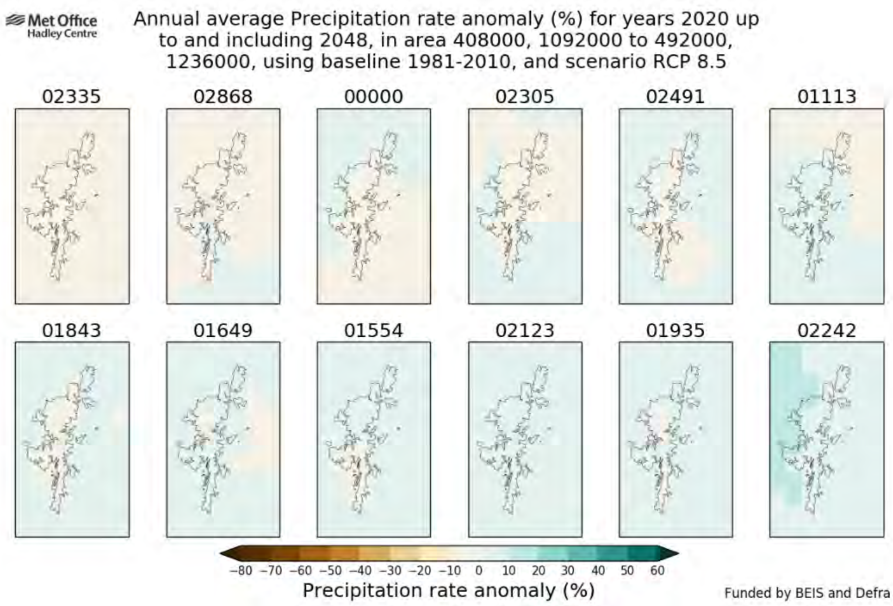

Figure 11.5 Annual Average Precipitation Rate Variation 2020-2048

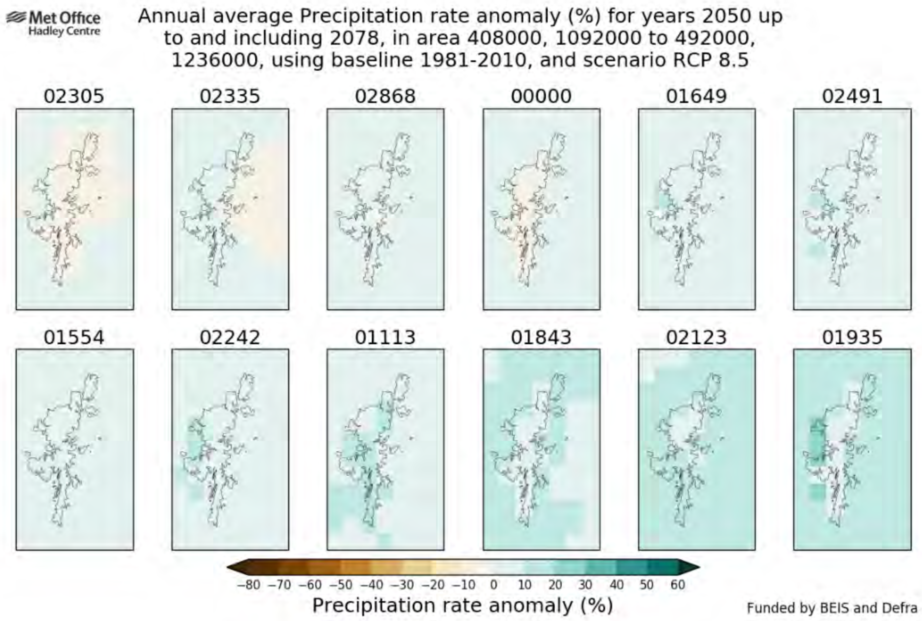

Figure 11.6 Annual Average Precipitation Rate Variation 2050-2078

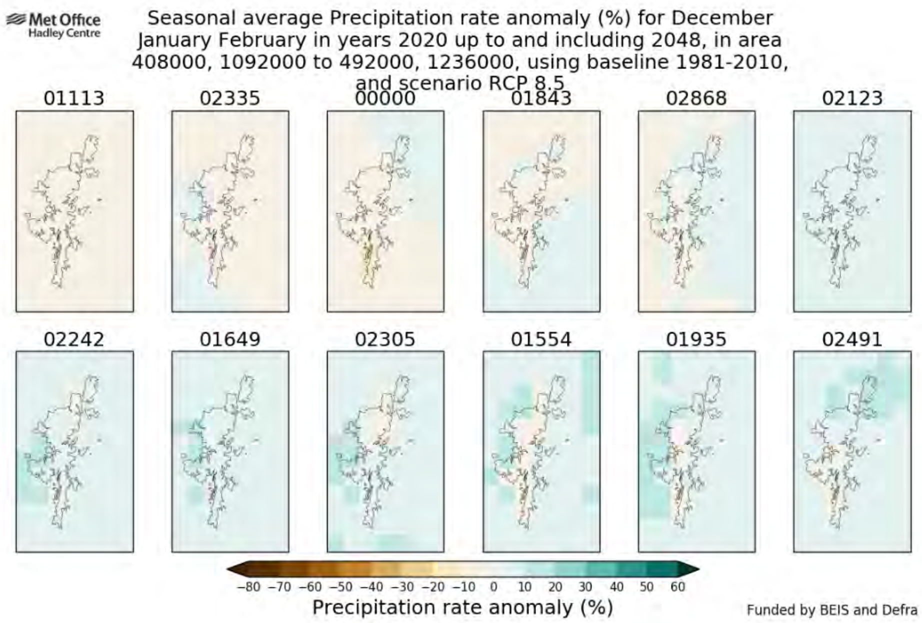

Figure 11.7 Winter Average Precipitation Rate Variation 2020-2048

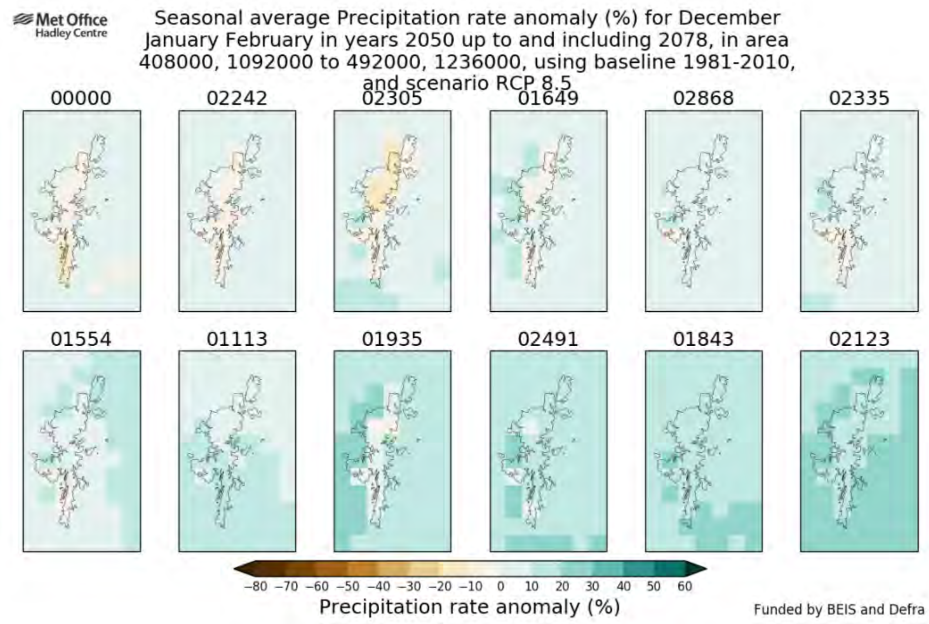

Figure 11.8 Winter Average Precipitation Rate Variation 2050-2078

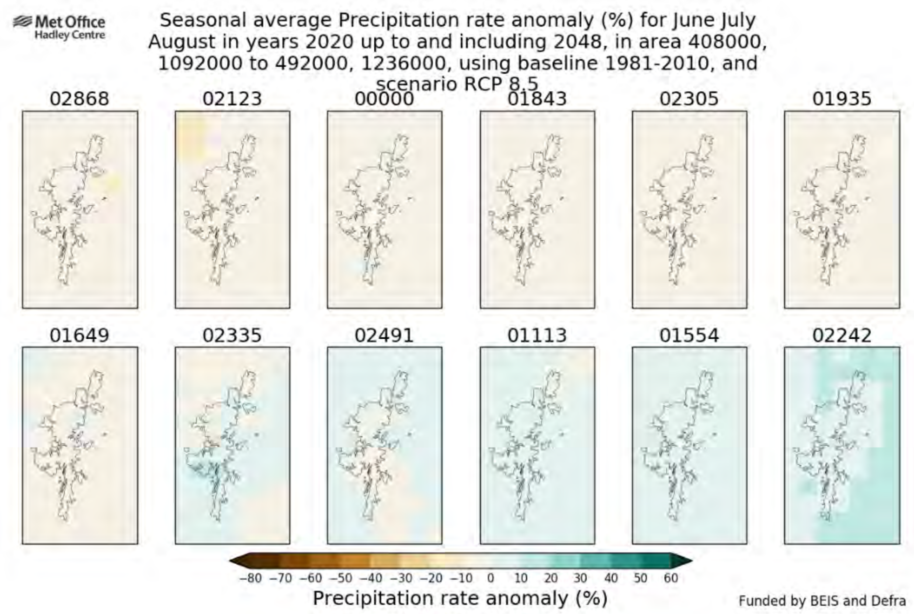

Figure 11.9 Summer Average Precipitation Rate Variation 2020-2048

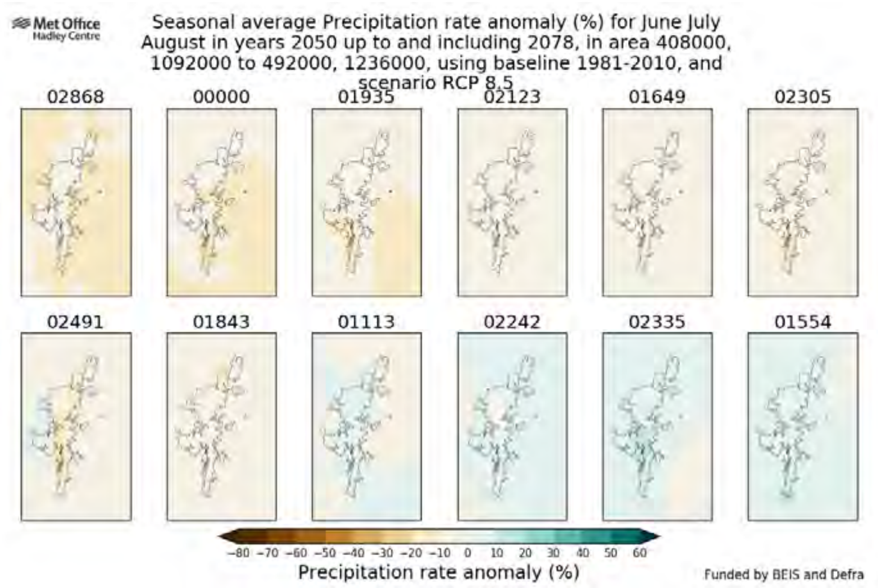

Figure 11.10 Summer Average Precipitation Rate Variation 2050-2078

11.6 Receptors Brought Forward for Assessment

11.6.1 The sensitive receptors in the instance of this climate change assessment are the built assets and associated infrastructure of the Proposed Project itself in terms of climate vulnerability and the global atmospheric environment as the receiving body for GHG emissions. No individual receptors have been selected for assessment.

11.7 Standard Mitigation

11.7.1 A range of standard mitigation measures will be implemented to lessen the impact of potentially significant climate effects on the Proposed Project:

- Lamba Ness has localised areas at risk from pluvial surface water flooding, meaning the site is vulnerable to heavy rainfall. Within the full development site there are small unnamed natural streams and watercourses, and drainage ditches have been cut in the flatter areas to aid drainage into these natural streams. A comprehensive drainage system will be implemented to mitigate flood risk during operation of the Proposed Project.
- Site activities will be suspended during extreme weather events to mitigate against health and safety risks for site personnel and potential damage to structures and equipment.
- Deluge pumps will be installed as a fire protection measure.

11.7.2 IEMA best practice guidance considers all GHG emissions to be significant due to their contribution towards climate change. Therefore, to mitigate against potential significant effects caused by the Proposed Project, the following measures will be applied to reduce resulting GHG emissions:

- The Proposed Project will switch from diesel generators to mains electricity supply as soon as is reasonably practicable, currently assumed to be around 2023/2024, will immediately lead to a reduction in routine operational GHG emissions. These GHG emissions will tend towards zero in the later 2020s and 2030s as the UK grid decarbonises – the decarbonisation of the Shetland grid will be markedly ahead of the rest of the UK given the concentration of high yield wind turbines on the islands.
- Surface and marine vehicle transport will similarly decarbonise over the later 2020s and 2030s reducing GHG emissions from these sources

11.8 Potential Effects

Influence of the development on climate change

11.8.1 An assessment of the likely GHG emissions resulting from the Proposed Project has been undertaken in accordance with the methodology specified in Section 11.4 above.

11.8.2 A number of input parameters were required in order to quantify the carbon footprint, these are specified in Table 11.3.

11.8.3 Emissions factors were obtained primarily from the UK Government GHG Conversion Factors for Company Reporting (BEIS, 2020). On-site electricity and fuel consumption figures were estimated from the CIBSE Energy Benchmarks 2008 (CIBSE, 2008). A full overview of the specific values and sources of emissions factors and benchmarks is provided in Appendix 11.1.

Table 11.3 GHG Assessment Boundaries

Source of GHG Emissions	Input Data	Emissions Factor Source	Description
On-site electricity and gas consumption	Square metre floor area	CIBSE Energy Benchmarks 2008	GHG emissions caused by electricity and gas consumption of buildings on site
Transport	Distance travelled by HGV and car	UK Government GHG Conversion Factors for Company Reporting	GHG emissions from vehicles transporting resources and personnel to and from the site.
Launch campaigns	Mass of fuel consumed	UK Government GHG Conversion Factors for Company Reporting	GHG emissions resulting from fuel consumption for rocket launches
On-site diesel consumption by generators	Mass of fuel consumed	UK Government GHG Conversion Factors for Company Reporting	GHG emissions resulting from diesel use of on-site generators

11.8.4 The transportation of payloads to site was excluded from the assessment due to high levels of uncertainty around their source destinations. It can be assumed that this contribution would be very small for domestically-produced payload items.

11.8.5 The emissions associated with a single year of operation of the Proposed Project have been calculated. Launch campaigns, transportation of materials and personnel, and on-site energy consumption were considered when calculating emissions for an average year of operation of the Proposed Project.

11.8.6 Two separate calculations of annual GHG emissions have been undertaken to account for the phased approach to securing the site's energy supply. It is anticipated that until a permanent 3-phase power supply is installed, the primary energy demands will require the use of diesel generators. After the installation of a permanent utility connection, launch water deluge pumps will still be supplied with power from the two 500 kVA mobile generators.

Table 11.4 GHG Assessment (before permanent utility connection)

Source of GHG Emissions	GHG Emissions (tCO_2e) from Operation
Launch campaigns	764
Transport	413
Transport of LVs	39
Diesel generators	1339
Total	**2555**

Table 11.5 GHG Assessment (after installation of a permanent utility connection)

Source of GHG Emissions	GHG Emissions (tCO_2e) from Operation
Launch campaigns	764
Gas and electricity consumption on-site	412
Transport	413
Transport of LVs	39
Diesel generators	13
Total	**1641**

11.8.7 The majority of emissions are expected to arise from the transportation of LVs to site. These are anticipated to be sourced from a range of international spacecraft manufacturers. Assumptions have been made regarding source locations, with LVs anticipated to be supplied from the US, continental Europe and the UK. As such, some emissions will arise from sea freight. Any GHG emissions resulting from the transportation of payloads to site have been excluded from scope due to significant uncertainties regarding where these will be sourced from.

11.8.8 Launch campaigns may produce up to 764 tCO_2e of emissions annually as the rocket engines consume RP-1 fuel which has a high carbon content. The site will have capacity to support 30 launches per year, each generating an average of 25.5 tCO_2e.

11.8.9 Prior to the implementation of a permanent utility connection, 6 diesel generators will meet the energy demands of the site (including 2 x FG Wilson P300-4, 2 x FG Wilson P400-3 and 2 x FG Wilson P500-3). This temporary solution will result in an anticipated 1339 tCO_2e of emissions annually.

11.8.10 GHG emissions arising from the site's power supply are expected to decrease once a permanent three phase electrical supply is secured. Diesel generators will continue to be used to meet the demands of launch water deluge pumps but will contribute a minor 13 tCO_2e annually. On-site electricity and gas consumption are anticipated to produce 412 tCO_2e annually. This figure is based on the CIBSE benchmarks which estimate emissions based on the proposed floor areas of buildings. The following structures were included within the assessment and were assigned to the CIBSE benchmarking categories outlined below:

- Launch Site Processing Facility building 1 (storage facility);
- Launch Site Processing Facility building 2 (storage facility);
- Hazardous materials store (storage facility);
- Administration building (general office);
- Gate House (storage facility);
- Pyrotechnic store (storage facility);
- 3 Control rooms at launch pads (EGSE and MGSE) (general office);
- Launch and Range Control Centre in former brewery building (general office); and,
- Integration Hangar (storage facility).

11.8.11 GHG emissions are assessed as a low impact of minor significance given that they are too large to be considered negligible but do not represent a significant proportion of regional emissions.

Vulnerability of the development to climate change

High wind speeds

11.8.12 Damage to buildings and equipment may occur as a result of high wind loading. Launch cycles may be delayed due to the suspension of ferry routes and flights. The Proposed Project is considered moderately sensitive to the effects of high wind speeds.

11.8.13 Met Office climate models anticipate that there will be a barely distinguishable change from baseline wind speed conditions between 2020 - 2078.

11.8.14 The annual average wind speed is predicted to be between 0-0.5 ms^{-1} lower than the 1981 - 2010 baseline levels. This minor decrease in wind speed can be considered a negligible impact of climate change. Although climate change is likely to result in a negligible decrease in wind speed for the northern Shetland Islands, extreme wind events will remain a risk to the Proposed Project site as the baseline annual mean wind speed for Unst is amongst the highest in the UK at 13.4 knots. Consequently, wind speed can be considered to pose a moderate adverse effect to the Proposed Project.

11.8.15 To mitigate against launch failure during extreme wind conditions, the weather needs to be closely monitored in the days preceding a launch and the launch event should be delayed if wind speeds are deemed high enough to potentially cause damage to the LV, payload or on-site structures. Furthermore, to minimise the effect that transport route suspensions may have on launch cycles, goods and services should be sourced as close to the Proposed Project site as practicable. Following the implementation of these mitigation measures, the effect of strong winds on the Proposed Project can be considered minor adverse and insignificant.

Heavy precipitation

11.8.16 Extreme rainfall events could cause pluvial surface water flooding which may impact upon operation of the Proposed Project. On-site roads and off-site access routes may experience erosion through scour caused by surface water flooding events. This may result in access restrictions for equipment and staff critical to the launch cycle procedure. In addition, electrical equipment (i.e. deluge pumps and generators) may fail due to water ingress. Due to the potential for delay to launch cycles, the receptors are deemed to be moderately sensitive to heavy rainfall.

11.8.17 A slight increase in the annual average precipitation rate is expected during the lifetime of the Proposed Project. Throughout both the 2020-2048 and 2050- 078 periods, two thirds of scenarios predict a 0-10% increase in the annual average precipitation rate in Unst, compared to baseline levels. The projected slight increase in precipitation can be considered a minor adverse impact of climate change due to the low magnitude of change above baseline levels.

11.8.18 Due to the above factors, prior to the implementation of mitigation, pluvial flooding caused by heavy rainfall has the potential to have a moderate adverse impact on the Proposed Project.

11.8.19 A drainage strategy and system has been designed to mitigate against localised surface water pooling and flooding, and the implementation of this mitigation measure will reduce the potential effect of heavy rainfall on the operation of the Proposed Project to minor adverse and insignificant.

High temperatures

11.8.20 High temperatures may result in heatwaves and droughts, which could cause personnel welfare impacts (for example, heat stress), damage to machinery through overheating, and an increased risk of fire.

11.8.21 Throughout the design life of the Proposed Project, an increase in mean air temperature in northern Shetland is predicted. For the period 2020-2048, the annual mean air temperature in Unst is projected to be 1-2°C higher than the 1981-2010 average. This rises to 2-3°C above baseline levels for the 2050-2078 timescale, according to 75% of member scenarios.

11.8.22 Based on Met Office climate data from 1981 - 2001, temperatures in Unst are consistently low; the baseline maximum temperature is 15.2°C for August, compared to an average of 19.1°C across the UK. Furthermore, extreme hot weather events occur infrequently and are of a low magnitude; the hottest temperature ever recorded at Baltasound was 25°C in July 1958. The predicted trend towards rising temperatures may increase the frequency of heatwaves and droughts in Unst. However, extreme temperatures are unlikely to be of a high enough magnitude to have a significant impact on the Proposed Project site so this constitutes a minor climate change impact.

11.8.23 Considering the sensitivity of the receptor of human health and the potential for the magnitude of impact to rise throughout the design life of the Proposed Project, high temperatures have the potential to have a minor effect.

11.8.24 Appropriate standard mitigation measures should be applied in the event of high temperature conditions. Personnel should be provided with appropriate personal protective equipment (PPE) to mitigate against the health and safety risks posed by heat. Furthermore, deluge pumps must be installed as a fire protection measure. Following the implementation of these measures, heat will pose a negligible and insignificant risk to the Proposed Project.

11.9 Residual Effects

11.9.1 No significant residual effects have been identified following the implementation of mitigation measures.

11.10 Cumulative Assessment

11.10.1 The climate resilience risks identified are limited in their spatial extent to the Proposed Project and therefore no cumulative effect with other committed developments is considered in this climate change impact assessment.

11.11 Summary

11.11.1 An assessment of the potential effects of GHG emissions associated with the Proposed Project on climate change has been undertaken.

11.11.2 The assessment considered emissions arising from the operation of the Proposed Project including transportation and electricity and fuel consumption.

11.11.3 A climate resilience assessment has been carried out to assess the vulnerability of the Proposed Project to climate change.

11.11.4 The assessment evaluated the impact of climatic variables such as wind speed, precipitation and temperature on sensitive receptors associated with the Proposed Project.

11.11.5 The climate baseline was characterised using Met Office climate data for the period 1981-2001.

11.11.6 Potential climate change effects caused by GHG emissions associated with the Proposed Project should be considered significant in accordance with IEMA best practice guidance. These GHG emissions in the context of overall annual emissions by the Shetland Islands are considered of minor significance.

11.11.7 Mitigation measures, including the switch to electrical power and the continued decarbonisation of passenger and freight transport, will contribute to reducing GHG emissions.

11.11.8 Climate resilience impacts on the Proposed Project associated with high temperatures are considered to be of negligible significance.

11.11.9 High wind speeds are predicted to have an effect of minor significance on the Proposed Project.

11.11.10 The effects of heavy precipitation on the Proposed Project are considered to be of minor significance.

11.11.11 Standard mitigation has been considered in the inference of effect significance. Committed mitigation measures include installing deluge pumps to protect against fire, undertaking a dust impact assessment and implementing a dust management plan, establishing a drainage system to minimise flood risk, suspending activities during extreme weather events, and providing personnel with appropriate PPE.

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Chapter 12 Land, Soils and Peat

12. Land, Soils and Peat

12. Land, Soils and Peat

12.1 Introduction

12.1.1 This chapter provides an assessment of the effects of the Proposed Project on land, soils and peat.

12.1.2 The Proposed Project comprises operation of a vertical launch Spaceport, located on the Lamba Ness peninsula and comprising three launch pad complexes, associated storage and integration hangars, satellite tracking stations and launch support buildings.

12.1.3 Full details of the Proposed Project are provided in Chapter 3 of this AEE Report.

12.1.4 This chapter considers any potential significant effects from operation of the Proposed Project.

12.2 Legislation, Policy and Guidelines

Legislation

Space Industry Act

12.2.1 The Space Industry Act (2018) regulates all spaceflight activities carried out in the United Kingdom, and associated activities. The Act requires any person or organisation to obtain the relevant licence to:

- launch a launch vehicle from the UK;
- return a launch vehicle launched elsewhere than the UK to the UK landmass or the UK's territorial waters;
- operate a satellite from the UK;
- conduct sub-orbital activities from the UK;
- operate a spaceport in the UK; or
- provide range control services from the UK.

12.2.2 As the Applicant wishes to operate a vertical launch spaceport (the SaxaVord Spaceport) and provide range control services (at the Launch and Range Control Centre, LRCC) they are required to apply for a both a spaceport licence and a range control licence. However, AEE is only relevant to applications for spaceport licences.

Space Industry Regulations 2021

12.2.3 The Space Industry Regulations 2021 (the Regulations) set out in more detail the requirements for each licence the Regulators Licensing rules, which specify what information the UK Civil Aviation Authority (CAA), the regulator, requires in support of an application.

Additional Legislation

12.2.4 There is a range of environmental legislation that the Proposed Project must adhere to throughout its life cycle. Relevant legislation and guidance documents have been reviewed and taken into account as part of this assessment of effects on land, soils and peat. Key legislative drivers which have been considered within this assessment are listed below:

- Control of Pollution Act 1974;
- Environmental Protection Act 1990;
- Environment Act 1995; and

- The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017.

Policy

12.2.5 Scottish Planning Policy (SPP) (Scottish Government, 2014) identifies the range of considerations likely to be relevant to the determination of developments of the nature of the Proposed Project, including impacts on carbon rich soils.

12.2.6 It also states that '*Development management decisions should take account of potential effects on landscapes and the natural and water environment, including cumulative effects*' (paragraph 202).

12.2.7 The Shetland Local Development Plan (Shetland Islands Council, 2014), identifies considerations relevant to the Proposed Project including:

- NH1 International and National Designations;
- NH5 Soils; and
- NH6 Geodiversity.

Guidance

Guidance to the regulator on environmental objectives relating to the exercise of its functions under the Space Industry Act 2018

12.2.8 The Department for Transport issued its document '*Guidance to the regulator on environmental objectives relating to the exercise of its function under the Space Industry Act 2018*' in 2021, clarifying the government's environmental objectives relating to spaceflight and associated activities in the UK:

The environmental objective for spaceflight are to:

- *Minimise emissions contributing to climate change resulting from spaceflight activities*
- *Protect human health and the environment from the impacts of emissions on local air quality arising from spaceflight activities*
- *Protect people and wildlife from the impacts of noise from spaceflight activities*
- *Protect the marine environment from the impact of spaceflight activities.*

Guidance for the Assessment of Environmental Effects

12.2.9 The CAA (July 2021) document Guidance for the Assessment of Environmental Effects (AEE) explains the process for completing an assessment of environmental effects as part of a licence application under the Space Industry Act.

12.2.10 The AEE Guidance requires that potential direct and indirect significant effects of proposed spaceflight activities on environmental features, including land condition, are considered. The guidance further requires that:

- Specific potential effects are identified and, where possible, quantified;
- The focus of the AEE should be on significant effects arising from the proposed activities;
- Applicants for a spaceport licence set an environmental budget, comprising a maximum number of launches per launch vehicle type which can take place over the course of a year that can be carried out in an environmentally sustainable manner, taking into account the cumulative effect of all launches; and
- The AEE must address a range of environmental topics, including land, soils and peat.

12.2.11 Other relevant guidance includes:

- Environmental good practice on site C650 (CIRIA, 2010);
- Guidance on Developments on Peatland - Site Surveys (Scottish Natural Heritage, SEPA and The James Hutton Institute, 2017);
- Developments on Peatland: Guidance on the assessment of peat volumes, reuse of excavated peat and the minimisation of waste (Scottish Renewables and SEPA, 2012); and,
- Developments on Peat and Off-Site Uses of Waste Peat (SEPA, 2017).

12.3 Consultation

12.3.1 Extensive statutory consultation in relation to land, soils and peat was carried out during preparation and determination of the planning application for the SaxaVord Spaceport, where the Proposed Project will be operated. Where directly relevant to this AEE, consultation responses received during the SaxaVord Spaceport planning application period have been summarised in Table 12.1.

Table 12.1 Consultation Relevant to AEE

Consultee	Notes
SEPA	To inform the assessment, a database of regulatory information including water quality classifications, flood risk, historical landfill sites, waste sites, and authorised industrial process was obtained by AECOM (the project civil engineer) and has been reviewed. During the planning application determination period, consultation was undertaken with SEPA in relation to the proposed excavation, re-use and management of peat during construction, and the potential use of excavated peat for restoration of peatland habitats both on and off-site. This consultation related to the construction phase of the Proposed Project, therefore is not discussed further in this chapter.

12.4 Assessment Methodology and Significance Criteria

12.4.1 The following section sets out the approach that was followed to collect relevant baseline information and the methodology for assessing impacts and the significance of effects.

Environmental Zone of Influence

12.4.2 For the purposes of this assessment the environmental zone of influence (EZI) is limited to areas within the Proposed Project boundary, as shown on Drawing 3.2.

Desk Study

12.4.3 Baseline conditions have been established primarily via desk-based research and has included the following:

- consultation with relevant regulatory authorities as described in Table 12.1 above;
- review of geological mapping of the area, British Geological Survey, Geology of Britain Viewer, 1:50,000 scale; and,
- AECOM report *Shetland Space Centre, Desk Study and Site Appraisal* (AECOM, 2019), which is included as Volume IV Technical Appendix 9.1 to this AEE Report.

12.4.4 Details of the Proposed Project relevant to geological resources have been provided by the project team, principally AECOM as the project civil engineer. Specifically, this includes the following:

- AECOM project drawing 0037(S) – Launch Site Layout (reproduced as Drawing 3.2); and
- AECOM report *Shetland Space Centre, Drainage Strategy Rev.4* (AECOM, 2020a), which is included as Volume IV Technical Appendix 9.2 to this AEE Report.

Site Visit and Surveys

12.4.5 As part of AECOM's site appraisal (as reported in the above-noted desk study and site appraisal report), AECOM staff undertook a detailed site walkover of the Proposed Project in November 2019. Photographs were taken and are included in the report with descriptions. Observations were made of extant buildings, other relic infrastructure, and former quarries. Ground conditions were also observed where possible, including along the sea cliffs and at the quarries, where the soil profile was reported to be clearly exposed. The presence and nature of watercourses and drainage ditches was also noted.

12.4.6 Subsequently, in October and November 2020, AECOM undertook a preliminary ground investigation at the Proposed Project , to determine the depth of peat, where present, and the nature of underlying deposits and depth to bedrock. This investigation comprised excavation of 42 trial pits and advancing 304 peat probes. Information from this investigation is included and referred to as appropriate within this chapter. Full details are provided in the AECOM report *Shetland Space Centre, Preliminary Ground Investigation – Factual Report* (AECOM, 2020b) which is included as Volume IV Technical Appendix 9.3 to this AEE Report.

12.4.7 As part of the ecological assessment for the Proposed Project, Alba Ecology undertook field surveys in July 2018, updated in July 2020. These included an extended Phase 1 Habitat survey, a National Vegetation Classification (NVC) survey, and protected species surveys.

Assessment of Potential Effect Significance

12.4.8 The characterisation of geological sensitivities has been guided by the matrix presented in Table 12.2 below which lists the characterisation criteria.

Table 12.2 Geological, Hydrological and Hydrogeological Sensitivity

Sensitivity	Description
High	Areas containing geological or geomorphological features considered to be of international or national interest, for example Aquatic Natura 2000 sites, SACs (Special Areas of Conservation), SSSIs (Site of Special Scientific Interest). Raised or blanket bog.
Medium	Areas containing features of designated regional importance, for example Regionally Important Geological and Geomorphological Sites (RIGS), considered worthy of protection for their educational, research, historic or aesthetic importance. Significant peat deposits.
Low	Geological features not currently protected and not considered worthy of protection. Thin superficial peat deposits.

12.4.9 The criteria for sensitivity have been developed based on a hierarchy of factors relating to quality of the geological environment including international and national designations, soil quality information, consultations, site reconnaissance and the professional judgement of the assessment team.

12.4.10 The prediction and assessment of effects on land, soils and peat has been undertaken using a series of tables to document the various potential impacts from operation of the Proposed Project. Effects have been predicted for the Proposed Project based on the guideline criteria for impact magnitudes set out in Table 12.3 below.

Table 12.3 Impact Magnitude

Impact Magnitude	Guideline Criteria
High	Total loss of, or alteration to, key features of the baseline resource such that characteristics or quality would be fundamentally and irreversibly changed e.g., extensive excavation of peatland.
Medium	Loss of, or alteration to, key features of the baseline resource such that characteristics or quality would be partially changed e.g., partial excavation of peatland.
Low	Small changes to the baseline resource, which are detectable, but the underlying characteristics or quality of the baseline situation would be similar to pre-development conditions.
Negligible	A very slight change from baseline conditions, which is barely distinguishable, and approximates to the 'no-change' situation.

12.4.11 The significance of the predicted effects has been assessed in relation to the sensitivities of the baseline resource and magnitude of predicted impacts. A matrix of significance has been developed to provide a consistent framework for evaluation and is presented in Table 12.4 below. Guideline criteria for the various categories of effect are included in Table 12.5 below.

Table 12.4 Effect Significance Matrix

	Sensitivity			
Magnitude	**High**	**Medium**	**Low**	**Not Sensitive**
High	Major	Major	Moderate	Minor
Medium	Major	Moderate	Minor	Negligible
Low	Moderate	Minor	Minor	Negligible
Negligible	Minor	Negligible	Negligible	Negligible

Table 12.5 Effect Significance Categories

Significance	Definition	Guideline Criteria
Major	A fundamental change to the environment.	Changes resulting in substantial loss of conservation value to land, soil and geological resources and designations.
Moderate	A larger, but non-fundamental change to the environment.	Changes resulting in loss of conservation value to geological designated areas.

Significance	Definition	Guideline Criteria
Minor	A small but detectable change to the environment.	Localised changes resulting in minor and reversible effects on land, soils, and peat.
Negligible	No detectable change to the environment.	No effects on geological resources.

12.4.12 In the above classification, fundamental changes are those which are permanent, either adverse or beneficial, and would result in widespread change to the baseline environment. For the purposes of this assessment, those effects identified as being major or moderate have been evaluated as significant environmental effects.

12.4.13 These matrices have been used to guide the assessment, although they have been applied with a degree of flexibility, since the evaluation of effects will always be subject to location-specific characteristics which must be taken into account. For this reason, the evaluation of the significance of effects in particular will not always correlate exactly with the cells in the relevant matrix, especially where professional judgement and knowledge of local conditions may result in a slightly different interpretation of the impact concerned. Additionally, effects may be assessed as having a significance level between those noted above, i.e., Minor to Moderate, or Moderate to Major.

12.4.14 Cumulative effects have been accounted for through the prediction and evaluation of effects cumulatively with those which could arise as a result of operation of other developments (operational, consented or in planning) within the EZI.

Requirements for Mitigation

12.4.15 Proposed mitigation measures are presented within this chapter (Sections 12.7 and 12.9 below) where the potential to affect sensitive geological receptors has been predicted.

Assessment of Residual Effect Significance

12.4.16 An assessment of any predicted significant residual effects on sensitive geological receptors, taking account of committed mitigation measures, is presented within this chapter (Section 12.11).

12.5 Baseline Conditions

Geography and Topography

12.5.1 The Proposed Project is located on the peninsula known as Lamba Ness, on the north-east coast of the Island of Unst. The coastline which forms the north, east and south boundaries comprises high, rocky cliffs, rising from sea level to approximately 10 to 20 m Above Ordnance Datum (AOD) along the north and east of the site, and as high as 50 m AOD in the south.

12.5.2 The Proposed Project site is generally flat, with a very gentle overall rise towards the west across the main body, steepening towards the west end (the western edge being at approximately 65 m AOD). A small, low hill feature (31 m AOD) is located towards the east end of the peninsula.

Designated Sites

12.5.3 There are no statutorily designated sites relevant to geology within the boundaries of the Proposed Project.

12.5.4 No internationally designated sites relevant to geology (i.e., Special Areas of Conservation) are located within the EZI.

12.5.5 There is one relevant nationally designated site within the EZI:

- The Norwick Site of Special Scientific Interest (SSSI) is approximately 150 m west of the Proposed Project along the coastal cliffs. It is designated for its geological interest (structural and metamorphic geology). This area is also identified as a Geological Conservation Review (GCR) site, and the GCR area extends further east, into the site boundary (refer to Drawing 12.1)

12.5.6 Given the nature of the Norwick SSSI and GCR site, and no works being proposed at or adjacent to the designated areas, there is considered to be low potential for the Proposed Project to impact on the designated features. Potential impacts on the Norwick SSSI and GCR site are therefore scoped out of the assessment.

12.5.7 There are three Local Conservation Sites on Unst, identified for their geological interest:

- Wick of Skaw, an identifiable exposure of a granite intrusion contact zone approximately 600 m north of the Proposed Project;
- Belmont Quarry, including rock exposures across a major sear zone/ophiolite thrust, over 14 km southwest of the Proposed Project; and,
- Clibberswick Cross Geo, part of the Shetland Ophiolite Suite, over three kilometres south of the Proposed Project .

12.5.8 Given the distance between these Local Conservation Sites and the Proposed Project, there is not considered to be any potential for any impacts from operation of the Proposed Project.

Geology

Superficial Geology and Peat

12.5.9 BGS geological mapping shows no artificial ground recorded on the Proposed Project site, although given that this area has been historically developed as an RAF facility, it is anticipated that localised made ground will be present.

12.5.10 The superficial geology at the Proposed Project site is indicated on BGS geological mapping to comprise till and morainic deposits across much of the area (typically poorly sorted sand, gravel, cobbles and boulders in a silt or clay matrix). An area in the central part of the Proposed Project, west of The Garths, is indicated to be underlain by blown sand.

12.5.11 No peat is shown on BGS mapping either within the Proposed Project site or in the close vicinity. The Scottish Natural Heritage (SNH) Carbon and Peatlands Map (2016) shows no Class 1 or Class 2 peat (i.e., nationally important carbon-rich soils, deep peat and priority peatland habitat) within the boundary of the Proposed Project. This map shows that an area of Class 1 peat is identified off-site but in close proximity to the west/north-west boundary. Most of the area is shown as Class 5 (area of peat soil but no peatland habitat recorded), with the western area shown as Class 4 (area unlikely to be associated with peatland habitats, and unlikely to include carbon-rich soils).

12.5.12 Although no peat is shown on BGS mapping, aerial photography suggests the potential presence of peat and/or organic soils, with drainage ditches cut across the central and western areas. Refer to Drawings 12.2a and b, which show aerial images of the Proposed Project.

12.5.13 The site walkover undertaken by AECOM in November 2019 identified thin superficial soils overlying rock across the Proposed Project site, with some localised peat deposits, particularly on flat-lying areas in the western part of the Proposed Project. AECOM reported observing peat in some exposures, for example at former quarry excavations, typically reported to be in the order of 0.5 m, where visible. Deeper peat was also reported to be locally evident where drainage ditches were cut across central parts of the site.

12.5.14 Information from the Alba Ecology habitat survey report indicates that habitats observed within the Proposed Project boundary are largely wet modified bog and wet modified bog/wet heath transitional habitat, with areas of neutral grassland, semi-improved grassland, and heath.

12.5.15 Although observations from the site walkovers and habitat surveys did not suggest the presence of extensive peat, recent intrusive investigations (trial pits and peat probing) did identify the presence of peat across parts of the site, locally extending to greater than 1 m depth and therefore defined as deep peat.

12.5.16 The peat depth survey work comprised peat probes on an approximately 25 m grid pattern across the Proposed Project areas, with additional information on ground conditions gained by excavating 42 trial pits. The investigations were targeted towards the Proposed Project areas rather than covering the full extent of the site, because the locations of the proposed launch pads, buildings, tracks and other infrastructure were highly restricted, and dictated by, other constraints including on-site archaeological and ornithological/ecological sensitivities, and health and safety considerations with respect to spacing and siting of the launch pads

12.5.17 The findings from the peat depth survey and trial pits are briefly summarised below and provided in full in Volume IV Technical Appendix 9.3.

- At the western extent of the site peaty topsoil was identified, directly overlying bedrock.
- Towards the middle of site, around the Satellite Tracking Areas and Launch Pads 2 and 3, layers of intermittent peat and wind-blown sand were identified, underlain by clayey sand and gravel (till) over bedrock. The peaty topsoil/peat tends to deepen to the east, with a maximum depth of 2.2 m identified in the trial pits and estimated depth of 2.75 m from the peat probes.
- Further east towards the end of the peninsula and up onto higher ground, peaty topsoil was identified, overlying weathered bedrock.
- The peat recorded at the site was assessed to range from very slightly decomposed to very highly decomposed peat, with a low to moderate field moisture content.
- Even in areas where deep peat was recorded, there is evidence of historical development and relic structures, such that the peat has been disturbed, and locally excavated.

Bedrock Geology

12.5.18 Bedrock across the Proposed Project site is indicated on BGS geological mapping to comprise Skaw Intrusion rock, namely porphyritic microgranite. Several igneous intrusions (North Britain Siluro-Devonian Calc-Alkaline Dyke Suite) are recorded along the fringes of the Proposed Project in the south, east and north-east.

12.5.19 The AECOM ground investigation concurred with the desk study findings, with trial pits encountering Skaw formation rock at depths of 0.2 to 2.2 m below ground level.

12.5.20 Immediately west of the Proposed Project, the bedrock comprises the Saxa Vord Pelite Formation (phyllitic pelite), according to BGS mapping.

Summary

12.5.21 All areas of the Proposed Project are underlain largely by Till, which is common and widespread. However, there is peat present across parts of the Proposed Project site, ranging from shallow peaty soils to, locally, peat over 2 m depth. Bedrock comprises metamorphic rock, with the coastal area at the south of the Proposed Project being of interest and identified as a GCR site. Just outside the Proposed Project, to the west, the metamorphic and structural geology observed at the cliffs is recognised with a SSSI designation.

12.5.22 Overall, the geological sensitivity of the study area is considered to be medium.

12.5.23 Drawing 12.3 illustrates the superficial geology of the study area based on BGS geological mapping and Drawing 12.4 illustrates the bedrock geology. Drawing 12.5 shows the peat depth data for all peat probes and trial pits at the Proposed Project site.

Contaminated Land

12.5.24 As reported in the AECOM Desk Study report, the Proposed Project site was historically used by the RAF as an early warning radar station during the Second World War (WW2). A review of available historical mapping is presented in the AECOM report and summarised below:

- In the late 1800s, a cairn was present in the centre of the Proposed Project site, and there were several buildings noted as ‘Inner Skaw’. The settlement of Skaw was just north of the western boundary of the Proposed Project.
- No significant changes were noted on historical maps up to and including the 1928 edition. The next available edition is from 1957, which shows a roadway across the Proposed Project site (as at present) and several small, unlabelled structures.
- The AECOM report provides additional information from a historical blog, ‘A History of RAF Saxa Vord’, by Gordon Carle. The blog notes that 150 servicemen were stationed there during WW2, housed in approximately 50 buildings. Four radio masts were also present.
- Information on the radar station is also available from its Scheduled Monument citation, summarised in the AECOM report. This notes that the station comprised numerous buildings providing an early warning function, with supporting infrastructure and domestic blocks.
- Mapping available from the early 1970s shows that the ‘Inner Skaw’ buildings were no longer present, but approximately 40 of the RAF radar station buildings were shown.
- By 2001, mapping indicates that site buildings were derelict, and some had been removed. Two quarries were present within the Proposed Project boundary, with a third immediately west.
- No significant changes are noted on map editions between 2001 and 2019, when fewer buildings are shown within the Proposed Project site. There is no evidence to suggest the former quarries have been infilled, and they are still visible on the 2019 map.

12.5.25 The AECOM Desk Study and Site Appraisal report (refer to Appendix 9.1) provides a summary of UXO risk at the Proposed Project, including a Pre-Desk Study Assessment undertaken by Zetica UXO. This concluded that a detailed desk study will be required to assess, and potentially zone, the UXO hazard level at the Proposed Project. A detailed UXO desk study was therefore undertaken by Zetica UXO in November 2020 (refer to Zetica UXO report *UXO Desk Study & Risk Assessment – Shetland Space Centre*, included as Volume IV Technical Appendix 12.1 to this AEE Report). This detailed study concluded that no significant sources of UXO hazard had been identified on the site, and the overall UXO risk was assessed as low.

12.5.26 The AECOM report notes that the Proposed Project is located within a Radon Affected Area. This is associated with the natural bedrock geochemistry and means that any new buildings may require radon protection measures, depending on their intended use, duration/frequency of occupation, and design.

Summary

12.5.27 In summary, the Proposed Project site has been historically developed as a radar station, and some buildings have since been removed. There is therefore potential for made ground across the Proposed Project site.

12.5.28 Given the age of the buildings at the Proposed Project site, the presence of asbestos-containing materials cannot be ruled out.

12.5.29 There is no evidence to suggest any significantly contaminative land uses at the Proposed Project site.

12.5.30 As noted in the Zetica UK detailed UXO desk study (refer to Appendix 12.1), an overall low UXO risk has been identified.

12.5.31 Contaminated land is not considered to represent a significant risk to the Proposed Project and is not considered further in this assessment.

12.6 Receptors Brought Forward for Assessment

12.6.1 Following review and analysis of the hydrological, hydrogeological and geological baseline as reported above, the following features/receptors have been taken forward for assessment:

- Peat deposits across the Proposed Project site.

12.7 Standard Mitigation

12.7.1 The following standard, or embedded, mitigation measures are applicable to operation of the Proposed Project

Drainage

12.7.2 Standard or 'embedded' mitigation of operational phase effects will be achieved through appropriate design of the Proposed Project drainage systems to avoid adverse effects on the hydrological regime and therefore the peat resources identified at the site.

12.7.3 The AECOM Drainage Strategy report and associated drawings provide full details of the proposed arrangements for the management of drainage throughout the Proposed Project areas. Of particular relevance to soils and peat, the drainage strategy incorporates the use of Sustainable Drainage Systems (SuDS).

Fuel Storage

12.7.4 Fuels and gases will not be permanently stored at the Proposed Project, rather they will be brought to the launch pads from external storage, via road haulage, as required.

12.7.5 Large volume fuel and gas containers will remain on their trailers for fuelling and de-fuelling. Small volumes of fuels and oils in containers will be off-loaded to the ground within the control areas of the launch pads, to facilitate electrical and mechanical support during launches. These will be stored in accordance with best practice procedures, including being kept within a designated storage site in appropriate impermeable bunded containers/areas.

12.8 Potential Effects

Potential indirect effect on peat deposits from changes to hydrology/ hydrogeology

12.8.1 The potential for significant impacts on peat deposits is primarily related to the construction phase and is therefore not considered in this AEE. However, there is also potential for longer-term impact on peatlands resulting from changes to the hydrological regime, through introduction and continued use of hardstanding and buildings, and drainage systems.

12.8.2 Taking account of the standard mitigation – principally the appropriate design of drainage systems and incorporation of SuDS – the potential impact magnitude is considered to be negligible to low, on a medium sensitivity receptor. Therefore, there are **no significant effects** predicted.

Potential direct effect from contaminated run-off or chemical spills on land, soils and peat

12.8.3 Oils, fuels and chemicals are likely to be used and stored at the Proposed Project site, with the potential to be mobilised through leaks and spills. Run-off has the potential to directly impact on land and soils, with the potential to be transported at least locally via shallow acrotelmic peat (likely to be permeable). Taking account of the standard mitigation, in particular implementation of suitable best practice for storage, transport and use of fuels and chemicals, the potential impact magnitude is considered to be negligible to low, on a medium sensitivity receptor. Therefore, there are **no significant effects** predicted.

12.9 Additional Mitigation

12.9.1 When taking account of the standard mitigation measures, potential effects have been assessed as not significant, with no additional mitigation therefore required.

12.10 Cumulative Assessment

12.10.1 Cumulative effects can be either inter-project or intra-project effects.

12.10.2 Inter-project cumulative effects are those where an environmental topic/receptor is affected by impacts from more than one project at the same time and the impacts act together. No consented or proposed (in planning) developments with the potential to create cumulative effects on land, soils or peat have been identified in the EZI.

12.10.3 Intra-project cumulative effects are those where an environmental topic/receptor is affected by more than one impact from the same Proposed Project and the impacts act together. Given that none of the other environmental topics considered impact directly on land, soils or peat, it is considered that there is no potential for additive or intra-project cumulative effects.

12.11 Residual Effects

12.11.1 No additional mitigation is proposed therefore, residual effects are as per the potential effects described in Section 12.8 above. All residual effects considered in this assessment are assessed as being minor adverse and therefore **not significant**.

12.12 Summary

12.12.1 The Proposed Project comprises three launch pads and ancillary buildings and access infrastructure. The site is a relatively flat area on the Lamba Ness peninsula with high, rocky cliffs forming the north, east and south boundaries.

12.12.2 There are no statutorily designated sites relevant to geology within the Proposed Project boundary. The Norwick SSSI is approximately 150 m west of the Proposed Project along the coastal cliffs, is designated for its geological interest and also subject to a GCR classification which extends into the Proposed Project boundary. The Norwick Meadows SSSI is approximately 800 m south-west of the proposed project and is designated for sand dunes and valley fen.

12.12.3 Geology across the Proposed Project site comprises till and/or morainic deposits, with blown sand and localised organic soils, peat and deep peat, over low-permeability igneous and metamorphic rock.

12.12.4 Likely operational effects include pollution of the land, soils and peat from surface runoff and fuel/chemical leaks and spills, and indirect effects on peatland through changes to the hydrological regime.

12.12.5 Standard mitigation measures include appropriate design of site drainage including incorporation of SuDS, no bulk storage of fuels at the Proposed Project, and appropriate spill control procedures.

12.12.6 The likely effects on geological receptors, taking account of the standard mitigation measures, have been assessed as minor and **no significant effects**.

12.12.7 The significance of residual effects on geological receptors is considered to be minor and **no significant effects**. No cumulative effects are predicted.

12.13 References

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Chapter 13 Landscape, Seascape and Visual Impact

Landscape, Seascape and Visual Impact

13. Landscape, Seascape and Visual Impact

13.1 Introduction

13.1.1 This chapter provides an assessment of the effects on landscape resources and visual amenity that are likely to result from the operation and maintenance of the Proposed Project.

13.1.2 The LVIA (Landscape and Visual Impact Assessment) chapter has been prepared by a Chartered Landscape Architect at Hermitage Environmental Planning and Landscape Architecture Limited (Hepla) with over 20 years of professional experience.

13.1.3 This chapter describes: the baseline landscape and visual conditions currently existing within the Proposed Project site and the surrounding Environmental Zone of Influence (EZI); the likely significant effects on the landscape and visual resource; the mitigation measures included to avoid, prevent, reduce or offset adverse effects; and the likely residual effects after these measures have been employed. The assessment is based on a potential reasonable 'worst case' scenario and the parameters that have defined this are set out in the methodology.

13.1.4 The LVIA concentrates on the key landscape and visual issues identified during the Environmental Impact Assessment (EIA) scoping stage undertaken as part of the planning application process. Consultation was undertaken with Shetland Islands Council and Scottish Natural Heritage (SNH, now NatureScot) in relation to:

- landscape effects – both physical changes to constituent elements of the landscape fabric, and how changes in the character and qualities of the landscape and designated areas are perceived by people, as a result of the Proposed Project; and
- visual effects – changes to views or visual amenity, as experienced by people, from key viewpoints, the surrounding sea, settlements, roads, footpaths and cycle routes, as a result of the Proposed Project.

13.1.5 Due to the proximity of the Proposed Project to the coastal edges of the northern islands of Shetland, the LVIA also considers effects on the coastlines and seascape. References to landscape effects used in this chapter also refer to effects on the coastlines and seascape.

13.1.6 The location of the Proposed Project and the extent of the Proposed Project boundary is shown on Drawing 13.1.1. This is also detailed in Chapter 3 (Proposed Project).

LVIA Contents

13.1.7 The LVIA is organised into the following main sections, with additional written data also included in appendices, as described below:

- Introduction;
- Project Description;
    - o a description of the aspects of the Proposed Project with the potential to influence landscape and visual amenity within the EZI;
- Design Optimisation and Mitigation Measures;
    - o a description of how the layout and design has responded to potential landscape and visual effects over the duration of the Assessment of Environmental Effects process, and reference to the embedded mitigation measures incorporated at the design stage, aimed at avoiding, reducing or minimising potentially adverse landscape and visual effects;

- Policy;
  - a review of the policy context relevant to landscape and visual matters;
- Consultation;
  - a summary of the consultation completed to agree the scope of the assessment and how matters raised during the consultation process have been addressed;
- Methodology;
  - an explanation of how the LVIA has been carried out, with reference to recommended methodologies and guidelines;
- Existing Environment;
  - a description of the existing landscape and visual amenity and receptors identified within the application area and the wider EZI;
- Assessment of Landscape and Visual Effects;
  - a detailed assessment of the likely significant effects arising from the operation of the Proposed Project on the landscape resources and the perception of landscape character and designated areas within the EZI;
  - an assessment of likely significant effects on visual amenity arising from the operation of the Proposed Project, including an assessment from a range of viewpoints identified and agreed through consultation with Shetland Islands Council and SNH;
- A Summary of In-combination Landscape and Visual Effects;
  - an assessment of the effects arising from the operation of the separate elements of the Proposed Project in combination. Note that this is incorporated into the main assessment under consideration of each receptor rather than being presented separately;
- Summary
  - a summary of the key landscape effects (including seascape and coastal) and visual effects arising from the Proposed Project, and conclusions on the significance of effects.

Supporting Graphics

13.1.8 The LVIA chapter should be read alongside the following plans, photographs and visualisations, which are included in Volume III.

13.1.9 The baseline landscape and visual context is illustrated in: Drawing 13.1.1, LVIA EZI; Drawing 13.1.2, Landscape Designations; and Drawing 13.1.3, Landscape/Coastal/Seascape Character Areas. Viewpoint locations are shown in Drawing 13.1.4.

13.1.10 The assessment of landscape and visual effects is supported by the Zone of Theoretical Visibility (ZTV) maps in Drawings 13.2.1 to 13.2.2, and viewpoint photographs and photomontages in Drawings 13.3.1.1 – 13.3.1.10, and 13.3.2.1 – 13.3.2.5.

Appendices

13.1.11 This chapter is accompanied by Appendices 13.1 to 13.6 in Volume IV. These provide greater detail and background information on:

- Appendix 13.1, LVIA Methodology;
- Appendix 13.2, Landscape Character Areas within the 15 km EZI;
- Appendix 13.3, Coastal Character Areas within the 15 km EZI;

- Appendix 13.4, Seascape Character Areas within the 15 km EZI; and,
- Appendix 13.5, Special Qualities Assessment, Shetland National Scenic Area.

Project Description

13.1.12 The assessment covers the operational of the Proposed Project, as described in Chapter 3.

13.1.13 The Proposed Project consists of the following and where appropriate throughout, the term "Proposed Project" shall mean all of the following elements which will be the subject of three planning applications, except where highlighted:

- Launch Site: located on the Lamba Ness peninsula and comprising three launch pad complexes, each incorporating a launch pad, ground services storage and control, lightning protection masts, liquid and compressed gas storage and water deluge tanks for launch operations;
- Satellite Tracking Station: an area of hardstanding housing satellite tracking and telemetry devices located on the Lamba Ness peninsula;
- Launch Site Processing Facility (LSPF) hangar buildings (two): located on the Lamba Ness peninsula, a building where the LVs are assembled and the payload (the satellites) integrated into the LVs;
- Administration Building, Pyrotechnics Store, and Hazardous Materials Store located adjacent to the LSPF on the Lamba Ness peninsula;
- Integration Hangar/TEL building: located on the Lamba Ness peninsula, a forward position building close to the launch pads housing the transporter erector launcher (TEL) and where the final integration activities take place as required;
- Support Infrastructure: located on the Lamba Ness peninsula including access, an internal track system and a series of small temporary buildings;
- Gate House, including a tourist information area, located on the Lamba Ness peninsula; and
- Wildlife Hide: located on the Lamba Ness peninsula.

Design Optimisation

13.1.14 Consideration of landscape and visual effects of operation of the Proposed Project has been considered as part of the evolution of project design via LVIA at the planning stage and as such mitigation of the effects of the Proposed Project have been embedded into the design. As such, all the effects from the operational stage described herein are essentially residual effects.

13.2 Legislation, Policy and Guidance

13.2.1 The legislation, policies and guidance relevant to the LVIA are set out below, and Drawing 13.1.2, Volume III identifies the location and extent of the landscape policy designations.

Legislation

Space Industry Act

13.2.2 The Space Industry Act (2018) regulates all spaceflight activities carried out in the United Kingdom, and associated activities. The Act requires any person or organisation to obtain the relevant licence to:

- launch a launch vehicle from the UK;
- return a launch vehicle launched elsewhere than the UK to the UK landmass or the UK's territorial waters;

- operate a satellite from the UK;
- conduct sub-orbital activities from the UK;
- operate a spaceport in the UK; or
- provide range control services from the UK.

Policy

13.2.3 Whilst there is no policy specific to the assessment of the landscape and visual effects of space ports, given the Proposed Project's characteristics, it is possible to follow existing guidance with regard to the effects of development from the planning regime.

National Policy

Scottish Planning Policy

13.2.4 Scottish Planning Policy (SPP) is the statement of the Scottish Government's policy on nationally important land-use planning matters. The 2014 document provides the core principles, statutory guidance, planning policies, and expectations of the Scottish planning system.

13.2.5 SPP acknowledges the importance of protecting valuable landscapes at an international, national and local level to ensure that *"the character and quality of a landscape which is important or particularly valued locally or regionally"* is safeguarded or enhanced. (Para 199)

13.2.6 SPP goes on to state that *"the siting and design of development should take account of local landscape character"* and notes that *"developers should seek to minimise adverse impacts through careful planning and design, considering the services that the natural environment is providing and maximising the potential for enhancement."* (Para 202)

13.2.7 Development of the land will aim to retain and enhance the positive aspects of the site's natural features, whilst addressing potential impacts on both the environment of the adjoining residential areas and the wider setting by promoting a proactive mitigation strategy.

Regional Policy

The Shetland Local Development Plan, 2014

Policy GP3, All Development: Layout and Design

13.2.8 Policy GP3 states that: *"All new development should be sited and designed to respect the character and local distinctiveness of the site and its surroundings,"* and goes on to set out that *"development should make a positive contribution to"* a number of considerations, including, *"maintaining identity and character."*

Policy NH1, International and National Designations

13.2.9 Policy NH1 states that: *"Development that affects a National Scenic Area…will only be permitted where:*

- It will not adversely affect the integrity of the area or the qualities or protected features for which it has been designated, or
- Any such adverse effects are clearly outweighed by social, environmental or economic benefits of national importance."

Policy NH4, Local Designations

13.2.10 Policy NH4 states that: *"Development that affects a Local Nature Conservation Site or Local Landscape Area will only be permitted where:*

- It will not adversely affect the integrity of the area or the qualities for which it has been identified; or

- Any such effects are clearly outweighed by social, environmental or economic benefits."

Policy HE5, Gardens and Designed Landscapes

13.2.11 Policy HE5 states that: *"Development affecting gardens and designed landscapes should protect, preserve and enhance such places and should not impact adversely upon their character, upon important views to, from and within them, or upon the site or setting of component features that contribute to their value."*

Guidance

Guidance for the Assessment of Environmental Effects

13.2.12 The Department for Transport document "Guidance for the Assessment of Environmental Effects" explains the process for completing an assessment of environmental effects as part of a licence application under the Space Industry Act and sets out the environmental topics likely to be affected by the proposed activities.

13.2.13 The Guidance requires that potential direct and indirect significant effects of proposed spaceflight activities on environmental features, including landscape and visual impact, are considered. The guidance further requires that:

- Specific potential effects are identified and, where possible, quantified;
- The focus of the AEE should be on significant effects arising from the proposed activities;
- The AEE should explain what other environmental assessments have been conducted in relation to the proposed activities (e.g. EIAs provided as part of a planning application) and whether they are being used in support of the AEE;
- Applicants for a spaceport licence set an environmental budget, comprising a maximum number of launches per launch vehicle type which can take place over the course of a year that can be carried out in an environmentally sustainable manner, taking into account the cumulative effect of all launches; and
- The AEE must address a range of environmental topics, including landscape and visual impacts.

13.3 Consultation

Scoping

13.3.1 Extensive statutory consultation on LVIA was carried out during preparation and determination of the planning application for the SaxaVord Spaceport, where the Proposed Project will be operated. Information provided to consultees included a draft zone of theoretical visibility (ZTV) and a list of suggested viewpoints with grid coordinates, which it was proposed would be assessed within the LVIA for EIA

13.3.2 Where directly relevant to this AEE, consultation responses received during the SaxaVord Spaceport planning application period have been summarised in Table 13.1.

Table 13.1 Consultation Relevant to AEE

Consultee	Comment
Shetland Islands Council - Natural Heritage Officer	Rather than Assessing the Impacts on Wild Land: Interim Guidance Note, SNH Heritage (2007), please use the current advice, which is Assessing

Consultee	Comment
Comments, 1st July 2020	impacts on Wild Land Areas -Technical Guidance note Consultation - SNH Jan 2017 The standard reference that describes landscape character in Shetland is now the "Scottish Landscape Character Types Map and Descriptions" (SNH, 2019) - https://www.nature.scot/professional-advice/landscape/landscape-character-assessment/scottish-landscape-character-types-map-and-descriptions, rather than the 1998 Gillespies report referred to. I'm pleased to see that the LVIA will include coastal character assessment, but I suggest you also assess to include the character of 20. Skaw Coastal Character Area, as well as area 16. East Unst Coastal Character Area I am of the view that the LVIA should also include an assessment of the [Proposed Project's] landscape and visual impact as viewed from the sea; namely, its impact in relation to its seascape character type (as described in "An assessment of the sensitivity and capacity of the Scottish seascape in relation to offshore windfarms. Scottish Natural Heritage Commissioned Report No.103, Scott, K.E., Anderson, C., Dunsford, H., Benson, J.F. and MacFarlane, R. (2005)). The [Proposed Project] site is remote, isolated and essentially undeveloped with extensive visibility from the sea. That report describes 2 seascape character types for Shetland, namely: Type 1: Remote High Cliffs Type 13: Low, rocky island coasts The area for the Proposed Project is described as Low, rocky island coasts. I should be happy to discuss how that might be achieved. In terms of the Key Questions for Consultees ➢ I confirm that GLVIA3 is the correct framework for the methodology ➢ I am content with the proposed 15 km extent of the [EZI]; ➢ I am content with the proposed viewpoint selection, which are sufficiently representative ➢ The only other documents I suggest you refer to are noted above ➢ I am not aware of any other development proposals that should be considered in the cumulative assessment ➢ I am content with the important landscape and visual receptors selected.
Scottish Natural Heritage (now NatureScot), Jonathan Swale, 7th July 2020	We are content with the scope of your proposed LVIA.

13.4 Assessment Methodology and Significance Criteria

13.4.1 This chapter is supported by Appendix 13.1, which contains a detailed description of the method of assessment.

Guidance

13.4.2 The Landscape and Visual Assessment methodology follows good-practice guidance and advice on the assessment of the impacts of development on landscape and visual resources. A key source of guidance is the Guidelines for Landscape and Visual Impact Assessment (Third Edition, 2013) (GLVIA 3). Other documents specific to photography and visualisation techniques, and cumulative impacts have also been referred to. These are listed in full in Appendix 13.1 Volume IV.

Overview of Methodology and Limitations

13.4.3 The general approach to the LVIA includes the following key tasks:

- Desk study: A desk study was undertaken to define the baseline landscape and visual resource within the EZI and identify the main users of the area, key viewpoints and key features. Refer to Appendix 13.1 for further details;
- Field survey: The landscape and visual resource identified through the Desk Study was then verified through field survey work. This allowed the assessor to gain a full appreciation of the relationship between the Proposed Project and the landscape. Refer to Appendix 13.1 for further details;
- Confirmation of scope, methodology and confirmation of the viewpoints to be included in the assessment was completed through correspondence with Shetland Islands Council and NatureScot. Viewpoints are used as a proxy in order to understand effects across the EZI, because it is not feasible to make an assessment of every visual receptor across an extensive area. This is standard practice;
- Baseline assessment of landscape and visual resources (consisting of desk study, field survey and reporting) reviews the existing landscape and visual resource of the EZI in terms of its character, quality (i.e., the baseline condition) and establishes sensitivity of the resources/receptors. The baseline assessment forms the basis against which to assess the magnitude and significance of the predicted landscape and visual effects arising from the Proposed Project;
- Layout and design optimisation, seeking to develop the design and layout of the Proposed Project based upon a combination of landscape and visual factors alongside, ecology, ornithology and peat constraints;
- Assessment of landscape and visual effects. The assessment describes the changes in the character and quality of the landscape and visual resources that are expected to result from the Proposed Project. In assessing landscape impacts, the potential direct effects on the fabric of the landscape are considered, together with the effects on the perception of landscape character. The baseline landscape character assessment together with an assessment of the effects on each character area is included in the assessment, along with consideration of the extent of potential significant effects. The visual assessment includes a viewpoint analysis which has been carried out to identify and evaluate the effects on visual amenity arising from the Proposed Project at specific representative locations in the EZI; and,
- Assessment of in-combination effects sets out the scope of work undertaken for the assessment of the potential landscape and visual effects arising from the interaction of the separate elements of the Proposed Project.

13.4.4 Limitations of the standard approach include the use of agreed viewpoints as a proxy in order to understand effects across a wide area, and the limitations of the ZTV modelling, which can only be as accurate as the underlying data and the resolution at which this is available (50 m Digital Terrain Model).

Environmental Zone of Influence (EZI)

13.4.5 The EZI for the LVIA is defined by a 15 km radius oval offset from the outermost edge of the Proposed Project, as shown in Drawing 13.1.1. This extent of EZI was determined as appropriate, given the height of the Proposed Project, and agreed in consultation with the relevant consultees. A wider area was considered in terms of the effects of a launch.

Process of Assessing Effects and their Significance

13.4.6 Once the baseline situation in relation to landscape and visual receptors has been reviewed, this information is combined with an understanding of the proposed change or development that is to be introduced, in order to identify and describe the landscape and visual effects. As the mitigation is embedded as part of the design, potential effects and residual effects will be the same. The assessment process determines whether the level of an effect will be significant or not through methodical consideration of, firstly, the sensitivity of landscape and visual receptors relative to changes as a result of the Proposed Project and, secondly, the magnitude of change that they will experience.

13.4.7 A more detailed description of the principles used in assigning sensitivity to change to landscape and visual receptors and evaluating the likely magnitude of change that will be experienced in relation to the Proposed Project, and in the subsequent consideration of sensitivity and magnitude in determining the level and overall significance of resultant effects, as informed by GLVIA 3, is set out in Appendix 13.1.

Level of Effects and Determination of Significance

The level of any identified landscape or visual effect has been assessed as major, moderate, minor or no effect, or intermediate categories (e.g., major/moderate) between these. These categories have been determined by consideration of the sensitivity of landscape or visual receptor and the predicted magnitude of change that will be experienced as a result of the Proposed Project, as summarised above and described in detail in Appendix 13.1, Volume IV. The following matrix in Table 13.2 is used as a guide to correlating sensitivity and magnitude to determine the level of predicted effects and their significance.

Table 13.2 - Significance of Effects on Landscape and Visual Receptors

Sensitivity	Magnitude of Change			
	Substantial	Moderate	Slight	Negligible
High	Major	Major to Moderate	Moderate	Moderate to Minor
Medium	Major to Moderate	Moderate	Moderate to Minor	Minor
Low	Moderate	Moderate to Minor	Minor	Minor to None
Negligible	Moderate to Minor	Minor	Minor to None	Minor to None

13.4.8 This assessment has been calibrated such that the threshold of significance in terms of AEE is major to moderate. In this assessment, moderate level effects, and those below this level are not considered to be significant. Where, for the purpose of this assessment, the landscape or visual effect has been classified as major or major/moderate, this is considered to be a significant effect.

13.4.9 The table is not used as a prescriptive tool, and the methodology and analysis of effects at any particular location must make allowance for the exercise of professional judgement. Thus, in some instances, a particular parameter may be considered as having a determining effect on the analysis.

Supporting Graphics

13.4.10 The LVIA is supported by a range of Drawings including viewpoint photography. These have been prepared in adherence to the principles presented in the Landscape Institute's Advice Note *TGN 06/19 Visual Representation of development proposals,* GLVIA3, and Naturescot's, *Visual Representation of Wind Farms*, Version 2.2, 2017.

13.5 Baseline Conditions

13.5.1 This section provides a general description of the landscape and visual context of the Proposed Project site and EZI. It briefly describes the historical and cultural context within the EZI, identifying both sensitive locations and receptors to be addressed in the subsequent impact assessment.

The Application Site

13.5.2 The location of the Proposed Project is shown in Drawing 13.1.1.

Proposed Project

13.5.3 The Proposed Project is located between Inner Skaw and Lamba Ness on the peninsula which extends east into the North Sea to the north east of Norwick on Unst. The peninsula falls into the Coastal Edge landscape character area (LCA), to the east of the Major Uplands LCA, as identified on the online NatureScot data: Scottish Landscape Character Types Map and Descriptions. The surrounding seascape is described in the Shetland Coastal Character Assessment (2016), falling within the East Unst coastal character area (CCA).

13.5.4 The broad, flat, grassed headland, now used for rough grazing, is accessed via a narrow tarmac track, with a regular scattering of derelict buildings and bunkers which formed part of the extensive former Skaw Radar Station. The complex of c.50 buildings and structures is now designated as a scheduled monument. At the edges of the peninsula the land falls away steeply through steep cliffs to the surrounding sea, with frequent sea stacks, skerries and inlets with the constant movement of waves and wind. The peninsula is seen against the backdrop of the rising uplands at Saxa Vord to the west, with expansive views across the sea at Nor Wick to the Hill of Clibberswick and island of Balta to the south, and the headland at Blue Jibs and the Holm of Skaw to the north.

13.5.5 The peninsula lies at c.11 m AOD, rising to high point of 31 m AOD at Lamba Ness. To the west the land begins to rise at Skaw, reaching c.60 m at the minor road (Holsens Road), rising steeply beyond to the Ward of Norwick to the west at 181 m AOD.

The Wider EZI

13.5.6 The wider EZI includes the exposed upland landscapes to the north and west with the Herma Ness headland to the north west and the adjoining uplands around Saxa Vord to the north east; the pronounced north-south ridge bounds the EZI along the western side of Unst at Valla Field. These upland landscapes contrast with the more sheltered central and eastern landscapes, with the long north – south central valley and rolling hills of central Unst, and the settled farmland along the east coast at Balta Sound, Nor Wick and Harold's Wick. Topographical elevations range from 0 m to c.250 m Above Ordnance Datum (AOD).

General Characteristics and Features of the EZI

Extent of the EZI

13.5.7 The 15 km radius EZI, focussed on north-eastern Unst, encompasses the northern and middle extent of the Island of Unst and the archipelago of islets.

Topographical Features

13.5.8 The western edge of Unst comprises a linear ridge of higher ground between Hermaness Hill (200 m AOD), Snuega (131 m AOD) and Valla Field (216 m AOD), dominated by peat moorland. This ridgeline shelters the undulating eastern portion of the island which is interspersed with areas improved grassland, rough grazing and heathland. The interlocking network of hills including Saxa Vord (250 m AOD), Ward of Norwick (186 m AOD), Housi Field (122 m AOD) and the Hill of Clibberswick (160 m AOD) frame the core of the EZI at Skaw, Lamba Ness and Norwick. The lower lying and sheltered land to the east around the coast, voes and sounds, as well as inland valleys are settled, with areas of enclosed farmland.

Natural Heritage Features

13.5.9 The EZI covers a diverse range of landscapes, encompassing coastal, maritime, lowland and upland areas that support a variety of flora and fauna. In addition, the geology of the region provides a broad range of sites of geological and geomorphological interest. The key natural heritage attributes can be broadly summarised as follows:

- upland/moorland habitats;
- rock outcrops;
- areas of acid grassland;
- littoral habitats;
- intertidal habitats; and,
- maritime habitats.

13.5.10 The non-porous nature of the metamorphosed sedimentary bedrock, the presence of boulder clay and the cool and damp climate have combined to create large expanses of peatland across the ridgeline along the western edge of Unst. The eastern area of Unst has an undulating landform with Serpentine and Greenstone bedrock, often close to the surface, with a surface layer of shattered rock and glacial drift. There are areas of improved grassland, good rough grazing land and heathland without peat, resulting from the nature of the underlying rock.

13.5.11 The eastern area of Unst has particular geological interest, formed from a fragment of the ancient Lapteus Ocean. The unusual serpentinite rocks are a focus for local geological interpretation, giving rise to a strange landscape of peat free rusty-brown crags, with rare minerals, flower-rich heathland and bare gravel that supports rare plants.

13.5.12 There is comparatively little farmland, with small pockets of improved and rough grassland concentrated along the coastal strip, around voes, inlets and along valleys, related to areas of boulder clay and other glacial drift deposits.

Archaeological Features

13.5.13 The EZI has a long cultural history with evidence of man's actions extending over some 8,000 years. Neolithic and Bronze Age settlement occurred in more favourable climatic conditions and as a result, occupied diverse locations across the islands. Subsequent patterns of settlement and land use have exploited the most productive land on the lower slopes of sheltered coasts and voes, benefitting from access to both hills for grazing and the sea for fishing and transport.

13.5.14 There are 392 Scheduled Monuments in Shetland ranging from Bronze Age burial chambers to later medieval features and Second World War defence infrastructure. The following Scheduled Monument sites are located on or close to the site:

- Skaw, radar station: The monument comprises the remains of a Second World War Chain Home radar station. The station is spread over two sites, a main and a reserve site, with over 50 buildings and structures reflecting its core early warning function and with supporting infrastructure and domestic blocks. It is located on rough grazing land over two headlands. Within the Proposed Project site at Lamba Ness and at Blue Jibs to the north; and,
- Inner Skaw, houses and field system, Unst: The monument comprises the remains of a series of farmhouses, the earliest of which may be of early Norse date, and a nearby series of abandoned fields of various dates and forms which would have been associated with different phases of the farming settlement.

13.5.15 More information on Material Assets and Cultural Heritage is detailed in Chapter 14, but these features are noted here as visitors are attracted to them and are potential visual receptors.

Built and other Heritage Features

13.5.16 Other important sites which may attract visitors, and hence be of relevance as potential visual receptors within the EZI include:

- Skaw, Boat-Roofed Shed – Category C Listed Building: Outbuilding to N of Skaw Cottage comprising roughly oval battered random rubble base with door centred to SE side, roofed with over-turned and tarred former lifeboat.
- Norwick, The Banks, including cottage, outbuilding, ruin, boundary and sea walls – Category C Listed Building: Group of crofting buildings, dry stone walls and sea wall with a traditional character.
- Unst Heritage Centre, Haroldswick;
- Unst Boat Haven;
- Cromite Horse Mill at Hagdale; and,
- Viking Unst: The Shetland Amenity Trust promote the understanding and interpretation of the period of Viking settlement in Unst. This includes interpretation, display and a sequence of trails. Specific sites relevant to the EZI include:
  - The Skidbladner (replica Gokstad ship), and the Viking Longhouse reconstruction, both located at Haroldswick.
  - Harald’s Grave, on the hillside above Harold’s Wick.

Settlement

13.5.17 The extensive upland and exposed coastline to the north-west of Unst is uninhabited. The climatic conditions place a strong emphasis for settlement in areas where the landform affords shelter from the high winds. The sheltered voes, sounds and inland valleys are, as a consequence, extremely important and these areas have been the focus for continued settlement and activity since the Iron Age. The adjoining productive low-lying land between the moorland hills and the sea, providing for grazing and fishing respectively.

13.5.18 Unst retains this traditional settlement pattern. In northern Unst, settlement is focussed on the low-lying land between Burra Firth, Harold’s Wick and Nor Wick with clusters of settlement at Haroldswick, Valsgarth and Norwick with scattered farming settlement between. Through mid Unst settlement is focussed through the lowlands around Balta Sound and the farming lands to the west with the main centre of settlement at Baltasound.

Roads

13.5.19 Roads have replaced the sea as the main way of travel. In the recent past many of the smaller winding roads have been straightened and widened and the engineering works associated with road upgrades has had a considerable effect on the character of the landscape in places.

13.5.20 The main A698 road, crosses Unst from the ferry port at Belmont in the south (receiving traffic from the mainland and Yell) and connects to Baltasound in the north-east. This road has been upgraded and forms an intrusive corridor through the wild landscape of the interior with modified vegetative cover related to the road's verges cuttings and embankments. The B9087 connects Baltasound to Valsgarth and settlement on the north-east coast of Unst; and B9086 connects to Burrafirth in the north. Minor spur roads connect to the smaller hamlets along the coastlines.

Cycle Network

13.5.21 National Cycle Route 1 connects from Sumburgh in the south of the Mainland through to Skaw in north-eastern Unst. On Unst, the route follows the main road, A968 and continues on the B9087.

Walking Routes

13.5.22 There are no national walking routes defined on Shetland however, there are extensive opportunities for walking throughout the islands. Shetland Islands Council has designated a core path network to provide a reasonable level of public access in the Shetland Core Paths Plan. Key routes on Unst relevant to the Proposed Project include a loop around Clibberswick Hill, a route at Haroldswick and a circular route at Hagdale.

13.5.23 A longer linear core path provides access to the north-western coastline and Hermaness Hill from Burrafirth and a linear route from Houlland at the southern edge of the Loch of the Cliff through to Woodwick.

Tourism and Recreation

13.5.24 Many tourists travel to Unst as one of their main destinations on Shetland. Opportunities for tourism and recreation within the EZI focus on outdoor pursuits such as walking, sea kayaking, bird watching, fishing, and visiting the numerous archaeological sites and geoparks. These activities tend to take place in the coastal areas enjoying the dramatic contrasts between sea, sky and land.

13.5.25 Visitor attractions on the island include important areas for bird watching on the coastal nature reserves around Herma Ness, Saxa Vord and Muckle Flugga stacks on the north and north-western coasts of Unst. At Baltasound the Unst Boat Haven and Unst Heritage Centre are a focus for tourist visits. Informal visitor attractions in the EZI include the beaches at Norwick and Skaw.

Baseline Landscape Resources

13.5.26 The character and value of the EZI has been reviewed in greater detail against existing landscape character assessments, landscape designations, and other relevant non-designated areas, as set out below.

Landscape Character Assessment

Scottish Landscape Character Types Map and Descriptions Online (NatureScot, 2020)

13.5.27 NatureScot has used a system of landscape character assessment to identify, describe, classify and map Shetland. Using accepted, systematic methods of landscape character assessment, the countryside has been subdivided into different Landscape Character Types (LCTs) and Landscape Character Areas (LCAs), each with a distinctive character based upon local patterns of geology, land form, land use, cultural and ecological features. These provide information that can be used to guide landscape change and provide a baseline against which to make judgements on the likely effects of the Proposed Project upon landscape character.

Shetland Coastal Character Assessment, NAFC Marine Centre (NAFC), 2016

13.5.28 In addition to the landscape character areas, the NAFC Marine Centre has prepared the Shetland Coastal Character Assessment, 2016 which provides a characterisation of the Shetland seascape. The coastal character assessment identifies and maps different Coastal Character Areas (CCAs).

An assessment of the sensitivity and capacity of the Scottish seascape in relation to offshore windfarms, Scottish Natural Heritage Commissioned Report No.103, 2005

This document defines seascape character types around the Scottish coast, combining coastal and marine character to define seascape character.

13.5.29 These studies provide an assessment of the landscape, seascape and coastal character of the area, and consider the likely pressures and opportunities for change in the landscape / seascape. The LCTs, SCAs and CCAs that fall within the 15 km radius EZI are illustrated in Drawing 13.1.3 Volume III and described in detail in Appendix 13.2, Appendix 13.3 and Appendix 13.4 respectively.

13.5.30 The Proposed Project includes parts of the 355 - Coastal Edge LCT and 349 - Major Uplands LCT as identified in the Scottish Landscape Character Types Mapping.

13.5.31 The Coastal Edge Landscape Type is described as follows:

"The dramatic Coastal Edge Landscape Character Type occurs in several narrow strips around the exposed, mainly rocky coastline of Shetland. It forms the edge of upland and lowland Landscape Character Types, and includes dramatic coastal features, including towering sea cliffs, stacks and natural arches."

13.5.32 Key characteristics of the Coastal Edge LCT are described as follows:

- *"Narrow, indented coastal edge of rocky headlands, inlets and promontories on exposed parts of the coast.*
- *Mainly high to moderately high cliffs with frequent features of coastal erosion including stacks, arches, blowholes, caves and storm beaches.*
- *Diversity of colour and rock forms derived from the wide variety of bedrock.*
- *Short, colourful swards of maritime heath and grasslands on cliff tops and some sheltered cliffs, with bare, scoured rock in exposed locations.*
- *Many prehistoric and wartime archaeological relics revealed in short grassy landcover.*
- *Diverse and dramatic coastal scenery with a variety of coastal views.*
- *Remote, exposed, open and highly natural landscape with wild character."*

13.5.33 The Major Uplands Landscape Type is described as follows:

"The Major Uplands Landscape Character Type occurs as several upland hill masses incorporating the highest land in Shetland, forming the main physical structure of Shetland. The Landscape Character Type occupies large parts of central and south Shetland Mainland, with western and eastern outliers at Bressay, Sandness Hill, Ronas Hill, Foula, Fair Isle and in the north at Unst. The landcover is dominated by peatland and heather moorland peaty mires."

13.5.34 Key characteristics of the Major Uplands LCT are described as follows:

- *"Rounded hills, occurring either in series connected by high level rounded ridges along a linear band, or as isolated single hills or hill groups.*
- *Often steep slopes at the coast, or cliff edges with dramatic natural coastal landforms.*

- *Mainly simple landcover of peat bog and heather moorland grading to rough grassland on some lower slopes, contrasting with the ordered fields of adjoining lowlands and the intricate coastline.*
- *Hill grazing and low-key peat cutting.*
- *Mainly uninhabited and often difficult to access on foot or by road, with roads mainly absent on higher land.*
- *Exposed high land with panoramic views, forming landmark features which themselves are often visible for miles.*
- *Relatively expansive, although scale is difficult to discern and reduced by the*
- *presence of manmade structures.*
- *A sense of remoteness and wild character in places."*

13.5.35 The Farmed and Settled Voes Landscape Type is described as follows:

"The Farmed and Settled Voes and Sounds Landscape Character Type occurs in Shetland around the enclosed coastal waters which are distributed around most parts of the islands... They are dominated by pasture and rough grassland resulting from long established farming. The type includes Shetland's main towns and many harbour settlements. Along with the Farmed and Settled Lowlands and Coasts, these areas constitute the majority of Shetland's most productive farmland."

13.5.36 Key characteristics of the Farmed and Settled Voes LCT are described as follows:

- *"Narrow, low lying coastal strips of gently sloping or undulating land around enclosed waters.*
- *Complex, indented coastline which provides shelter.*
- *Mainly agricultural land use on improved and unimproved pastures with heathland, wetland and wet pastures which add variety.*
- *Unusual grassland and heathland on base-rich soils on Unst and Fetlar.*
- *Scarce broadleaf tree cover found in very small remnant woodland patches and recent plantations.*
- *Mostly traditional crofting in linear or scattered patterns, with some estates.*
- *Larger settlements around harbours with historic built heritage.*
- *Mainly inland, minor road network with branches to beaches and harbours.*
- *Abundant archaeology across all periods of human settlement.*
- *Rural areas provide a contrasting backdrop and setting for settlements.*
- *Rural areas and settlements contrast with the surrounding, large scale hill land.*
- *Views are ever-changing due to the complex coastline and interlocking landforms.*
- *Remote settlements have a strong sense of isolation and tranquillity."*

13.5.37 In undertaking the preliminary assessment and review of baseline material against the visibility mapping of the Proposed Project, and through subsequent fieldwork, it is considered that (leaving aside a launch which will have wider visibility and is considered separately), beyond a 15 km radius the Proposed Project will be seen as a distant element in the landscape and that there will be only a limited influence on the characteristics, defining features and/or special qualities of the LCTs/SCAs/CCAs. Although there may be some effects on landscape character beyond a 15 km radius from the Site, these are not likely to be significant and, in this regard, LCTs/SCAs/CCAs (as well as sub units of the Shetland NSA, WLAs and LLAs) beyond 15 km of the Proposed Project Site have not been assessed further. LCTs/SCAs/CCAs within a 15 km radius of the Proposed Project have been reviewed in detail and provide an appropriate basis to describe the landscape/seascape/coastal character of the area surrounding the Proposed Project.

13.5.38 There are 12 LCTs/SCAs/CCAs within 15 km of the Proposed Project. Of these CCA 13 Bura Firth, Unst, CCA 19, Hermaness, and SCA 1: Remote High Cliffs will experience limited or no visibility to the Proposed Project and have therefore not been considered further in this assessment.

13.5.39 The nine remaining LCTs/ SCAs/CCAs have the potential to be significantly affected by the Proposed Project, as listed in Table 13.3 and are included in the detailed assessment reporting in Section 13.7.

Table 13.3 Summary of LCTs / CCAs within 15 km of the Proposed Project and within the Zone of Theoretical Visibility

Landscape Character / Seascape / Coastal Character Area (CCA)	Source	Value	Susceptibility	Overall Sensitivity to Change Associated with the Proposed Project
349 Major Uplands	NatureScot Online Maps and Descriptions	High	High	High
350 Peatland and Moorland	NatureScot Online Maps and Descriptions	Medium	Medium	Medium
352 Inland Valleys	NatureScot Online Maps and Descriptions	Medium	Medium	Medium
353 Farmed and Settled Lowlands and Coast	NatureScot Online Maps and Descriptions	High	Medium	High Medium
354 Farmed and Settled Voes and Sounds	NatureScot Online Maps and Descriptions	Medium	Medium	Medium
355 Coastal Edge	NatureScot Online Maps and Descriptions	High	Medium	High Medium
CCA 16, East Unst	SCCA, NAFC 2016	High	High	High
CCA 20, Skaw	SCCA, NAFC 2016	High	High	High
Seascape Character Type 13 D: Islands, Sounds and Voes	Sensitivity and Capacity of the Scottish Seascape, NatureScot, 2005	High	High	High

Landscape Designations and Other Relevant Areas

13.5.40 Landscape designations are important in the context of the LVIA with regard to the effects of the Proposed Project on the landscape quality and visual amenity of designated areas within the EZI.

13.5.41 Landscapes designated at the national scale include National Scenic Areas (NSAs). Local Landscape Areas (LLAs) are designated by Shetland Islands Council. The location and extent of these designations within the EZI are shown in Drawing 13.1.2 and are described below.

National Scenic Areas

13.5.42 Within Scotland, NSAs are areas of outstanding scenic value in a national context. There are 40 designated NSAs in Scotland, which cover approximately 13% of Scotland, with policies for protecting the NSAs set out in development plans. In 2007 and 2008 SNH, working in partnership with Historic Scotland and the Royal Commission on the Ancient and Historical Monuments of Scotland (RCAHMS), surveyed all NSAs to list the landscape qualities that make each special, as set out in *The Special Qualities of the National Scenic Areas*, Scottish Natural Heritage Commissioned Report No.374, 2010.

13.5.43 Seven small areas of coastal landscape in Shetland have been identified as being of outstanding scenic interest. These designated areas that make-up the Shetland NSA comprise Shetland's scenic highlights and epitomise the range of coastal forms varying across the island group.

13.5.44 One NSA sub-unit, Hermaness, is located within the EZI. The identified special qualities of the Hermaness sub-unit are as follows:

- "The stunning variety of the extensive coastline;
- The hidden coasts;
- The effects and co-existence of wind and shelter;
- A sense of remoteness, solitude and tranquillity;
- The notable and memorable coastal stacks, promontories and cliffs;
- The distinctive cultural landmarks; and
- Northern light."

13.5.45 The following additional notes relevant to the special qualities for the Hermaness NSA sub-unit are set out in the report:

"The stunning variety of the extensive coastline

At Hermaness on Unst, the coastal topography varies from the 175m high cliffs at the Neap, to the sandy beach and machair at the head of the narrow Burrafirth.

The notable and memorable coastal stacks, promontories and cliffs

Where open to the full fury of the Atlantic Ocean, the sea has carved impressive cliffs, forming spectacular, towering, vertical scenery, varying greatly in colour according to the complex geology.

The coast also contains many distinctive stacks, promontories and other features that form memorable images. Within the NSA these include:

The imposing cliffs of Hermaness itself, with its nesting seabirds."

Local Landscape Areas

13.5.46 In 2014 Shetland Islands Council published the Current Local Landscape Areas, as draft supplementary planning guidance. This document which follows on from the Shetland Local Landscape Designation Review, 2011, sets out for each of the proposed Local Landscape Areas (LLAs): the location and boundaries; the key characteristics; a designation statement; and provides development guidelines.

13.5.47 Three LLAs are identified within the EZI. Analysis of the ZTV indicates that there is very limited very long-distance visibility (in excess of 15 km), or no theoretical visibility of the Proposed Project from two of the LLAs that lie within or overlap with the EZI, as follows:

- Colvadale and Muness, Unst LLA: A small are of distant visibility from Muness, at distances of c.15 km; and,
- Gloup Voe and Bluemull Sound LLA: No visibility.

13.5.48 Owing to the very limited and long-distance nature of visibility, or absence of visibility, these LLAs will not be affected by the Proposed Project to a level that could result in significant effects therefore, they have not been considered further as part of this assessment. The draft designation statements for the remaining LLA at Haroldswick and Skaw taken from Current Local Landscape Areas, 2014 are set out below.

Proposed LLA 15: Haroldswick and Skaw

"Key characteristics:

- *Part of the most northerly area of Shetland and Britain*
- *Highly visible military defence infrastructure, including active and disused elements*
- *Rugged, exposed northern coast, with sheltered sandy bays*
- *Rich geology visible at the surface*
- *Actively settled area undergoing redevelopment as former military uses decline and new uses are found."*

Designation statement:

"This is a rugged landscape with a great variety in landform. The rocky headlands and dramatic folded cliffs of the north coast are topped with moorland, contrasting in its smoothness. This moorland continues upwards to a group of rounded hills, the highest being Saxa Vord."

Inventory Gardens and Designed Landscapes

13.5.49 The Inventory of Gardens and Designed Landscapes in Scotland is a list of nationally important Gardens and Designed Landscapes (GDLs) that meet the criteria published in Historic Scotland's 2011 publication, Scottish Historic Environment Policy.

13.5.50 Belmont House lies approximately 18 km from the Proposed Project and is screened from direct views. Effects will not be significant and have not been considered further in this assessment.

13.5.51 Table 13.4 below sets out a summary of the designated landscapes considered in the assessment and their sensitivity to the Proposed Project.

Table 13.4 - Summary of Landscape Designations within the Zone of Theoretical Visibility

Landscape Designation	Value	Susceptibility	Overall Sensitivity to Change Associated with the Proposed Project
Hermaness National Scenic Area	High	High	High
Haroldswick and Skaw, Local Landscape Area	High/Medium	Medium	Medium

Baseline Visual Resources

13.5.52 A key component of the assessment is the consideration of effects from key locations within the EZI. This assessment is undertaken through analysis of visibility mapping and confirmation of the extent of visibility, through the preparation of wireframes and use of these in the field in combination with photomontages.

Settlements

13.5.53 Settlement within the EZI is located in sheltered locations close to sheltered voes and sounds, typically comprising open settlements and dispersed aggregations of crofts.

13.5.54 In accordance with the criteria outlined in the detailed methodology in Appendix 13.1, residential receptors within settlements have a high susceptibility to change as views are experienced regularly for prolonged periods. Residential receptors are generally considered to have a high sensitivity overall to the Proposed Project.

13.5.55 The following table lists the principal areas of settlements into the zone of theoretical visibility of the Proposed Project where significant effects may arise, as illustrated in Drawings 13.2.1-13.2.2. and identifies those settlements which require further assessment.

Table 13.5 - Summary of Settlements within the Zone of Theoretical Visibility

Settlement	Distance and Direction to Proposed Project	Theoretical Visibility of the Proposal
Within 5 km of the Launch Pads		
The Haa, Skaw	c.750 m to Proposed Project boundary	No visibility.
Booths/Houlanbrindy	c.660 m to Proposed Project boundary	Partial visibility to the integration hangar/TEL building, boundary fencing, tracking station, LVs and lightning masts.
Norwick/Kirkaton	c.1.2 km to Proposed Project boundary	Partial visibility to the gate house, LSPF, boundary fencing, tracking station, integration hangar/TEL building, LVs and lightning masts.
Valsgarth/Saxa Vord	c.2.3 km to Proposed Project boundary	Partial visibility to the gate house, LSPF, boundary fencing, tracking station, integration hangar/TEL building, LVs and lightning masts.
Haroldswick	c.3.2 km to the Proposed Project boundary	No visibility.
Ungirsta/Stove	c.3.5 km to the Proposed Project boundary	No visibility.
Within 10 km of the Launch Pads		
Burrafirth Cluster	c.4.36 km to Proposed Project boundary	No visibility.
Quoys	c.4.46 km to Proposed Project boundary	Uninhabited.
Baltasound Cluster (closest location at bus garage)	c.5.29 km to Proposed Project boundary	No visibility.
Within 15 km of the Launch Pads		
Westing Cluster	c.13.4 km to Proposed Project boundary	No visibility.

Routes

13.5.56 Vehicular and non-vehicular route corridors within the EZI, include roads and designated cycle routes. The following table lists route corridors within 15 km of the Proposed Project, falling within the zone of theoretical visibility, as illustrated in Drawings 13.2.1-13.2.2. The table identifies which routes or parts of routes require further assessment.

Table 13.6 - Review of visibility from Routes within the EZI

Route	Theoretical Visibility of the Proposal
A968 (National Cycle Route 1)	No visibility to Proposed Project; no visibility south of Hagdale.
B9086	Intermittent visibility from higher ground around Ungrista to Proposed Project; limited visibility elsewhere - Included in the detailed assessment.
B9087 (National Cycle Route 1)	Extensive visibility north of Valsgarth/Saxa Vord to the Proposed Project- Included in the detailed assessment.

Viewpoint Selection

13.5.57 Viewpoints for the visual assessment were identified following production of the ZTV and a list of viewpoints were selected and confirmed with consultees as part of the scoping exercise, as summarised in Section 13.3. The types of receptors considered included the following:

- different LCTs/CCAs/SCAs;
- designated and other sensitive landscapes;
- settlements (towns and villages, as well as smaller groups of residential properties);
- roads (main and minor);
- footpaths and cycle routes including Core Paths and the National Cycle Network (NCN) Routes;
- marked/ popular viewpoints;
- other outdoor recreational resources (including frequently visited historical and archaeological sites); and,
- visitor/ tourist facilities such as camp sites, hotels and visitor attractions.

13.5.58 In order to confirm the appropriateness of the viewpoint selection, field survey verification was carried out. This involved checking the viewpoint grid references on the ground, to ensure that there will be views of the Proposed Project from these locations.

13.5.59 The viewpoints taken forward for full assessment include 21 viewpoints that cover a range of representative landscape and visual receptors, distances from the Proposed Project, altitudes and directions, with the aim of achieving a reasonable distribution at compass points around the application site. Viewpoints were visited as part of the baseline visual assessment, and panoramic photographs of the existing views were taken. The final list of viewpoints, agreed through written correspondence with Shetland Islands Council and SNH, is shown in Table 13.7, and their locations are illustrated in Drawing 13.1.4. Photographs of the existing views from these viewpoints are shown in Drawings 13.3.10.1 – 13.3.2.5. The existing and predicted views of the Proposed Project are described in the assessment of effects in Section 13.8.

Table 13.7 – Selected Viewpoints

No.	Viewpoint Location	Distance and Direction to Proposed Project	Receptors	Grid Reference
Viewpoints to the Proposed Project				
1.1	Bluejibs above the Wick of Skaw	1.1 km to the south.	Local Landscape Area and recreational walkers, representative of views from the north-east coast of Unst.	466309, 1216806
1.2	The Haa, Wick of Skaw	860 m to the south.	Local Landscape Area and residential settlement.	465968, 1215187
1.3	The Garths, Lamba Ness	320 m to the east.	Local view to the launch pads.	465405, 1215187
1.4	Car park at The Taing, Norwick	800 m to the north east.	Local Landscape Area and residential settlement.	465172, 121459
1.5	The cemetery, Norwick	1.2 km to the north.	Local Landscape Area and residential settlement.	465188, 1214128
1.6	B9087 Norwick	1.6 km to the north east.	Local Landscape Area and residential settlement.	464872, 1213830
1.7	Hill of Clibberswick	2.4 km to the north.	Local Landscape Area and recreational walkers.	466351, 1212904
1.8	Hermaness Hill	5.32 km to the east.	National Scenic Area, Recreational walkers.	460648, 1217592
1.9	Lay by on A968 above Harold's Wick	4.4 km to the north east.	Road users and cyclists on NCR1. Recreational walkers.	463144, 1210817
1.10	Headland to the north of Saxa Vord radar station	3.3 km to the east.	National Scenic Area, Recreational walkers.	462970, 1217656

Other Baseline Built/ Consented Infrastructure

13.5.60 At the time of writing, other significant infrastructure development within the 15 km EZI is confined to the recent reactivation of the Saxa Vord remote radar head. The Royal Air Force radar station is named after Saxa Vord which is the highest hill on Unst at 285 m AOD. The infrastructure at Saxa Vord includes the remains of the Saxa Vord radar station built in 1941, the access tracks, the associated radar infrastructure to the north of Saxa Vord and to the east at the Ward of Norwick, and the former RAF camp and domestic accommodation buildings at Valsgarth/Saxa Vord which are now privately owned as the Saxa Vord Resort complex. The remains of the former Skaw Radar Station, also built in 1941, are scattered across the peninsula of land between Inner Skaw and Lamba Ness, comprising the Skaw scheduled monument site. As this infrastructure is already part of the current landscape and visual baseline resource it is considered as an integral part of the baseline within the main assessment of landscape and visual effects in Sections 13.7 and 13.8.

13.6 Assessment of Effects

13.6.1 This section comprises the assessment of the effects on landscape and visual resources arising from operation of the Proposed Project. The effects can be thought of as 'residual' effects because they take into account embedded mitigation measures included already in the previous design and construction stages of the Proposed Project, as summarised below.

Existing 'Embedded Mitigation

13.6.2 Design iteration of the Proposed Project was undertaken as part of the LVIA at the planning stage to reduce the visual effects. The assessment for AEE has, therefore, been completed taking into account the following embedded mitigation measures.

Topography and Landform

13.6.3 The buildings and roads will be sited to minimise the requirement for major ground modelling thereby reducing the extent of earth moving and the need to alter the existing landform within the site. This will have the added benefit of reducing, or indeed, negating the need to remove surplus material from the site.

Massing and Form

13.6.4 Through careful site planning an integrated relationship has been developed between the proposed buildings and infrastructure and the existing site roads and former radar infrastructure, which are listed as scheduled monuments, to create a simple harmony that builds on the existing grain of the landscape and fits the Proposed Project sensitively between existing structures.

13.6.5 Visual integration will be secured through orientation, positioning of buildings and structures, profile, colour and facade treatments, design detailing, use of materials, use of land profiling, all selected to give cohesion to the Proposed Project and create an appropriate response to the components of the surrounding landscape and be seen as an appropriate addition in the context of the existing site elements and infrastructure. A summary of the development and design strategy for the main building groups is set out below.

Inner Skaw Assembly Building Cluster

13.6.6 The western sector of the Lamba Ness site at Inner Skaw is set aside for a cluster of buildings which will form the entrance area to the Proposed Project. A new gate house will control access to the site at the western limit of the site and will also provide visitor facilities and information about site access and interpretation. Access will lead from this point from an upgraded road following the existing track to provide general site access. A new side road will lead to an area set aside for the LV assembly and the storage of materials with associated hard standings. This cluster of buildings will include: an administration building, 6 m high and with a footprint of c. 20 m x 20 m; two adjacent large hangars (forming the LSPF) rising to c. 13 m, with a footprint each of c. 29 m x 63 m; a small pyrotechnics store; a hazardous Materials Store 5 m high, with a footprint of 13 m x 13 m; and a small substation.

13.6.7 The detailing of the gate house differs slightly from the hangar and storage buildings to draw it apart from the main cluster, and to foster a sense of arrival and welcome to the site.

Satellite Tracking Station

13.6.8 Mid-way along the site, a satellite tracking station is proposed. This will include an area of hardstanding and four separate telemetry devices, housed within geodesic radomes.

TEL Hangar

13.6.9 The transporter holding building, a large hangar rising to c.14 m, with a footprint of c.61 m x 41 m, will be located to the south of the three launch pads and the main access track. The hangar is linked to the launch pads through the upgraded access track and the new tracks leading to each of the separate launch pads.

Launch Pads

13.6.10 Three separate launch pads are proposed. Launch Pad 1 will be positioned to the northern side of the Lamba Ness peninsula, carefully set between the structures of the radar station. Some of the former radar station structures will need to be carefully removed to accommodate the new launch pad structures. Two more launch pads are proposed on the northern side of The Garths, spaced approximately 180 m apart and integrated as far as possible between the substantially retained structures of the former radar station.

13.6.11 Each launch pad will comprise a central area of hard standing flanked by earth sheltered gabion walls which shelter further areas of hardstanding where temporary control buildings, storage containers and fuel stores will be placed during the course a launch cycle. When the launch pad is not in use these temporary building and containers will not be present on the site.

13.6.12 The launch pad will have at its centre a simple permanent pedestal and gantry to receive the launch vehicle. The apparatus used during the launch cycle to erect the launch vehicle will be brought to site as mobile and temporary equipment for each launch.

13.6.13 Permanent lightning masts will be positioned either side of the launch pad, comprising telescopic towers which will be extended during a launch to their operational height of 46 m. At all other times the lightning masts will be retracted to their un-extended configuration of 25 m. As with other permanent structures on the site they will be finished in a recessive grey colour.

13.6.14 Adjacent to each launch pad will be a water tank / pump house to deliver water inundation during each launch cycle. The dimensions, base heights and overall heights for the structures are as follows: water tank 4 m x 4 m x 2 m high located at ground level; pump house 10 m x 6 m x 4 m high (to apex).

13.6.15 The earth sheltered bunds comprise a grassed earth bund on the inner face and rock filled gabion walls on the outer faces. The grassed faces will be vegetated with grass turves won from the site. The gabion walls will be filled with locally won rock to ensure effective integration with the surrounding rock type seen in the surrounding landscape and coastline. These measures will ensure that the simple structure of the launch pad sites will recede in views against the wider setting and marry in with the existing structures of the former radar station.

13.6.16 A wildlife hide is proposed to the east of Launch Pad 3 on the eastern edge of Lamba Ness.

Colour

13.6.17 The clusters of new buildings at Lamba Ness will be given unity by use of similar colour themes and colour palettes that draw upon colours seen in buildings across Unst and natural colours occurring within the local Unst landscape. The red hues proposed in buildings are based on those colours seen in the: minerology of the landscape; the tan colours of the surrounding grassland and cut hay meadows; and in local buildings such as the painted barns and the large hangar at Baltasound Airport.

13.6.18 The graduation of colours in the elevations is intended to assist in breaking up the elevations of the larger buildings, with a transition from red, through tan, to the cool grey tones seen in the fast-moving cloudscape, a colour which will also be seen reflected in the foreground of the surrounding seascape.

Lighting

13.6.19 Lighting has been considered as an important element of the Proposed Project. Potential light sources will be associated with flood lighting for the launch pads during launch cycles and cut off lighting within the new network of external spaces around the proposed buildings, including car parking areas.

13.6.20 A sympathetic lighting strategy will be prepared within the context of the design of the buildings to minimise any potential adverse effects. A number of measures will be introduced within the context of the operational requirements of the site to minimise the unwanted effects associated with light sources. These will include:

- Cowls/shielding of lights to prevent glare;
- Minimisation of light spread through the use of directional lighting;
- Minimising the potential for sky glow by avoiding the potential for upward reflected light;
- Reducing the operational hours of the lighting to reduce the potential for disturbance; and,
- In some areas, intelligent dimming technology may be used to activate lighting through activity.

13.6.21 These measures are proposed to minimise light pollution and reduce night-time glare, while providing appropriate night-time illumination within the Proposed Project.

Services

13.6.22 All services associated with the Proposed Project will be routed underground and therefore, any visual effects will be limited to directional flood lighting units.

13.6.23 The site drainage strategy will, subject to the necessary agreements, be based upon roadside filtration trenches which are likely to include a combination of open swales and buried pipes/culverts and sustainable drainage systems.

Assessment of Effects on the Landscape Resource

13.6.24 The landscape resource is the distinctive physical pattern of components and features that combine to form and characterise the landscape. The effects of the Proposed Project on this resource are those that will directly alter this physical pattern and will thus have an effect on the character of the landscape. These effects will occur within the landscape character area in which the Proposed Project is located. Beyond this, changes to the landscape character will be confined to indirect changes to the landscape resource. The assessment of the effects on the landscape resource is subdivided into direct effects on the landscape resource and indirect effects on landscape character.

13.6.25 The following assessment of landscape effects addresses:

- Effects on the application sites;
- Effects on Landscape Character; and,
- Effects on Designated Landscapes

13.6.26 Identification of the potential for significant effects has been undertaken following a review of the visualisations provided in Drawings 13.3.1.1 to 13.3.2.5. This is in addition to comprehensive field work assessment and the use of computer-generated visualisations in order to inform the judgements made by the landscape professional undertaking the assessment.

Duration and Reversibility of the Landscape and Visual Effects

13.6.27 The magnitude of changes that will be experienced by receptors as a result of the Proposed Project relates in part to the duration of effects and their permanence/reversibility. The effects will be permanent on completion of the Proposed Project.

Effects During a Launch Sequence

13.6.28 The assessment of effects set out below is based on the configuration of the Proposed Project and its associated landscape and visual effects during the day to day operation of the Proposed Project.

During the run up to and the launch of LVs, there will be a range of additional landscape effects experienced during run up to and 'take off' sequence of a launch. These effects will largely be associated with the launch of the LV itself however, it is acknowledged that at certain times of year, and particularly during the summer tourist season, the launch of a LV in itself will be a notable attraction for tourists and visitors to Unst. Therefore, there are also likely to be additional short-term landscape and visual effects deriving from the attraction of visitors and associated traffic during their visits to the area.

Typical Characteristics of a Launch Sequence

13.6.29 Prior to the launch, temporary vehicles and containers will be moved into position within the earth sheltered areas of hard standing, beside the launch pad. As the LV is prepared for launch the LV will be taken, from the Integration Hangar/TEL building, to the launch pad, on a mobile transporter-erector-launcher, which will erect the LV into a vertical position at the launch pad. The LV will be held in place with a 'strongback', a metal structure that supports the LV in an upright before it launches. In the same period the lighting masts will be extended to their maximum length. Close to the launch, as various propellants and fuels are loaded into the LV, there will be additional effects arising through the emission of occasional vapours from the LV and surrounding equipment, as well as the presence of activity and lighting. The LV may be at the launch pad for several days prior to launch and the LV and launch pad and surrounding structures will be brightly illuminated at night.

13.6.30 The launch of the LV itself will be very short in duration and give rise to a range of very short term but significant and widespread landscape and visual effects. As the LV ignites, a process of water inundation is commenced as a measure to both reduce the roar of the LV but also to protect the LV from its own flames. The resulting interaction of the flames and water will give rise to a localised plume of water vapour and smoke at the base of the launch pad. This will quickly dissipate after take-off and is expected to flow away to the north-east given the predominant wind direction.

13.6.31 The launch itself will be very quick, with the LV moving above the strongback within c.3 seconds of the initial LV firing, the overall noise and emissions reaching a peak up to 10 seconds into the launch, immediately reducing thereafter. The LV will be seen to speed away from the launch site, reaching an altitude of c.1 km after approximately 23 seconds into the launch, and c.2 km after approximately 30 seconds. There may at times be a visible trail or plume from the LV, however, it is expected that the principal feature of the lift -off will be the rapidly ascending cone of super-heated exhaust gases, immediately beneath the LV.

13.6.32 The short-term effects of the actual launch will give rise to significant very short-term effects on landscape and visual receptors with primary visibility extending across northern areas of Unst, largely coincident with the landscape and visual receptors reviewed in the assessment of operational effects. However, it is acknowledged that the LV itself will be visible for much greater distances for a very short period of time as it rises through the lower atmosphere. The trajectory of the launch will arc away from the Shetland Islands to the north across the North Sea and therefore direct visibility will rapidly decay.

13.6.33 These significant effects will give rise to short term changes in qualities of tranquillity experienced within the EZI, giving rise to very short-term disturbance. It is noted that the EZI is characterised by its wild remote qualities, the experience of tranquillity and the ability to 'get away from it all', and that many people living within and visiting the EZI choose to visit and live here to find an escape.

13.6.34 The frequency of launches will increase once all three launch pads are operational, and whilst individual launches will be well separated, there will be an overall cumulative effect on general tranquillity within the EZI. As such, whilst the effects of an individual launch will be short lived, it is noted that there will be an ongoing requirement to inform and consult on issues arising from launch sequences.

13.6.35 Following the launch, the strongback will be lowered and removed back to the TEL Hangar, the lightning masts retracted, and the temporary vehicles and containers removed from the launch pad site. The launch pad is expected to return to its normal configuration within a few days after launch.

Visitors

13.6.36 As discussed above, in the days running up to launches during the tourist season, there are likely to be a greater number of visitors to the surrounding area in the immediate few hours before and after a launch. This will give rise to short term effects of increased traffic and pedestrian movement, pressure for temporary car parking and localised aggregations of spectators. A Visitor Management Strategy has been developed by the Applicant.

13.6.37 Whilst the effects will be temporary, the increased visitor pressure will inevitably give rise to secondary localised landscape and visual effects at publicly accessible vantage points around the Proposed Project.

Assessment of Direct Effects on the Landscape Resource

Location

13.6.38 The baseline assessment identifies the gently sloping peninsula of land between Inner Skaw and Lamba Ness as the context for the Proposed Project forming the Proposed Project.

13.6.39 The main land use on the site is as pasture for sheep grazing, with subdivision by stock proof fencing and sections of drystone dyke into a series of large fields. Steep cliffs surround the coastal edge of the site, with a small area of the northern site shelving to a small beach at the Sand of Inner Skaw.

Landscape Sensitivity

13.6.40 It is considered that the sensitivity of the Landscape to change is Medium. The factors which have contributed to this judgement are as follows:

Value

13.6.41 Medium/High: The site lies within the Haroldswick and Skaw Local Landscape Area. The site area encompasses the Skaw Radar Station scheduled monument site.

Susceptibility to Change

13.6.42 The simple grassland across the site is not a scarce resource in this area and can accommodate the level of change proposed however, areas of wetland and the remaining structures within the scheduled monument sites are vulnerable to change and will be protected where possible.

Magnitude of Change

13.6.43 The overall magnitude of change to the existing landscape fabric across the site will be Substantial. The factors which have contributed to this judgement are set out below.

Size or Scale

Inner Skaw Assembly Building Cluster

13.6.44 The western sector of the Lamba Ness site at Inner Skaw is set aside for a cluster of buildings which will form the entrance area to the Proposed Project. This will include: a Gate house, 6.3m high, with a footprint of 17 m x 17 m; an administration building, 6 m high and with a footprint of c. 20 m x 20 m; two adjacent large integration hangars (comprising the LSPF) rising to c.13 m, with a footprint each of c. 29 m x 63 m; a small pyrotechnics store; a hazardous Materials Store 5 m high, with a footprint of 13 m x 13 m; c.3,250 m² of hard standing; and a small electricity substation.

Satellite Tracking Station

13.6.45 Mid-way along the Proposed Project, a Satellite Tracking Station is proposed. This will include an area of hardstanding and four separate telemetry devices, housed within geodesic radomes.

TEL Hangar

13.6.46 The transporter holding building, a large hangar rising to c.14 m, with a footprint of c.61 m x 41 m, will be located to the south of the three launch pads and the main access track.

Launch Pads

13.6.47 Three separate launch pads are proposed, one at Lamba Ness and two on the northern side of The Garths.

13.6.48 Each launch pad will comprise a central area of hard standing flanked by earth sheltered gabion walls which shelter further areas of hardstanding where temporary control buildings, storage containers and fuel stores will be placed during the course a launch cycle. Each launch pad extends to a footprint of approximately 100 m x 100 m.

13.6.49 A wildlife hide is proposed at the eastern edge of Lamba Ness to the east of Launch Pad 3.

Access Tracks

13.6.50 The disparate elements of the Proposed Project will be connected by an upgraded access track, which will predominantly follow the alignment of the existing track, with some further sections of new track connecting the launch pads, etc.

Geographical Extent

13.6.51 The Proposed Project occupies an area of approximately 80.8 ha.

Significance of Effect

13.6.52 The combination of the individual judgements of Medium sensitivity and Substantial magnitude of change on the landscape fabric of the site at the operational stage of the Proposed Project, are considered to result in a Major/Moderate effect, which in the context of this assessment is considered to be Significant. As discussed in the methodology, not all change is adverse and whilst the Proposed Project represents a significant effect upon the landscape resources of the site area, the Proposed Project is considered to represent a positive change to the existing landscape.

Assessment of Effects on Landscape Character and Designations

13.6.53 People's perceptions of the effects of development on landscape character and designated or other relevant landscape areas are closely related to the potential extent and nature of visibility of the development and ancillary infrastructure. An overview of the nature of the visibility of the Proposed Project (the components most likely to be visible) within the EZI is therefore provided below.

General Appraisal of Visibility

13.6.54 The potential visual influence of the Proposed Project is closely related to a range of parameters, which include position, elevation, and distance. Due to the position of the Proposed Project on the promontory of land at Lamba Ness, which extends c.2.5 km eastwards into the North Sea between the Blue Jibs peninsula to the north and the headland at the Hill of Clibberswick to the south, the Proposed Project will be seen locally in oblique views to the peninsula. It is considered that within 3 km, where terrain allows, the proposed hangar buildings which rise to c. 14 m, the LVs when temporarily in launch configuration rise up to c.30 m, and the lightning masts which in their operational extended configuration extend to 45 m, will be the most clearly visible elements in the landscape. Although they may not necessarily be intrusive or prominent, these components of the Proposed Project have the potential to be an important and/ or readily noticeable element in the landscape.

13.6.55 The network of local hills and headlands including the Ward of Norwick to the west, 186 m AOD, Ritten Hamar to the north-west, 132 m AOD, Housi Field to the south-west, 122 m AOD, and the Hill of Clibberswick to the south, 160 m AOD, together define a relatively tight visual envelope to the landward side. Visibility to the east is unrestricted and extends across the sea to the apparent horizon.

13.6.56 Local visibility encompasses the settlement at Norwick including the beach and houses close to the Taing and extends along the valley of the Burn of Norwick to include the northern edges of Valsgarth and the former RAF buildings at Saxa Vord. To the north, partial visibility is indicated around the isolated farmstead at Skaw.

13.6.57 Beyond this inner core area of visibility, the Proposed Project will recede in views and be seen as a component in the wider landscape, becoming less distinct, and appearing as distant new elements set in the context of wider views.

13.6.58 To the north-west visibility extends across the upland flank on the eastern side of Saxa Vord, 284 m AOD.

13.6.59 A narrow band of visibility extends to the south-west, to the north of the ridge of land at Valsgarth, across areas of lower lying farmland, encompassing the scattered farmsteads between Ungirsta, Stove, and Quoys. The rising ridge of land to the south west, Crussa Field and Muckle Hoeg, which form the backdrop to the lower lying farmland, define strong containment to views to the south.

13.6.60 Smaller patches of more distant visibility are picked up on the higher ridge of land at Valla Field to the south west, including the uplands at Houllna Gruna 153 m AOD at c.8 km and beyond 10 km the Ward of Houlland, 156 m AOD, and the Byre of Scord, 216 m AOD.

13.6.61 Drawings 13.2.1 - 13.2.2 indicate the zone of theoretical visibility of the Proposed Project within a 15 km radius, based on the maximum potential visibility of the Proposed Project during the launch configuration and the baseline visibility of the Proposed Project when not in operation.

Assessment of Effects upon Landscape, Coastal and Seascape Character Areas (LCTs/CCAs/SCAs)

13.6.62 This section assesses effects upon LCTs/CCAs/SCAs within 15 km of the Proposed Project, as defined in the Scottish Landscape Character Types Map and Descriptions Online (SNH, 2020), the Shetland Coastal Character Assessment, 2016, and Scottish Seascape Areas defined in the NatureScot Report No.103, 2005.

13.6.63 The location of the LCTs/CCAs/SCAs is presented in Drawing 13.1.3. The ZTV of the Proposed Project overlaid with the LCTs/CCAs/SCAs and landscape designations is shown in Drawings 13.2.1 - 13.2.2 to a 15 km limit. The visibility indicated within these Drawings is derived from computer modelling and represents a bare-earth environment, i.e. the modelling does not include built development or localised changes in landform, all of which may screen the development, either in full or in part.

13.6.64 Areas of landward visibility beyond 15 km are very limited, due to the screening effects of landform. It is not considered that the resulting changes to perception of landscape character could give rise to significant effects beyond 15 km, and therefore no further assessment of LCTs/CCAs/SCAs beyond 15 km has been made.

13.6.65 This section describes the operational and in-combination effects resulting from the Proposed Project on the nine landscape, coastal and seascape character areas, as identified in the baseline in Table 13.3, where potentially significant effects may occur, as set out in Tables 13.8 – 13.16.

Table 13.8 Effects on LCT 349 Major Uplands

Location
The landscape character type covers the three main areas of uplands on Unst, at Saxa Vord, Hermaness and Valla Field. The western sector of the Proposed Project located within the LCT. The Hermaness and Valla Field sub-units are located at distances of 4 km and 8.2 km, respectively.

The following development, which is within the LCT, currently influences the existing baseline landscape character within the core 15 km EZI:

- Saxa Vord Radar Station.
- Remnants of the former Skaw Radar Station at Inner Skaw – Lamba Ness.

Determination of Landscape Sensitivity

The sensitivity is considered to be **High**. The factors which have contributed to this judgement are as follows:

Value - High

- Hermaness NSA; and,
- Part of the Haroldswick and Skaw LLA.

Susceptibility to Change – High to Medium

- Very large-scale landscape;
- Long exposed mountain with steep sides;
- Low moorland vegetation; and,
- Perceptual Qualities: sense of remoteness due to the limited road access and settlement. Open and exposed.

Magnitude of Change

The magnitude of change to the Major Uplands LCT caused by the introduction of the Proposed Project is considered to be **Substantial** locally within the site at Inner Skaw and across the eastern flank of the Ward of Norwick, reducing over distance to **Slight** on the eastern flank of Saxa Vord Hill, and Negligible within the Hermaness and Valla Field sub units of the LCT. The factors which have contributed to this judgement are as follows:

Size or Scale

The landscapes of the Major Uplands are characterised by expansive views experienced from the exposed summits and flanks. From the eastern flanks of the Ward of Norwick and Saxa Vord, the Proposed Project will be seen below as a new large-scale man-made feature in the landscape, extending across the headland at Lamba Ness. Closer to the site and from the minor road crossing the peninsula the large hangar buildings will appear as angular structures rising above the coastline, though the careful use of colour will assist in reducing their overall bulk.

The prominence of the Proposed Project buildings and infrastructure will vary with light conditions, often receding during reduced light conditions or during haze but, more visible on clear sunny days. The Proposed Project will be viewed in the context of the large-scale, expansive character of the landscape, and will form a visible addition to the landscape in views east, introducing clusters of new development within the context of the existing structures and track of the former Skaw Radar Station, influencing the perception of scale in wider views.

During the short duration of launch cycles at the individual launch pads, the extended lightning masts, the LV and the supporting strong back will be visible as additional vertical structures. However, within the context of the expansive views from the LCT, these elements will have only a limited additional influence.

The Proposed Project will not alter the openness and expansive nature of views from the uplands and will not substantially affect views between hills within the interior of the island or the visual relationships to the surrounding coastlines. However, some views immediately adjacent to the Proposed Project will be interrupted by the large new vertical structures.

Geographical Extent

The ZTV indicates that there will be visibility from the east facing flanks of the Ward of Norwick, Saxa Vord and Housi Field. There will be small areas of distant influence on the landscape at Houllna Gruna, the Ward of Houlland and the Byre of Scord, marking the higher points along the southern extent of the ridgeline at Valla Field, to the west of Unst, which intersects with a band of distant visibility. There will be no visibility from the western areas of the LCT. Viewpoint 1.3, Drawing 13.3.3 illustrates a local view from the minor road crossing to the west of the site beneath the Ward of Norwick.

Significance of Effect

The combination of the individual judgements of **Medium/High** sensitivity and a locally **Substantial** magnitude of change from Inner Skaw and the eastern flank of the Ward of Norwick are considered to result in a **Major/Moderate** local effect on the perception of the landscape, which in the context of this assessment is considered to be **Significant**.

Elsewhere effects on the LCT will give rise to no greater than a **Slight** magnitude of change, with a **Moderate/Minor** and Not Significant effect on the perception the landscape.

With distance and the topographic screening by the hills, the influence of the Proposed Project will reduce and will not give rise to any further significant effects on this LCT.

Table 13.9 Effects on LCT 350 Peatland and Moorland

Location

The landscape character type covers areas of rocky heather moorland areas of uplands on Unst, including the Hill of Clibberswick to the south and the ridge line between Muckle Heog and Crussa Field to the south-west, located at distances of 1.2 km and 4.3 km, respectively.

The following development, which is within the LCT, currently influences the existing baseline landscape character within the core 15 km EZI:

- Telecommunications masts at Muckle Heog.

Determination of Landscape Sensitivity

The sensitivity is considered to be **Medium**. The factors which have contributed to this judgement are as follows:

Value - Medium

- Part of the Haroldswick and Skaw LLA.
- Part of the Colvadale and Muness LLA.

Susceptibility to Change – Medium

- Medium-scale landscape, contrast between contained internal views and expansive coastal views, with few reference points or features against which to judge scale and perspective; and
- Low moorland vegetation.

Magnitude of Change

The magnitude of change to the Peatland and Moorland LCT caused by the introduction of the Proposed Project is considered to be **Moderate** from the north facing flank of the Hill of Clibberswick. There will be Minor influences, on both the north facing flanks of the ridgeline between Muckle Heog and Crussa Field, and from the Keen of Hamar. There will be more distant Negligible influences on the Hill of Colvadale. The factors which have contributed to this judgement are as follows:

Size or Scale

These lower hills provide vantage points across the adjacent lowlands. The open simple character of the moorlands contrasting abruptly with the settled coastlines and cultivated lowlands. The introduction of new built form on the peninsula is consistent with the prevailing character and whilst the new built forms will be noticeable, influencing the perception of scale in closer views, they will be experienced within the context of the modified lowlands and against the expansive views across hills and coastlines. The careful use of colour will assist in assimilating the new built form.

During the short duration of launch cycles, the extended lightning masts, the LV and the supporting strong back will have only a limited additional influence.

Geographical Extent

The ZTV indicates that there will be visibility from the north facing flanks of the Hill of Clibberswick at c.1.6 km. There will be areas of visibility from both the north facing flanks of the ridgeline between Muckle Heog and Crussa Field at c.4.5 km, and from the Keen of Hamar at c.5.5 km. There will be more distant Negligible influences on the Hill of Colvadale at 8.5 km, to the south of Baltasound, where parts of the LSPF will be seen at Inner Skaw. Viewpoint 1.7, Drawing 13.3.1.7 from the Hill of Clibberswick is representative of the typical views within this LCT, at c.2.8 km from the Proposed Project.

Significance of Effect

The combination of the individual judgements of **Medium** sensitivity and a locally **Moderate** magnitude of change from the Hill of Clibberswick are considered to result in a **Moderate** local effect on the perception of the landscape, which in the context of this assessment is considered to be **Not Significant**.

Elsewhere effects on the LCT will give rise to no greater than a **Slight** magnitude of change, with a **Minor** and **Not Significant** effects on the perception the landscape.

Table 13.10 Effects on LCT 352 Inland Valleys

Location
Within the EZI the Inland Valleys landscape character type includes the area of incised land form, located to the south of Burrafirth and encompassing the lands around the Loch of Cliff, and the continuation of the same feature to the south lying to the east of Valla Field.
Determination of Landscape Sensitivity
The sensitivity is considered to be **Medium**. The factors which have contributed to this judgement are as follows: *Value - Medium* ➢ A small part of the Shetland NSA. *Susceptibility to Change – Medium* ➢ Medium scaled landscapes with channelled views, contained by the adjoining uplands; and ➢ Simple palette of land uses and limited settlement.
Magnitude of Change
The magnitude of change to the Inland Valleys LCT caused by the introduction of the Proposed Project is considered to be **Negligible** across the north-east facing flank of Houllna Gruna. The factors which have contributed to this judgement are as follows: *Size or Scale* The hill flanks surrounding the incised valleys reveal extended views to the adjacent lowlands. The simple character of the Inland Valley gives way to diverse settled landscapes of the coastlines and cultivated lowlands beyond. The introduction of new built form on the peninsula will be seen within the diverse landscapes beyond the Inland Valleys in distant views experienced within the context of the modified lowlands. The careful use of colour will assist in assimilating the new built form into the landscape. During the short duration of launch cycles, the extended lightning masts, the LV and the supporting strong back will have only a limited additional influence. *Geographical Extent* The ZTV indicates that visibility will be limited to the north-east facing flank of the hill slope at Houllna Gruna, over at c.7.5 km.
Significance of Effect
The combination of the individual judgements of **Medium** sensitivity and a **Negligible** magnitude of change from the north-east facing flank of the hill slope at Houllna Gruna are considered to result in a **Minor** local effect on the perception of the landscape, which in the context of this assessment is considered to be **Not Significant**.

Table 13.11 Effects on LCT 353 Farmed and Settled Lowlands and Coast

Location
Within the EZI the Farmed and Settled Lowlands and Coast landscape character type includes the areas farmland at Skaw, on the west of the island of Balta, at Woodwick on the west coast and along coastal edge of Colvadale.
Determination of Landscape Sensitivity
The sensitivity is considered to be of **High - Medium**. The factors which have contributed to this judgement are as follows: *Value - Medium* ➢ Colvadale and Muness, Local Landscape Area ➢ Haroldswick and Skaw, Local Landscape Area *Susceptibility to Change – High-Medium* ➢ This landscape is characterised by a small-scale crofting landscape, strongly associated with the sheltered voes and neighbouring uplands. ➢ The limited modern development and significant historic interest in this landscape, lend a higher degree of sensitivity.
Magnitude of Change
The magnitude of change to the Farmed and Settled Lowlands and Coast LCT caused by the introduction of the Proposed Project is considered to be **Moderate** at Skaw reducing to **Negligible** on the eastern side of the island of Balta. The factors which have contributed to this judgement are as follows: *Size or Scale* The open coastal grazing lands at Skaw are open to views to the headlands to the north and south of the Wick of Skaw which contribute to a diverse setting. The introduction of new built form on the peninsula to the south will be partially seen as new elements beyond the immediate setting of Skaw in views to the wider Wick of Skaw, adding new elements along the bounding skyline to the south. During the short duration of launch cycles, the extended lightning masts, the LV and the supporting strong back will have additional influence. *Geographical Extent* The ZTV indicates that visibility will extend across the farmland at Skaw. Very small areas of visibility are indicated in across the southern extent of Balta Island.

Significance of Effect
The combination of the individual judgements of **High-Medium** sensitivity and a **Moderate** magnitude of change from the pastures at Skaw are considered to result in a **Major/Moderate** local effect on the perception of the landscape, which in the context of this assessment is considered to be **Significant**.

Table 13.12 Effects on LCT 354 Farmed and Settled Voes and Sounds

Location
Within the EZI the Farmed and Settled Voes and Sounds landscape character type includes the low-lying settled farmland between Norwick, Haroldswick and Burrafirth, and a further area of settled farmland around Baltasound.
Determination of Landscape Sensitivity
The sensitivity is considered to be of **Medium**. The factors which have contributed to this judgement are as follows: *Value - Medium* ➢ Haroldswick and Skaw, Local Landscape Area ➢ Partially within the Hermaness sub unit of the Shetland NSA however, the area of the LCT within the NSA will experience no intervisibility with the Proposed Project. *Susceptibility to Change – Medium* ➢ This landscape is of a small scale with occasional settlements maintaining the traditional pattern of crofting settlement. There is a strong association with the coastal fringe and significant historic interest. Overall, the LCA has a medium sensitivity to development.
Magnitude of Change
The magnitude of change to the Farmed and Settled Voes and Sounds LCT caused by the introduction of the Proposed Project is considered to be **Moderate** at Norwick reducing to Slight at Valsgarth and **Negligible** further to the west. The factors which have contributed to this judgement are as follows: *Size or Scale* The open coastal settled farmland at Norwick is open to views to the adjoining headland at Lamba Ness and the Hill of Clibberswick to the south which form part of the wider and diverse backdrop to the LCT. The introduction of new built form on the peninsula to the north will be partially seen as new elements beyond the immediate setting of Norwick, adding additional features along the skyline to the north. During the short duration of launch cycles, the extended lightning masts, the LV and the supporting strong back will have additional influence.

Geographical Extent The ZTV indicates that visibility will extend across the farmland at Norwick, with partial fragmented visibility at Saxa Vord, and then distant visibility to the south-west of the LCT. No visibility is indicated around Baltasound.
Significance of Effect
The combination of the individual judgements of **Medium** sensitivity and a **Moderate** magnitude of change from the farmland at Norwick are considered to result in a **Moderate** local effect on the perception of the landscape, which in the context of this assessment is considered to be **Not Significant**. Elsewhere effects on the LCT will give rise to no greater than a **Slight** magnitude of change, with a **Minor** and **Not Significant** effect on the perception the landscape.

Table 13.13 Effects on LCT 355 Coastal Edge

Location
Within the EZI the Coastal Edge landscape character type includes the eastern section of the headland at Lamba Ness, the coastal edge of the Hill of Clibberswick, the north eastern coastline of Unst, The eastern side of Balta Island, the headland at Muness and much of the western coastline of Unst. The following development, which is within the LCT, currently influences the existing baseline landscape character: ➢ Remnants of the former Skaw Radar Station at Lamba Ness and Inner Skaw.
Determination of Landscape Sensitivity
The sensitivity is considered to be of **Medium-High** sensitivity, reducing to **Medium** sensitivity around Lamba Ness and Skaw. The factors which have contributed to this judgement are as follows: *Value - Medium* ➢ Haroldswick and Skaw, Local Landscape Area ➢ Gloup Voe and Bluemull Sound, Local Landscape Area ➢ Colvadale and Muness, Local Landscape Area ➢ Hermaness subunit of the Shetland NSA *Susceptibility to Change – Medium* ➢ This landscape has a rugged and irregular landform made up of complex coastal features. There is an absence of settlement and modern development that lends a higher degree of sensitivity. However locally at Skaw and Lamba Ness the presence of disused radar and defence infrastructure it has a locally low to moderate sensitivity to the Proposed Project.

Magnitude of Change

The magnitude of change to the Coastal Edge LCT caused by the introduction of the Proposed Project is considered to be locally **Substantial** at Lamba Ness, reducing to **Moderate** on the headland to the north at Bluejibs and to **Slight** over distance on the northern flank of the Hill of Clibberswick, and to **Negligible** in very distant partial views from Muness and Saxa Vord Hill sub units of the LCT. The factors which have contributed to this judgement are as follows:

Size or Scale

The landscapes of the Coastal Edge are heavily influenced by their close association with the surrounding coastline and sea. The large hangar buildings and launch pad infrastructure as well as the wildlife hide will extend across the headland at Lamba Ness, with large scale new structures and infrastructure extending across the coastal grasslands.

The prominence of the Proposed Project buildings and infrastructure will vary with light conditions, often receding during reduced light conditions or during haze but, more visible on clear sunny days. The Proposed Project will be viewed in the context of the large-scale, expansive character of the landscape, and will form a prominent addition to the landscape in views east, introducing clusters of new development within the context of the existing structures and the track of the former Skaw Radar Station, influencing the perception of scale in wider views.

During the short duration of launch cycles at the individual launch pads, the extended lightning masts, the LV and the supporting strong back will be visible as additional vertical structures.

The Proposed Project will introduce locally significant change to the headland.

Further afield the presence of new structures will be seen to alter the openness and expansive nature of views however, whilst the influence of the Proposed Project is localised, the landscapes closer to the Proposed Project will be altered by influence by the large new structures.

Geographical Extent

The ZTV indicates that there will be direct visibility across Lamba Ness, from the peninsula to the north at Bluejibs and across the north facing flanks of the Hill of Clibberswick.

There will be a distant influence on the eastern side of Balta Island over 6 km to the south and fragmented partial visibility to the lightning masts only from small areas of the headland to the north of Saxa Vord Hill to the west and from Muness to the south.

Viewpoint 1.1, Drawing 13.3.1.1 from the peninsula above Bluejibs and the Wick of Skaw to the north is representative of the typical nature of close views within this LCT, at c.1.1 km from the application site. Viewpoint 1.7, Drawing 13.3.1.7 illustrates a more distant view from the Hill of Clibberswick. Viewpoint 1.8, Drawing 13.3.1.8 illustrates the very limited partial views to the lightning masts from the headland to the north of Saxa Vord which lies within the Hermaness sub unit of the Shetland NSA.

Significance of Effect
The combination of the individual judgements of **Medium** sensitivity and a locally **Substantial** magnitude of change at Lamba Ness are considered to result in a **Major/Moderate** local effect on the perception of the landscape, which in the context of this assessment is considered to be **Significant**. Effects are reduced by distance to **Moderate** magnitude of change across the headland to the north of Bluejibs however, the sensitivity is **High**, giving rise to a with a **Major/Moderate** effect on the perception of landscape character, which in the context of this assessment is considered to be **Significant**. Elsewhere effects on the LCT will give rise to no greater than a **Slight** magnitude of change, with no greater than a **Moderate/Minor** and **Not Significant** effect on the perception the landscape.

Table 13.14 Effects on CCA 20: Skaw

Location
Within the EZI the Skaw Coastal Character Area runs from the Noup to Lamba Ness characterised by a rocky exposed coastline with small bays. The landscape is mainly heather moorland and coastal grasses ending in cliffs.
Determination of Landscape Sensitivity
The sensitivity is considered to be of **High** sensitivity, reducing to **Medium** sensitivity around Lamba Ness and Skaw. The factors which have contributed to this judgement are as follows: *Value – Medium-High* ➢ Haroldswick and Skaw, Local Landscape Area ➢ Edge of the Hermaness subunit of the Shetland NSA *Susceptibility to Change – Medium-High* ➢ The Skaw CCA is valued for its scenic qualities. The coast is of high sensitivity to the Proposed Project. However locally at Skaw and Lamba Ness the presence of disused radar and defence infrastructure it has a, locally lower, moderate sensitivity to the Proposed Project.
Magnitude of Change
The magnitude of change to the Skaw Coastal Character Area caused by the introduction of the Proposed Project is considered to be locally **Substantial** at Lamba Ness, reducing to **Moderate** on the headland to the north at Bluejibs. The factors which have contributed to this judgement are as follows: *Size or Scale* The Proposed Project will be seen as a new large-scale man-made development, experienced in the context of the expansive coastal views, forming prominent elements in local views. The large hangar buildings and launch pad infrastructure will extend across the headland at Lamba

Ness, with large scale new structures, infrastructure extending across the coastal grasslands and the proposed wildlife hide at the end of the peninsula.

The new development will be seen within the context of the existing structures and the track of the former Skaw Radar Station, influencing the perception of scale in wider views.

During the short duration of launch cycles at the individual launch pads, the extended lightning masts, the LV and the supporting strong back will be visible as additional vertical structures.

Further afield the presence of new structures will be seen to alter the openness and expansive nature of views however, whilst the influence of the Proposed Project is localised, the landscapes closer to the Proposed Project will be altered by the influence of the large new structures.

Geographical Extent

The ZTV indicates that there will be direct visibility across Lamba Ness and from the peninsula to the north at Bluejibs.

Viewpoint 1.1, Drawing 13.3.1.1 from the peninsula above Bluejibs and the Wick of Skaw to the north, at from Viewpoint 1.2, Drawing 13.3.1.2 at Skaw Beach to the north west, are representative of the typical nature of close views within this CCA, at c.1.1 km and 1.2 km from the application site respectively.

Significance of Effect

The combination of the individual judgements of **Medium** sensitivity and a locally **Substantial** magnitude of change at Lamba Ness are considered to result in a **Major/Moderate** local effect on the perception of the coastal character, which in the context of this assessment is considered to be **Significant**.

Effects are reduced by distance to **Moderate** magnitude of change across the headland to the north of Bluejibs however, the sensitivity is **High**, giving rise to a with a **Major/Moderate** effect on the perception of the coastal character, which in the context of this assessment is considered to be **Significant**.

Elsewhere effects on the LCT will give rise to no greater than a **Slight** magnitude of change, with no greater than a **Moderate** and **Not Significant** effect on the perception the landscape.

Table 13.15 Effects on CCA 16: East Unst

Location

Within the EZI the East Unst Coastal Character Area runs from Lamba Ness in the north to Mu Ness in the south.

Determination of Landscape Sensitivity

The sensitivity is considered to be of **High** sensitivity. The factors which have contributed to this judgement are as follows:

Value – Medium

- Haroldswick and Skaw, Local Landscape Area

Susceptibility to Change – High

- Much of the East Unst CCA is devoid of modern development. The coast is of high sensitivity to the Proposed Project.

Magnitude of Change

The magnitude of change to the East Unst Coastal Character Area caused by the introduction of the Proposed Project is considered to be locally **Moderate** on the beaches at Nor Wick around the Taing and the coastline at the northern edge of the Hill of Clibberswick. The factors which have contributed to this judgement are as follows:

Size or Scale

The Proposed Project will be seen as a new large-scale man-made development, experienced in the context of the expansive coastal views, introducing new structures along the headland at Lamba Ness. The large hangar buildings and launch pad infrastructure and the proposed wildlife hide will be partially visible across the headland at Lamba Ness, influencing the perception of scale in wider views.

During the short duration of launch cycles at the individual launch pads, the extended lightning masts, the LV and the supporting strong back will be visible as additional vertical structures.

Further afield the presence of new structures will be seen to alter the openness and expansive nature of views however, whilst the influence of the Proposed Project is localised, the landscapes closer to the Proposed Project will be altered by the influence of the large new structures.

Geographical Extent

The ZTV indicates that there will be indirect visibility across the beaches at the Taing and along the coastal edge to the north of the Hill of Clibberswick. More distant visibility is indicated on the northern sector of Balta Island over c.6 km.

Viewpoint 1.4, Drawing 13.3.1.4 from The Taing at Nor Wick is representative of the typical nature of views within this CCA, at c.800 m from the application site.

Significance of Effect

The combination of the individual judgements of **High** sensitivity and a locally **Moderate** magnitude of change at The Taing and along the coastline north of the Hill of Clibberswick are considered to result in a **Major/Moderate** local effect on the perception of the coastal character, which in the context of this assessment is considered to be **Significant**.

Elsewhere effects on the LCT will give rise to no greater than a **Negligible** magnitude of change, with no greater than a **Minor** and **Not Significant** effects on the perception the landscape.

Table 13.16 Effects on Seascape Character Type 13 D: Islands, Sounds and Voes

Location
Within the EZI the Seascape Character Type 13 D: Islands, Sounds and Voes includes the areas of the North Sea adjoining the farmed and settled coastal lowlands to the east of Unst where a deeply indented coastline creates sounds and voes with fragmented islands. This sub type generally has an insignificant low, hard coastal edge, often appearing smooth and 'submerged'. Voes and sounds form sheltered narrow channels of coastal waters with open, gently sloping hinterland of pasture, rough grazing and scattered crofting. Views over small islands to open sea are often a feature.
Determination of Landscape Sensitivity
The sensitivity is considered to be of High sensitivity. The factors which have contributed to this judgement are as follows: *Value – Medium* ➢ Haroldswick and Skaw, Local Landscape Area *Susceptibility to Change – High* ➢ Development may affect the intricate land/sea relationship and views of outlying islands and the appreciation of the vertical scale of high cliffs where these are present. The perception of remoteness and wildland qualities of some coastal areas and the highly natural character of the outlying islands may also be affected by development.
Magnitude of Change
The magnitude of change to the Seascape Character Type 13 D: Islands, Sounds and Voes caused by the introduction of the Proposed Project is considered to be locally **Moderate** from the seas around the Wick of Skaw, beyond Lamba Ness and from Nor Wick. The factors which have contributed to this judgement are as follows: *Size or Scale* Whilst there be few receptors the Proposed Project will be seen as a new large-scale man-made development in wider seascape, experienced in the context of the expansive coastal views, introducing new structures along the headland at Lamba Ness. The main visible structures will be the large hangar buildings on the headland, influencing the perception of scale in wider views. During the short duration of launch cycles at the individual launch pads, the extended lightning masts, the LV and the supporting strong back will be visible as additional vertical structures. Further afield the presence of new structures will diminish with distance, seen against the open and expansive nature of views. The strong influence of the Proposed Project is localised, limited to the closer inshore seascape which will be altered by the influence of the large new structures. However, the given the strong tidal movements around the headlands and the presence of overfalls which together influence a considerable area of the surrounding sea, for long periods, inshore receptors are limited to periods of rare calmer and benign sea conditions.

Geographical Extent
The ZTV indicates that there will be the potential for extensive visibility from the sea.
Significance of Effect
The combination of the individual judgements of **High** sensitivity and a locally **Moderate** magnitude of change to the inshore waters within the Wick of Skaw, around the headland at Lamba Ness and within Nor Wick, are considered to result in the potential for **Major/Moderate** local effect on the perception of the seascape, which in the context of this assessment is considered to be **Significant**. Effects on seascape will reduce with distance and will give rise to no greater than **Slight** magnitudes of change, with **Moderate/Minor** and **Not Significant** effects on the perception the seascape.

Summary of Effects on Landscape, Coastal and Seascape Character Areas

Table 13.17 lists and summarises effects on Landscape, Coastal and Seascape Character Areas assessed above. It sets out their sensitivity to change, the magnitude of change that will arise as a result of the Proposed Project, and the level of resultant effects and their significance.

Table 13.17 Summary of Effects on Landscape, Coastal, and Seascape Character Areas

Landscape/ Coastal/ Seascape Character Areas	Overall Sensitivity to Change	Magnitude of Change	Level of Effect	Significance
349 Major Uplands	High	Locally Substantial Elsewhere Slight	Locally Major/Moderate Elsewhere Moderate / Minor	Locally Significant Elsewhere Not Significant
350 Peatland and Moorland	Medium	Locally Moderate Elsewhere Slight	Locally Moderate Elsewhere Minor	Not Significant
352 Inland Valleys	Medium	Negligible	Minor	Not Significant
353 Farmed and Settled Lowlands and Coast	High Medium	Moderate	Major/Moderate	Significant
354 Farmed and Settled Voes and Sounds	Medium	Locally Moderate Elsewhere Slight	Locally Moderate Elsewhere Minor	Locally Significant Elsewhere Not Significant

Landscape/ Coastal/ Seascape Character Areas	Overall Sensitivity to Change	Magnitude of Change	Level of Effect	Significance
355 Coastal Edge	High Medium	Locally Substantial (Lamba Ness) Moderate (Blue Jibs) Elsewhere Slight	Major/Moderate (Lamba Ness) Major/Moderate (Blue Jibs) Elsewhere Moderate/Minor	Locally Significant (Lamba Ness and Blue Jibs) Elsewhere Not Significant
CCA 16, East Unst	High	Locally Substantial (Lamba Ness) Moderate (Blue Jibs) Elsewhere Negligible	Major/Moderate (Lamba Ness) Major/Moderate (Blue Jibs) Elsewhere Minor	Locally Significant (Lamba Ness and Blue Jibs) Elsewhere Not Significant
CCA 20, Skaw	High	Locally Moderate Elsewhere Negligible	Locally Moderate Elsewhere Minor	Not Significant
Seascape Character Type 13 D: Islands, Sounds and Voes	High	Locally Moderate Elsewhere Slight	Locally Major/Moderate Elsewhere Moderate/Minor	Locally Significant Elsewhere Not Significant

Assessment of Effects on Designated Landscapes

13.6.66 This section considers the implication of the Proposed Project on designated landscapes falling within the EZI. The designated landscapes listed below have been considered in more detail, following the preliminary analysis of visibility of the Proposed Project, with some designated landscapes having been scoped out of the assessment because of the absence of visibility (see Table 13.4).

- Hermaness sub-unit of the Shetland NSA
- Haroldswick and Skaw, LLA

13.6.67 The analysis cross references to the assessment of landscape, coastal and seascape character, the assessment of visual effects, the assessment of in-combination effects, and has given regard to the special qualities and features for which each receptor has been designated. Designated landscapes are shown on Drawings 13.2.1 – 13.2.2 overlaid with the ZTVs of the respective components of the Proposed Project to a 15 km radius.

Shetland NSA

13.6.68 The Shetland NSA includes seven designated areas. Of these a very small area of the Hermaness sub-unit falls into the zone of theoretical visibility within 15 km of the Proposed Project. The overall special qualities of the Shetland NSA are described within The Special Qualities of the National Scenic Areas, NatureScot commissioned report, 2010, as:

- The stunning variety of the extensive coastline
- Coastal views both close and distant

- Coastal settlement and fertility within a large hinterland of unsettled moorland and coast
- The hidden coasts
- The effects and co-existence of wind and shelter
- A sense of remoteness, solitude and tranquillity
- The notable and memorable coastal stacks, promontories and cliffs
- The distinctive cultural landmarks
- Northern light

13.6.69 Some special qualities are generic to all the identified NSA areas, others are specific to each area within the NSA. For the Hermaness sub-unit the feeling of being at the northern limits of the British Isles is marked, and within the Shetland archipelago these areas have a greater degree of remoteness.

13.6.70 The Hermaness sub-unit of the Shetland NSA includes the following specific special qualities, which are described within the NatureScot report:

- "At Hermaness on Unst, the coastal topography varies from the 175 m high cliffs at the Neap, to the sandy beach and machair at the head of the narrow Burrafirth.
- Cultural landmarks include the western edge of the Hermaness area which contains the northerly military installations in the British Isles at Saxa Vord."

13.6.71 Drawings 13.2.1 – 13.2.2 illustrate the extent of theoretical visibility to the Proposed Project, indicating two very limited areas of visibility, firstly on the summit of Saxa Vord in the context of the existing radar dome over a distance of 2.5 km, and secondly limited visibility to lightning masts only from a very small area of the headland to the north of Saxa Vord Hill, in the context of dismantled radar masts over a distance of 3.3 km. Viewpoint 1.8, Headland to the north of Saxa Vord radar station, Drawing 13.3.1.8 illustrates the nature of views from the headland within the NSA.

13.6.72 The sub-unit of the NSA includes parts of LCT 349 Major Uplands, LCT 355 Coastal Edge, LCT 354 Farmed and Settled Voes and Sounds, CCA 19 Hermaness, and CCA 13 Burrafirth. The assessment of effects on LCTs and CCAs finds no significant effects on these areas within the area of the NSA, and no potential significant additional combined effects. This is due to the screening effects of topography. A Minor (Not Significant) effect was found to affect receptors at Viewpoint 1.8, Headland to the north of Saxa Vord Radar Station, Drawing 13.3.1.8.

13.6.73 A separate Special Landscape Qualities (SLQ) Assessment on the Special Qualities of National Scenic Areas based on the new draft NatureScot Guidance for Assessing the Effects on Special Landscape Qualities Working Draft November 2018, is set out in Appendix 13.5.

13.6.74 In summary, the special qualities of the Special Landscape Qualities of the Hermaness sub area of the Shetland NSA will not be at risk or compromised by the Proposed Project and the overall integrity and objectives of the Shetland NSA will be maintained.

Local Landscape Areas

13.6.75 Designation statements for Local Landscape Areas (LLAs) in Shetland are set out in the Shetland Islands Council Report, Local Landscape Designations Review (LLDR), 2011.

13.6.76 The Proposed Project lies within the Haroldswick and Skaw LLA which comprises the hills and headlands between Harold's Wick in the south and Burra Firth to the north-west, including the Hill of Clibberswick and Saxa Vord. The LLA has been identified with the following Key characteristics:

- *"Part of the most northerly area of Shetland and Britain;*
- *Highly visible military defence infrastructure, including active and disused elements;*

- *Rugged, exposed northern coast, with sheltered sandy bays;*
- *Rich geology visible at the surface;*
- *Actively settled area undergoing redevelopment as former military uses decline and new uses are found."*

13.6.77 The LLA comprises an extensive area of hills and headlands and the north-eastern extent of Unst. Drawings 13.2.1 – 13.2.2 illustrate the extent of theoretical visibility to the Proposed Project, indicating a swathe of visibility across the eastern flank of Saxa Vord Hill and the Ward of Norwick, the north flank of the Hill of Clibberswick, at Skaw to the north, and across Inner Skaw and the headland at Lamba Ness.

13.6.78 The LLA includes parts of LCT 349 Major Uplands, LCT 350 Peatland and Moorland, LCT 353 Farmed and Settled Lowlands and Coast, LCT 354 Farmed and Settled Voes and Sounds, and LCT 355 Coastal Edge, all of which experience areas of visual influence of the Proposed Project. The assessment of effects on LCTs found locally significant effects on each of the LCTs (excluding LCT 350) within the area of the LLA, and no potential significant in-combination effects. This is due to the influence of the Proposed Project which will be seen as a new relatively large-scale development across the headland between Inner Skaw and Lamba Ness. Whilst the Proposed Project will be seen in the context of the major uplands and expansive coastal views, locally the scale of the new built form will have an influence on landscape scale, forming large contrasting elements, seen against coastal views or the prevailing moorland backdrop.

13.6.79 The key characteristics and integrity of the LLA will be locally altered by the Proposed Project across the headland between Inner Skaw and Lamba Ness, with a reduction in the scenic qualities of the LLA.

13.7 Assessment of Effects on the Visual Resource

13.7.1 The following sections provide an assessment of the visual effects that will likely arise from the Proposed Project. The following assessment addresses effects on the visual amenity of people, through assessing:

- effects on settlements;
- effects on key transport routes; and,
- effects on viewpoints.

Assessment of Effects on Settlements

13.7.2 The following section provides an assessment of the predicted effects on the visual amenity that will be experienced by residents of principal settlements within the EZI. The assessment has been undertaken through field survey and the analysis of mapping ZTV and photomontage views, in order to confirm the likely nature of visibility.

13.7.3 In accordance with the criteria outlined in the detailed methodology in Appendix 13.1, residential receptors, within settlements in the EZI, have a high susceptibility to change as views are experienced regularly for prolonged periods, and are generally considered to have a high sensitivity overall to the Proposed Project.

13.7.4 An indication of the predicted extents of visibility for the Proposed Project across the settlements is provided within the visibility mapping in Drawings 13.2.1 to 13.2.2. All ZTV drawings are based on bare-ground conditions, in accordance with current good practice as indicated in GLVIA 3. For those settlements where the ZTV indicates theoretical visibility, buildings and, to a small degree land form, are likely to provide a degree of containment between receptors and the Proposed Project. Buildings and localised topography do not register on the ZTV and, therefore, views to the Proposed Project will tend to be more restricted and more intermittent than the ZTV indicates.

13.7.5 The settlements in the EZI with potential views of the Proposed Project, as identified in Table 13.5, are assessed below.

Table 13.18 Effects on settlement at Booths/Houlanbrindy

Location
The cluster of settlement at Booths/Houlanbrindy, c.660 m to the south-west of the site, lies sheltered to the rear of Nor Wick and beneath the Ward of Norwick. The properties face east across Nor Wick which is framed by the cliffs of the Lamba Ness headland to the north and the Hill of Clibberswick to the south. The following development currently weakly influences the existing baseline: ➢ Redundant derelict wartime buildings on Lamba Ness.
Determination of Visual Sensitivity
The settlement at Booths/Houlanbrindy is of High sensitivity. The factors which have contributed to this judgement are as follows: ***Value*** *– High* ➢ Residents are highly likely to be aware of any changes to their existing visual amenity. ***Susceptibility to Change*** *– Medium/High* ➢ Expansive coastal views; ➢ Orientation of buildings to the east; ➢ Influence of existing development at the former Skaw Radar Station.
Magnitude of Change
The magnitude of change to the settlement at Booths/Houlanbrindy caused by the introduction of the Proposed Project is considered to be **Moderate**. The factors which have contributed to this judgement are as follows: *Size or Scale* Elements of the Proposed Project including: partial view to the roofline of the LSPF; site fencing; partial view to the southern radome of the tracking station; the lightning masts; launch vehicles on pad 3, will be seen as a new man-made development appearing above the cliffs to the north of Nor Wick, influencing the perception of scale in wider views. During the short duration of launch cycles, the extended lightning masts, the LV and the supporting strong back will be visible as additional vertical structures. *Geographical Extent* The ZTV indicates that there will be the potential for partial visibility away from the primary orientation of the views from the properties.

Significance of Effect
The combination of the individual judgements of **High** sensitivity and a locally **Moderate** magnitude of change are considered to result in the potential for **Major/Moderate** local effect on the settlement at Booths/Houlanbrindy, which in the context of this assessment is considered to be **Significant**.

Table 13.19 Effects on settlement at Norwick/Kirkaton

Location
The cluster of settlement at Norwick/Kirkaton, c.1.2 km to the south-west of the site, lies sheltered to the rear of Nor Wick and beneath the Ward of Norwick. The properties face east across Nor Wick which is framed by the cliffs of the Lamba Ness headland to the north and the Hill of Clibberswick to the south. The following development currently weakly influences the existing baseline: ➢ Redundant derelict wartime buildings on Lamba Ness.
Determination of Visual Sensitivity
The settlement at Norwick/Kirkaton is of **High** sensitivity. The factors which have contributed to this judgement are as follows: ***Value*** *– High* ➢ Residents are highly likely to be aware of any changes to their existing visual amenity. ***Susceptibility to Change*** *– Medium/High* ➢ Expansive coastal views; ➢ Orientation of buildings to the east; ➢ Influence of existing development at the former Skaw Radar Station.
Magnitude of Change
The magnitude of change to the settlement at Norwick/Kirkaton caused by the introduction of the Proposed Project is considered to be **Moderate**. The factors which have contributed to this judgement are as follows: *Size or Scale* Elements of the Proposed Project including: partial visibility to the gate house and LSPF; boundary fencing; the southern radomes of the tracking station; the Integration/TEL Building; LVs and lightning masts, will be seen as a new man-made development appearing above the cliffs to the north of Nor Wick, influencing the perception of scale in wider views. During the short duration of launch cycles at each of the launch pads, the extended lightning masts, the LVs and the supporting strong backs will be visible as additional vertical structures.

Geographical Extent

The ZTV indicates that there will be the potential for partial visibility from the properties.

Significance of Effect

The combination of the individual judgements of **High** sensitivity and a **Moderate** magnitude of change are considered to result in the potential for **Major/Moderate** effects on the settlement at Norwick/Kirkaton, which in the context of this assessment is considered to be **Significant**.

Table 13.20 Effects on settlement at Valsgarth/Saxa Vord

Location

The cluster of settlement at Valsgarth/Saxa Vord, c.2.3 km to the south-west of the site, lies on elevated ground to the south of Northdale. The north-eastern properties have a relatively open aspect towards Norwick and the coastline around Nor Wick beyond.

The following development currently influences the existing baseline:

- Redundant derelict wartime structures between Inner Skaw and Lamba Ness.

Determination of Visual Sensitivity

The settlement at Valsgarth/Saxa Vord is of **High** sensitivity. The factors which have contributed to this judgement are as follows:

***Value** – High*

- Residents are highly likely to be aware of any changes to their existing visual amenity.

***Susceptibility to Change** – Medium/High*

- Expansive views, contrasting with truncated views between housing;
- Orientation of the north eastern edge towards Norwick;
- Influence of existing development at the former Skaw Radar Station.

Magnitude of Change

The magnitude of change to the settlement at Valsgarth/Saxa Vord caused by the introduction of the Proposed Project is considered to be **Moderate**. The factors which have contributed to this judgement are as follows:

Size or Scale

Elements of the Proposed Project including: partial visibility to the gate house and LSPF; boundary fencing; the southern radomes of the tracking station; the integration/TEL building, LVs and lightning masts, will be seen as a new man-made development appearing in more distant views above the cliffs to the north of Nor Wick, influencing the perception of scale in wider views.

During the short duration of launch cycles at each of the launch pads, the extended lightning masts, the LVs and the supporting strong backs will be visible as additional vertical structures.

Geographical Extent The ZTV indicates that there will be the potential for partial visibility from the north-eastern edge of the settlement which has a sight line to the Proposed Project.
Significance of Effect
The combination of the individual judgements of **High** sensitivity and a **Moderate** magnitude of change are considered to result in the potential for **Major/Moderate** effects on the settlement at Valsgarth/Saxa Vord, which in the context of this assessment is considered to be **Significant**.

Table 13.21 Effects on settlement at Clibberswick

Location
The cluster of settlement at Clibberswick, c.1.05 km to the south east of the site, lies within open farmland to the south of Saxa Vord. The properties have a relatively open aspect towards Valsgarth/Saxa Vord seen beneath the Ward of Norwick.
Determination of Visual Sensitivity
The settlement at Clibberswick is of **High** sensitivity. The factors which have contributed to this judgement are as follows: ***Value*** *– High* ➢ Residents are highly likely to be aware of any changes to their existing visual amenity. ***Susceptibility to Change*** *– Medium/High* ➢ Expansive views across the open farmland and coastline.
Magnitude of Change
The Proposed Project has no influence on the settlement at Clibberswick.
Potential for in-Combination Effects
No combined effects are predicted.
Significance of Effect
No Effect.

Table 13.21 Effects on settlement at Haroldswick

Location
The cluster of settlement at Haroldswick, c.3.2 km to the south-west, lies within farmland at the head of Harold's Wick. The southern edge of the settlement extends along the foreshore and is

visually screened from the Proposed Project. The more dispersed properties to the north are set on slightly elevated ground with more open views across the farmland to the north.
Determination of Visual Sensitivity
The settlement at Haroldswick is of High sensitivity. The factors which have contributed to this judgement are as follows: ***Value*** *– High* ➢ Residents are highly likely to be aware of any changes to their existing visual amenity. ***Susceptibility to Change*** *– Medium/High* ➢ Expansive views across the open farmland and coastline.
Magnitude of Change
The Proposed Project has no influence on the settlement at Haroldswick. *Size or Scale* Changes to the views from Haroldswick will be Negligible. *Geographical Extent* There will be the potential for partial visibility from the properties at the northern edge of Haroldswick.
Potential for In-Combination Effects
No combined effects are predicted.
Significance of Effect
No effect.

Table 13.22 Effects on settlement at Ungirsta/Stove

Location
Ungirsta and Stove encompass the dispersed crofting settlement to the north and west of Haroldswick, set across the farmed lowlands between the ridge at Crussa Field to the south and Housi Field to the north, c.3.05 km to the south west of the Proposed Project. The properties are dispersed and experience oblique views across the surrounding open farmland against the backdrop of low rounded hills.
Determination of Visual Sensitivity
The properties at Ungirsta and Stove are of **High** sensitivity. The factors which have contributed to this judgement are as follows: ***Value*** *– High*

➢ Residents are highly likely to be aware of any changes to their existing visual amenity. ***Susceptibility to Change*** – *Medium/High* ➢ Views across the open farmland and to the surrounding hills.
Magnitude of Change
The Proposed Project has no influence on the scattered settlement at Ungirsta and Stove. *Size or Scale* The changes to the views from Ungirsta and Stove will be Negligible. *Geographical Extent* There will be the potential for partial visibility from the properties at the northern edge of Ungirsta and Stove.
Potential for In-Combination Effects
No combined effects are predicted.
Significance of Effect
No Effect.

Summary of Effects on Settlements

13.7.6 Table 13.23 lists and summarises effects on the settlements assessed above. It sets out their sensitivity to change, the magnitude of change that will arise as a result of the Proposed Project, and the level of resultant effects and their significance.

Table 13.23 Summary of Effects on Settlements

Settlement	Sensitivity to Change	Magnitude of Change	Level of Effect	Significance
Booths/ Houlanbrindy	High	Moderate	Major/Moderate	Significant
Norwick/ Kirkaton	High	Moderate	Major/Moderate	Significant
Valsgarth/ Saxa Vord	High	Moderate	Major/Moderate	Significant
Haroldswick	High	Negligible.	No effect	Not Significant
Ungirsta/ Stove	High	Negligible.	No effect	Not Significant

Assessment of Effects on Routes

13.7.7 The following section provides an assessment of the predicted effects of the Proposed Project on visual amenity that will be experienced by travellers using vehicular and non-vehicular route corridors within the EZI, including roads and designated cycle routes. The assessment has been undertaken through field survey and the analysis of mapping ZTV and wireframe views, in order to confirm the likely nature of visibility.

13.7.8 In accordance with the criteria outlined in the detailed methodology in Appendix 13.1, the sensitivity of receptors from cycle routes is generally considered to be high. Receptors using road routes (i.e., motorised vehicle users of cars/ motorbikes/ buses) are considered to range from low or low to medium (e.g., for trunk and main roads) through to medium (for B-roads, minor roads etc.) sensitivity, although vehicle users of routes promoted or noted for scenic value may be of medium to high sensitivity. There may also be value attached to specific views along the routes or particular stretches where they pass through or overlook designated landscapes.

13.7.9 An indication of the predicted extents of visibility route corridors is provided within the visibility mapping in Drawings 13.2.1 to 13.2.2.

13.7.10 The principal effects on these routes with potential views of the Proposed Project, as identified in Table 13.6, are assessed below.

Table 13.24 Operational Effects on A968/National Cycle Route 1

Route Description
The A968/NCR1 connects through the EZI between Gunnister in mid-Unst at c.15 km through to Haroldswick within 5 km of the Proposed Project. The following development currently weakly influences the existing baseline: ➢ Telecommunications relay building on the Hill of Caldback. ➢ Telecommunications mast on Little Hoeg. ➢ Radar radome on Saxa Vord Hill.
Determination of Visual Sensitivity
People in motorised vehicles using the route are considered to be of **Medium** sensitivity to changes resulting from the Proposed Project. Cyclists using the route are considered to be of **High** sensitivity to changes resulting from the Proposed Project. The factors which have contributed to this judgement are as follows: **Value** – Medium **Susceptibility to Change** – Medium/High ➢ Motorists travelling through or past the landscape on roads will focus on the route corridor; ➢ Cyclists are likely to be using the route for recreation and tourism purposes and will be aware of views to the surrounding landscape; ➢ Relative simplicity of landform with smooth and rounded pastures and expansive views.
Magnitude of Change
From a short c.600 m section of the route as it passes across the col to the east Little Hoeg, there will be a locally **Slight** magnitude of change as the Proposed Project is partially seen on the horizon above Clibberswick. *Size or Scale* The LSPF at the western extent of the site will be partially visible to their rooflines, as a noticeable new element on the horizon in views to the north seen in the distance over c.4.5 km.

The new man-made development will be seen to contrast slightly with the scale of the existing development and with the soft hues of the moorland hills. *Geographical Extent* The ZTV indicates that there will be the potential for partial visibility over a short c.600m section of the route.
Potential for In-Combination Effects
There will be a locally **Minor Not Significant** combined effect on a very short section of the route corridor over the short term.

Significance of Effect				
Section of A968 / NCR 1	**Sensitivity to Change**	**Magnitude of Change**	**Level of Effect**	**Significance**
600m section of the route, east of Little Hoeg	Motorists – Medium Cyclists - High	Slight	Moderate/Minor to Motorists and Moderate to Cyclists	**Not Significant**

Table 13.25 Operational Effects on B9086

Route Description
The B9086 connects between Burrafirth and Haroldswick through the study area at c.3.9 km from the Proposed Project and c.1.3k m from the LCC/RCC building. The following development currently weakly influences the existing baseline: ➢ Telecommunications mast on Little Hoeg. ➢ Radar radome on Saxa Vord Hill.
Determination of Visual Sensitivity
People in motorised vehicles using the route are considered to be of **Medium** sensitivity to changes resulting from the Proposed Project. Cyclists using the route are considered to be of **High** sensitivity to changes resulting from the Proposed Project. The factors which have contributed to this judgement are as follows: **Value** – Medium **Susceptibility to Change** – Medium/High ➢ Motorists travelling through or past the landscape on roads will focus on the route corridor; ➢ Cyclists are likely to be using the route for recreation and tourism purposes and will be aware of views to the surrounding landscape; ➢ Relative simplicity of landform with smooth and rounded pastures and expansive views.

Magnitude of Change
Proposed Project From a short c.500 m section of the route, between the minor road leading to Ungirsta and the cross road junction at Lower House, there will be a locally **Slight** magnitude of change as the Proposed Project is partially seen on the distant horizon above Norwick. *Size or Scale* The LSPF at the western extent of the site will be partially visible to their rooflines, as a distant new element on the horizon in views to the north east, over c.3.9 km. *Geographical Extent* The ZTV indicates that there will be the potential for partial visibility over a short c.500 m section of the route.
Potential for in-Combination Effects
There will be a locally **Minor Not Significant** combined effect on a very short section of the route corridor over the short term.

Significance of Effect				
Section of B9086	**Sensitivity to Change**	**Magnitude of Change**	**Level of Effect**	**Significance**
1.2 km section of the route west of Haroldswick	Motorists – Medium Cyclists - High	Slight	Moderate/Minor to Motorists and Moderate to Cyclists	**Not Significant**

Table 13.26 Operational Effects on B9087

Route Description
The B9087 connects between Haroldswick and Norwick through the EZI with areas of closest visibility over c. 1.3 km from the Proposed Project. The following development currently influences the existing baseline: ➢ Telecommunications mast on Little Hoeg. ➢ Radar radome on Saxa Vord Hill. ➢ The former RAF base at Saxa Vord.
Determination of Visual Sensitivity
People in motorised vehicles using the route are considered to be of **Medium** sensitivity to changes resulting from the Proposed Project. Cyclists using the route are considered to be of **High** sensitivity to changes resulting from the Proposed Project. The factors which have contributed to this judgement are as follows: **Value** – Medium

Susceptibility to Change – Medium/High ➢ Motorists travelling through or past the landscape on roads will focus on the route corridor; ➢ Cyclists are likely to be using the route for recreation and tourism purposes and will be aware of views to the surrounding landscape; ➢ Relative simplicity of landform with smooth and rounded pastures and expansive views.				
Magnitude of Change				
There will be increasing visibility between Saxa Vord and Norwick, with a locally **Moderate** magnitude of change as the Proposed Project is seen on the peninsula between Inner Skaw and Lamba Ness. *Size or Scale* Elements of the Proposed Project including: partial visibility to the gate house and LSPF; boundary fencing; the southern radomes of the tracking station; the integration hangar/TEL building; LVs and lightning masts, will be seen as a new man-made development appearing above the cliffs to the north of Nor Wick, influencing the perception of scale in wider views. During the short duration of launch cycles at each of the launch pads, the extended lightning masts, the LVs and the supporting strong backs will be visible as additional vertical structures. *Geographical Extent* The ZTV indicates that there will be the potential for partial visibility over a c.1.2 km section of the route.				
Potential for In-Combination Effects				
There will be a locally **Minor Not Significant** combined effect on a very short section of the route corridor over the short term.				
Significance of Effect				
Section of B9087	**Sensitivity to Change**	**Magnitude of Change**	**Level of Effect**	**Significance**
1.2 km section of the route west between Saxa Vord/ Valsgarth and Norwick.	Motorists – Medium Cyclists - High	Moderate	Moderate to Motorists and Major/Moderate to Cyclists	**Not Significant/ Significant**

Assessment of Effects at Viewpoints

13.7.11 The viewpoint assessment has been carried out to identify and evaluate the effects on visual amenity arising from the Proposed Project at specific representative locations in the study area. The selection of viewpoints is discussed at paragraph 13.5.60.

13.7.12 The predicted views from each of the 15 viewpoint locations are illustrated using photomontages in Drawings 13.3.1.1 to 13.3.1.10 in respect of the Proposed Project and, as relevant, and in

Drawings 13.3.2.1 – 13.3.2.5 for the LRCC. The visualisations are accurate graphic representations in terms of the positioning, spatial distribution and size of the Proposed Project.

13.7.13 For the purposes of assessing the effects on visual amenity, the sensitivity of the receptors is as defined in Appendix 13.1.

13.7.14 The following detailed analysis of the 15 viewpoints include a description of the existing and predicted view, an assignment of receptor sensitivity (including confirmation of receptor susceptibility and the value applied to the viewpoint), an analysis of the magnitude of change, and an assessment of the level of predicted effects on visual amenity, and a determination of their significance. The supporting Drawings include existing photographic view alongside a photomontage visualisation of the Proposed Project. These visualisations have been prepared in adherence to the principles presented in the Landscape Institute's Technical Guidance Note TGN 06/19 Visual Representation of Development Proposals, as described in Appendix 13.1.

Duration and Reversibility of the Visual Effects

13.7.15 The magnitude of changes that will be experienced by visual receptors as a result of the Proposed Project relates in part to the duration of effects and their permanence/ reversibility. For the purposes of this assessment the effects are assumed to be permanent.

13.7.16 As the duration and reversibility of the effects of the Proposed Project will be common to all visual receptors, they have been implicitly considered with regard to the likely magnitude of change in all views but are not repeated with regard to each viewpoint to avoid repetition.

Proposed Project Viewpoints, Viewpoints 1.1 – 1.10

Table 13.27 Effects at Viewpoint 1.1, Bluejibs above the Wick of Skaw

Viewpoint 1.1, Bluejibs above the Wick of Skaw **Drawing 13.3.1.1 existing view and a panoramic photomontage of the Proposed Project.**	
Distance and Direction to the Proposed Project	Proposed Project: 1.1 km to the south
LCT/CCA and Designations	LCT355. Coastal Edge / East Unst CCA Haroldswick and Skaw LLA
Receptor and Sensitivity to Change	Walkers/Visitors – High
Theoretical visibility	Proposed Project only
Location and Rationale for Selection	
The viewpoint is located on the north-eastern peninsula of Unst, looking south across the Wick of Skaw. The headland at the northern tip of British Isles is a popular location for visitors and for walkers accessing the northern coastline of Unst. The following development currently influences the existing baseline: ➢ The derelict buildings and infrastructure associated with the former Skaw Radar Station both across the foreground of the headland and also as seen in more distant views across the peninsula to the south at Lamba Ness. ➢ The maritime navigation beacon on the Holm of Skaw. ➢ The radar radome on Saxa Vord hill to the west.	

Description of Existing View
The existing view looks south across the Wick of Skaw to the peninsula between Inner Skaw and Lamba Ness. The Sand of Inner Skaw is seen to the right of the image, with the distant high cliffs of the Hill of Clibberswick beyond. Flowering cotton grass carpets the foreground of the view. The viewpoint, at 30 m AOD, provides an attractive vantage point for views to the surrounding coastlines. The intense tidal races around this headland with standing waves and overfalls at certain states of tides add local interest. Features of the former Radar Station on Lamba Ness are noticeable including the following: the earth banked building of the former receiver building at the end of Lamba Ness; the earth banked power house building towards the centre of the peninsula; and the further concrete power house block seen on the crest of the peninsula above the Sand of Inner Skaw.
Determination of Visual Sensitivity
The sensitivity to change associated with the Proposed Project at this location is considered to be **High** for walkers and visitors who access the headland for recreation and therefore more susceptible to changes in the view: ***Value*** *– Medium* ***Susceptibility to Change*** *– High* ➢ Walkers will be engaged in the experience of the landscape, with a strong awareness of their surroundings and an expectation of remoteness. ➢ Elemental coastal scenery with expansive views.
Magnitude of Change
The overall magnitude of change on receptors at this viewpoint will be a **Substantial**. ***Size or Scale*** The Proposed Project will be seen extending across the headland between Inner Skaw and Lamba Ness. The new built form will appear on the horizon line to the south, adding new noticeable features along the peninsula. The radomes of the tracking station will be seen against the backdrop of coastal hills and cliffs beyond. The lightning masts will be seen as tall vertical elements punctuating the skyline. Launch pad three is illustrated in its extended pre-launch condition with the LV and strongback erected and the lightning masts extended in full. The wildlife hide will be seen as new small-scale structure at the eastern edge of the Lamba Ness peninsula. Launch pads one and two are shown in their retracted state. The TEL hangar is seen between launch pads one and two, breaking the horizon line. The base infrastructure around launch pad one is also seen on top of the peninsula. ***Geographical Extent*** The Proposed Project across the Proposed Project will be seen over a c.50° angle of view. Views of this nature will be experienced across the southern edge of the headland above the Wick of Skaw.

Potential for In -Combination Effects
No combined effects are predicted.
Significance of Effects
The combination of the individual judgements of **High** sensitivity and a **Substantial** magnitude of change are considered to result in a **Major** effect on walkers and visitors, which in the context of this assessment is considered to be **Significant**.

Table 13.28 Operational Effects at Viewpoint 1.2, The Haa, Wick of Skaw

Viewpoint 1.2, The Haa, Wick of Skaw Drawing 13.3.1.2: existing view and a panoramic photomontage of the Proposed Project.	
Distance and Direction to the Proposed Project	Proposed Project: 860 m to the south east
LCT/CCA and Designations	LCT 353. Farmed and Settled Lowlands and Coast/ East Unst CCA, Haroldswick and Skaw LLA
Receptor and Sensitivity to Change	Walkers/Visitors/Residents of the Haa – High
Theoretical visibility	Proposed Project only
Location and Rationale for Selection	
The viewpoint is located at the rear of Skaw Beach, to the north-east of Unst, looking south-east across the Wick of Skaw. The beach which lies towards the northern tip of British Isles is a popular location for visitors and for walkers accessing the northern coastline of Unst. The following development currently influences the existing baseline: ➢ The derelict buildings and infrastructure associated with the former Skaw Radar Station both across the headland at Lamba Ness. ➢ The maritime navigation beacon on the Holm of Skaw. ➢ The radar radome on Saxa Vord hill to the west.	
Description of Existing View	
The existing view looks south-east across the Wick of Skaw to Lamba Ness. The sandy beach in the foreground gives way to the rocky coastline and cliffs along the edge of the peninsula. The tidal races are seen in the distance across the bay, beyond the headland, with standing waves and overfalls at certain states of tides which add local interest. Features of the former Radar Station on Lamba Ness are noticeable at the end of Lamba Ness including: the earth banked building of the former receiver building and the associated cluster of radar buildings.	

Determination of Visual Sensitivity
The sensitivity to change associated with the Proposed Project at this location is considered to be **High** for walkers and visitors who access the beach for recreation and who are more susceptible to changes in the view: ***Value** – Medium* ***Susceptibility to Change** – High* ➢ Walkers will be engaged in the experience of the landscape, with a strong awareness of their surroundings and an expectation of remoteness. ➢ The landform orientates principal views from Skaw Beach east towards the bay and the North Sea beyond. ➢ Visitors will be focussed on the surrounding scenery and views. ➢ Relative simplicity of landform and expansive coastal views.
Magnitude of Change
The overall magnitude of change on receptors at this viewpoint will be a Moderate. ***Size or Scale*** The Proposed Project will be seen extending across the headland between Inner Skaw and Lamba Ness, with the development at Inner Skaw contained from view, and with restricted visibility to the TEL Hangar. The new built form will appear on the horizon line to the south, adding new noticeable features along the peninsula. The lightning masts will be seen as tall vertical elements punctuating the skyline. Launch pad three is illustrated in its extended pre-launch condition with the LV and strongback erected and the lightning masts extended in full. Launch pads one and two are shown in their retracted state. The base infrastructure around launch pads one and two is also seen on top of the peninsula. ***Geographical Extent*** The Proposed Project across the Proposed Project will be seen over a c.20° angle of view. Views of this nature will be experienced in views south from the beach at Skaw.
Potential for In-Combination Effects
No combined effects are predicted.
Significance of Effects
The combination of the individual judgements of **High** sensitivity and a **Substantial** magnitude of change are considered to result in a **Major** effect on walkers and visitors which in the context of this assessment is considered to be **Significant**.

Table 13.29 Effects at Viewpoint 1.3, The Garths, Lamba Ness

Viewpoint 1.3, The Garths, Lamba Ness **Drawing 13.3.1.3 existing view and a panoramic photomontage of the Proposed Project.**	
Distance and Direction to the Proposed Project	Proposed Project: 320 m to the east
LCT/CCA and Designations	LCT 349. Major Uplands/ East Unst CCA Haroldswick and Skaw LLA
Receptor and Sensitivity to Change	Walkers/Cyclists – High Road Users - Medium
Theoretical visibility	Proposed Project only
Location and Rationale for Selection	
The viewpoint is located at the high point on Holsens Road, which connects between Norwick and Skaw Beach, located close to the south western site boundary. It has been selected to illustrate the effects on visitors, walkers and cyclists accessing the northern coastline of Unst. The following development currently influences the existing baseline: ➢ The derelict buildings and infrastructure associated with the former Skaw Radar Station between Inner Skaw and Lamba Ness.	
Description of Existing View	
The existing view looks east across the rough pastures at Clinkapund and Inner Skaw and beyond to the Lamba Ness peninsula. The view looks beyond to the North Sea to the east and Nor Wick bay to the south. The tidal races are seen in the distance beyond the Lamba Ness peninsula. Features of the former Radar Station across Inner Skaw and Lamba Ness are noticeable including: the decontamination building to the left of the image, the earth banked building of the former power house building towards the centre of the peninsula and the earth banked receiver building and associated cluster of radar buildings on Lamba Ness.	
Determination of Visual Sensitivity	
The sensitivity to change associated with the Proposed Project at this location is considered to be **High** for walkers, cyclists and visitors accessing area for recreation and **Medium** for road users: ***Value*** *– Medium* ***Susceptibility to Change*** *– High* ➢ Walkers and cyclists will be engaged in the experience of the landscape, with a strong awareness of their surroundings and an expectation of remoteness. ➢ Views are expansive across the simple landscape of the peninsula and to the North Sea beyond. ➢ Visitors will be focussed on the surrounding scenery and views.	

Magnitude of Change
The overall magnitude of change on receptors at this viewpoint will be a **Substantial**. ***Size or Scale*** The Proposed Project will be prominently seen, with the large-scale LSPF, gate house and associated out buildings seen in the foreground at Inner Skaw. Whilst the hangar buildings have a similar character to the modern barns seen within the wider Unst landscape their scale is larger, despite the absence of features in the landscape can be easily scaled by eye. The lightning masts will be seen as tall vertical elements however, they are seen against the backdrop of the sea beyond and are seen to recede in views. Launch pad three is illustrated in its extended pre-launch condition with the LV and strongback erected and the lightning masts extended in full. The TEL hangar is noticeable as new built form to the foreground. Launch pads one and two are contained from view though their lightning masts are visible. ***Geographical Extent*** The main structures at Inner Skaw are seen within a c.20° angle of view, with further elements of the Proposed Project seen as a localised pocket of development at Lamba Ness. Views of this nature will be experienced in views east from Holsens Road.
Potential for In-Combination Effects
No combined effects are predicted.
Significance of Effects
The combination of the individual judgements of **High** and **Medium** sensitivity and a **Substantial** magnitude of change are considered to result in a **Major** effect on Walkers, Visitors and Cyclists, and a **Major/Moderate** effect on Road Users which in the context of this assessment are considered to be **Significant**.

Table 13.30 Effects at Viewpoint 1.4, Car Park at The Taing, Norwick

Viewpoint 1.4, Car Park at The Taing, Norwick Drawing 13.3.1.4 existing view and a panoramic photomontage of the Proposed Project.	
Distance and Direction to the Proposed Project	Proposed Project: 800 m to the north east
LCT/CCA and Designations	LCT 354. Farmed and Settled Voes and Sounds / East Unst CCA Haroldswick and Skaw LLA
Receptor and Sensitivity to Change	Walkers/Visitors/Residents – High
Theoretical visibility	Proposed Project only

Location and Rationale for Selection
The viewpoint is located in the public car park at The Taing, Norwick Beach, looking east across the bay at Nor Wick. The beach and coastline are a popular destination for visitors and walkers and the viewpoint is representative of the nature of views experienced by residents at Booths. The following development currently influences the existing baseline: The derelict buildings and infrastructure associated with the former Skaw Radar Station as seen in more distant views across the peninsula to the north east at Lamba Ness.
Description of Existing View
The existing view looks across the bay at Nor Wick and to the peninsula to the north between Inner Skaw and Lamba Ness. The outcrop of rock on the beach at Norwick, The Taing, is seen at the northern edge of the beach in the foreground. The cliffs along the southern edge of the peninsula frame the view to the north, contrasting with the waters of Nor Wick below. Features of the former Radar Station are noticeable in the distance on Lamba Ness; the most noticeable of which is the earth banked receiver building.
Determination of Visual Sensitivity
The sensitivity to change associated with the Proposed Project at this location is considered to be **High** for walkers, visitors and residents who access the area for recreation and residents of who are more susceptible to changes in the view: ***Value*** *– Medium* ***Susceptibility to Change*** *– High* ➢ Residents are highly likely to be aware of any changes to their existing visual amenity. ➢ Walkers and visitors will be engaged in the experience of the landscape, with a strong awareness of their surroundings and an expectation of remoteness. ➢ The landform orientates principal views east towards the bay and the North Sea beyond. ➢ Visitors will be focussed on the surrounding scenery and views. ➢ Relative simplicity of landform and expansive coastal views.
Magnitude of Change
The overall magnitude of change on receptors at this viewpoint will be a **Moderate**. ***Size or Scale*** The LSPF will be seen above the cliffs at Inner Skaw. The southernmost radome of the tracking station will be seen above the cliffs towards the middle of the peninsula. Launch pad three is illustrated in its extended pre-launch condition with the LV and strongback erected and the lightning masts extended in full, these elements are seen above the end of the peninsula at Lamba Ness. Launch pads one and two are hidden from view.

Whilst parts of the Proposed Project will be visible above the peninsula, breaking the skyline, the careful approach to the use of colour in the facades will assist in the new structures being seen to recede in views against the typically grey skies. ***Geographical Extent*** Views of this nature will be experienced from the beach and coastline at Norwick.
Potential for In-Combination Effects
No combined effects are predicted.
Significance of Effects
The combination of the individual judgements of **High** sensitivity and a **Moderate** magnitude of change are considered to result in a **Major/Moderate** effect on walkers, visitors and residents, which in the context of this assessment is considered to be **Significant**.

Table 13.31 Effects at Viewpoint 1.5, The Cemetery, Norwick

Viewpoint 1.5, The Cemetery, Norwick **Drawing 13.3.1.5 existing view and a panoramic photomontage of the Proposed Project.**	
Distance and Direction to the Proposed Project	Proposed Project: 1.2 km to the north east
LCT/CCA and Designations	LCT 354. Farmed and Settled Voes and Sounds / East Unst CCA Haroldswick and Skaw LLA
Receptor and Sensitivity to Change	Walkers/Visitors/Residents – High
Theoretical visibility	Proposed Project only
Location and Rationale for Selection	
The viewpoint is located at the north-eastern edge of the cemetery at Norwick which is raised on a platform above the adjoining farmland to the east of Norwick. The cemetery is a focus for local visits at Norwick and is representative of the nature of views experienced by residents. The following development currently influences the existing baseline: ➢ The derelict buildings and infrastructure associated with the former Skaw Radar Station as seen in more distant views across the peninsula to the north east at Lamba Ness.	

Description of Existing View
The existing view looks north across the bay at Nor Wick, to the peninsula to the north between Inner Skaw and Lamba Ness, and to the North Sea beyond. The coastal views contrast with the foreground pastures. The Taing and Norwick beach are seen to the left of the view, beneath the cliffs at Braehead. Features of the former Radar Station are noticeable in the distance on Lamba Ness; the most noticeable of which is the earth banked receiver building on Lamba Ness, the earth banked structure of the power house to the west of Lamba Ness and the noticeable decontamination building at Inner Skaw.
Determination of Visual Sensitivity
The sensitivity to change associated with the Proposed Project at this location is considered to be **High** for walkers and visitors who access the area for recreation and residents of who are more susceptible to changes in the view: ***Value*** *– Medium* ***Susceptibility to Change*** *– High* ➢ Residents are highly likely to be aware of any changes to their existing visual amenity. ➢ Walkers and visitors will be engaged in the experience of the landscape, with a strong awareness of their surroundings. ➢ Visitors will be focussed on the surrounding scenery and views.
Magnitude of Change
The overall magnitude of change on receptors at this viewpoint will be a **Moderate**. ***Size or Scale*** The LSPF will be seen above the cliffs at Inner Skaw. The southernmost two radomes of the tracking station will be seen above the cliffs towards the middle of the peninsula. Launch pad three is illustrated in its extended pre-launch condition with the LV and strongback erected and the lightning masts extended in full, these elements are seen above the end of the peninsula at Lamba Ness. The TEL Hangar is seen against the skyline to the west of Lamba Ness. Launch pads one and two are hidden from view. Whilst parts of the Proposed Project will be visible above the peninsula, breaking the skyline, the careful approach to the use of colour in the facades assist in the new structures being seen to recede in views against the typically light grey skies. ***Geographical Extent*** Views of this nature will be experienced from in and around the settlement at Norwick.
Potential for In-Combination Effects
No combined effects are predicted.

Significance of Effects
The combination of the individual judgements of **High** sensitivity and a **Moderate** magnitude of change are considered to result in a **Major/Moderate** effect on walkers, visitors and residents, which in the context of this assessment is considered to be **Significant**.

Table 13.32 Effects at Viewpoint 1.6, B9087 Norwick

Viewpoint 1.6, B9087 Norwick **Drawing 13.3.1.6 shows: a) 90° existing view and a panoramic photomontage of the Proposed Project.**	
Distance and Direction to the Proposed Project	Proposed Project: 1.6 km to the north east
LCT/CCA and Designations	LCT 354. Farmed and Settled Voes and Sounds / East Unst CCA, Haroldswick and Skaw LLA
Receptor and Sensitivity to Change	Cyclists/Residents – High Road Users - Medium
Theoretical visibility	Proposed Project only
Location and Rationale for Selection	
The viewpoint is located on the B9087/NCR1 between Saxa Vord and Norwick, adjacent to the entrance to the property at 'Virse'. The view represents views experienced by road users and cyclists and is also representative of the nature of views experienced by residents form the surrounding scattered crofting settlement. The following development currently influences the existing baseline: ➢ The derelict buildings and infrastructure associated with the former Skaw Radar Station as seen in more distant views across the peninsula to the north east at Lamba Ness. ➢ Masts and radar equipment at the Ward of Norwick.	
Description of Existing View	
The existing view looks north across the settled farmland of Norwick Meadow and beyond to the settlement at Norwick, the bay at Nor Wick, the peninsula to the north between Inner Skaw and Lamba Ness, and the expansive North Sea beyond. Features of the former Radar Station are seen in relatively distant views to Lamba Ness and Inner Skaw, the most noticeable of which is the earth banked receiver building on Lamba Ness, the earth banked structure of the power house to the west of Lamba Ness and the noticeable decontamination building at Inner Skaw.	

Determination of Visual Sensitivity
The sensitivity to change associated with the Proposed Project at this location is considered to be **High** for Cyclists and Residents of who are more susceptible to changes in the view, and **Medium** for Road Users: ***Value** – Medium* ➢ The B9087 forms part of National Cycle Route 1. ***Susceptibility to Change** – High* ➢ Residents are highly likely to be aware of any changes to their existing visual amenity. ➢ Cyclists will be engaged in the experience of the landscape, with a strong awareness of their surroundings. ➢ Motorists travelling through or past the landscape on roads will focus on the route corridor.
Magnitude of Change
The overall magnitude of change on receptors at this viewpoint will be a **Moderate**. ***Size or Scale*** The LSPF will be seen above the cliffs at Inner Skaw. The southernmost two radomes of the tracking station will be seen above the cliffs towards the middle of the peninsula. Launch pad three is illustrated in its extended pre-launch condition with the LV and strongback erected and the lightning masts extended in full, these elements are seen above the end of the peninsula at Lamba Ness. The TEL Hangar is seen against the skyline to the west of Lamba Ness. Launch pads one and two are hidden from view however the lightning masts break the skyline. ***Geographical Extent*** Views of this nature will be experienced along the B9087 between Saxa Vord and Norwick.
Potential for In-Combination Effects
No combined effects are predicted.
Significance of Effects
The combination of the individual judgements of **High** and **Medium** sensitivity and a **Moderate** magnitude of change are considered to result in a **Major/Moderate** effect on cyclists and residents, and a **Moderate** effect on Road Users, which in the context of this assessment is considered to be **Significant** and **Not Significant** effects respectively.

Table 13.33 Effects at Viewpoint 1.7, Hill of Clibberswick

Viewpoint 1.7, Hill of Clibberswick **Drawing 13.3.1.7 existing view and a panoramic photomontage of the Proposed Project.**	
Distance and Direction to the Proposed Project	Proposed Project: 2.4 km to the north
LCT/CCA and Designations	LCT 355. Coastal Edge / East Unst CCA Haroldswick and Skaw LLA
Receptor and Sensitivity to Change	Walkers – High
Theoretical visibility	Proposed Project only
Location and Rationale for Selection	
The viewpoint is located close to the summit of the Hill of Clibberswick, looking north across the Norwick. The headland is a popular route with walkers accessing the north eastern coastline of Unst. The following development currently influences the existing baseline: ➢ The derelict buildings and infrastructure associated with the former Skaw Radar Station in distant views across the peninsula to the north at Lamba Ness. ➢ The maritime navigation beacon on the Holm of Skaw. ➢ The radar infrastructure at the Ward of Norwick, and the radome at Saxa Vord Hill (beyond the left-hand edge of the view).	
Description of Existing View	
The existing view looks north across Nor Wick to the peninsula between Inner Skaw and Lamba Ness, forming part of expansive views across the north eastern extent of Unst. The cliffs of the horns of Hagmark are seen in the foreground of the view. The viewpoint, at c.160m AOD, provides an elevated vantage point for views to the surrounding coastline. Features of the former Radar Station on Lamba Ness are noticeable including the following: the earth banked building of the former receiver building at the end of Lamba Ness; the concrete power house block seen on the crest of the peninsula; and the cluster of buildings including the decontamination building at Inner Skaw.	
Determination of Visual Sensitivity	
The sensitivity to change associated with the Proposed Project at this location is considered to be **High** for walkers who access the headland for recreation and are therefore more susceptible to changes in the view: ***Value** – Medium* ***Susceptibility to Change** – High*	

➢ Walkers will be engaged in the experience of the landscape, with a strong awareness of their surroundings and an expectation of remoteness. ➢ Elemental coastal scenery with expansive views.
Magnitude of Change
The overall magnitude of change on receptors at this viewpoint will be a **Substantial**. ***Size or Scale*** The Proposed Project will be seen extending across the headland between Inner Skaw and Lamba Ness. The new built form will appear across the peninsula to the north, adding new noticeable features. The radomes of the tracking station will be seen towards the centre of the peninsula. The lightning masts will be seen as tall vertical elements, seen against the sea beyond and will slightly recede in views. Launch pad three is illustrated in its extended pre-launch condition with the LV and strongback erected and the lightning masts extended in full. Launch pads one and two are shown in their retracted state, with the surrounding ancillary structures seen as distant features many of which are earth sheltered. The TEL hangar is seen in front of launch pad two, contrasting with the sea beyond. The base infrastructure around launch pad one is contained from view beyond Lamba Ness. ***Geographical Extent*** The components of the Proposed Project seen across the Proposed Project will extend over a c.45° angle of view. Views of this nature will be experienced from the elevated north facing flank of the Hill of Clibberswick.
Potential for In-Combination Effects
No combined effects are predicted.
Significance of Effects
The combination of the individual judgements of **High** sensitivity and a **Moderate** magnitude of change are considered to result in a **Major/Moderate** effect on walkers, which in the context of this assessment is considered to be **Significant**.

Table 13.34 Effects at Viewpoint 1.8, Headland to the north of Saxa Vord Radar Station

Viewpoint 1.8, Headland to the north of Saxa Vord radar station **Drawing 13.3.1.8 existing view and a panoramic photomontage of the Proposed Project.**	
Distance and Direction to the Proposed Project	Proposed Project: 3.3 km to the east
LCT/CCA and Designations	LCT 355. Coastal Edge / Skaw CCA Herma Ness sub unit of the Shetland NSA
Receptor and Sensitivity to Change	Walkers – High

Theoretical visibility	Proposed Project – lightning masts only

Location and Rationale for Selection

The viewpoint is located on the remote headland to the north of the Saxa Vord radar station. The headland is accessible only by foot, with occasional walkers accessing the northern coastline of Unst.

The following development currently influences the existing baseline:

- The derelict radar equipment and fencing on the headland.
- The maritime navigation beacon on the Holm of Skaw seen in the distance.
- The radome and buildings associated with the radar station at Saxa Vord Hill.

Description of Existing View

The existing view looks west across the northern flank of Saxa Vord Hill and the headlands at Ritten Hamar and Hill Ness to the Holm of Skaw and Inner Flae beyond at the north-eastern edge of Unst. The viewpoint, at c.150 m AOD, provides an elevated vantage point for views across the northern coastline of Unst.

Determination of Visual Sensitivity

The sensitivity to change associated with the Proposed Project at this location is considered to be **High** for walkers who access the headland for recreation and therefore more susceptible to changes in the view:

Value *– High ((Herma Ness sub unit of the Shetland NSA)*

Susceptibility to Change *– High*

- Walkers will be engaged in the experience of the landscape, with a strong awareness of their surroundings and an expectation of remoteness.
- Elemental coastal scenery with expansive views.

Magnitude of Change

The overall magnitude of change on receptors at this viewpoint will be **Negligible**.

Size or Scale

The tips of the lightning masts on launch pad 3 will be visible as very minor elements faintly visible extending above the line of cliffs above The Punds, only being visible during launch sequences when the lasts are extended. The remainder of the Proposed Project will be screened from view.

Geographical Extent

The lightning masts as shown on the ZTV in **Drawing 13.2.1a** over a very small area of the headland.

Potential for In-Combination Effects
No combined effects are predicted.
Significance of Effects
The combination of the individual judgements of **High** sensitivity and a **Negligible** magnitude of change are considered to result in a **Minor** effect on walkers, which in the context of this assessment is considered to be **Not Significant**. This minor effect will only be experienced as a temporary effect during launch sequences on launch pad three.

Table 13.35 Effects at Viewpoint 1.9, A968 beneath Little Hoeg

Viewpoint 1.9, A968 beneath Little Hoeg Drawing 13.3.1.9 existing view and a panoramic photomontage of the Proposed Project.	
Distance and Direction to the Proposed Project	Proposed Project: 4.4 km to the north
LCT/CCA and Designations	LCT 350. Peatland and Moorland / East Unst CCA
Receptor and Sensitivity to Change	Cyclist – High Road users - Medium
Theoretical visibility	Proposed Project and LRCC
Location and Rationale for Selection	
The viewpoint is located on A968 as the route descends beneath Little Hoeg on the approach to Haroldswick. The viewpoint is representative of wider views for travellers using the road network on the north eastern extent of Unst. The following development currently influences the existing baseline: ➢ The radome and buildings associated with the radar station at Saxa Vord Hill. ➢ Telecommunications masts beside Little Hoeg.	
Description of Existing View	
The existing view looks north across Harold's Wick to Saxa Vord Resort on the ridge of land beneath Saxa Vord Hill and the Ward of Norwick. The Hill of Clibberswick frames the view to the right. The viewpoint, at c.54m AOD, provides a vantage point for views across the north eastern coastline of Unst.	

Determination of Visual Sensitivity

The sensitivity to change associated with the Proposed Project at this location is considered to be **High** for Cyclists and Residents of who are more susceptible to changes in the view, and **Medium** for Road Users:

Value *– Medium*

- The B9087 forms part of National Cycle Route 1.

Susceptibility to Change *– High*

- Residents are highly likely to be aware of any changes to their existing visual amenity.
- Cyclists will be engaged in the experience of the landscape, with a strong awareness of their surroundings.
- Motorists travelling through or past the landscape on roads will focus on the route corridor.

Magnitude of Change

The overall magnitude of change on receptors at this viewpoint will be a **Slight**.

Size or Scale

The LSPF will be seen on the distant horizon to the right of the Saxa Vord Resort. The hangar buildings have a similar character to the large modern barns seen within the wider Unst landscape although their scale is larger. The careful approach to the use of colour in the facades assist in the new structures being seen to recede in views against the typically light grey skies.

Geographical Extent

Views of this nature will be experienced along a short c.600m section of the A968 as crosses the low col between Baltasound and Haroldswick.

Potential for in-Combination Effects

There will be a **Negligible** magnitude of change with a **Minor** and **Not Significant** combined effects on Cyclists and Road Users.

Significance of Effects

The combination of the individual judgements of **High** sensitivity and a **Slight** magnitude of change are considered to result in a **Moderate/Minor** effect on Cyclists and Road Users, which in the context of this assessment is considered to be **Not Significant**.

Table13.35 Effects at Viewpoint 1.10, Hermaness Hill

Viewpoint 1.10, Hermaness Hill **Drawing 13.3.1.10 existing view and a panoramic photomontage of the Proposed Project.**	
Distance and Direction to the Proposed Project	Proposed Project: 5.32 km to the east
LCT/CCA and Designations	LCT 349. Major Uplands/ Remote High Cliffs SCA Herma Ness sub unit of the Shetland NSA
Receptor and Sensitivity to Change	Walkers/Bird Watchers – High
Theoretical visibility	None
Location and Rationale for Selection	
The viewpoint is located on the summit of Hermaness Hill at the remote Herma Ness headland to the west of the Saxa Vord radar station. The headland, which is accessible only by foot, forms part of the Hermaness National Nature Reserve popular with wildlife watchers and walkers accessing the north-western coastline of Unst. The following development currently influences the existing baseline: ➢ The radome and buildings associated with the radar station at Saxa Vord Hill. ➢ The radar equipment on the summit of the Ward of Norwick.	
Description of Existing View	
The existing view looks west to Saxa Vord Hill and the Ward of Norwick. The viewpoint, at c. 200 m AOD, provides an elevated vantage point for views across the north western coastline of Unst.	
Determination of Visual Sensitivity	
The sensitivity to change associated with the Proposed Project at this location is considered to be **High** for walkers and wildlife watchers who access the headland for recreation and therefore more susceptible to changes in the view: ***Value*** *– High ((Herma Ness sub unit of the Shetland NSA)* ***Susceptibility to Change*** *– High* ➢ Walkers and wildlife watchers will be engaged in the experience of the landscape and wildlife, with a strong awareness of their surroundings and an expectation of remoteness. ➢ Elemental coastal scenery with expansive views.	
Magnitude of Change	
The overall magnitude of change on receptors at this viewpoint will be **No Change**.	

Size or Scale
The Proposed Project will be screened from view.
Geographical Extent
As shown on the ZTV in **Drawing 13.2.1a** the peninsula at Herma Ness experiences no visibility of the Proposed Project.
Potential for In-Combination Effects
No combined effects are predicted.
Significance of Effects
There will be no change to views experienced at Herma Ness.

LRCC Viewpoints, Viewpoints 2.1 – 2.5

Table 13.36 Operational Effects at Viewpoint 2.1, Minor road at Valsgarth

Viewpoint 3.1, Minor road at Valsgarth **Drawing 13.3.2.1 existing view and a panoramic photomontage of the Proposed Project.**	
Distance and Direction to the LRCC	LRCC: 400 m to the west
LCT/CCA and Designations	LCT 354. Farmed and Settled Voes and Sounds Haroldswick and Skaw LLA
Receptor and Sensitivity to Change	Cyclists / Residents – High Road Users - Medium
Theoretical visibility	Proposed Project and LRCC
Location and Rationale for Selection	
The viewpoint is located on the minor road at Valsgarth to the south-east of the former RAF base at Saxa Vord. The viewpoint is representative of the range of view in and around Saxa Vord for Residents and Road Users. The following development currently influences the existing baseline: ➢ The complex of buildings associated with the former Saxa Vord RAF base, now forming part of the Saxa Vord Resort. ➢ The clusters of radar equipment on the Sothers Field.	
Description of Existing View	
The existing view looks north west to the southern edge of the Saxa Vord Resort, the pastures and scattered properties at Valsgarth are seen in the foreground. The Shetland Reel Distillery and the former Valhalla Brewery buildings are seen to their rooflines, set at a slightly lower	

level than the main resort buildings. The moorland hills at Housi Field and Sothers Field rise to the rear.
Determination of Visual Sensitivity
The sensitivity to change associated with the Proposed Project at this location is considered to be **High** for Residents and Cyclists who are more susceptible to changes in the view, and **Medium** for Road Users: ***Value*** *– Medium* ***Susceptibility to Change*** *– High* ➢ Residents are highly likely to be aware of any changes to their existing visual amenity. ➢ Cyclists will be engaged in the experience of the landscape, with a strong awareness of their surroundings. ➢ Motorists travelling through or past the landscape on roads will focus on the route corridor.
Magnitude of Change
The overall magnitude of change on receptors at this viewpoint will be **Negligible**. ***Size or Scale*** There will be no significant change to the view. ***Geographical Extent*** Views to the refurbishment works will be experienced from Valsgarth.
Potential for In-Combination Effects
There will be no combined effects from this viewpoint.
Significance of Effects
No effects.

Table 13.37 Effects at Viewpoint 2.2, Methodist Church, Valsgarth / Saxa Vord

Viewpoint 3.2, Methodist Church, Valsgarth/Saxa Vord **Drawing 13.3.2.2 existing view and a panoramic photomontage of the Proposed Project.**	
Distance and Direction to the LRCC	LRCC: 520 m to the south west
LCT/CCA and Designations	LCA 354. Farmed and Settled Voes and Sounds Haroldswick and Skaw LLA
Receptor and Sensitivity to Change	Residents/Visitors/Walkers – High

Theoretical visibility	LRCC only
Location and Rationale for Selection	
The viewpoint is located on elevated ground adjacent to the Methodist Church at Sunnyside, beside the Saxa Vord Resort. The viewpoint is representative of the range of views in and around Saxa Vord for Residents. The following development currently influences the existing baseline: ➢ The complex of buildings associated with the former Saxa Vord RAF base, now forming part of the Saxa Vord Resort.	
Description of Existing View	
The existing view looks west to the rear of the clusters of development at the Saxa Vord Resort, pastures and the Saxa Vord games court are seen in the foreground. The moorland hills at Housi Field and Sothers Field rise to the rear. The low-lying farmland art Ungirsta extends to the left of the view.	
Determination of Visual Sensitivity	
The sensitivity to change associated with the Proposed Project at this location is considered to be **High** for residents who are more susceptible to changes in the view: ***Value*** *– Medium* ***Susceptibility to Change*** *– High* ➢ Residents/Visitors are highly likely to be aware of any changes to their existing visual amenity. ➢ Walkers will be engaged in the experience of the landscape, with a strong awareness of their surroundings.	
Magnitude of Change	
There will be no effect on this view as the former Valhalla Brewery Building is screened from view behind the buildings of Saxa Vord Resort.	
Potential for In-Combination Effects	
There will be no combined effects from this viewpoint.	
Significance of Effects	
There will be no effect on this Viewpoint.	

Table 13.38 Operational Effects at Viewpoint 2.3, B9087 adjacent to the Unst Heritage Centre, Haroldswick

Viewpoint 3.3, B9087 adjacent to the Unst Heritage Centre, Haroldswick Drawing 13.3.2.3 existing view and a panoramic photomontage of the Proposed Project.	
Distance and Direction to LRCC	LRCC: 850 m to the north east
LCT/CCA and Designations	LCT 354. Farmed and Settled Voes and Sounds Haroldswick and Skaw LLA
Receptor and Sensitivity to Change	Cyclists / Residents – High Road Users - Medium
Theoretical visibility	LRCC only
Location and Rationale for Selection	
The viewpoint is located on the B9087 adjacent to the Unst Heritage Centre. The viewpoint is representative of the range of views between Haroldswick and Saxa Vord/Valsgarth for Residents and Road Users. The following development currently influences the existing baseline: ➢ The complex of buildings associated with the former Saxa Vord RAF base, now forming part of the Saxa Vord Resort. ➢ The clusters of radar equipment on the Ward of Norwick.	
Description of Existing View	
The existing view looks to the north east across the open farmland between Haroldswick and Saxa Vord Resort, beneath the rising moorland flank of Sothers Field and the Ward of Norwick. The settlement at Valsgarth/Saxa Vord Resort extends across the locally elevated middle ground.	
Determination of Visual Sensitivity	
The sensitivity to change associated with the Proposed Project at this location is considered to be **High** for Residents and Cyclists who are more susceptible to changes in the view, and **Medium** for Road Users: ***Value*** *– Medium* ***Susceptibility to Change*** *– High* ➢ Residents are highly likely to be aware of any changes to their existing visual amenity. ➢ Cyclists will be engaged in the experience of the landscape, with a strong awareness of their surroundings. ➢ Motorists travelling through or past the landscape on roads will focus on the route corridor.	
Magnitude of Change	

The overall magnitude of change on receptors at this viewpoint will be **Negligible**. ***Size or Scale*** No prominent long-term effects are expected. ***Geographical Extent*** Views will be experienced locally to the south-west of Saxa Vord.
Potential for In-Combination Effects
There will be no combined effects from this viewpoint.
Significance of Effects
The combination of the individual judgements of **High** sensitivity and a **Negligible** magnitude of change are considered to result in a **Minor** effect on Residents, Cyclists and Road Users, which in the context of this assessment is considered to be **Not Significant**.

Table 13.39 Effects at Viewpoint 2.4, Minor road at Houlanbrindy

Viewpoint 3.4, Minor road at Houlanbrindy **Drawing 13.3.2.4 existing view and a panoramic photomontage of the Proposed Project.**	
Distance and Direction to the LRCC	LRCC: 1 km to the south west
LCT/CCA and Designations	LCA 349. Major Uplands Haroldswick and Skaw LLA
Receptor and Sensitivity to Change	Cyclists – High Road Users - Medium
Theoretical visibility	LRCC only
Location and Rationale for Selection	
The viewpoint is located on the minor road which leads above Norwick Meadow to join into Holsens Road. The viewpoint is representative of the range of views in and around Saxa Vord/Northdale for Road Users. The following development currently influences the existing baseline: ➢ The complex of buildings associated with the former Saxa Vord RAF base, now forming part of the Saxa Vord Resort. ➢ The telecommunications masts at Little Hoeg.	
Description of Existing View	
The existing view looks south across the pastures at Northdale to the distinctive rooflines of the former RAF base at Saxa Vord. Views to Saxa Vord are seen against the northern flanks of the	

Hill of Clibberswick, Little Hoeg and Muckle Hoeg. The North Sea is seen beyond to the left of the view.
Determination of Visual Sensitivity
The sensitivity to change associated with the Proposed Project at this location is considered to be **High** for Cyclists who are more susceptible to changes in the view, and **Medium** for Road Users: ***Value*** *– Medium* ***Susceptibility to Change*** *– High* ➢ Cyclists will be engaged in the experience of the landscape, with a strong awareness of their surroundings. ➢ Motorists travelling through or past the landscape on roads will focus on the route corridor.
Magnitude of Change
There will be no effect on this view as the former Valhalla Brewery Building is screened from view behind the building of the Shetland Reel Distillery.
Potential for In-Combination Effects
There will be no combined effects from this viewpoint.
Significance of Effects
There will be no effect on this Viewpoint.

Table 13.40 Effects at Viewpoint 2.5, Minor road, off the B9087 at Norwick

Viewpoint 3.5, Minor road, off the B9087 at Norwick **Drawing 13.3.2.5 existing view and a panoramic photomontage of the Proposed Project.**	
Distance and Direction to the LRCC	LRCC: 1.1 km to the west
LCT/CCA and Designations	LCT 354. Farmed and Settled Voes and Sounds Haroldswick and Skaw LLA
Receptor and Sensitivity to Change	Cyclists / Residents – High Road Users - Medium
Theoretical visibility	None

Location and Rationale for Selection
The viewpoint is located on the minor road off the B9087, at Norwick Meadow, looking west towards the Saxa Vord Resort and Northdale. The viewpoint is representative of the range of views in and around Norwick for Residents and Road Users.
Description of Existing View
The existing view looks west across the fields of pasture west of Norwick towards the Saxa Vord Resort. The background is framed by the rising hillside at Crussa Field and Valla Field beyond.
Determination of Visual Sensitivity
The sensitivity to change associated with the Proposed Project at this location is considered to be **High** for Residents and Cyclists who are more susceptible to changes in the view, and **Medium** for Road Users: ***Value*** *– Medium* ***Susceptibility to Change*** *– High* ➢ Residents are highly likely to be aware of any changes to their existing visual amenity. ➢ Cyclists will be engaged in the experience of the landscape, with a strong awareness of their surroundings. ➢ Motorists travelling through or past the landscape on roads will focus on the route corridor.
Magnitude of Change
There will be no visibility to the LRCC which is contained from view by built form at Saxa Vord and the local ridgeline.
Potential for In-combination Effects
There will be no combined effects from this viewpoint.
Significance of Effects
There will be no effect on this Viewpoint.

Summary of Effects on Viewpoints

13.7.17 Table 13.41 lists and summarises effects on the viewpoints assessed above. It sets out their sensitivity to change, the magnitude of change that will arise as a result of the Proposed Project, and the level of resultant effects and their significance.

Table 13.41 Summary of Effects on Viewpoints

Viewpoint	Receptor and Sensitivity	Magnitude of Change	Level of Effect	Significance
Proposed Project, Viewpoints – 1.1 – 1.10				
1.1 - Bluejibs above the Wick of Skaw	Walkers/Visitors – High	Substantial	Major	**Significant**
1.2 - The Haa, Wick of Skaw	Walkers/Visitors/ Residents – High	Substantial	Major	**Significant**
1.3 - The Garths, Lamba Ness	Walkers/Cyclists – High Road Users - Medium	Substantial	**Major** - Walkers, Visitors and Cyclists **Major/Moderate** - Road Users	**Significant**
1.4 - Car park at The Taing, Norwick	Walkers/Visitors/ Residents – High	Substantial	**Major** - Walkers, Visitors and Residents	**Significant**
1.5 - The cemetery, Norwick	Walkers/Visitors/ Residents – High	Moderate	**Major/Moderate** - Walkers, Visitors and Residents	**Significant**
1.6 - B9087 Norwick	Residents/Cyclists – High Road Users - Medium	Moderate	**Major/Moderate** – Residents and Cyclists **Moderate** - Road Users	**Significant** Not Significant
1.7 - Hill of Clibberswick	Walkers – High	Moderate	**Major/Moderate** - Walkers	**Significant**
1.8 - Headland to the north of Saxa Vord radar station	Walkers – High	Negligible	**Minor** - Walkers	Not Significant
1.9 - A968 beneath Little Hoeg	Cyclists – High Road Users - Medium	Slight	**Moderate/Minor** – Cyclists and Road Users	Not Significant
1.10 - Hermaness Hill	Walkers/wildlife Watchers – High	No Change	None	No Effect

13.8 Assessment of Night-time Lighting Effects

13.8.1 The following section provides an overview of the predicted effects of night-time lighting at the Proposed Project.

13.8.2 Light pollution is a recognised problem in the UK, with lighting potentially contributing to an adverse effect on peoples' views, including their enjoyment of the night skies. SNH has noted the need to be cautious when proposing lighting in the UK's darker, more sensitive landscapes.

13.8.3 Night-time lighting will be required on the site for safety during launch cycles. The need for lighting will extend visibility of the Proposed Project into hours of darkness. Outside of Launch Cycles the lighting on site will be reduced to the minimum required for site security and occasional maintenance operations.

Baseline

13.8.4 The baseline environment of Shetland and of the site is generally dark and relatively light free at night, with the only lighting being associated with settlements and residential properties, lighting around the ferry terminals and piers (e.g., at Baltasound), and infrastructure such as fish farms or industrial operations such as the Sullom Voe Oil Terminal. Lighting on vehicles on roads, and on ferries at night, as well as on channel or hazard marker buoys in the sea between the islands also influences the night sky. Relative to the rest of the UK however, Shetland is characterised by very dark skies.

Assessment

13.8.5 Whilst lighting on the Proposed Project Launch Site will be reduced to a minimum with cut off lighting used wherever possible there will be times when elements of the site and in particular the launch pads and LVs will need to lighted with directional lighting. The lights at the launch pads have the potential to be seen in clear conditions over long distances.

13.8.6 Shetland has long hours of daylight in the summer months, when the effects of safety lighting at the Proposed Project will be minimal, but there will be long hours of darkness in winter when the effects will extend over longer durations. In Shetland in winter at this latitude it can be dark from 3pm through to 9am, which includes times when people will be active and able to be affected by the proposed lighting.

13.8.7 Lighting may also be seen to interfere with natural phenomena such as the Northern Lights, when it occurs.

13.8.8 As such, the effects of lighting on night-time views have the potential to be Significant, particularly in closer views and during launch cycles. It has the potential to have a significant effect during hours of darkness at all locations within up to approximately 1-2 km (depending upon atmospheric conditions) where the Proposed Project is visible.

Seasonal variation in effects

13.8.9 The effect will be more noticeable and significant in winter months, when people are active during hours of darkness. In summer months however, when the islands are typically more populated with tourists and more people will be outside, most people will be asleep during the very short hours of darkness at this latitude, and the effect of the lighting will be not significant. Between these two extremes, the duration of lighting required and thus the level of significance of effects will gradually increase as the natural daylight tapers off.

Supporting Graphics – Night-time lighting Visualisations

13.8.10 Drawings are provided to illustrate the effects of lighting. The following viewpoint Drawings have been prepared to illustrate the effects of night-time lighting at two selected viewpoints, representative of the local residential clusters that will experience direct views towards the Proposed Project.

- Night-time Lighting Viewpoint 1: Virse, Norwick
  - Drawing 13.3.1a: Virse, Norwick – 90° Existing View (Dusk) and 90° Predicted Photomontage View (Cylindrical)
- Night-time Lighting Viewpoint 2: Skulhus, Sunnyside/Saxa Vord Resort
  - Drawing 13.3.2a: Skulhus, Sunnyside/Saxa Vord Resort – 90° Existing View (Darkness) and 90° Predicted Photomontage View (Cylindrical)

13.8.11 The individual assessment from these representative locations is provided below.

Table 13.42 Effects at Night-time Lighting Viewpoint 1, Virse, B9087 Norwick

Night-time Lighting Viewpoint 1, Virse, B9087 Norwick **Drawing 13.3.1 existing view and a panoramic photomontage of the Proposed Project (Darkness).**	
Distance and Direction to the Proposed Project	Proposed Project: 2 km to the north east
LCA/CCA and Designations	LCT 354. Farmed and Settled Voes and Sounds / East Unst CCA Haroldswick and Skaw LLA
Receptor and Sensitivity to Change	Residents – High Road Users - Medium
Theoretical visibility	Proposed Project
Location and Rationale for Selection	
The viewpoint is located on the B9087/NCR1 between Saxa Vord and Norwick, adjacent to the entrance to the property at 'Virse'. It has been selected to illustrate the effects of night-time lighting on local residents.	
Description of Existing View	
The existing view looks north across the settled farmland of Norwick Meadow and beyond to the settlement at Norwick, the bay at Nor Wick, the peninsula to the north between Inner Skaw and Lamba Ness, and the expansive North Sea beyond. Lighted windows visible at the scattered properties at Norwick are the only visible artificial light sources.	
Determination of Visual Sensitivity	
The sensitivity to change associated with the Proposed Project at this location is considered to be **High** for residents of who are more susceptible to changes in the view, and **Medium** for Road Users: ***Value** – Medium* ***Susceptibility to Change** – High* ➢ Residents are highly likely to be aware of any changes to their existing visual amenity. ➢ Motorists travelling through or past the landscape on roads will focus on the route corridor.	
Magnitude of Change	
The overall magnitude of change on receptors at this viewpoint will be a **Moderate**. ***Size or Scale*** The proposed lighting will be visible in the distance varying from being dimly visible at low light, more resolved and noticeable at dusk, to being seen as a clearly seen at darkness.	

Light sources are likely to include: ➢ Cut off lighting at the launch pads. ➢ Directional lighting onto the LV, strongback and the lightning masts. ➢ Low level lighting at the Integration/TEL Hangar, LSPF and gate house. ***Geographical Extent*** Views to the lighting will be experienced along the B9087 between Saxa Vord and Norwick. ***Duration*** The effect will be more noticeable and Significant in winter months, when people are active during hours of darkness. In summer months however, when the islands are typically more populated with tourists and more people will be outside, most people will be asleep during the very short hours of darkness at this latitude, and the effect of the lighting will not be significant. Between these two extremes, the duration and thus level of significance of effects will gradually increase as the natural daylight tapers off again.
Significance of Effects
The combination of the individual judgements of **High** and **Medium** sensitivity and a **Moderate** magnitude of change are considered to result in a **Major/Moderate** effect on Residents, and a **Moderate** effect on Road Users, which in the context of this assessment are considered to be **Significant** and **Not Significant** effects respectively.

Table 13.43 Operational Effects at Night-time Lighting Viewpoint 2, Skulhus, Sunnyside/Saxa Vord.

Night-time Lighting Viewpoint 2, Skulhus, Sunnyside/Saxa Vord. **Drawing 13.3.2 existing view and a panoramic photomontage of the Proposed Project (Dusk).**	
Distance and Direction to the Proposed Project	Proposed Project: 1.6 km to the north east
LCA/CCA and Designations	LCT 354. Farmed and Settled Voes and Sounds / East Unst CCA Haroldswick and Skaw LLA
Receptor and Sensitivity to Change	Residents – High Road Users - Medium
Theoretical visibility	Proposed Project
Location and Rationale for Selection	
The viewpoint is located at the edge of Saxa Vord / Sunnyside, adjacent to the property at ‘Skulhus’. It has been selected to illustrate the effects of night-time lighting on local residents.	

Description of Existing View
The existing view looks to the north-east across the scattered settlement between Saxa Vord and Norwick. The peninsula between Inner Skaw and Lamba Ness is partly seen on the skyline below the tapering ridgeline of The Ward of Norwick. Lighted windows visible at the properties in the foreground are the only visible artificial light sources.
Determination of Visual Sensitivity
The sensitivity to change associated with the Proposed Project at this location is considered to be **High** for Residents of who are more susceptible to changes in the view, and **Medium** for Road Users: ***Value*** *– Medium* ***Susceptibility to Change*** *– High* ➢ Residents are highly likely to be aware of any changes to their existing visual amenity. ➢ Motorists travelling through or past the landscape on roads will focus on the route corridor.
Magnitude of Change
The overall magnitude of change on receptors at this viewpoint will be a **Moderate**. ***Size or Scale*** The proposed lighting will be visible in the distance varying from being dimly visible at low light, more resolved and noticeable at dusk, to being seen as a clearly seen at darkness. Light sources are likely to include: ➢ Cut off lighting at the launch pads. ➢ Directional lighting onto the LV, strongback and the lightning masts. ➢ Low level lighting at the Integration/TEL Hangar, LSPF and gate house. ***Geographical Extent*** Views to the lighting will be experienced along the B9087 between Saxa Vord and Norwick. ***Duration*** The effect will be more noticeable and Significant in winter months, when people are active during hours of darkness. In summer months however, when the islands are typically more populated with tourists and more people will be outside, most people will be asleep during the very short hours of darkness at this latitude, and the effect of the lighting will not be significant. Between these two extremes, the duration and thus level of significance of effects will gradually increase as the natural daylight tapers off again.

Significance of Effects

The combination of the individual judgements of **High** and **Medium** sensitivity and a **Moderate** magnitude of change are considered to result in a **Major/Moderate** effect on Residents, and a **Moderate** effect on Road Users, which in the context of this assessment are considered to be **Significant** and **Not Significant** effects respectively.

Summary

13.8.12 Shetland has long hours of daylight in the summer months, when the effects of safety lighting and task lighting will be minimal, but long hours of darkness in winter when the effects will extend over longer durations. In Shetland in winter at this latitude it can be dark from 3pm through to 9am, which includes times when people will be active and able to be affected by the proposed lighting.

13.8.13 Lighting may also be seen to interfere with natural phenomena such as the Northern Lights when they occur.

13.8.14 As such, the effects of lighting on night-time views is likely to be Significant, particularly in closer views. It is likely to be Significant during hours of darkness at locations within approximately 1-2 km where visible.

13.8.15 The effect will be more noticeable and significant in winter months, when people are active during hours of darkness. In summer months however, when the islands are typically more populated with tourists and more people will be outside, most people will be asleep during the very short hours of darkness at this latitude, and the effect of the lighting will be not significant. Between these two extremes, the duration and intensity of lighting and thus level of significance of effects will gradually increase as the natural daylight tapers off.

13.9 Summary of In-Combination Landscape and Visual Assessment

13.9.1 The assessment of in-combination effects is incorporated into the main LVIA, with separate judgements for the combined effects presented within each of the tables throughout, for each landscape and visual receptor. This section summarises the key issues, informed by the analysis and assessment which has already been presented.

13.9.2 There will be short term combined effects on the settlement at Saxa Vord and areas around Northdale where parts of the Proposed Project will be seen in combined views and successive views. These effects are Not Significant in-combination effects.

13.10 Summary

13.10.1 A Landscape and Visual Impact Assessment has been undertaken for the Proposed Project. It sets out the predicted effects on the landscape, which, in the context of Shetland and this assessment, also includes effects on coastal and seascape character.

13.10.2 The assessment includes consideration of effects upon designated landscapes including the Shetland NSA and other locally designated landscapes such the draft LLAs.

13.10.3 From a visual perspective, the assessment considers effects upon residents at settlements, users of roads and recreational routes, which include tourists. This was informed by assessment of visual effects at a series of representative viewpoints, which were agreed with NatureScot and Shetland Islands Council.

13.10.4 The assessment of in-combination effects between the component parts of the Proposed Project is incorporated into the main assessment of landscape and visual effects. Some limited in-combination interactions will occur.

13.10.5 The proposed launch pads will need to be lighted at night for a short term during individual launch cycles for reasons of safety. The lighting will extend visual effects into hours of darkness for local visual receptors.

13.10.6 Whilst it is always necessary to take account of and to balance the wide range of technical and environmental requirements, it is also a requirement to seek to optimise the layout design through mitigation measures embedded into the project design to reduce the resulting effects from a landscape and visual perspective. Landscape and visual input into the Proposed Project design has been provided through the design development stages of the project. These measures include the careful selection of colour in the proposed built forms, sensitive use of construction materials, and a careful approach to the manipulation of the land form to accommodate the new structures.

13.10.7 A number of significant effects are predicted including significant landscape effects on the landscape character of the site and its surroundings, visual effects on residents at settlements and tourists including recreational walkers.

Summary of Effects on the Landscape Resource

Effects on Landscape Fabric

13.10.8 Effects on the fabric of the landscape will be limited in extent. The physical changes to the landscape, such as the construction of access tracks, launch pads, and buildings will occupy only a small portion of the overall site area and the existing use of the land for grazing will persist. The Proposed Project will be operated in such a way as to mitigate the extent of any unnecessary damage, potential soil erosion or indirect off-site effects due to changed surface or groundwater conditions.

13.10.9 The landscape is of Medium sensitivity, given the presence of the sensitive remains of the former Skaw Radar Station. Operation the Proposed Project is considered to have a Substantial magnitude of change. There will be Major/Moderate and Significant effects on the fabric of the application sites in and around the immediate vicinity of the Proposed Project.

Effects on Landscape Character

13.10.10 The Proposed Project Launch Site includes parts of the 355 - Coastal Edge Landscape Character Type (LCT) and 349 - Major Uplands LCT as identified in the Scottish Landscape Character Types Mapping.

13.10.11 The Proposed Project is located within the Coastal Edge LCT and the eastern edge of the Major Uplands LCT and the implementation of the development will introduce additional built form and infrastructure to the peninsula between inner Skaw and Lamba Ness within the context of the derelict structures of the former Skaw Radar Station. The new buildings and infrastructure will reinforce development as a component of the prevailing landscape character. Although the Proposed Project will add to the influence of development on the peninsula, the presence of existing development will reduce the magnitude of change on the character and qualities of the LCTs.

13.10.12 Within the Coastal Edge LCT, there will be a locally Substantial magnitude of change, which in combination with the Medium/High sensitivity of the landscape, is considered to result in a locally Major/Moderate and Significant effect across the immediate site area and the LCT.

13.10.13 The rising ridgeline of the Ward of Norwick is open to direct views to the Proposed Project and there will be direct and indirect effects on the character of the Major Uplands LCT. There will a locally Substantial magnitude of change, which in combination with the High sensitivity of the landscape, is considered to result in a locally Major and Significant effect across the immediate site area and a generally Major/Moderate and Significant effect across the eastern extent of the LCT.

13.10.14 Whilst topography limits the influence of the Proposed Project there will be indirect impacts on the perceived qualities and characteristics of the Skaw unit of the Farmed and Settled Lowlands and

Coast LCT to the north and the Norwick-Valsgarth area of the Farmed and Settled Voes and Sounds LCT to the south.

13.10.15 The Proposed Project between Inner Skaw and Lamba Ness will be seen in partial views, as new structures and buildings protruding above and along the peninsula, reinforcing the influence of development. From the Farmed and Settled Lowlands and Coast LCT and the Farmed and Settled Voes and Sounds LCT there will be a generally Slight magnitudes of change, which in combination with the High/Medium and Medium sensitivities respectively of the landscape types, is considered to result in a Moderate and Not Significant effect.

13.10.16 During launch cycles the lightning masts, hardbacks and LV s, erected at separate times on each of the launch pads, will be seen as prominent structures which will influence the setting of both LCTs. The launch cycle will give rise to short term increases in the magnitude of change experienced From the Farmed and Settled Lowlands and Coast LCT and the Farmed and Settled Voes and Sounds LCT, with a Moderate magnitude of change, which in combination with the High/Medium and Medium sensitivities respectively of the landscape types, is considered to result in locally Major/Moderate and Significant effects.

13.10.17 There will also be areas of inter-visibility with the elevated coastal LCTs including the Blue Jibs area of the Coastal Edge LCT to the north, and the north facing flank of the Hill of Clibberswick to the south which includes sections of the Coastal Edge LCT and Peatland and Moorland LCT. Actual influence on the perception of landscape character is reduced by distance and there will be a Slight magnitude of change, which in combination with the High/Medium and Medium sensitivities respectively of the landscape types, is considered to result in locally Moderate and Not Significant effects.

13.10.18 During launch cycles the lightning masts, strongbacks and LVs, erected at separate times on each of the launch pads, will be seen as prominent structures which will influence the setting of both LCTs. The launch cycle will give rise to short term increases in the magnitude of change experienced From the Coastal Edge LCT and Peatland and Moorland LCT, with a Moderate magnitude of change, which in combination with the High/Medium and Medium sensitivities respectively of the landscape types, is considered to result in locally Major/Moderate and Significant effects on these LCTs.

13.10.19 Beyond 3 km, due to the effect of topography which provides containment to the site and also the effect of distance, the Proposed Project will be a less visible element in the landscape. The resultant effects on landscape character will only give rise to Slight or Negligible magnitudes of change beyond 3 km with effects on landscape character being Not Significant.

Effects on Coastal and Seascape Character

13.10.20 The Proposed Project is located between the Skaw and East Unst Coastal Character Areas (CCA), and the Islands, Sounds and Voes Seascape Character Area (SCA) lies to the east. The implementation of the Proposed Project will introduce additional development to the peninsula between inner Skaw and Lamba Ness within the context of the derelict structures of the former Skaw Radar Station. The new buildings and infrastructure and will reinforce the perception of development as a component of the prevailing coastal/seascape character.

13.10.21 There will be locally Moderate magnitudes of change on these CCAs/SCA, which in combination with the High sensitivity of the coastline/seascape, is considered to result in a locally Major/Moderate and Significant effects across the CCAs/SCA within the Wick of Skaw to the north and Nor Wick to the south and across the open sea to the east. As with the effects on landscape character there will be a greater short-term magnitude of change experienced from the CCAs/SCA during launch cycles with the temporary infrastructure of extended lightning masts, strongback and LVs appearing as prominent temporary elements above the low profile of the coastal peninsula.

Effects on Designated Landscapes

13.10.22 Potential effects on the quality and setting of designated landscapes within the EZI were assessed, in particular relating to the Shetland NSA, LLAs and Inventory Gardens and Designed Landscapes.

13.10.23 Locally Major/Moderate and Significant effects are predicted upon the coastal edges of the Haroldswick and Skaw Local Landscape Area.

13.10.24 Minor and not significant effects are also predicted on a very limited area of the Hermaness sub-unit of the Shetland NSA where there will be very minor visibility of the lightning masts of Launch Pad 3, visible only during a launch cycle, moderated by the distinct separation of the Proposed Project from the designation and the diverse nature of views. There will not be important changes to the special qualities of the Shetland NSA. A detailed assessment of effects on the Shetland NSA is included at Appendix 13.5.

13.10.25 No significant effects as a result of the Proposed Project will occur in relation Inventory Gardens and Designed Landscapes.

Summary of Effects on Visual Amenity

13.10.26 The study included an assessment of the effects of the Proposed Project upon settlements, transport corridors and viewpoints representative of a range of receptors within the EZI.

Effects on Settlements, Transport Corridors and Recreational Routes

13.10.27 Effects were assessed on visual amenity from settlements. It is predicted that there will be Major/Moderate and Significant effects from the settlements at Booths, Norwick/Kirkaton and the north-eastern edge of Saxa Vord/Valsgarth. This effect is moderated by the existing presence of the structures of the former Skaw Radar Station development in the landscape, the effects of distance and the context of the Proposed Project within expansive and diverse coastal views.

13.10.28 During launch cycles the lightning masts, strongbacks and LVs, erected at separate times on each of the launch pads, will be seen as prominent structures which will influence views from Norwick and the north-eastern edge of Saxa Vord/Valsgarth. The launch cycle will give rise to short term increases in the magnitude of change.

13.10.29 Similar effects will be experienced by cyclists on the National Cycle Route 1 using the B9087 and also the minor road, Holsens Road, leading on from Norwick to Skaw.

13.10.30 Effects assessed on visual amenity from other settlements, roads and long-distance cycle ways within the EZI, are concluded to be Not Significant.

Effects on Viewpoints

13.10.31 The nature of the visibility of the Proposed Project was also assessed from 15 viewpoints. The viewpoints included settlements, route corridors, landmarks, hill summits and other visitor attractions.

13.10.32 The assessment of the viewpoints concluded that there will be significant effects on visual amenity from six of the selected viewpoints as follows:

- Viewpoint 1.1, Coastal footpath above Bluejibs and the Wick of Skaw: From the headland at Blue Jibs to the north of Skaw Beach the Proposed Project be seen in its full extent along the peninsula between Inner Skaw and Lamba Ness adding new built form within the remnant structures of the Skaw Radar Station and introducing significant local change with the outlines of the new hangars prominent on the skyline of the peninsula.
- Viewpoint 1.2, The Haa, Wick of Skaw, and Viewpoint 1.4, Car Park at The Taing, Norwick: From Skaw Beach to the north of the peninsula and from Taing Beach to the south the Proposed Project will be seen as new vertical elements visible along the profile of the peninsula.
- Viewpoint 1.3, Holsens Road, Clinkapund above the site entrance to Lamba Ness: The viewpoint is located at the western edge of the Proposed Project and affords a

locally elevated position across the site between Inner Skaw and Lamba Ness. The proposed large hangars will be as noticeable new large scale-built form on the site.

- Viewpoint 1.5, Norwick Cemetery: The viewpoint is located at the eastern edge of the settlement at Norwick within Norwick Cemetery and in a slightly elevated position affording a direct view across Nor Wick to the peninsula to the north. The proposed hangar at the western sector of the site will be prominent on the skyline above the beach at Taing, whilst the TEL hangar, and the lightning mast will be visible as new vertical elements visible along the profile of the peninsula.
- Viewpoint 1.6, B9087, Norwick: Similar views will be experienced from the scattered houses at the north-eastern edge of Valsgarth/Saxa Vord.
- Viewpoint 1.7, Hill of Clibberswick: This viewpoint from the northern side of the Hill of Clibberswick illustrates the effect on view that will be experienced by recreational walkers accessing the elevated coastline to the south of Nor Wick. The elevated viewpoint looks down onto the peninsula and the Proposed Project will be noticeable in views.

13.10.33 At each of these viewpoints, during launch cycles, the lightning masts, strongbacks and LVs, erected at separate times on each of the launch pads, will be seen as further prominent structures in these views. There will also be associated temporary night-time lighting effects during each launch cycle.

13.10.34 From more distant viewpoint locations, the Proposed Project will appear in a large-scale and diverse landscape/coastal/seascape setting, which can accommodate the level of change associated with the Proposed Project and which will not give rise to further significant effects on visual amenity. The Proposed Project will recede within wider panoramic views, particularly with distance.

13.10.35 The Proposed Project is focussed away from the scattered settlement and coastal crofting land and is positioned on the Lamba Ness peninsula. The site has previously been the focus for the large-scale development of the wartime Skaw Radar Station with many of the original structures, buildings and tracks remaining evident in this coastal landscape. The Proposed Project has been carefully planned to retain the integrity of the remaining Skaw Radar facility, by using the existing site access and by positioning the proposed built forms in less prominent positions within the landscape and, avoiding the remains of the Skaw Radar Station where possible. Whilst the effects will be significant locally to the site, and for some visual receptors in local views to the site, it is considered that these can be accommodated in this open, diverse coastal landscape.

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Chapter 14 Material Assets and Cultural Heritage

14. Material Assets and Cultural Heritage

14 Material Assets and Cultural Heritage

14.1 Introduction

14.1.1 This chapter considers the issues associated with the likely significant cultural heritage effects of the Proposed Project.

14.1.2 This chapter has been produced by AOC Archaeology Group, a Registered Organisation of the Chartered Institute for Archaeologists (CIfA). The assessment has been carried out by Victoria Oleksy and Lisa Bird of AOC Archaeology Group. Victoria Oleksy is an Assistant Director and Consultancy Sector Head with over 15 years of experience working on cultural heritage assessments. Victoria specialises in EIAs, Archaeological Impact Assessment and Conservation Management Plans and has appeared as an expert witness for planning appeals and called-in planning applications. Lisa Bird is a Project Officer with five years of experience working on a range of EIAs, desk-based assessments and large walkover survey projects.

14.1.3 This assessment has been carried out in accordance with the standards of professional conduct outlined in the CIfA *Code of Conduct* (CIfA, 2021) and *Regulations for Professional Conduct* (CIfA, 2019), as well as the CIfA *Standard and guidance for commissioning work on, or providing consultancy advice on, archaeology and the historic environment* (CIfA, 2014a); *Standard and guidance for historic environment desk- based assessment* (CIfA, 2017); field evaluations (CIfA, 2020) and other relevant guidance.

14.1.4 This assessment makes the distinction between designated heritage assets, referred to as 'designated assets', which have statutory designations (including Scheduled Monuments and Listed Buildings), and 'heritage features', which relate to non-designated assets which have no statutory designation but are protected under national and local planning policy. Individual elements within Skaw radar station (centred Site 3; hereafter RAF Skaw) and Inner Skaw (Site 2) which make up part of these larger designated assets and are statutorily protected are also referred to as 'heritage features.' Hitherto unknown buried archaeological remains are referred to as 'remains'.

14.1.5 This assessment considers the potential for effects on cultural heritage and archaeology associated with the operation of the Proposed Project. The specific objectives of the chapter are to:

- describe the cultural heritage baseline;
- describe the assessment methodology and significance criteria used in completing the effect assessment;
- assess the potential for direct effects on designated assets and non-designated heritage features and remains resulting from operation of the Proposed Project;
- assess the setting effects upon designated assets within the Site and the 1 km cultural heritage study area during the operational phase;
- identify measures that would mitigate or offset any predicted significant adverse effects; and,
- assess the significance of residual effects following the implementation of mitigation.

14.1.6 This chapter is supported by the Drawings and Appendices presented in Table 14.1. All site numbers referred to in the text and Drawings relate to designated assets and heritage features listed in the Site Gazetteer (Appendix 14.1)

Table 14.1 List of Drawings and Appendices in Volume 3 and 4 Respectively

Document Title	Document Description
Drawing 14.1	Designated Assets in the Proposed Project Site and the study area
Drawing 14.2a-c	Heritage features in the Proposed Project Site
Drawing 14.3	Heritage features in the study area of the Proposed Project
Drawing 14.4	Proposed Project Site - Extract from Ordnance Survey map, 1882
Appendix 14.1	Cultural Heritage Site Gazetteer
Appendix 14.2	Cultural Heritage Plates
Appendix 14.3	Consultation Meeting Notes
Appendix 14.4	Cultural Heritage Viewpoints
	Cultural Heritage Viewpoint Location Plan
	Cultural Heritage Viewpoint 1: Inner Skaw Scheduled Monument (Site 2)
	Cultural Heritage Viewpoint 2: RAF Skaw Interpretation Board
	Cultural Heritage Viewpoint 3: Advance Chain Home (ACH) Transmitter (Site 96)
	Cultural Heritage Viewpoint 4: Chain Home (CH) Transmitter (Site 85)
	Cultural Heritage Viewpoint 5: Gun and Crew Shelter (Site 74)
	Cultural Heritage Viewpoint 6: Track (Site 85hh) looking towards CH Transmitter (Site 85)
	Cultural Heritage Viewpoint 7: CH/S Power House (Site 93)
	Cultural Heritage Viewpoint 8: CH Receiver Block (Site 111)
Appendix 14.5	Review of Existing Structures
Appendix 14.6	Detailed Archaeological & Historical Background
Appendix 14.7	Results of Walkover Survey
Appendix 14.8	Data Structure Report: RAF Skaw, Watching Brief on Ground Investigation Works
Appendix 14.9	Draft Interpretation Strategy
Appendix 14.10	Conservation Management Plan

14.2 Legislation, Policy and Guidelines

Legislation

Space Industry Act

14.2.1 The Space Industry Act (2018) regulates all spaceflight activities carried out in the United Kingdom, and associated activities. The Act requires any person or organisation to obtain the relevant licence to:

- launch a launch vehicle from the UK;
- return a launch vehicle launched elsewhere than the UK to the UK landmass or the UK's territorial waters;

- operate a satellite from the UK;
- conduct sub-orbital activities from the UK;
- operate a spaceport in the UK; or
- provide range control services from the UK.

14.2.2 As the applicant wishes to operate a vertical spaceport (at the SaxaVord Spaceport) and provide range control services (at the Launch and Range Control Centre, LRCC) they are required to apply for a both a spaceport licence and a range control licence.

Space Industry Regulations 2021

14.2.3 The Space Industry Regulations 2021 (the Regulations) set out in more detail the requirements for each licence the Regulators Licensing rules, which specify what information the UK Civil Aviation Authority (CAA), the regulator, requires in support of an application.

Statutory Framework for Heritage

14.2.4 The statutory framework for heritage in Scotland is outlined in the Town and Country Planning (Scotland) Act 1997 (HMSO, 1997a), as amended in the Planning (Listed Buildings and Conservation Areas) (Scotland) Act 1997 (HMSO, 1997b) and the Ancient Monuments and Archaeological Areas Act 1979 (HMSO, 1979) both of which are modified by the Historic Environment (Amendment) (Scotland) Act 2011 (HMSO, 2011).

14.2.5 The Proposed Project is located within the southern portion of the Scheduled Monument of Skaw, radar station (centred Site 3; hereafter RAF Skaw). As such Scheduled Monument Consent (SMC) will be required for works within the RAF Skaw Scheduled Monument in line with the Ancient Monuments and Archaeological Areas Act 1979.

14.2.6 Historic Environment Scotland's (HES) Scheduled Monument Consents Policy (SMCP) (HES, 2019a) sets out policies applied to consent decisions with regard to proposals for work on Scheduled Monuments. The following policies are relevant to this assessment:

- *'SMCP1: When undertaking works to scheduled monuments, their significance should be maintained.*
- *SMCP3: Extensive intervention to a scheduled monument will only be allowed where:*
    - it has minimal effect on the cultural significance of the monument; or
    - it is clearly necessary to secure the long-term preservation of the monument; or
    - it will clearly generate public benefits of national importance which outweigh the impact on the nationally important cultural significance of the monument. Such public benefits could come from, for example, interventions which improve public access to a scheduled monument (where appropriate) or assist public understanding once the works are completed or provide economic benefits of national importance once completed.
- *SMCP4: Proposals for change should be carefully considered, based on good authority, sensitively designed, and properly planned and executed. The level of information provided should be in proportion to the sensitivity of the monument or feature and the level of change proposed.'*

Planning Policy

14.2.7 The implications of the Acts noted above, with regard to government planning policy, are described within Scottish Planning Policy (SPP) (Scottish Government, 2014), Historic Environment Policy for Scotland (HEPS) (HES, 2019b) and Planning Advice Notes (PAN) for Scotland. SPP, HEPS and PAN 2/2011 'Archaeology and Planning' (Scottish Government, 2011) deal specifically with planning policy in relation to heritage. The planning guidance expresses a general presumption in favour of preserving designated assets and non-designated features in situ. Their 'preservation by record' (i.e. through excavation and recording, followed by analysis and publication, by qualified archaeologists) is a less desirable alternative. SPP expresses the following policy principles:

'The planning system should:

- *promote the care and protection of the designated and non-designated historic environment (including individual assets, related settings and the wider cultural landscape) and its contribution to sense of place, cultural identity, social well-being, economic growth, civic participation and lifelong learning; and*
- *enable positive change in the historic environment which is informed by a clear understanding of the importance of the heritage assets affected and ensure their future use. Change should be sensitively managed to avoid or minimise adverse impacts on the fabric and setting of the asset, and ensure that its special characteristics are protected, conserved or enhanced' (Scottish Government 2014, Para 137).*

14.2.8 HEPS (HES, 2019b) sets out the Scottish Government's policy for decision making that affects the historic environment. It contains six policies for managing the historic environment, all of which favour protection, understanding and promotion of the historic environment as well as the preservation of the benefits of the historic environment for future generations. Historic environment policies 3 and 4 both state '*if detrimental impact on the historic environment is unavoidable, it should be minimised. Steps should be taken to demonstrate that alternatives have been explored, and mitigation measures should be in place*' (HES, 2019b). The following historic environmental policies are relevant to this assessment:

- *'HEP1: Decisions affecting any part of the historic environment should be informed by an inclusive understanding of its breadth and cultural significance.*
- *HEP2: Decisions affecting the historic environment should ensure that its understanding and enjoyment as well as its benefits are secured for present and future generations.*
- *HEP3: Plans, programmes, policies and strategies and the allocation of resources should be approached in a way that protects and promotes the historic environment.*

  If detrimental impact on the historic environment is unavoidable, it should be minimised. Steps should be taken to demonstrate that alternatives have been explored and mitigation measures should be put in place.
- *HEP4: Changes to specific assets and their context should be managed in a way that protects the historic environment. Opportunities for enhancement should be identified where appropriate.*

  If detrimental impact on the historic environment is unavoidable, it should be minimised. Steps should be taken to demonstrate that alternatives have been explored, and mitigation measures should be put in place.'

14.2.9 The sites are located in Unst, Shetland and the local authority is the Shetland Islands Council. Shetland Islands Council adopted the Local Development Plan (LDP) in September 2014 (SIC, 2014). The LDP sets out the vision and spatial strategy for the development of land in the Shetland Islands for the forthcoming 10 to 20 years.

14.2.10 The Historic Environment is recognised as having value and through the planning system Shetland Islands Council seeks to manage the Historic Environment in a sustainable way. The following policies are relevant to this assessment:

- *HE1 Historic Environment: The Council should presume in favour of the protection, conservation and enhancement of all elements of Shetland's historic environment, which includes buildings, monuments, landscapes and areas.*
- *HE2 Listed Buildings: Development affecting a listed building, or its setting, should preserve the building, its setting, and any features of special architectural or historic interest that it possesses.*
- *HE4 Archaeology: Scheduled monuments, designated wrecks and other identified nationally important archaeological resources should be preserved in situ, and within an appropriate setting. Developments that have an adverse effect on scheduled monuments and designated wrecks or the integrity of their settings should not be permitted unless there are exceptional circumstances.*

  All other significant archaeological resources should be preserved in situ wherever feasible. Where preservation in situ is not possible the planning authority should ensure that developers undertake appropriate archaeological excavation, recording, analysis, publication and archiving in advance of and/ or during development. (SIC, 2014: 31-34)

14.2.11 Shetland Islands Council published draft Supplementary Guidance on the Historic Environment (SGHE) in 2012 (SIC, 2012). The draft Supplementary Guidance sets out the policies which affect the historic environment and the setting of individual elements of the historic environment. The following draft policy is relevant to this assessment:

- *Policy SGHE 3 Archaeological assessment: Where archaeological remains are known or thought likely to exist the developer may be requested to supply a report of an archaeological evaluation prior to determination of a planning or listed building consent application.*

14.2.12 Shetland Islands Council planned for the emerging Local Development Plan 2 (LDP2) to be published in August 2019. However, at the time of writing, LDP2 has still not been published.

Guidance

Guidance to the regulator on environmental objectives relating to the exercise of its functions under the Space Industry Act 2018

14.2.13 The Department for Transport issued its document '*Guidance to the regulator on environmental objectives relating to the exercise of its function under the Space Industry Act 2018*' in 2021, clarifying the government's environmental objectives relating to spaceflight and associated activities in the UK:

The environmental objective for spaceflight are to:

- *Minimise emissions contributing to climate change resulting from spaceflight activities*
- *Protect human health and the environment from the impacts of emissions on local air quality arising from spaceflight activities*
- *Protect people and wildlife from the impacts of noise from spaceflight activities*
- *Protect the marine environment from the impact of spaceflight activities.*

Guidance for the Assessment of Environmental Effects

14.2.14 The Guidance for the Assessment of Environmental Effects (AEE) explains the process for completing an assessment of environmental effects as part of a licence application under the Space Industry Act.

14.2.15 The AEE Guidance requires that potential direct and indirect significant effects of proposed spaceflight activities on environmental features, including noise and vibration, are considered. The guidance further requires that:

- Specific potential effects are identified and, where possible, quantified;
- The focus of the AEE should be on significant effects arising from the proposed activities;
- Applicants for a spaceport licence set an environmental budget, comprising a maximum number of launches per launch vehicle type which can take place over the course of a year that can be carried out in an environmentally sustainable manner, taking into account the cumulative effect of all launches; and
- The AEE must address a range of environmental topics, including material assets and cultural heritage.

HES Setting Guidance

14.2.16 HES's setting guidance defines setting as *'the way the surroundings of a historic asset or place contribute to how it is understood, appreciated, and experienced'* (HES, 2016, updated 2020). The guidance further notes that *'planning authorities must take into account the setting of historic assets or places when drawing up development plans and guidance, when considering various types of environmental and design assessments/statements, and in determining planning applications'*. It advocates a three-stage approach to assessing potential impacts upon setting which is followed by the setting assessment included in this assessment. The three-stage approach includes:

- Stage 1: Identify the historic asset;
- Stage 2: define and analyse the setting; and,
- Stage 3: evaluate the potential impact of the proposed changes.

14.3 Consultation

14.3.1 Extensive statutory consultation in relation to material assets and cultural heritage was carried out during preparation and determination of the planning application for the SaxaVord Spaceport, where the Proposed Project will be operated. Where directly relevant to this AEE, consultation responses received during the SaxaVord Spaceport planning application period have been summarised in Table 14.2.

Table 14.2 Consultation Relevant to AEE

Consultee	Summary	Response
Historic Environment Scotland (HES) Pre-Application Consultation Case ID: 300044616 (29th May 2020)	The Proposed Project is located within the Scheduled Monument known as Skaw, radar station (SM13097- centred Site 3- Drawing 14.1).	Direct and settings impacts on RAF Skaw and Inner Skaw were discussed at length within the EIA and as required are summarised for the operational phase in this AEE chapter. The settings assessment is cognisant of the relationship between the north and

		southern portions of RAF Skaw, as well as the character, setting and legibility of the surviving remains within the Scheduled Monument. Impacts upon the settings of other designated assets within 1 km have also been considered.
Historic Environment Scotland (HES) (16th June 2020) Meeting included Shetland Regional Archaeologist (Shetland Amenity Trust (SAT))	Cultural Heritage and Archaeology to be considered in the EIA. Cultural Heritage visualisations to be included and agreed with HES and SAT. An assessment of the direct impact of vibration on the upstanding RAF features within the Proposed Project needs to be undertaken.	Also included for the operational phase in the AEE at the request of the CAA. Proposed Cultural Heritage visualisation locations were submitted to HES on 10th July 2020 and were confirmed to HES on the 17th August 2020. AEE Chapter 8: Noise and Vibration
Val Turner, Regional Archaeologist Shetland Amenity Trust (SAT) (23rd July 2020- on-site)	Consultation on the proposed Cultural Heritage visualisations to be produced for the Proposed Project.	In addition to the proposed Cultural Heritage visualisations submitted on the 10th July 2020, three further visualisations were identified and agreed on-site and confirmed on 17th August 2020.

14.3.2 Upon review of the submitted Planning Application and EIA Report for the Proposed Project, HES issued a statutory consultation response on 29th March 2021 objecting to the planning application and requesting that further work be undertaken with the aim of reducing effects on the Historic Environment assets of the site at Lamba Ness, principally arising from direct effects on the derelict structures of the former Skaw Radar Station (Scheduled Monument 13097).

14.3.3 A review of the Proposed Project Site Layout was undertaken in response to HES' consultation comment on the planning application (Planning Application Reference 2021/005/PPF) that 'there is no indication that any alteration in design was considered to relocate this area to avoid the impact on these features despite the presence of open areas without known features in the near vicinity'.

14.3.4 Heritage assets impacted by the original design were reviewed, resulting in further changes to the site layout design:

- Car Park moved from the south to the west of the Administration Building.
- Hardstanding to the north of the assembly area moved east.
- Road and future west Assembly buildings moved as a block east.
- TEL Hangar building moved to the south of the existing road.

14.3.5 These alterations have been included in the description of the Proposed Project included in Chapter 3 and are used as the basis of this assessment for AEE.

14.4 Assessment Methodology and Significance Criteria

Consultation

14.4.1 Consultation was undertaken directly with the relevant consultees namely HES and the Shetland Regional Archaeologist at Shetland Amenity Trust (SAT), as advisor to Shetland Islands Council. Online meetings were held with the Shetland Regional Archaeologist on the 26th May 2020 and with HES and the Shetland Regional Archaeologist on 16th June 2020 and 19th November 2020. The Shetland Regional Archaeologist also undertook a site visit with AOC on 23rd July 2020. A number of consultation responses were provided by HES as detailed in Table 14.2 above.

14.4.2 Upon review of the submitted Planning Application and EIA Report for the Proposed Project, HES issued a statutory consultation response on 29th March 2021 objecting to the planning application and requesting that further work be undertaken with the aim of reducing effects on the Historic Environment assets of the site at Lamba Ness, principally arising from direct effects on the derelict structures of the former Skaw Radar Station (Scheduled Monument 13097).

14.4.3 Heritage assets impacted by the original design were reviewed, resulting in further changes to the site layout design as described above.

Environmental Zone of Influence (EZI)

14.4.4 An environmental zone of influence (EZI) comprising the Proposed Project boundary and an area of 1 km surrounding was identified for this assessment. This was considered to be sufficient to develop an historic environment baseline, identify assets which could be subject to impact and to identify archaeological potential. The study area was deemed sufficient given the height and nature of the Proposed Project and the density of known designated assets and heritage features within the study area. The study area was subject to agreement with HES and SAT during initial meetings as detailed above.

Desk Study

14.4.5 Data on known designated assets and heritage features within the sites and in the surrounding study area has been collated from the following sources:

- HES
  - National Record of Historic Environment (NRHE) data (downloaded in March 2020);
  - Designated asset data (downloaded in July 2020); and,
  - Published and unpublished archaeological reports.
- Shetland Amenity Trust (SAT) Sites and Monuments Record (SMR) obtained in May 2020
  - Designated heritage asset and heritage features as recorded by the Shetland Islands SMR; and,
  - Unpublished archaeological reports (referred to as Events).
- National Library for Scotland
  - Ordnance Survey maps and pre-Ordnance Survey historical maps.
- National Collection of Aerial Photography (NCAP), held by HES
  - Vertical and oblique historic aerial photographs online and as reproduced in the Unexploded Ordnance assessment by Zetica (Zetica, 2020).

- Walkover Surveys and Site Visits
  - Walkover surveys of the Sites and site visits to designated assets within the study area were undertaken between 20th and 25th July 2020.
- Shetland Museum and Archives
  - Archival material including pre-Ordnance Survey mapping, and unpublished reports were viewed at the Shetland Museum and Archives, Lerwick on the 24th July 2020 by appointment.
- A History of RAF Saxa Vord blogpost
  - A series of blogs disseminating documentary research and oral histories relating to the Royal Airforce (RAF) bases on Unst were reviewed. Several relate to the construction, use and abandonment of the Scheduled Skaw, radar station, the former RAF Skaw.

Site Visit

14.4.6 A walkover survey of the Site was undertaken between the 20th and 25th July 2020. The survey was undertaken with the aim of identifying any previously unknown heritage features, and to confirm the presence and extent of previously recorded designated assets and heritage features. All known and accessible designated assets and heritage features were assessed in the field to establish their survival, extent, significance, and relationship to other designated assets and heritage features. Weather and any other conditions affecting the visibility during the surveys were also recorded. All heritage features encountered were recorded and photographed. The location of features noted in the field was recorded on an US GPS Navstar enabled iPad using ESRI's ArcGIS Collector software or an iPhone using iGIS. All features were recorded directly through ArcGIS Collector and iGIS in full British National Grid coordinates.

Assessment of Potential Effect Significance

14.4.7 This assessment distinguishes between the term 'impact' and 'effect'. An impact is defined as a physical change to a designated asset, heritage feature or its setting, whereas an effect refers to the significance of this impact. The first stage of the assessment involves establishing the value and importance of the designated assets and/or heritage feature and assessing the sensitivity of the asset or feature to change (impact). Using the proposed design for the Proposed Project, an assessment of the impact magnitude is made and a judgement regarding the level and significance of effect is arrived at.

Criteria for Assessing Sensitivity of Heritage Assets

14.4.8 The definition of cultural significance is readily accepted by heritage professionals both in the UK and internationally and was first fully outlined in the Burra Charter, which states in article one that 'cultural significance' or 'cultural heritage value' means aesthetic, historic, scientific, social or spiritual value for past, present or future generations (ICOMOS, 2005). This definition has since been adopted by heritage organisations around the world, including HES. HEPS notes that to have cultural significance an asset must have a particular '*aesthetic, historic, scientific or social value for past, present and future generations*' (HES, 2019b). Heritage assets also have value in the sense that they '*...create a sense of place, identity and physical and social wellbeing, and benefits the economy, civic participation, tourism and lifelong learning*' (Scottish Government, 2014).

14.4.9 All assets and/or features have significance; however, some are judged to be more important than others. The level of that importance is, from a cultural resource management perspective, determined by establishing the asset or feature's capacity to contribute to our understanding or appreciation of the past (HES, 2019c). In the case of designated assets their importance has already been established through the designation (i.e., Scheduling, Listing and Inventory) processes applied by HES.

14.4.10 The rating of importance of assets and features is first and foremost made in reference to their designation. For non-designated assets importance will be assigned based on professional judgement and guided by the criteria presented in Table 14.3; which itself relates to the criteria for designations as set out in Designation Policy and Selection Guidance (HES, 2019c) and Scotland's Listed Buildings (HES, 2019d).

Table 14.3: Criteria for Establishing Relative Importance of Designated Assets and Heritage Features

Importance	Receptors
Very High	World Heritage Sites (as protected by SPP, 2014); Other designated or non-designated assets or heritage features with demonstrable Outstanding Universal Value.
High	Scheduled Monuments (as protected by the Ancient Monuments and Archaeological Areas Act 1979 (the '1979 Act'); Category A Listed Buildings (as protected by the Planning (Listed Buildings and Conservation Areas) (Scotland) Act 1997) (the '1997 Act'); Inventory Gardens and Designed Landscapes (as protected by the 1979 Act, as amended by the Historic Environment (Amendment) (Scotland) Act 2011); Inventory Battlefields (as protected by the 1979 Act, as amended by the 2011 Act); Outstanding examples of some period, style or type; Non-Designated features considered to meet the criteria for the designations as set out above (as protected by SPP, 2014).
Medium	Category B and C Listed Buildings (as protected by the 1997 Act); Conservation Areas (as protected by the 1997 Act); Major or representative examples of some period, style or type; or Non-designated features considered to meet the criteria for the designations as set out above (as protected by SPP, 2014);
Low	Locally Listed assets; Examples of any period, style or type which contribute to our understanding of the historic environment at the local level.
Negligible	Relatively numerous types of features; Findspots of artefacts that have no definite archaeological remains known in their context; The above non-designated features are protected by Paragraph 137 of SPP, 2014.

14.4.11 Determining cultural heritage significance can be made with reference to the intrinsic, contextual and associative characteristics of an asset or feature as set out in HEPS (HES, 2019b) and its accompanying Designation Policy and Selection Guidance (HES, 2019c). HEPS Designation Policy and Selection Guidance (HES, 2019c) indicates that the relationship of an asset or feature to its setting or the landscape makes up part of its contextual characteristics. The Xi'an Declaration (ICOMOS, 2005) set out the first internationally accepted definition of setting with regard to heritage assets and features, indicating that setting is important where it forms part of or contributes to the significance of a heritage asset or feature. While SPP does not differentiate between the importance of the asset itself and the importance of the asset's setting, HES's Managing Change Guidance on setting (HES, 2016, updated 2020b), in defining what factors need to be considered in assessing the impact of a change on the setting of a historic asset or place, states that the magnitude of the proposed change should be considered *'relative to the sensitivity of the* *setting of an asset'* ; thereby making clear that assets vary in their sensitivity to changes in setting and thus have a relative sensitivity.

14.4.12 The EIA Handbook suggests that cultural significance aligns with sensitivity but also states that '*the relationship between value and sensitivity should be clearly articulated in the assessment'* (SNH et al., 2018). It is therefore recognised that the importance of an asset or feature is not the same as its sensitivity to changes to its setting. Elements of setting may make a positive, neutral or negative contribution to the significance of an asset. Thus, in determining the nature and level of effects upon assets and their settings by the development, the contribution that setting makes to an asset or feature's significance and thus its sensitivity to changes to setting needs to be considered.

14.4.13 This approach recognises the importance of preserving the integrity of the setting of an asset or feature in the context of the contribution that setting makes to the experience, understanding and appreciation of a given asset or feature. It recognises that setting is a key characteristic in understanding and appreciating of some, but by no means all, assets and features. Indeed, assets or features of High or Very High importance do not necessarily have high sensitivity to changes to their settings (e.g., do not necessarily have a high relative sensitivity). An asset or feature's relative sensitivity to alterations to its setting refers to its capacity to retain its ability to contribute to our understanding and appreciation of the past in the face of changes to its setting. The ability of an asset or feature's setting to contribute to an understanding, appreciation and experience of it and its significance also has a bearing on the sensitivity of that asset to changes to its setting. While heritage assets or features of High or Very High importance are likely to be sensitive to direct effects, not all will have a similar sensitivity to effects on their setting; this would be true where setting does not appreciably contribute to their significance. The HES guidance on setting makes clear that the level of effect may relate to '*the ability of the setting* [of an asset or feature] *to absorb new development without eroding its key characteristics'* (HES, 2016, updated 2020b). Assets or features with Very High or High relative sensitivity to settings effects may be vulnerable to any changes that affect their settings, and even slight changes may erode their key characteristics or the ability of their settings to contribute to the understanding, appreciation and experience of them. Assets or features whose relative sensitivity to changes to their setting is lower, may be able to accommodate greater changes to their settings without having key characteristics eroded.

14.4.14 The criteria used for establishing an asset or feature's relative sensitivity to changes to its setting is detailed in Table 14.4. This table has been developed based on AOC's professional judgement and experience in assessing setting effects. It has been developed with reference to the policy and guidance noted above including SPP (Scottish Government, 2014), HEPS (HES, 2019b) and its Designation Policy and Selection Guidance (HES, 2019c), the Xi'an Declaration (ICOMOS, 2005), the EIA Handbook (SNH et al., 2018) and HES's guidance on the setting of heritage assets and features (HES, 2016, updated 2020b).

Table 14.4 – Criteria for Establishing Relative Sensitivity of a Heritage Asset to Changes to its Setting

Relative Sensitivity	Criteria
Very High	An asset or feature, the setting of which, is critical to the ability to understand, appreciate and experience it should be thought of as having Very High Sensitivity to changes to its setting. This is particularly relevant for assets or features whose settings, or elements thereof, make an essential direct contribution to their cultural significance (e.g., form part of their Contextual Characteristics (HES, 2019c).
High	An asset or feature, the setting, of which, makes a major contribution to an understanding, appreciation and experience of it should be thought of as having High Sensitivity to changes to its setting. This is particularly relevant for assets or features whose settings, or elements thereof, contribute directly to their cultural significance (e.g., form part of their Contextual Characteristics (HES, 2019c)).

Relative Sensitivity	Criteria
Medium	An asset or feature, the setting of which, makes a moderate contribution to an understanding, appreciation and experience of it should be thought of as having Medium Sensitivity to changes to its setting. This could be an asset or feature for which setting makes a contribution to significance but whereby its value is derived mainly from its other characteristics (HES, 2019c).
Low	An asset or feature, the setting of which, makes some contribution to an understanding, appreciation and experience of it should generally be thought of as having Low Sensitivity to changes to its setting. This may be an asset or feature whose value is predominantly derived from its other characteristics
Marginal	An asset or feature whose setting makes minimal contribution to an understanding, appreciation and experience of it should generally be thought of as having Marginal Sensitivity to changes to its setting.

14.4.15 The determination of an asset or feature's relative sensitivity to changes to its setting is first and foremost reliant upon the determination of its setting and the key characteristics of setting which contribute to its cultural significance and an understanding and appreciation of that cultural significance. This aligns with Stage 2 of the HES guidance on setting (HES, 2016, updated 2020b). The criteria set out in Table 14.4 are intended as a guide. Assessment of individual assets and features is informed by knowledge of the asset or feature itself; of the asset or feature type if applicable and by site visits to establish the current setting of the assets and features. This will allow for the use of professional judgement and each asset and/or feature is assessed on an individual basis.

Criteria for Assessing Magnitude of Impact

14.4.16 Potential impacts, that is the physical change to known designated assets, heritage features, and unknown buried archaeological remains, or changes to their settings, in the case of the Proposed Project relate to the possibility of disturbance to upstanding RAF features due to vibrations during the operational phase or the placement of new features within their setting during the operational phase.

14.4.17 The magnitude of the impacts upon designated assets or heritage features caused by operation of the Proposed Project is rated using the classifications and criteria outlined in Table 14.5.

Table 14.5- Criteria for Classifying Magnitude of impact

Magnitude of impact	Criteria
High	Substantial loss of information content resulting from total or large-scale removal of deposits from an asset or feature; Major alteration of an asset's baseline setting, which materially compromises the ability to understand, appreciate and experience the contribution that setting makes to the significance of the asset or feature and erodes the key characteristics (HES 2020) of the setting.
Medium	Loss of information content resulting from material alteration of the baseline conditions by removal of part of an asset or feature; Alteration of an asset or feature's baseline setting that effects the ability to understand, appreciate and experience the contribution that setting makes to the significance of the asset to a degree but whereby the cultural significance of the monument in its current setting remains legible. The key characteristics of the setting (HES 2020) are not eroded.
Low	Detectable impacts leading to minor loss of information content.

Magnitude of impact	Criteria
	Alterations to the asset or feature's baseline setting, which do not affect the ability to understand, appreciate and experience the contribution that setting makes to the asset or feature's overall significance.
Negligible	Loss of a small percentage of the area of an asset or feature's peripheral deposits; A reversible alteration to the fabric of the asset or feature; A marginal alteration to the asset or feature's baseline setting.
None	No effect predicted

Criteria for Assessing Significance

14.4.18 The predicted level of effect on each designated asset or heritage feature is then determined by considering the asset or feature's importance and/or relative sensitivity in conjunction with the predicted magnitude of the impact. The method of deriving the level of effect is provided in Table 14.6.

Table 14.6 - Level of Effect based on Inter-Relationship between the Sensitivity of a Heritage Asset and/or its setting and the Magnitude of Impact

Magnitude of Impact	Important and/or Sensitivity				
	Negligible	Low	Medium	High	Very High
High	Minor	Moderate	Moderate	Major	Major
Medium	Negligible/Neutral	Minor	Moderate	Moderate	Major
Low	Negligible/Neutral	Negligible/Neutral	Minor	Minor	Moderate
Negligible	Negligible/Neutral	Negligible/Neutral	Negligible/Neutral	Minor	Minor

14.4.19 The level of effect is judged to be the interaction of the asset or feature's importance and/or relative sensitivity (Tables 14.3 and/or 14.4) and the magnitude of the impact (Table 14.5). In order to provide a level of consistency, the assessment of importance and relative sensitivity, the prediction of magnitude of impact and the assessment of level of effect is guided by pre-defined criteria. However, a qualitative descriptive narrative is also provided for each asset to summarise and explain each of the professional value judgements that have been made in establishing sensitivity and magnitude of impact for each individual asset.

14.4.20 Using professional judgment and with reference to the Guidelines for Environmental Impact Assessment (as updated) (IEMA, 2017), and the EIA Handbook (SNH et al., 2018) the assessment considers moderate and greater effects to be significant (shaded grey in Table 14.6), while minor and lesser effects are considered not significant.

Integrity of Setting

14.4.21 SPP notes that where there is potential for a proposed project to have an adverse effect on a Scheduled Monument or on the integrity of its setting permission should only be granted where there are '*exceptional circumstances*'. Adverse effects on integrity of setting are judged here to relate to whether a change would adversely affect those attributes or elements of setting which contribute to an asset or feature's significance to the extent that the ability to understand and appreciate the asset is diminished.

14.4.22 In terms of effects upon the setting of designated assets or heritage features, it is considered that only those effects identified as 'significant' in the assessment will have the potential to adversely affect integrity of setting. Where no significant effect is found it is considered that the integrity of an asset or feature's setting will remain intact. This is because for many assets and features, setting may make a limited contribution to their significance and as such changes would not affect integrity of their settings. Additionally, as set out in Table 14.5, lower ratings of magnitude of change relate to changes that would not obscure or erode key characteristics of setting.

14.4.23 Where significant effects are found, a detailed assessment of adverse effects upon integrity of setting is made. Whilst non-significant effects are unlikely to affect integrity of setting, the reverse is not always true. That is, the assessment of an effect as being 'significant' does not necessarily mean that the adverse effect to the asset's or feature's setting will harm its integrity. The assessment of adverse effect upon the integrity of an asset or feature's setting, where required, will be a qualitative one, and will largely depend upon whether the effect predicted would result in a major impediment to the ability to understand or appreciate the designated asset or heritage feature such that its cultural significance is reduced.

Requirements for Mitigation

14.4.24 National and local planning policies and planning guidance outlined in Section 14.2, require a mitigation response that is designed to take cognisance of the possible impacts upon heritage assets and/or features by a proposed project and avoid, minimise or offset any such impacts as appropriate. The planning policies and guidance express a general presumption in favour of preserving heritage assets, features and remains in situ wherever possible. Their 'preservation by record' (i.e., through excavation and recording, followed by analysis and publication, by qualified archaeologists) is a less desirable alternative (Scottish Government, 2014), (SIC, 2014).

Assessment of Residual Effect Significance

14.4.25 The residual impact is what remains following the application of mitigation and management measures and is thus the final level of impact associated with the Proposed Project. The level of direct residual effect is defined using criteria outlined in Tables 14.3, 14.5 and 14.6. No direct mitigation, beyond those embedded in the in the Proposed Project's design, is possible for setting effects of the Proposed Project and therefore residual effects on the setting of heritage assets and/or feature will be the same as predicted without mitigation.

Limitations to Assessment

14.4.26 This assessment is based upon data obtained from publicly accessible archives as described in the Data Sources. Sites and Monuments Record (SMR) data was received in May 2020 and NRHE data on known heritage assets was downloaded from HES in March 2020 and checked in July 2020. This assessment does not include any records added after this date.

14.4.27 Access to historic vertical and oblique aerial photography is currently limited due to Covid-19 restrictions. AOC Archaeology Group have a subscription to NCAP and as such any available aerial photography which is available online has been viewed. Further copies of relevant aerial photographs obtained by Zetica for the unexploded ordnance assessment have been examined (Zetica 2020).

14.4.28 Due to Covid-19 Unst Heritage Centre was unfortunately be closed throughout 2020. Access to archival material held by Unst Heritage Centre regarding the former RAF Skaw was provided digitally by Lynn Thomson, Unst Heritage Centre.

14.4.29 Nevertheless, the assessment is considered to be robust and is based upon accepted principles of assessment.

14.5 Baseline Conditions

14.5.1 This section presents a summary of the baseline conditions relevant to the historic environment. Full discussion of the archaeological and historical background is set out in Appendix 14.6 and the results of the walkover survey undertaken to inform this assessment are presented in Appendix 14.7. All heritage assets and features referred to below are individually recorded within Appendix 14.1, Cultural Heritage Site Gazetteer. The numbering within the Gazetteer is not sequential due to the methodology employed during the walkover survey. All heritage assets and features referred to in the text and within Appendices 14.1, 14.6 and 14.7 are shown on Drawings 14.1-14.3.

14.5.2 Within the Gazetteer, Appendix 14.1, designated heritage assets are identified by their statutory designation, either 'Scheduled Monument' or 'Listed Building'. Individual heritage features within the southern portion of the RAF Skaw (centred Site 3) are identified by 'RAF feature within Scheduled Monument', 'Non-RAF feature within Scheduled Monument' or 'Features excluded from Scheduled Monument' to differentiate between the features which are directly related to the Scheduling, those of which are included within the Scheduled Area and those which have been specifically excluded from the Scheduling.

14.5.3 Features identified as 'Non-RAF feature within Scheduled Monument' relate to features within the Scheduled Area which are not specifically noted as being excluded in the Scheduling but which do not specifically relate to evidence of the construction, use and abandonment of the Chain Home radar station which forms the reason for designation. Individual heritage features within the Scheduled Monument of Inner Skaw (centred Site 2) are identified as 'Feature within Inner Skaw Scheduled Monument' where the feature relates to the specifics of the Inner Skaw Scheduling, or 'RAF feature within Inner Skaw Scheduled Monument', where a feature dating to the Second World War has been identified.

14.5.4 The Proposed Project comprises the following principal elements:

- Launch area at Lamba Ness comprising three launch pads, a satellite tracking station, launch vehicle integration buildings, roadways (largely re-using existing roads), fuel storage and ancillary infrastructure.

14.5.5 The Proposed Project extends across the southern portion of the Scheduled Area of RAF Skaw (centred Site 3). RAF Skaw is the northernmost 20th century Chain Home Radar Station and is composed of two areas, the northern portion is located c. 830 m to the north-east of Skaw and is centred on Site 24, whilst the southern portion is centred on Site 3. Numerous individual features within the southern portion of RAF Skaw have been recorded, including the remains of radar structures, domestic blocks and defensive structures and these are shown on Drawings 14.2a-c.

14.5.6 Inner Skaw (Site 2) Scheduled monument is located immediately north of the Proposed Project. The Proposed Project boundary does not extend within it and no development is proposed within the Scheduled Area. The designated asset comprises the remains of a multiperiod settlement with associated agricultural remains which dates from the Early Historic period onwards.

14.5.7 The Scheduled Monument of St John's Church at Norwick (Site 1) is a multi-period asset which encompasses an Iron Age broch and the remains of a chapel located c. 1.19 km south-west of the Proposed Project.

14.5.8 There are two Listed Buildings (Sites 4 and 6) located within 1km of the Proposed Project. The Banks, Norwick (Site 4), a group of Category C Listed 19th century crofts, are recorded c. 670 m south-west of the Proposed Project. A Category C Listed boat-roofed shed (Site 6) is located c. 740 m north of the Proposed Project.

Geology and topography

14.5.9 According to the British Geological Survey GeoIndex (BGS 2020), the Proposed Project is underlain by Skaw Intrusion, a microgranite, porphyritic igneous bedrock formed approximately 359 to 444 million years ago in the Devonian and Silurian periods. This bedrock is indicative of an environment previously dominated by silica rich magma.

14.5.10 The superficial deposit recorded in the eastern and western portion of the Proposed Project is recorded by the BGS (2020) as Till and Morainic deposits, formed approximately 3 million years ago in the Quaternary period under Ice Age conditions. The central area is underlain by superficial blown sand deposits also formed approximately 3 million years ago in the Quaternary period. In the areas not subject to previous development during the Site's use as an RAF radar station, the ground investigation works have indicated that in general, the deposits encountered consist of peaty topsoil overlying peat, which in turn overlies blueish grey sandy clay. The clay overlies bedrock with varying levels of weathering. The peat across the Site varies in depth from c. 0.15 m to c. 2.75 m, with the deepest deposits being located in the vicinity of Launch Site 2.

14.5.11 The land slopes gently north-eastward. The western boundary is recorded at c.36 m AOD and the land slopes eastward to 1 m AOD and then rises slightly to 9 m AOD at the eastern end of the Proposed Project Site. The land in the south-western corner is recorded at 17 m AOD and slopes north-eastward to 2 m AOD.

Archaeological and Historical Background

Prehistoric

14.5.12 There is evidence of prehistoric activity in Shetland from the Mesolithic period and evidence of activity in Unst from at least the Neolithic period, largely in the form of chambered cairns. An Iron Age settlement which is thought to have been in use for at least 500 years between the late 1st millennium BC and the 1st millennium AD was uncovered between 2004 and 2007 at Sandwick, c.14 km south of the Site, on the south-eastern coast of Unst. Iron Age deposits associated with settlement remains were also recorded as underlying Viking remains at the Broch of Underhoull, on the south-west coast of Unst (Small, 1965).

14.5.13 Details of known prehistoric features within the Proposed Project Site and within the surrounding EZI are set out in Detailed Archaeological and Historical Background in Appendix 14.6. Prehistoric features, including a possible cairn (Site 9) and a midden (Site 48) have been identified within the Proposed Project site and prehistoric activity is well documented in the surrounding 1 km and in Unst. As such there is judged to be a High potential for prehistoric remains to survive within the Proposed Project site, particularly around the edges of the peninsula and around natural boat landing locations.

Early Historic

14.5.14 Minimal Roman activity is known in the Shetland Islands, although a Roman brooch has been reported at Site 1 which suggests a potential trading relationship with the Romans further south or perhaps evidence of an heirloom. As such the end of the prehistoric period is generally regarded as the 9th century and the arrival of Norse peoples (SIC, 2019).

14.5.15 The Viking invasions started about 800AD and settlement subsequently followed. The Orkenyinga Sagas record Shetland as the northern third of the great earldom of Orkney (SIC, 2019). The etymology of Unst suggests a Norse origin for the name of the island. Unst is believed to have originated in 'Ǫstr' meaning 'corn stack', however it is argued that the name was converted from the pre-Norse name (Shetland Amenity Trust, n.d.). Norwick to the south-east of the Sites contains 'wick' which is thought to originate from 'Vik', a Norse word for 'bay', referencing the settlement's location.

14.5.16 The Scheduled Monument of Inner Skaw (Site 2) is located immediately north and west of the boundary for the Proposed Project. The Scheduled Area encompasses a series of settlement and agricultural remains dating from the Early Historic period onwards. Further evidence of Early Historic remains has been encountered in the study area, the details of which are set out in Appendix 14.6.

14.5.17 Given the proximity of Inner Skaw Scheduled Monument (Site 2), which dates from this period, there is judged to be a High potential for hitherto unknown Early Historic remains to survive within the area of the Proposed Project.

Medieval

14.5.18 Shetland was mortgaged to the Scottish crown in 1468 as part of the dowry of Princess Margaret in her marriage to James III of Scotland (SIC, 2019). In 1471, as the Danish struggled to pay Margaret's dowry, Scotland annexed Orkney and Shetland in lieu of the dowry (SIC, 2019). As such, the annexation of Shetland to Scotland in 1471 draws to an end the period of Norse rule and as such acts as the boundary between the Early Historic and medieval period.

14.5.19 Full details of medieval assets and features within the Proposed Project Site and the surrounding EZI are set out in the Detailed Archaeological and Historical Background in Appendix 14.6. The Proposed Project lies immediately south and east of the Scheduled Area of Inner Skaw (centred Site 2). The Scheduled Area is recorded as containing evidence of continuous settlement and agrarian activities from the Early Historic period onwards.

14.5.20 While there are no further medieval assets and/or features recorded within 1 km of the Proposed Project, post-medieval buildings and farmstead identified within the study area may have had earlier, medieval antecedents. As such there is judged to be a High potential for medieval remains to survive within the area of the Proposed Project; given the proximity to Inner Skaw these would most likely be associated with settlement or agricultural activities.

Post-Medieval

14.5.21 Pre-Ordnance Survey maps tend to be schematic and lack detail, although they give some idea of the nature of settlement. Blaeu's 1654 map depicts the Shetland Islands. In the north-east of Unst, 'Harolswick', to the south of the site, Norwick to the south-east and Saxa Vord, over 1 km to the west of the site are annotated. A pictogram of a church is depicted at each of the settlements recorded by Blaeu (1654) which indicates that each settlement had a chapel or church in the mid-17th century. Whilst the size of each settlement is not record by Blaeu (1654), the number of settlements annotated suggest that the north-eastern area of Unst was well populated in this period.

14.5.22 Moll's 1732 map is not dissimilar to Blaeu's earlier illustration; however, it appears to have been drawn at a larger scale and the settlements in Unst are not annotated, only noted by pictograms of churches.

14.5.23 A map by Preston (1781- not illustrated) records a singular church in the north-east of Unst, which is most likely the Scheduled Church of St John (Site 1), to the east of the Site. Norwick is annotated to the south-east of the site and Lamba Ness, on which the Proposed Project is situated, is labelled. This map is described as a hydrographical survey and was most likely designed to help in the navigation around the Shetland Islands. As such the map was less interested in recording land use or settlement density. However, the map does indicate that the Church of St John (Site 1) must have been a seaward point of interest, and potentially a navigational aid.

14.5.24 The Old Statistical Account of Scotland (OSA) for Unst was recorded in 1793 (Mouat and Barclay, 1793). A map engraved for the OSA (D6/158) annotates Lamba Ness, which appears to be occupied by at least three structures, a relatively large settlement at Norwick with a Chapel (Site 1) and another Kirk to the south (possibly Site 17). Unst is recorded in the OSA as being in the presbytery of Shetland in the late 18th century. Unst is described as having a ragged, and broken coastline with a number of bays and creeks, and Norwick to the south-east of the Proposed Project is noted as being one of the principal bays of Unst. Lamba Ness, where the Proposed Project is situated, is described as the most north-eastern point which has free communication to the North Atlantic Ocean. However, it was recorded that there was no lighthouse in the area in the late 18th century which made fishing and shipping in the area problematic. The OSA notes that Dr Webster recorded the population of Unst as 1,368 in 1755, and the OSA recorded the population in 1793 as 1,988, which indicates a 45% growth in the population in the late 18th century. No proper roads are noted in Unst in 1793. Agriculture is documented as being the main employment type in Unst, largely dominated by black oats, potatoes and green and garden roots, black cattlemen, pigs and sheep, although in the years prior to the publication of the OSA, harsh winters had decreased the sheep population by a third. Fishing is noted as being another form of employment on the island, however the OSA suggests that it was a secondary pursuit in the late 18th century. No mines or quarrying activity was documented in Unst in 1793, and the main source of fuel was peat. Mills in Unst were recorded as being wheel-less, instead being 'tirl'-horizontal mills, two of which (Sites 19 & 20) are recorded within 1 km of the Proposed Project.

14.5.25 Two undated maps, probably dating to the late 18th or early 19th century, one by George Thomas (D23/123) and one of unknown origin (D16/389/112/12), depict the north-eastern area of Unst. Lamba Ness is depicted as a peninsula, and no structures are depicted on the peninsula. However, a group of buildings are depicted on a north-south aligned stream which runs to a beach on the north coast of the peninsula, possibly in the vicinity of Sites 48 and 75 and another group of buildings is depicted in the vicinity of Inner Skaw (Sites 2 & 25). Another building is recorded in the vicinity of Site 61. A north, south aligned boundary is depicted in the vicinity of the western boundary of the Proposed Project on these maps, which may also be a road which originates at The Floggie, the road from Norwick, along the coast to Lamba Ness which extends to the village of Skaw. Buildings are depicted around Skaw, and dispersed buildings, most likely small farmsteads or crofts, are depicted from Haroldswick to Norwick on these maps, although no roads are depicted in this area.

14.5.26 Thomson's 1827 map of Unst depicts the north-eastern coast of Unst. Topographically, an area of high land is depicted in the northern central area of Unst, and another slight area of high land is depicted at the western end of the Lamba Ness peninsula. A chapel labelled on the east coast of Unst is likely the Scheduled St John's Chapel (Site 1).

14.5.27 The New Statistical Account (NSA) for Unst (Ingram et al., 1845) records that the population of Unst was hit by two smallpox outbreaks, due to the lack of inoculations available in Unst, however overall the population was documented as 2,909 persons in 1831, an increase of 43% from the OSA (Mouat et al., 1793). A poor climate in the 5-6 years prior to the NSA being written, is noted as hitting the population as well as impacting on the number of people relying on fishing. Smaller farms than those recorded in the late 19th century further support the move of the population towards fishing over farming. Two thousand acres of arable land are recorded in Unst in 1845, which was organised as an infield, outfield system. Iron stone and limestone quarrying is record in Unst by 1845. A quarry (Site 62), visible on aerial photography taken in 2014 is located within the north-eastern area of the Proposed Project.

14.5.28 Full details of post-medieval assets and features both within the Proposed Project Site and in the EZI are set out in the Detailed Archaeological and Historical Background presented in Appendix 14.6. This includes further map regression related to the Proposed Project itself. Heritage features comprise farm buildings and houses, crofts, enclosures and land boundaries both on site and in the surrounding study area. The site was clearly located within a post-medieval agricultural landscape. Given this, there is judged to be a High potential for remains associated with the post-medieval occupation and agricultural use of the Proposed Project Site.

Modern

14.5.29 The First World War destroyed the booming herring industry which had supported the population of the Shetland Islands from the post-medieval period. Emigration increased in the 1920s and 1930s which decreased the overall population (SIC, 2019). The Second World War caused a temporary boom on the Shetland Islands as it was utilised as a base for covert and secretive missions between the continent and the British Isles due to the bonds between Shetland and Norway. The 'Shetland Bus' which used fishing boats to support the Norwegian resistance ran from Shetland (SIC, 2019).

14.5.30 Map regression indicates little change on the Proposed Project Site in the early half of 20th century, prior to the development of RAF Skaw (Site 3) on Site. The radar station is the most northerly of the chain home radars of the Second World War. The Scheduled Area (Site 3) is composed of two separate areas, the largest and southern most within the site was the location of the Advanced

Chain Home (ACH) and latterly the main Chain Home (CH) radar with the smaller reserve station located c. 855 m north. The Floggie, a route from Norwick northwards, along the coast was straightened, widened, and strengthened in 1940 to facilitate the construction of the radar station (Carle, 2018a).

14.5.31 A detailed history of the construction use and abandonment of RAF Skaw are provided in Appendix 14.6. Based on the presence of RAF Skaw within the Proposed Project boundary and having regard for the detail set out in Appendix 14.6, there is a High potential for further modern remains to survive within the Site. Any remains would most likely be associated with the construction, use and abandonment of RAF Skaw radar station (Site 3).

14.5.32 Modern assets within the study area include a Category C Listed boat-roofed shed (Sites 6 & 64), built in 1940 which is located c. 740 m north of the Proposed Project.

Walkover Survey

14.5.33 A walkover survey of the Site was undertaken between the 21st and 25th July 2020 in dry weather conditions which varied between bright sun and overcast. The weather provided ideal walkover survey conditions, good ground visibility was available and good visibility of the surrounding landscape and seascape was achieved. The walkover survey covered the Proposed Project Site and recorded the extent and condition of previously identified heritage features as well as recording any previously unrecorded features. The full results of the walkover survey are set out in Appendix 14.7; cultural heritage plates referred to in the walkover survey text can be found in Appendix 14.2.

Drone Survey

14.5.34 A drone survey has been undertaken across the Proposed Project Site. The drone survey noted the presence of many upstanding remains previously recorded via the NRHE, SMR and during the walkover survey.

14.5.35 Several linear features, potentially post-medieval field boundaries (Sites 484-486), not visible during the walkover survey were visible from the results of the drone survey. These features have not been directly dated but appear to be similar in form to others identified within the Proposed Project Site (Sites 214-217b, 230 & 434). It is possible that these linear features may be of post-medieval date or older, especially due to the proximity of Inner Skaw (centred Site 2) and the field system identified around Site 75.

14.5.36 A north to south aligned linear feature (Site 484) was identified to the west of Site 85 and a number of potentially interconnecting or overlapping linear features (Site 485) were identified around Site 85, to the east of Site 484. These may be the remains of a field system, similar to that recorded to the west centred Site 216 and the field system record around Site 75.

14.5.37 Another linear feature aligned north north-east to south south-west (Site 486) was identified to the west of Site 288. Historic maps record this area as '*The Garths*' and it is possible that this linear feature is an old field boundary associated with the post-medieval or earlier use of the land.

14.5.38 Two large negative features (482 & 483) were identified east of the CH Transmitter block (Site 85). These appear to be similar in form to the excavated areas identified during the walkover survey (Sites 321, 345,247, 373, 410) and may be additional areas which have been reduced around the CH Transmitter block (Site 85) and mast bases (centred Site 102 & 103) for either; spoil to create the banks and bunds around the CH radar blocks and other earthwork protective defences; or to enable the construction of the steel masts at Sites 102 & 103.

14.5.39 The field system within the Scheduled Inner Skaw (centred Site 2) and the field system around Site 75, a post-medieval stone building, is visible on the drone survey as a larger field system, extending south to the track which bisects the Proposed Project and further east and west, than either the Scheduled extent of Inner Skaw (centred Site 2) or the SMR recorded area around Site 75 indicate. The southern extent of the field system seems to survive in a relatively poor condition, compared to that observed around Site 75 and within Inner Skaw (centred Site 2). No evidence of rig and furrow is visible, and the field systems appear to be similar to the medieval and post-medieval infield, outfield systems.

Results of Ground Investigation Works and Archaeological Watching Brief

14.5.40 Ground investigation (GI) works were undertaken, with SMC, in October and November 2020. GI works were required to inform the design of the Proposed Project and were subject to an archaeological watching brief.

14.5.41 The GI works took place between the 27th October and the 3rd November 2020 and comprised of 304 peat probes, one Russian Core and the excavation of 42 machine dug test pits. Peat probes were sunk away from known archaeological remains and their locations were chosen in consultation with the onsite archaeologist, and they were undertaken in a regular grid pattern. Peat probes recorded the depth of peat across the Site between 0.15 m and 2.75 m in depth.

14.5.42 A singular Russian core was sunk beside TP020. No archaeological remains, buried land surfaces or the potential for environmental proxies were identified.

14.5.43 Test pits were positioned 5m away from all known archaeological features and five tests pits were abandoned due to the proximity of archaeological remains and the difficulty in reaching the proposed locations with a machine. One test pit was abandoned due to wet ground conditions. The probable hiatus of peat development was noted in TP017, a plastic pipe was encountered in the section of TP029 and a brick, denoting the presence of an electrical cable was identified in TP043. No archaeological remains were observed in any of the other excavated test pits. The full report on the results of the archaeological watching brief is included in Appendix 14.8.

Review of Existing Buildings

14.5.44 Aecom has produced a review of the existing buildings on Site and this is contained in Appendix 14.5. The review has considered the current condition of the extant upstanding buildings on site and commented on their condition and stability.

14.5.45 Overall, the review has indicated that there has been significant degradation of the buildings on site since the decommissioning of RAF Skaw. Concrete buildings and features are subject to degradation from weathering and carbonation and the review indicates that the degradation of exposed concrete features, given the location of the Site and the time since abandonment, has likely reached the reinforcement allowing decay.

14.5.46 Of particular note is the safety of the Power House (Site 77). The review indicates that as a result of loss of the roof and internal walls, the external walls are no longer supported at roof level. Large vertical cracks from the ground level are evident on the south-west elevation wall. The review indicates that the Power House is at risk of collapse in high winds.

14.5.47 Also, of note are the roofs of the CH Transmitter, Receiver and Power House (Sites 85, 93 and 111). The review indicates that waterproofing has deteriorated, exposing the roof slab in some areas. This in turn is impacting the surface of the roof and allowing significant deterioration of the concrete and the reinforcements.

14.5.48 Brick structures on Site, including the ACH buildings (Sites 96, 98 and 99), also show signs of deterioration due to weathering and carbonation. Buildings which remain roofed with concrete appear to be in reasonable condition. However, unroofed buildings no longer have roof support and in time will be at risk of collapse in high winds.

Conservation Management Plan (CMP)

14.5.49 A CMP incorporating a Condition Survey Report has been produced for the Skaw radar station and this is contained in Appendix 14.10. The CMP assesses the significance of Skaw radar station, evaluates the issues and opportunities it has and provides a range of conservation policies to guide the future development, preservation, interpretation and use of the site.

14.5.50 The Condition Survey was undertaken by Adams Napier Partnership and David Narro Associates to inform the CMP. Despite lack of any recent meaningful maintenance, the exposure of the Site and the widely acknowledged issues with deterioration of Second World War structures the Condition Survey has revealed the majority to be generally in a fair and stable condition, albeit some structures, including the Power House (Site 77), are in poor condition Detailed descriptions of each of the buildings surveyed is presented in the Condition Survey report

14.6 Receptors Brought Forward for Assessment

14.6.1 All designated heritage assets including individual features therein and all non-designated heritage features within the Proposed Project boundary are brought forward for assessment to allow for consideration of the potential for direct effects upon them resulting from operation of the Proposed Project.

14.6.2 All designated heritage assets within the study area for the Proposed Project were found to lie within the zone of theoretical visibility and, as such, all have been brought forward for assessment to allow for consideration of the potential for setting impacts upon these designated heritage assets as a result of the operation of the Proposed Project.

14.7 Standard Mitigation

14.7.1 It is acknowledged that operation of the Proposed Project will have a direct impact upon a number of features within the Scheduled RAF Skaw (Site 3). Further, and despite the extensive survey undertaken to inform this assessment, there may be potential for further previously unrecorded archaeological features within the Site.

Conservation Management Plan (CMP)

14.7.2 The CMP (appendix 14.10) represents a commitment to the ongoing management and maintenance of the Skaw radar station site during operation of the Proposed Project and presents a range of broad policies to allow for this commitment to be met.

14.7.3 An outline of proposed conservation works, and an assessment of their priority is provided within the CMP. In making these management, maintenance and repair recommendations, the aim has been to retain the surviving buildings and structures in a safe and manageable condition whilst respecting and preserving their significance.

14.7.4 In addition, a programme of annual inspection and maintenance will be carried out on all structures to control unwanted vegetation growth, stabilise loose brickwork and make good any localised areas of failing mortar, with regular inspections formalized to identify any defects.

Vibration and Terrain Monitoring

14.7.5 A review of the upstanding buildings on Site has been undertaken to inform the planning application, to identify any structures which are already in a state of compromise and therefore may be more vulnerable to direct impacts resulting from vibrations from satellite launches. The results of this are outlined in Appendix 14.5. The mitigation measures to be implemented to monitor and protect these buildings during the operational phase are outlined below.

Vibration Modelling

14.7.6 HES requested that consideration be given to the potential for the operation of the Proposed Project to directly impact upon standing structures within the Proposed Project Site. A review of the condition and stability of the upstanding buildings on Site has therefore been undertaken to establish, insofar as possible, a baseline structural stability for these features. Modelling ground and structural vibration is complex and dependent on the unique material properties of each element and its respective boundary conditions, the maintenance condition of the structure, and the incident sound wave characteristics. These complexities have resulted in structural damage criteria for launch vehicle environmental reviews that are largely based on findings from anecdotal evidence and static horizontal rocket testing. Thus, while it is acknowledged that future research is needed, the damage claim criteria used in the Shetland noise study (AEE Chapter 8) represents the best available dataset regarding the potential for structural damage resulting from rocket noise – as the findings are based on actual rocket noise and community surveys over a large number of events. This indicates that the potential for structural damage is likely to be low.

14.7.7 For structures of historical significance, typical practice is to document conditions prior, during, and after a launch event. In extremely sensitive cases, measurements on individual structural elements of interest may be performed during launch for comparison with established damage criteria. On this basis vibration monitoring will be undertaken on Sites 96, 98, 99 and 111 in the vicinity of Launch Site 3 and Site 85 in the vicinity of Launch Site 2 and Site 90 between Launch Sites 2 and 3. Further, baseline data will be gathered prior to launches commencing on Site and monitoring will initially take place during launches to ensure that there is no damage to structures as a result of the operation of the Proposed Project. A programme of regular monitoring will be established thereafter and be dependent upon the results of initial monitoring. Where monitoring identifies the potential for structural damage, HES and the Shetland Regional Archaeologist will be informed immediately and further mitigation strategies will be discussed, agreed and implemented to prevent damage to any affected structures.

14.8 Potential Effects

Direct effects

14.8.1 Ongoing launches and works associated with the operational phase of the Proposed Project have the potential to directly impact the heritage features within the Proposed Project Site. Vibrations from proposed launches have the potential to cause structural damage to upstanding features.

14.8.2 Several upstanding buildings within the Proposed Project Site have been identified as part of review of existing structures presented in Appendix 14.5, as being in various states of degradation. These include the unroofed brick structures at Sites 90, 96, 98 and 99, the roofs of the CH buildings (Sites 85, 93 and 111) and the Power House (Site 77), which have been structurally compromised to some extent. A detailed study of these structures is also presented in the Condition Survey Report in Appendix 14.10.

14.8.3 These reviews have established a baseline structural stability for these features insofar as possible, as set out in Appendix 14.5 and 14.10. However, the extent to which they might suffer impacts as a result of the vibration associated with launches is difficult to assess at this stage. This is because modelling ground and structural vibration is complex and dependent on the unique material properties of each element and its respective boundary conditions, the maintenance condition of the structure, and the incident sound wave characteristics. These complexities have resulted in structural damage criteria for launch vehicle environmental reviews that are largely based on findings from anecdotal evidence and static horizontal rocket testing. Thus, while it is acknowledged that future research is needed, the damage claim criteria used in the Shetland noise study (Chapter 8) represents the best available dataset regarding the potential for structural damage resulting from rocket noise – as the findings are based on actual rocket noise and community surveys over a large number of events. This indicates that the potential for structural damage is likely to be low. However, as per the above, the potential magnitude of impact cannot be accurately identified at this stage. Mitigation measures outlined in Section 14.7 will ensure that any potential for impact is identified early and mitigation is put in place to ensure that no significant effects arise.

Setting effects

14.8.4 Zone of Theoretical Visibility (ZTV) analysis and mapping have been used to identify those designated assets that could potentially be affected by changes to their settings during the operational phase of the Proposed Project and all designated heritage assets within the study area have been carried forward for assessment. The detailed assessments have included a review of the contextual characteristics of each asset using information drawn from their designation documentation, supplemented by observations on the morphology, condition and character of each asset and the nature of their settings made during site visits undertaken in July 2020.

14.8.5 The qualitative setting assessment for each asset considered is set out below. The assessment follows HES guidance on setting assessment (HES, 2016, updated 2020). Having identified the assets which could be affected, this section defines the setting of each heritage asset and how this contributes to the understanding, appreciation and experience of the assets. This is followed by consideration of the impact of the Proposed Project on the setting of the asset in question and consideration as to whether the integrity of the assets' setting would be adversely affected. Sensitivity of the assets to changes to their settings, the magnitude of impact and the resulting level of effect are given in line with the methodology set out in Section 14.4.

St John's Church, remains of, Norwick (Site 1)

14.8.6 St John's Church (Site 1) comprises the remains of a former church which survives as the turf covered footings of the walls of the nave. The asset is thought to be located on the site of a former Iron Age broch. The chancel has been built over with a later memorial. The Statement of National Importance associated with the Scheduling states that:

> '*The monument is of national importance as the remains of a simple pre-Reformation parish church, with the potential to provide information about medieval church architecture and parish organisation. It was probably constructed at about the time that Shetland was passing from Danish to Scottish rule*.' (HES, 2020a).

14.8.7 The current setting of the church is defined by the post-medieval and modern burial ground, which currently occupies the site, and the surrounding residential properties of the village of Norwick. The church sits on elevated ground above Nor Wick bay which lies to the north-east and there are views down to the associated beach, across Nor Wick and to the Lamba Ness peninsula to the north. The ground rises to the south to the summit of the Hill of Clibberswick. The current surroundings of the asset contribute to an understanding of it as a place of worship for the immediately surrounding settlement, within which it forms a moderately prominent landmark. Salvage excavations in 2003 found evidence for Viking and Iron Age settlement at the site, though not necessarily a broch –as local tradition holds. The setting, on a knoll above, but with access to the sea at the beach and Nor Wick bay, and the natural defensive cliffs of Lamba Ness and the Hill of Clibberswick to the north and south respectively contribute to an understanding and appreciation of reasons for selecting this site for settlement in earlier periods. On this basis St John's Church is judged to have a high relative sensitivity to changes to its setting.

14.8.8 Elements of the Proposed Project would be visible, above the cliffs of Lamba Ness, from St John's Church. In particular, the buildings associated with the Assembly and Storage Area and some security fencing around these would be visible. A small portion of two of the dishes associated with the Satellite Tracking Area and the upper portions of the Integration Hangar would also be visible. The Integration Hanger would be visible behind the CH/S Power House (Site 93). Launch vehicles and lightning towers required for launches from the Proposed Project would also be visible for a limited amount of time. However, only one launch pad would be utilised at any given time and these items of infrastructure would only be visible on launch days.

14.8.9 While the elements of the Proposed Project described above would be visible, they would only occupy a small proportion of the view of Lamba Ness when viewed from the church; and they would not obscure or detract from the ability to understand, appreciate or experience the relationship between the church and the settlement of Norwick, Nor Wick bay or the surrounding and inherently defensive coastline. In addition, launch events may be audible but these impacts would be short-lived and number no more than 30 per year. As such they are not considered to materially impact upon the setting of the church.

14.8.10 On this basis the Proposed Project is judged to constitute an alteration to the setting of the church but one which would not affect an ability to understand the contribution that setting makes to the asset's overall significance. The magnitude of impact is predicted to be low and this would result in a minor level of effect, resulting in **no significant effects**.

Inner Skaw, houses and field system (Site 2)

14.8.11 Inner Skaw, houses and field system (Site 2) is a Scheduled Monument which comprises the remains of a series of farmhouses, the earliest of which may be of early Norse date, and their associated field system(s). The monument is visible as a series of stone wall and building foundations or footings with some upstanding walls remaining. The field systems extend, within the Scheduled area to the north, north-east and north-west of the structural remains and also appear to extend further east and south beyond the Scheduled Inner Skaw area, as shown by the walkover survey and the drone survey (see Site 75 extents). The Statement of National Importance associated with the Scheduling states that:

> '*The monument is of national importance as a remarkably fine example of a long-lived agricultural settlement, which may have its roots in the period immediately after the Norse settlement of Shetland in the ninth century AD, and which has been re-used on several occasions up to the nineteenth century.*
>
> *The settlement's importance is enhanced by the adjacent field systems, which represent several episodes of use, and although the earliest visible remains are probably Medieval rather than Norse, there is the potential for further investigation to clarify this and the whole settlement sequence*. (HES, 2020b).

14.8.12 The Scheduled Monument sits on land either side of a burn which flows north from the centre of the peninsula, down to the Sand of Inner Skaw. The buildings are primarily located in the south of the Scheduled Area and to the west of the burn. The field systems extend down slope to the coast and to the burn, where they then rise upslope on the eastern side of the burn, where the cultivation remains are particularly well defined (Plate 145). An ashy midden (Site 48) was found within the Scheduled Area and excavated in 2001, and numerous artefacts including steatite vessels, pottery and stone tools were recovered. The Scheduled remains are separated from land to the south by a post and wire fence which largely runs along the access road associated with the remains of RAF Skaw, the post and wire fence also dog legs north on the eastern side of the burn cutting across cultivation remains and the Scheduled Area.

14.8.13 The agricultural nature of the settlement and field systems is discernible in the current setting of the asset, even with the juxtaposition with later Second World War remains. The relationship between the building remains and the visible cultivation remains contained with the field system are particularly important in understanding the nature and longevity of settlement at this site, along with the asset's relationship to the burn which it straddles and the sea, at Inner Skaw Sands, to the north. The placement of the settlement, and indeed its longevity, would likely have been predicated on access to suitable agricultural land as well as other resources which could be exploited, as represented by the burn and easy access to the coast. The asset is considered to be of high relative sensitivity to changes which would affect the ability to understand the relationship between its built and agricultural elements and which would diminish the ability to appreciate its relationship to the important topographic and landscape features noted here, namely the burn, sloping land and Inner Skaw Sands beach and inlet.

14.8.14 Viewpoint 1 indicates that the infrastructure associated with the Satellite Tracking would be prominent in views towards the south-east, truncating views in this direction. A portion of the Satellite Tracking Station would also be located in part of the field system outwith Inner Skaw Scheduled Area but within RAF Skaw Scheduled Area and would be located c. 73 m to the south-east of the boundary of the Inner Skaw Scheduled Area. Launch Site 1 would be located c. 250 m to the east and Launch Sites 2 and 3 would be visible behind this. The Integration Hangar would also be visible as a large new structure in views eastwards. While not indicated on Viewpoint 1, buildings associated with the Assembly and Storage Area are likely to be partially visible on higher ground to the west from the western edges of the Scheduled Area.

14.8.15 The Launch Sites and Integration Hangar would all be located outwith the designated area of Inner Skaw though it would be located in the wider associated field system and they further would not affect the relationship between the built and agricultural remains and the topographical features of the burn, the sloping land to the north and the beach at Inner Skaw Sands. However, the proximity and nature of these elements of the Proposed Project to the remains at Inner Skaw are such that they would change the current setting of the asset. Similar impacts upon the setting of Inner Skaw would have been experienced during the operational period of RAF Skaw, given the extent of former buildings and masts at the Site. On balance and given the above, and particularly as a result of the proposed construction of the security fencing and portions of the Satellite Tracking Station within the wider and less well-preserved portions of the field system, the predicted magnitude of impact would be medium. This would result in a moderate level of effect which is equivalent to a **likely significant effect**. As elements of the monument would largely remain legible in terms of their function and relationship to one another, it is considered that this effect would not adversely affect the integrity of the asset's setting.

Skaw, radar station (RAF Skaw) (Site 3)

14.8.16 The history and the features of RAF Skaw are outlined in Section 14.5, Appendix 14.6 and Appendix 14.7 and, as such, are not repeated in full here. A key reason for the asset's designation is the fact that it has survived as a coherent monument representing a largely intact RAF complex. The statement of National Importance makes particular reference to the asset as providing a '*complete example of the technical, support and domestic buildings and structures necessary to provide an early warning reporting function*'. And further states that '*the loss of the monument would significantly diminish our future ability to appreciate and understand the scale of the efforts employed on the home front in the defence of Britain*' (HES, 2020a).

14.8.17 As it currently stands the buildings, structures and individual features contained within the bounds of the RAF Skaw and their function and historical relationship to one another are easily interpreted and understood by an informed observer. Taken together the features within the boundaries of RAF Skaw allow for a detailed understanding of the construction and operation of the site as a chain home radar base during the Second World War. The topographical setting of RAF Skaw, on a peninsula with cliffs to the coastline on three sides, also contributes to an understanding of the strategic placement of the base in a location which provided a naturally defendable position from the sea, in a location between mainland Europe and the Atlantic. It is of high relative sensitivity to changes within its boundaries.

14.8.18 The continued operation of new infrastructure in the vicinity of these locations will result in a number of new features within and amongst the RAF structures and these will impact upon the character and setting of the asset and the ability to understand how the base functioned as a whole.

14.8.19 Cultural Heritage Viewpoint 2 (Appendix 14.4) was chosen as the location offers a good vista over the eastern portion of RAF Skaw from which the CH Transmitter (Site 85), the CH/S Power House and the CH Receiver Block (Site 111) are clearly visible along with the Power House (Site 77) and a number of ACH buildings (Sites 96 & 98). The field system associated with Inner Skaw (Site 2) is also clearly visible from this location. While a clear understanding of the above RAF features and the relationship to one another requires closure examination and consideration of some of the less visible features to allow for a true understanding of construction, use and abandonment of RAF Skaw; the viewpoint does allow for an understanding of the strategic location of the site on the defensible Lamba Ness peninsula and for an understanding of the scale and distribution of the RAF remains. The visualisation indicates that Launch Site 1 is likely to obscure views of the CH Transmitter (Site 85). Views of the CH/S Power House and CH Receiver along with views of the northern ACH buildings will remain possible but they will be juxtaposed with the Integration Hangar and Launch Site 3 respectively. The Satellite Tracking Area would be seen in the foreground of views of the Power House. The interspersion of the Proposed Project amongst the RAF remains would diminish the ability to understand the relationship of the RAF remains to one another from this location. The strategic nature of the topographic position of the site would remain clear.

14.8.20 Cultural Heritage Viewpoint 3 (Appendix 14.4) was chosen for similar reasons to Viewpoint 1, in that it provides an overview of RAF Skaw from the east, looking west and inland over the CH/S Power House (Site 93) and the nearby guard hut (Site 142). From this position the remains of the CH masts (Sites 102 & 103) are visible with the top of the CH Transmitter building (Site 85) beyond. The Power House (Site 77) and another small guard hut (Site 84; due to be lost) are visible further to the west. The visualisation indicates that the Integration Hangar building would obscure the most westerly RAF buildings currently visible in this view and it would form a prominent new feature, located adjacent to the CH/S Power House. It will obscure views westward of much of the access road and it would remove portions of the remains of southern most of the two masts (Site 103). The security fencing and infrastructure associated with Launch Site 2 would remove the remains of the mast at Site 102 and would obscure views of the CH Transmitter (Site 85). When operational, prior to launch, the launch vehicles at Launch Sites 1 and 2 would form high vertical features. Though it is noted in the case of Launch Site 2 that this may allow for an understanding of some elements of the former character of the Site when it was an operational RAF facility; as the Launch Site would be in the location of a former mast (Site 102) and when operational the Launch Site would reintroduce a tall vertical feature in this location. However, overall, the interspersion of the Proposed Project amongst the RAF remains would diminish the ability to understand the relationship of the RAF remains to one another from this location and the some of the ability to understand how the site operated.

14.8.21 Cultural Heritage Viewpoint 4 (Appendix 14.4) was taken from the north-east corner of the CH Transmitter (Site 85) which is one of the most prominent and imposing remaining RAF buildings on the Site. It is of concrete construction with double blast walls, the outer of which has been banked up with earthen bunding. The view looks towards the remains of one of the transmitter masts (Site 102) associated with the transmitter. Launch Site 2 is proposed to be constructed at the location of the former mast and, as the visualisation indicates, security fencing and infrastructure associated with the Launch Site would be visible in close proximity. The loss of the remains of the mast footings (discussed in terms of direct effects above) would have an impact upon the contextual understanding of the CH Transmitter as directly associated features would be removed. Though it is noted in the case of Launch Site 2 that this may allow for some understanding of the former character of the Site when it was an operational RAF facility; as the Launch Site would reintroduce a tall vertical feature in this former mast location. As such it may allow, for short periods and with proper interpretation, for the appreciation of the height and location of the lost mast and its relationship to Site 85.

14.8.22 Cultural Heritage Viewpoint 5 (Appendix 14.4) is taken from near the gun and crew shelter (Site 74) and looks north-eastward. It marks the probable location of a strategic surveillance position with billets (Site 79) in the foreground and an air raid shelter (Site 78) located further to the south-east. The position is elevated above land further east along the peninsula and located near to the cliff top offering views over Nor Wick bay and out to sea in a south-easterly direction. The location also affords views over much of the radar infrastructure associated with RAF Skaw with several guard huts and the Power House (Site 77) visible along the access road and the CH Transmitter (Site 85), the CH/S Power House (Site 93) and the CH Receiver (Site 111) all clearly visible north-east and east. Elements of the early accommodation block (centred around Site 83 & 109) are also visible directly to the east and elements of the ACH infrastructure are visible on the northern coast of the end of Lamba Ness peninsula. As such this viewpoint offers a vantage point which illustrates the contextual relationship between several of the main elements of RAF Skaw.

14.8.23 The visualisation indicates that the Integration Hangar would be a prominent feature in views from this location and that while the CH Transmitter, CH/S Power House and the CH Receiver would still be visible they would be backed by infrastructure associated with Launch Sites 2 and 3 and in the case of the CH/S Power House the Integration Hangar would be seen in a dominant position adjacent to the power house. As the new infrastructure is proposed to be interspersed with the remains of the RAF infrastructure and given the extent and the scale of the Proposed Project, the contextual relationships between and functional associations of individual elements of RAF Skaw would be more difficult to appreciate.

14.8.24 Cultural Heritage Viewpoint 6 (Appendix 14.4) was taken from the track (85hh) looking towards the CH Transmitter (Site 85) with the remains of the transmitter masts (Sites 102 & 103) in the background. It, like Viewpoint 5, was chosen to demonstrate the contextual and functional relationship between particular elements of the CH Transmitter infrastructure. The large cuttings (Sites 410, 392, 479 and 402) are also apparent in the slope to the east of the track and leading up towards the mast locations. Elements of the ACH infrastructure and the CH Receiver (Site 111) are visible in the background. This viewpoint in particular allows for understanding, by an informed observer, as to the extent of construction work that was required to establish RAF Skaw. The construction of the access track between Launch Site 2 and the Integration Hangar would remove much of the remains of the large cuttings which appear to be associated with the transmitter masts and would result not only in an inability to understand them as coherent features but would also prevent an understanding of their relationship to the former masts. Security fencing and infrastructure associated with operations at Launch Site 2 would sit above the CH Transmitter and the satellite in preparation for launch would form a prominent feature behind it. Though it is noted that when in launch preparation the vertical feature would be located in the historical location of the former vertical mast. The Integration Hangar will largely prevent views of the RAF features located at the extreme eastern extent of the peninsula from this location. The Proposed Project when considered from this viewpoint will diminish the ability to understand the relationship between individual elements of the CH Transmitter operations.

14.8.25 Cultural Heritage Viewpoint 7 (Appendix 14.4) is included at the request of the Shetland Regional Archaeologist and has been taken from the top of the northern bank surrounding the CH/S Power House (Site 93) looking north towards the CH Transmitter (Site 85) and the former masts (Sites 102 & 103). Given the proximity of the Integration Hangar to the CH/S Power House it would obscure all views in this direction from the CH/S Power House.

14.8.26 Cultural Heritage Viewpoint 8 (Appendix 14.4) was also included at the request of the Shetland Regional Archaeologist and has been taken from the north-east corner of the bank surrounding the CH Receiver block (Site 111). The security fencing along with the infrastructure associated with Launch Site 3 will largely prohibit views of the topography of the peninsula and the cliff edge in this view.

14.8.27 Consideration has also been given to how the Proposed Project might impact upon the setting and character of RAF Skaw in terms of its relationship to the northern element of the Scheduled Area which represents the reserve radar station. Currently the large buildings associated with the main site at RAF Skaw (the CH Receiver and the CH/S Power House) are clearly visible from the northern portion of the Scheduled Monument. LVIA viewpoint 1-1 (Drawing 13.3.1.1) indicates the launch sites and the Integration Hangar would be seen in this view but that the CH Receiver and Power House would remain obvious features.

14.8.28 Operation of the Proposed Project will result in the continued use of new structures interspersed amongst the RAF remains which adversely affect the ability of to understand the contextual relationships and associations of the individual features. Given the above, the Proposed Project would impact upon the intactness and the coherence of the Scheduled Monument and the impact upon its character and setting is judged to be high. The level of effect would be **major** and result in **likely significant effects**. The integrity of the asset's setting would be adversely affected as a result of the diminishment of the coherence of the monument and intrinsic and contextual characteristics of the asset would be adversely affected.

14.8.29 HES have also requested specific comment on how the Proposed Project might impact upon the associative characteristics and social value of the asset. Associative characteristics can relate to how the asset is perceived and valued by people today. As noted above, associative value for RAF Skaw can be measured, in part, by the interest shown in the monument by local people and by military enthusiasts. This is evident in previous exhibitions held at Unst Heritage Centre and in the publication of a blog on the History of RAF Skaw. However, it would seem that most of that value resides in the historical associations of the asset which are well recorded. It is also the case that these characteristics can be appreciated remotely/indirectly through interactions with representations of and information regarding the asset. On this basis, while there is likely to be an adverse effect on associative characteristics there is potential to mitigate these effects, and indeed to enhance appreciation of the asset, through the proposed Interpretation Strategy set out below and in Appendix 14.9.

Norwick, The Banks, Including Cottage, Outbuilding, Ruin, Boundary and Sea Walls (Site 4)

14.8.30 The Banks (Site 4) comprise a group of buildings including a house, cottage, outbuilding and sea walls along with a ruin. The group is Listed together at Category C and the main house dates to the later 19th Century. The Listing description states the following in the Statement of Special Interest:

> *The Banks was originally known as The Bod. Despite the installation of modern glazing, this group retains its traditional appearance characterised by low-pitched tarred roofs and thick rubble walls. The contrast of the startling white walls with the black tarred roofs enhances the picturesque quality of this group in its dramatic and rocky setting.* (HES, 2020c).

14.8.31 The group sits to the north of the beach at Nor Wick bay and its main elevations face south and east across the beach and out to the bay. The land rises steeply behind (to the north) of the buildings up The Cliffs towards Braehead and eventually the Ward of Norwick and extends east along the cliffs of the Lamba Ness landform (Plate 146; and visible in LVIA viewpoint 1.6 (Drawing 13.3.1.6). As the Statement of Special Interest notes the buildings' setting against the beach and the rocky cliffs contributes to an understanding of its placement. That being a relatively protected location for a croft in an otherwise rocky and potentially harsh location. The Statement of Special Interest also references the picturesque qualities of the buildings assigning significance to their aesthetic qualities. The buildings' setting primarily relates to the Nor Wick bay and cliff side setting and is less sensitive to changes beyond this setting. On balance the group is judged to have a medium relative sensitivity to changes to its setting, as the setting makes an overall moderate contribution to an understanding, appreciation and experience of the buildings.

14.8.32 Elements of the Proposed Project would be visible, largely in views of The Banks when approached along the beach road from the south and from further way, along the B9087 travelling towards Norwick (LVIA viewpoint 1.6 (Drawing 13.3.1.6)). Views of the Proposed Project from the buildings themselves would be more limited given their orientation and steeply rising cliffs to the north and north-east. In views of The Banks from the south infrastructure associated with Storage and Assembly Area would be visible above and behind the Listed Buildings as would limited elements of the Satellite Tracking equipment. Launch vehicles at all three Launch Sites would be visible when preparing for launch but infrastructure associated with the Launch Sites would not. While these elements would be visible, they would not obscure or detract from the ability to understand, appreciate or experience the relationship between The Banks and Nor Wick bay or the surrounding coastline. The relationship between The Banks and the beach, bay and cliffs would not be obscured. In addition, launch events may be audible at The Banks, but these impacts would be short-lived and number no more than 30 per year. As such they are not considered to materially contribute to the impact upon the setting of The Banks.

14.8.33 On this basis, the Proposed Project would constitute an alteration to the setting of The Banks but one which would not affect the ability to understand the contribution that setting makes to its significance. The magnitude of impact is predicted to be low and this would result in a minor level of effect, resulting in **no significant effects**.

Papil, Valsgarth, Including Outbuildings and Walls (Site 5)

14.8.34 The croft buildings at Papil, Valsgarth (Site 5) are Category B Listed and include a house and outbuildings located within improved fields with their main elevation facing south towards the bay at Harold's Wick (Plates 147 & 148). The land slopes up behind the buildings towards the rise on which Saxa Vord Resort is located and to the summit of the Hill of Clibberswick to the east. The Statement of Special Interest states:

'*A particularly fine example of a larger crofthouse and outbuildings in little-altered condition and sporting an excellent glazed timber porch of the type that was once a common characteristic of buildings in Unst. The building may have been altered to its present form by settlers from Sutherland in the 1870s, accounting for its larger size and quality of construction. This picturesque group is prominently sited near the road.'* (HES, 2020d)

The setting of Papil, such that it contributes to an understanding, appreciation and experience of the asset, primarily relates to its location on the road, the surrounding improved agricultural fields and its relationship with Harold's Wick bay to the south. These features contribute to an understanding and appreciation of the croft's siting in a location where agricultural resources could be readily exploited and, in a location, which provided access to good transport and communication links. It is sensitive to changes within this defined setting and less sensitive to changes in the wider landscape. On balance it is considered to be of medium relative sensitivity to changes to its setting, as its setting makes an overall moderate contribution to an understanding, appreciation and experience of it.

14.8.35 The Proposed Project would not be discernible from Papil due to intervening topography and built structures. None of the elements of the Proposed Project would affect the ability to understand the relationship of Papil to its setting as described above. Launch events may be audible, but these impacts would be short-lived and number no more than 30 per year. As such they are not considered to materially contribute to any impact upon the setting of Papil.

14.8.36 As such the magnitude of impact upon the setting of Papil by the Proposed Project would be negligible at most. The level of effect would be neutral and result in **no significant effects**.

Skaw, Boat-Roofed Shed (Site 6)

14.8.37 Skaw, Boat-Roofed Shed (Site 6) is designated as a Category C Listed Building. It dates to c. 1940 and forms an outbuilding to Skaw Cottage (Plate 149). It is set at the opening of the deeply incised valley associated with the Burn of Skaw where it opens onto Skaw beach to the east. The boat-roofed shed is orientated with its main elevation to the south-east towards the road and the beach. The ground rises to the north of the shed towards Skaw and rises steeply to the south on the other side of Skaw Burn (Plate 150). The Statement of Special Interest implies that the majority of the assets cultural value lies in its architectural and historical interest and in its rarity.

> *The boat used for this shed was one of 2 lifeboats from the British steamer Sea Venture, which was sunk by a German submarine on 20th October 1939. Once a fairly common sight in Shetland, these boat-roofed sheds are becoming increasingly rare.* (HES, 2020e).

14.8.38 The setting of the boat-roofed shed is largely limited to the Wick of Skaw and the settlement at Skaw cottage and the wider landscape does not contribute to an understanding, appreciation or experience of it, though it does have wider contextual value as noted in the Statement of Special Interest. On this basis it is considered to have low relative sensitivity to changes to its wider setting.

14.8.39 None of the Proposed Project would be visible from the boat-roofed shed, with the possible exception of upper elements of rockets when in preparation for launch. Launch events may be audible, but these impacts would be short-lived and number no more than 30 per year. As such they are not considered to materially contribute to any impact upon the setting of the boat-roofed shed at Skaw. A precautionary negligible magnitude of impact is predicted which would result in a neutral level effect, which would give rise to **no significant effects**.

14.9 Additional Mitigation and Enhancement

14.9.1 It is acknowledged that operation of the Proposed Project will have a major and significant effect upon RAF Skaw and the integrity of its setting. There will also be a moderate and significant effect upon the setting of Inner Skaw. As such, it proposed to offer compensatory measures aimed at enhancing the understanding and appreciation of RAF Skaw and Inner Skaw, which would include the opportunity for enhancement of the assets' associated characteristics.

14.9.2 The Proposed Project offers the opportunity for investment into the protection and interpretation of the remains at RAF Skaw. As the review of existing buildings (see Appendix 14.5) has shown, many of the buildings would benefit from regular monitoring to prevent further degradation and loss. The detailed policies outlined in the CMP in Appendix 14.10 along with the regular monitoring of structural integrity recommended in Appendix 14.5, will ensure that further deterioration can be mitigated through intervention or, if a building is structurally unsound such that it is beyond repair ensure that it can be adequately recorded prior to any required demolition which may need to take place on H&S grounds. As such, the Proposed Project may be able to help limit further loss from degradation through weathering and carbonation and, where loss cannot be minimised, ensure preservation by record.

14.9.3 In addition to the potential for increased care of the features within RAF Skaw, interpretative measures could be used to enhance the associative characteristics of the asset, making it more readily understandable and accessible to a wider audience. This will ensure that the surviving elements of RAF Skaw are secured for the understanding and enjoyment of present and future generations (HES, 2019b). The programme would aim to make the knowledge about RAF Skaw and its significance accessible to the widest audience possible (Scottish Government , 2014) . In line with Our Place in Time: The Historic Environment Strategy for Scotland the mitigation package would seek to '*enhance participation through encouraging access to and interpretation and understanding of the significance*' of RAF Skaw and Inner Skaw (ibid, 24),

14.9.4 To achieve this aim, it is envisaged that the mitigation package will include, as noted in part above, the following:

- **Implementation of the Conservation Management Plan** - to ensure that the significance of the remaining features of RAF Skaw and Inner Skaw are not impacted upon during the operation of the Proposed Project and to ensure that any works undertaken to facilitate interpretation and access are done in such a way as to avoid further impact upon RAF Skaw and Inner Skaw.
- **Interpretation Strategy** - to enhance understanding, appreciation and experience of RAF Skaw and Inner Skaw. This will include some or all of the following with the agreement of the Shetland Islands Council and relevant consultees:
  - On-site interpretation hubs for both RAF Skaw and Inner Skaw.
  - School packs for dissemination to Shetland schools e.g., to fit in with Second World War topics (RAF Skaw) and Viking's topics (Inner Skaw) for both primary and secondary students.
  - A mobile-friendly website (standalone or linked to the Shetland Space Centre Website) which could include 3D models, VR/AR tour, history of the base including its context in the wider Chain Home Radar network.
  - Potential re-use of one of the RAF Skaw buildings as an on-site interpretation centre with standing and/or rotating exhibits subject to further structural assessment.

14.9.5 Appendix 14.9 sets out these proposals in greater detail.

14.10 Residual Effects

14.10.1 There is potential for residual direct effects during the operational phase as a result of the vibration associated with launches. Mitigation has been put forward in Section 14.7 to ensure that upstanding historic structures will be monitored during the operational period and that this will ensure the potential for further impacts are identified prior to any harm being experienced and that steps are taken to mitigate this. This will ensure that any residual direct operational effects are negligible and there are **no likely significant effects**.

14.10.2 The predicted residual impacts on the settings and character of designated heritage assets will be the same as assessed for the operational effects. However, as set out in Section 14.9 and Appendix 14.9, compensatory measures are proposed.

14.11 Summary

14.11.1 This chapter identifies the archaeological and cultural heritage significance of the Proposed Project Site and assesses the potential for direct and settings effects on cultural heritage assets and features resulting from the operation of the Proposed Project. This chapter also identifies measures that should be taken to mitigate predicted adverse effects.

14.11.2 Major and significant direct and setting effects are predicted upon the Scheduled remains of RAF Skaw (Site 3) resulting from the operation of the Proposed Project. This would result from the removal of a number of features associated with the construction, use and abandonment of RAF Skaw and, from the construction of new and large-scale structures associated the Proposed Project. The impacts would adversely affect the integrity of the asset's setting.

14.11.3 Moderate and significant setting effects are expected on the Inner Skaw Scheduled Monument (Site 2) as a result of the Proposed Project. There would be no direct effects upon the Scheduled Monument. The relationship of the component parts of the asset to each other and to its surroundings would still largely be legible and so the integrity of the asset's setting would not be adversely affected.

14.11.4 Significant effects upon RAF Skaw and on the setting of Inner Skaw Scheduled Monuments are acknowledged and a programme of compensatory measures are proposed to enhance the understanding and appreciation of these designated assets and provide increased access to them through implementation of a CMP and Interpretation Strategy.

14.11.5 The CMP represents a commitment to the ongoing management and maintenance of the Skaw radar station site during operation of the Proposed Project and presents a range of broad policies to allow for this commitment to be met. An outline of proposed conservation works and an assessment of their priority is provided within the CMP. In making these management, maintenance and repair recommendations, the aim has been to retain the surviving buildings and structures in a safe and manageable condition whilst respecting and preserving their significance. In addition, a programme of annual inspection and maintenance will be carried out on all structures to control unwanted vegetation growth, stabilise loose brickwork and make good any localised areas of failing mortar, with regular inspections formalized to identify any defects

14.11.6 In terms of residual effects, vibration monitoring will take place during the operational phase to ensure that the potential for any impact upon upstanding remains resulting from vibration during launch events is identified early and that further steps are taken to avoid or minimise any harm. As such any direct residual effects resulting from vibration during the operational phase are predicted to be negligible and as such no likely significant effects are predicted. There will however be major and significant residual setting effects upon RAF Skaw and moderate and significant residual setting effects upon Inner Skaw.

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Chapter 15 Accidents and Disasters

15. Accidents and Disasters

15. Accidents and Disasters

15.1 Introduction

15.1.1 This chapter considers the potential for activities at the Proposed Project to cause major accidents or be affected by natural disasters, in both cases focussing on where harm to the environment as a consequence could reasonably occur.

15.1.2 The assessment is intended to inform management and mitigation of risks to the environment at a general level. It does not assess the probability of any major accident or disaster; this level of assessment being included separately in the Spaceport Licence application as part of the safety case.

15.1.3 The chapter considers environmental hazards inherent to the Proposed Project, the receptor groups likely to be affected in the event of an accident event, and the potential severity of the impact. The management of these risks by design or further mitigation is discussed.

15.1.4 The chapter considers significant effects from major accidents and natural disasters, it does not represent an exhaustive treatment of every possible risk of environmental damage. "Major" is defined as having the potential to cause permanent or long-term damage to a receptor, including loss of life or permanent destruction of habitat. Environmental hazards have been identified in collaboration with the Applicant's operations team.

15.2 Legislation, Policy and Guidelines

Legislation

15.2.1 The treatment of major accidents and disasters within an AEE is a requirement since the Space Industry Regulations 2021 came into force. Guidance document 'Guidance for the Assessment of Environmental Effects' (CAA et. al., 2021) states in paragraph 4.65:

'The AEE must include a description of the environmental effects of reasonable worst-case scenarios from accidents and disasters which could occur during, or as a result of, the proposed activities. These must include as a minimum:

- *Possible off-nominal launch scenarios, account for where these occur (for example, on the launch pad)*
- *Fuel and hazardous material storage and handling (for example, failure of containment).'*

15.2.2 The Proposed Project will be a workplace and The Health and Safety at Work Act (1974) (UK Government, 1974) and Management of Health and Safety at Work Regulations (1999) (UK Government, 1999) will apply. The Act's position on controlling risks, as interpreted by the Health and Safety Executive, to a level "As Low as Reasonably Practical" (ALARP) informs the approach to mitigation in the AEE Report context.

15.2.3 The Control of Major Accident Hazards Regulations (2015) (COMAH) (UK Government, 2015) and the Town and Country Planning (Hazardous Substances)(Scotland) Regulations 2015 (Scottish Government, 2017) will not apply to the Proposed Project as the thresholds for storage of the relevant hazardous materials (principally RP-1 rocket propellant) will not be exceeded.[1]

15.2.4 The Control of Substances Hazardous to Health (COSHH) Regulations 2015 (UK Government, 2002) will be applicable to the Proposed Project as will the related technical guidance EH40 (Health and

[1] This is a Category 3 Flammable Liquid and the threshold for on-site storage is 5000 tonnes under the Town and Country Planning (Hazardous Substances) (Scotland) Regulations 2015. The lower tier COMAH threshold is 2500 tonnes for jet fuel which is the closest analogue to RP-1.

Safety Executive, 2005) which sets out airborne pollutant limits for occupational groups. These are referred to in this chapter where workplace exposure to a hazardous material is considered following an accidental release.

Guidance

15.2.5 Specific guidance for the production of Accidents chapters for AEE is currently limited and therefore reference has been made to examples of current practice shared by the Institute of Environmental Management and Assessment (IEMA, 2020).

15.2.6 The Health and Safety Laboratory (HSL) has produced the guidance document "Safety at Spaceports" (Health and Safety Laboratory, 2018) on behalf of the Civil Aviation Authority (CAA) and the UK Space Agency. This assessment recognises this guidance and sets out a list of potential hazard areas to examine the potential environmental effects as the guidance suggests. The HSL guidance then recommends a tiered risk assessment process tailored more towards the protection of occupational groups, and as such diverges from the AEE process. This element of the risk assessment is therefore included separately in the Spaceport licence application safety case.

15.3 Assessment Methodology and Significance Criteria

15.3.1 Under the guidance and regulations accompanying the Space Industry Act 2018, a safety case and quantitative operational risk assessments is required to be produced by the Applicant for approval by the regulator. This assessment for AEE does not replace these requirements but rather separately considers reasonably realistic accident and disaster events in the context of their environmental consequences. It would be unrealistic to exclude workers and nearby residents as receptor groups from this assessment however, since any environmental changes would affect these groups as well as potentially wildlife and habitat sites.

15.3.2 A list of potential major accident and disaster events has been drafted on the basis of the Proposed Project's potential vulnerabilities and a range of reasonably plausible accident scenarios. The longlist was then reviewed against the definition of significant effects used for the assessment, and a number of events with lesser potential consequences were screened out accordingly.

15.3.3 The shorter list of events which could potentially meet the definition were considered in terms of the nature of the potential environmental effects, the potential severity and significance of the effect and the requirements for mitigation.

15.3.4 The meaning of "major" should be understood in the context of the Proposed Project. The "major" events assessed are expected to represent the potential events with the highest severity at an operational spaceport for relatively small launch vehicles (LVs). These "major" events would not necessarily be considered in the context of a much larger spaceport or a facility which stored or used flammable materials in far greater quantities such as a petrochemical refinery.

Environmental Zone of Influence

15.3.5 A one-kilometre buffer area around the Proposed Project Launch Pad locations has been considered for the potential effects of loss of containment and combustion events because effects meeting the definition of a major accident or disaster would be unlikely beyond this distance.

Assessment of Significance

15.3.6 Potential effect significance must be understood in the context of major accidents and disasters. These are inherently rare events, and it is entirely plausible that no major accident or disaster befalls the Proposed Project during its operational life. Even if such an event took place, it is also plausible that there might be no effects beyond the Proposed Project.

15.3.7 The terminology used in the assessment, to be consistent with other Chapters of the AEE Report and, notwithstanding the caveat in the above paragraph, are as follows:

- Sensitivity – all potential human, wildlife and habitat receptors are assumed highly sensitive on a precautionary basis;
- Magnitude of impact –The usual terminology for the significance of effect is irrelevant in this case as only events with potential for high impacts (loss of life or permanent damage to habitats) are considered; and,
- Significance of effect – Although receptors are assumed to all be of high sensitivity and impacts inherently large and adverse, the significance will still vary depending on the nature of the effect, particularly in terms of duration and reversibility. For instance, a catastrophic release of cryogenic fluid could have a major effect on a human receptor, with the potential for fatality, but a minor effect on a habitat which could readily regenerate following brief exposure. The scale of significance used, in descending order, is major, moderate, minor and negligible, with major and moderate being considered as significant effects in terms of AEE.

Requirements for Mitigation

15.3.8 Mitigation of the risk of significant adverse environmental effects is generally embedded in the design of the Proposed Project.

Assessment of Residual Effect Significance

15.3.9 The residual effects are intended to be the management of the risk of a major accident or disaster to a level that is ALARP, noting that this AEE Report represents a high-level assessment of such risks, with further assessment undertaken elsewhere in the Spaceport Licence application.

Limitations to Assessment

15.3.10 The assessment is qualitative. It includes no probabilistic treatment of risk, simply identifying plausible major accident and disaster events and commenting on their potential severity and the outline approach to mitigation. It purposely considers environmental effects as its focus, and where effects on human health are noted, it is not intended to substitute for current and future safety case development.

15.4 Baseline Conditions

15.4.1 Baseline conditions are assumed to be routine spaceport operations, rather than any physical description.

15.5 Receptors Brought Forward for Assessment

15.5.1 The following receptors have been brought forward for assessment:

- Habitats within a one-kilometre radius of the proposed Launch Pads were reviewed. Norwick SSSI is a geological designation and not considered sensitive. Norwick Meadows SSSI is a habitat designation for its sand dunes and valley fen which support several plant species of national and international interest.
- Wildlife receptors: The Proposed Project boundary will continue to be populated by species identified in Chapters 5 and 6 during the operational phase. These have been treated generically as residents of, or visitors to, the Proposed Project.
- Human receptors: The nearest inhabited receptor points outside of the Proposed Project boundary are Banks Cottage and the village of Norwick, though both are considerably over one kilometre from the Proposed Project. Employees and contractors working on the Proposed Project will therefore be the nearest human receptors considered.

15.6 Standard Mitigation

15.6.1 Standard mitigation measures have been informed by the safety case and risk assessment work undertaken as part of the application for Spaceport Licence. Standard mitigation will include the following:

- Development of management system and operating procedures;
- Establish and maintain an appropriate Safety Clear Zone when required;
- Minimal storage of reagents on site in favour of ”just-in-time” delivery for any given launch campaign; and
- Propellant / diesel transfer and storage on hardstanding with integral containment (i.e., a sump of sufficient volume to hold a spillage indefinitely).

15.7 Potential Effects

15.7.1 Major accident and disaster events which were screened out of assessment are shown in Table 15.1 below, along with reasons for no further consideration. They are generally natural disasters and extreme weather events with no serious risk of occurrence.

Table 15.1 Events screened out

Event	Reason for screening out
Tectonic activity	British Geological Survey records show no recorded earthquake above 3.4 local magnitude (“light”) within 50 km of Unst since records began (British Geological Survey, 2020).
Extreme temperature	Highly unlikely under the most pessimistic climate change scenarios given Unst’s latitude (see Chapter 11)
Extreme storm	Building Regulations are tolerant of reasonably foreseeable extremes. Launches with the potential to be compromised by extreme weather conditions would be postponed until a storm event had passed.
Storm surge (inundation)	Elevation makes inundation highly unlikely. No accounts of storm surge at the Proposed Project.

15.7.2 Climate-related risks are discussed in more detail in Chapter 11 of this AEE Report.

15.7.3 Events taken forward for assessment are summarised in Table 15.2 below. The events have been grouped into failure of containment (liquids), failure of containment (gases), ignition (liquids and gases) and off-nominal launch scenarios. The nature of the hazards is discussed in the following sections.

Failure of containment (liquids)

15.7.4 There will be a range of LVs used by the various operators making use of the Proposed Project and will vary in size and payload.

RP1 (Kerosene)

15.7.5 RP1 rocket propellant will not be kept at the Proposed Project, being delivered on a just-in-time basis by road tanker on a campaign basis.

15.7.6 To illustrate the typical quantities in use at the Proposed Project, the propellant capacity of one of the larger LVs being developed for the launch of small satellites is quoted in their corporate literature as 4500 gallons (Firefly Aerospace, 2019) , assumed to mean US gallons, which is just over 17,000 litres or 17 cubic metres. For context, a road tanker of the capacity commonly encountered on UK roads will carry up to 35 cubic metres – therefore the LV's propellant load is less than half a typical road tanker's worth.

15.7.7 It is assumed for this assessment that loss of containment, if uncontrolled, could lead to damage to on-site soil and groundwater and ultimately designated habitat site and the wildlife supported.

Diesel

15.7.8 Diesel will be stored on site in the low tens of cubic metres for use principally as generator fuel. As per RP1, it is assumed that a catastrophic loss of containment could lead to damage to on-site soil and groundwater and ultimately designated habitat site, and the wildlife supported.

Cryogenic fluids

15.7.9 Liquid oxygen and nitrogen will be tankered to site for testing and launches on a just-in-time basis for a given campaign. Following a loss of containment, these fluids will rapidly boil off but in the seconds following the loss may cause cold stress on infrastructure, liquid and vapour burns, and changes to combustibility of nearby fuels and propellants.

Hydrogen peroxide

15.7.10 Hydrogen peroxide would be tankered to site on a just-in-time basis, in quantities required for a given campaign vehicle as per other propellants. Hydrogen peroxide is corrosive to organic matter at high concentrations and can exothermically decompose into water and oxygen on contact with many substrates. A catastrophic loss of containment could lead to human health effects and topical damage to on-site vegetation though is too unstable to percolate very far into groundwater and travel offsite.

Hydrazine

15.7.11 Hydrazine may potentially be used as payload propellant, as distinct from LV propellant. Satellites may be required to have the capacity to autonomously generate thrust for station-keeping i.e., minor positional corrections during orbit. Hydrazine (N_2H_4) is commonly used as a monopropellant in satellite thrusters. It does not burn as such but dissociates through catalysis into nitrogen, hydrogen and ammonia. The dissociation is strongly exothermic (i.e., generates a lot of heat) and a small quantity of hydrazine can produce a large volume of hot, gaseous dissociation products which are directed to generate bursts of thrust.

15.7.12 To illustrate the quantities in use, the largest payloads are anticipated to have a gross weight of up to 600 kg, which may represent multiple satellites, and a hydrazine propellant load of 60 kg.

15.7.13 Hydrazine is toxic and highly flammable. Potential hazards include uncontrolled combustion if ignited and explosion if ignited within the propellant tank. Explosive combustion and dissociation may occur, with risk to human health and damage to site infrastructure.

15.7.14 The quantity used as payload propellant is relatively small and any accidental release and subsequent high-temperature decomposition and/or explosive combustion is unlikely to affect human receptors beyond the site boundary.

15.7.15 Hydrazine could potentially spill without ignition and evaporate. This could lead to temporarily elevated concentration above HSE Workplace Exposure Levels but unless containment was lost within a building, the vaporised hydrazine would dilute, disperse and decompose within a short time.

15.7.16 Loss of hydrazine is considered unlikely; the material is sealed within the payload and the containment seal is designed to withstand launch and transport conditions.

Failure of containment (gases)

15.7.17 Oxygen may act as an accelerant to a combustion process already in progress but otherwise the consequences of an oxygen leak will be minimal in terms of damage to human, wildlife or habitat receptors.

15.7.18 Nitrogen and helium leaks may temporarily reduce atmospheric oxygen concentration within a built environment, but evacuation and ventilation would mitigate against short-term health effects particularly asphyxia. Nitrogen or helium loss in an outdoor environment would have no particular effect.

15.7.19 There may be potential mechanical effects and risk of harm to occupational groups due to a sudden blast of pressurised gas.

Ignition of hazardous materials

15.7.20 RP-1 and diesel are the only flammable materials likely to be used in bulk (i.e., tonne) quantities at the Proposed Project.

15.7.21 Uncontrolled combustion of RP-1 during delivery or LV fuelling would result in deflagration rather than explosion and then only if vapour had built up to a concentration above the lower explosive limit for either propellant of 0.6% in a given volume of air.

Off-nominal Launch Scenarios

15.7.22 The resulting deflagration following ignition of propellant during a launch failure would create a short-lived initial fireball potentially extending several tens of metres from the launch pad, with the residual propellant rapidly burning off over several minutes.

15.7.23 Relatively little empirical data on the environmental effects of directly comparable catastrophic losses of a LV exist. Research by NASA summarising all available historic data for the accidental and planned test destruction of RP-1 propelled LVs suggests that the initial overpressure wave, which approximately corresponds to the deflagration radius (fireball) decays within tens of metres of the point of ignition (Blackwood, 2015).

15.7.24 The initial deflagration radius is not therefore expected to extend beyond the boundary of the Proposed Project and the duration of any subsequent propellant burn-off would be minimal in the open air.

15.7.25 The exact radius of the initial deflagration will be calculated in more detail during the development of relevant Launch Operator Ground Safety Analysis and Flight Safety Analysis.

15.7.26 Site survey work is planned to determine the quality of peat according to NatureScot classification, as an indicator of relative flammability of the substrate. The working expectation is that it will be low and will not be at risk of ignition following a rocket propellant deflagration.

15.7.27 The loss of all or part of the LV to the marine environment are considered in Chapter 10 – Marine and Transboundary Effects of this AEE Report; whether accidental or expected these effects will be generally similar and unlikely to meet the definition of a major accident or disaster.

15.7.28 Flight safety analysis from individual Launch Operators will inform the equivalent AEE for these activities.

Table 15.2 Events assessed

Event	Receptors	Potential Consequences	Significance	Mitigation
Failure of containment – liquid				
RP1	Hu, W, Hab	Soil and groundwater contamination. Runoff to watercourse or sea.	**Moderate (Significant)**	Bunded transfer. Maintenance regime. Management system which proceduralises materials handling (general mitigation measure).
Diesel	Hu, W, Hab	Soil and groundwater contamination. Runoff to watercourse or sea. Likely to evaporate at a lower rate than RP1 so greater risk of interaction of spill with wildlife.	**Major (Significant)**	Bunded transfer.
Liquid Oxygen (LOx)	Hu, W	Cryogenic injury and damage to receptors in close proximity to release before rapid evaporation takes place. Temporarily enhanced potential for fire and explosion during evaporation – oxygen enriched atmosphere.	Minor	Transfer away from routinely occupied workstations.
Hydrazine	Hu, W, Hab	Soil and groundwater contamination. Increased atmospheric concentration [toxicity] following evaporation.	**Major (Significant)**	Minimisation of handling – within satellite payload. “Just in time” delivery to Proposed Project to minimise storage duration.
Hydrogen peroxide	Hu, W, Hab	Corrosive damage to receptors in close proximity to release.	**Moderate (Significant)**	Bunded transfer
Liquid nitrogen	Hu, W	Cryogenic injury and damage to receptors in close proximity to release before rapid evaporation takes place.	Minor	Transfer away from routinely occupied workstations.
Failure of containment – gas				
Oxygen gas	Hu	Inundation of an indoor workspace could lead to increased risk of ignition of flammable substances	Minor	External storage.
Nitrogen gas	Hu	Inundation of an indoor workspace could lead to asphyxia if worker egress was prevented. There may be potential mechanical effects and risk of	Minor	External storage.

Event	Receptors	Potential Consequences	Significance	Mitigation
		harm to occupational groups due to a sudden blast of pressurised gas.		
Helium gas	Hu	Inundation of an indoor workspace could lead to asphyxia if worker egress was prevented though dispersion will be quicker than nitrogen.	Minor	None required – inert.
Ignition of bulk quantities				
RP1	Hu, W	Initial blast could affect human and wildlife receptors within the site boundary, with off-site effects less likely. Residual fires could cause a short-term episode of high air pollutant concentrations near the blast site and immediate downwind locations.	**Major (Significant)**	Bulk storage off-site i.e. restriction of quantities held at launch site. Fire risk assessment to inform safe working practices around flammable materials.
Diesel	Hu, W	Initial blast could affect human and wildlife receptors within the site boundary, with off-site effects less likely. Residual fires could cause a short-term episode of high air pollutant concentrations near the blast site and immediate downwind locations.	**Major (Significant)**	Fire risk assessment to inform safe working practices around flammable materials.
Hydrazine	Hu, W	Any blast will be of a far smaller magnitude than that following ignition of bulk propellant. Combustion products are likely to be far less environmentally damaging than hydrazine itself.	Minor	Payload and LV designed to withstand launch and transport conditions hence appropriately sealed against leakage. Fire risk assessment to inform safe working practices around flammable materials.
Aeronautical events				
Rocket crash – ground strike	Hu, W, Hab	Damage to receptors through impact and loss of propellant containment, potential ignition of propellant vapour and flammable substrate (peat).	**Major (Significant)**	CAA license requirements for launch management. All launch trajectories are to the north and have minimal land overflight. Areas around launch pad are not peat rich.

Event	Receptors	Potential Consequences	Significance	Mitigation
Rocket crash – water strike	W, Hab	Damage to receptors through impact and loss of propellant containment.	**Moderate (Significant)**	CAA licence requirements for launch management. Propellant load will be partially combusted. Recovery where practicable.
Emergency Plan Implementation				
Loss of firefighting water or foam	W, Hab	Increased chemical loading to soil and watercourse	Minor	Full emergency management plan to be developed under CAA requirements. Presumption of controlled burn where no human exposure is likely. Firefighting water likely to be limited to damping / suppression and hence not mobilise any combustion products. Foam is highly unlikely to be deployed given the rapid burnout of any fires.

Key to receptor abbreviations: Hu(man), W(ildlife), Hab(itat).

15.8 Additional Mitigation

15.8.1 Inherent safe operating practices are required under CAA licensing requirements. Other than where fluid containment and transfer arrangements are noted in Table 15.2 above and included within the design as standard mitigation, the mitigation of other accidents and disasters with potentially significant environmental effects will be managed through parallel risk and hazard management processes under CAA licensing i.e., the safety case.

15.9 Residual Effects

15.9.1 Residual effects are not strictly relevant to the discussion of significant environmental effects of major accidents and disasters. The effectiveness of the proposed mitigation cannot be absolutely guaranteed as these are low-frequency random events.

15.10 Cumulative Assessment

15.10.1 Cumulative effects have not been assessed. The Proposed Project is at one of the most remote locations in Shetland and the UK, and there are no known nearby developments of relevance. Intra-operation risks on site will be managed in accordance with CAA licensing requirements and mitigated by use of Safety Clear Zones and Launch Exclusion Zones. The nearest other proposed space port is on the Scottish mainland and environmental interactions between the two are considered highly improbable.

15.11 Summary

15.11.1 This chapter considers the potential for activities at the Proposed Project site to cause major accidents or be affected by natural disasters, in both cases, focussing on where harm to the environment as a consequence could reasonably occur. The assessment is quantitative for the context of an AEE Report and does not examine the probabilities of major accident events and disasters occurring.

15.11.2 A list of potential events was drawn up based on the expected activities at the Proposed Project.

15.11.3 Natural disasters including flooding and tectonic activity are considered highly unlikely given the location of the Proposed Project. Extreme weather effects have been addressed in the Climate Change Chapter 11 of this AEE Report and it is considered that the proposed infrastructure design provides sufficient resilience to the effects of extreme weather events over the design life of the Proposed Project.

15.11.4 Accident events were subcategorised into failure of containment of propellant, diesel fuel and hazardous materials, ignition and off-nominal launch scenarios. The effects on generic on-site human and wildlife receptors and off-site designated habitat sites were considered for each of these events.

15.11.5 Failures of containment were generally considered to be minor or moderate significance and largely restricted to the areas immediately within the vicinity of the release point, given the quantities in use and the rapid expected evaporation and/or dispersion of the majority of bulk liquids and gases used. Certain losses, notably of diesel and the satellite thruster propellant hydrazine, were considered to be major with the potential for significant effects owing to their likely environmental persistence and toxicity to humans and other wildlife respectively. Mitigation will be through management procedures, robust containment and restrictions on the quantities stored at the Proposed Project.

15.11.6 Again, noting the environmental context, ignition events are considered to be major with potential for significant effects inasmuch as damage to health or loss of life to human and wildlife receptors would be possible if in close proximity to the event. In the unlikely event that ignition of flammable materials (RP-1 rocket propellant, diesel or hydrazine) occurred, the initial blast radius would be relatively small (well within the Proposed Project boundary) and the subsequent blaze limited in duration by the quantities stored and used. Mitigation will be through the restriction of ignition sources from flammable materials through standard operating practices. Uncontrolled ignition events during launches are managed via the LV design process and integrity checks.

Off-nominal launch scenarios are considered to be of major significance should a ground strike take place, with potential for severe damage to human, wildlife and habitat receptors from impact and subsequent ignition of remaining propellant. Mitigation is inherent to the remote, northerly launch site location and exclusively northward launch trajectories to be used. Water strikes were considered of moderate significance as wildlife receptors could potentially be impacted and are discussed in the Marine Effects Chapter 10 of this AEE Report.

15.12 References

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Chapter 16 Summary of Environmental Effects

16. Summary of Residual Effects

16. Summary of Environmental Effects

16.1 Introduction

16.1.1 This Chapter provides a summary of the pre-mitigation effects of the Proposed Project, the mitigation measures applied and the residual effects anticipated after mitigation measures have been applied.

16.2 Summary of Environmental Effects

16.2.1 Pre-mitigation and residual environmental effects are summarised in Table 16.1 below. The table provides a concise reference to each of the pre-mitigation and residual environmental effects identified in the technical sections of the AEE Report (with the exception of the Ornithology, Ecology and Landscape and Visual Assessments), as well as a cross reference to the relevant mitigation measures identified.

16.2.2 Table 16.2 below provides a concise reference to each of the pre-mitigation and residual environmental effects identified to receptors in the Ornithology and Ecology Assessments of the AEE Report.

16.2.3 Table 16.3 below provides a concise reference to each of the residual environmental effects identified to receptors in the Landscape and Visual Assessment of the AEE Report.

16.3 Significant Residual Effects

16.3.1 Post mitigation, the remaining significant residual effects are:

- Likely significant beneficial effect: Population and Human Health - Total economic impact from operation of the Proposed Project in Unst of £4.9 million GVA and 139 jobs
- Likely significant adverse effect: Material Assets and Cultural Heritage - Major significant effects on the setting and character of RAF Skaw
- Likely significant adverse effect: Material Assets and Cultural Heritage - Moderate significant effects on the setting of Inner Skaw Scheduled Monument
- Likely significant adverse effect: Ecology - Minor-moderate significant effects on the coastal grassland
- Likely significant adverse effect: Various Landscape and Seascape assessment locations.

16.3.2 Of these, only the likely adverse effects need be considered further.

16.3.3 The likely significant cultural heritage, ecology and landscape effects are all inherently associated with the land-take and infrastructure required for the construction of the Proposed Project and carry over into AEE only by nature of the continued operation of that development and infrastructure. All three aspects (and potential alternatives) have been assessed by Shetland Islands Council and the relevant statutory consultees (including HES, NatureScot and SEPA) during the planning application stage of the Proposed Project and the Proposed Project found to be suitable with the development plans and mitigation measures outlined within this AEE and included in the planning permission as conditions accepted as being appropriate from a planning perspective.

16.3.4 As the AEE is concerned with the operational phase of the Proposed Project only, it is considered that the significant effects have been appropriately dealt with through the planning process and subsequent planning conditions and need not be considered further within the AEE. As such the findings of this AEE are that there are no significant operational effects of concern from the Proposed Project.

16.4 Monitoring

16.4.1 No monitoring of the significant landscape effects was required as part of the planning permission and therefore no monitoring is proposed as a result of this AEE.

16.4.2 Elements of monitoring covering the significant ecological and cultural heritage effects are however required as part of the planning permission conditions for the Proposed Project as follows:

- Condition 9 Habitat Management Plan: …the HMP shall also set out the proposed habitat management of the development site during the period of construction, operation, decommissioning, restoration and aftercare of the land, and shall provide for the maintenance, monitoring and restoration of the habitat on site, and for reporting on progress and for review of the HMP…;
- Condition 11 Scheduled Monument Condition Survey and Monitoring: (11a)… a scheme detailing monitoring of the condition of the Scheduled Monument during the operational phase of the development [must be] submitted to the Planning Authority and accepted by it… (11b) a scheme of vibration monitoring to take place during the operational phase of the development [must be] submitted to and agreed in writing by the Planning Authority; and
- Condition 12 Conservation Management Plan: Prior to the development site becoming an operational vertical launch space port, the developer shall submit to the Planning Authority… a Conservation Management Plan [identifying] future conservation needs based on the approved Scheduled Monument Condition Survey and the review of works required during the operational phase of the development;

16.4.3 These conditions and the monitoring programs developed to fulfil them are detailed at length in the relevant technical chapters (Chapter 6 Ecology and Chapter 14 Material Assets and Cultural Heritage) and the associated appendices in Volume IV.

16.5 Conclusion

16.5.1 The conclusion of this AEE is that there are no significant operational effects of concern from the Proposed Project and that the proposed activities will comply with statutory requirements and environmental policy objectives. As described in each of the technical chapters, this takes into consideration international, national and local legislation and objectives.

Table 16.1 Summary of Environmental Effects

Description of Effect	Potential Effect			Mitigation Measure(s)	Residual Effect		
	Magnitude	Beneficial / Adverse	Significance		Magnitude	Beneficial/ Adverse	Significance
Population and Human Health							
Total Economic Impact from operation of the Proposed Project in Unst of £4.9 million GVA and 139 jobs	Major	Beneficial	Significant beneficial effect	n/a	Major	Beneficial	**Likely significant beneficial effect**
Total Economic Impact from operation of the Proposed Project in the Shetland Islands of £7.5 million GVA and 209 jobs	Minor	Beneficial	Beneficial effect	n/a	Minor	Beneficial	Likely beneficial effect
Total Economic Impact from operation of the Proposed Project in Scotland of £9.3 million GVA and 255 jobs	Negligible	n/a	No likely significant effect	n/a	Negligible	n/a	No likely significant effect
Air Quality							
Effects at sensitive ecological and human receptors from operational phase traffic emissions	Negligible	n/a	No likely significant effect	None proposed	Negligible	n/a	No likely significant effect
Effects at sensitive human receptors from operational phase generator emissions	Negligible	n/a	No likely significant effect	None proposed	Negligible	n/a	No likely significant effect
Effects at sensitive human receptors from operational phase rocket launch event emissions	Negligible	n/a	No likely significant effect	None proposed	Negligible	n/a	No likely significant effect
Noise and Vibration							
Non-launch noise from fixed and mobile plant	Minor	Adverse	No likely significant effect	Commitment to meeting derived noise limits at NSRs and appropriate specification of plant	Minor	Adverse	No likely significant effect
Noise and vibration from engine test and launches	Minor	Adverse	No likely significant effect	Clear communication and engagement with the local community, on the Proposed Project.	Minor	Adverse	No likely significant effect
Water							
Potential impact from operational site run-off from the Proposed Project on local watercourses	Minor	Adverse	No likely significant effect	No additional mitigation.	Minor	Adverse	No likely significant effect
Marine and Transboundary Effects							
Study Area A							
Effects on Water Quality and Ecological Receptors from Fuel Spillage	Minor	Adverse	No likely significant effect	None proposed	Minor	Adverse	No likely significant effect
Effects on Water Quality and Ecological Receptors from Metal Corrosion	Minor	Adverse	No likely significant effect	None proposed	Minor	Adverse	No likely significant effect
Effects on Water Quality and Ecological Receptors from Debris and Microplastics	Minor	Adverse	No likely significant effect	None proposed	Minor	Adverse	No likely significant effect
Direct loss of Seabed Habitat via Deposition of Material on the Seabed	Minor	Adverse	No likely significant effect	None proposed	Minor	Adverse	No likely significant effect

Description of Effect	Potential Effect			Mitigation Measure(s)	Residual Effect		
	Magnitude	Beneficial / Adverse	Significance		Magnitude	Beneficial/ Adverse	Significance
Effects on Ecological Receptors from Direct Strike causing Mortality	Negligible	n/a	No likely significant effect	None proposed	Negligible	Adverse	No likely significant effect
Disturbance Effects on Ecological Receptors from the Return of Launch Parts	Negligible	n/a	No likely significant effect	None proposed	Negligible	Adverse	No likely significant effect
Displacement of Fishing Stock	Negligible	n/a	No likely significant effect	None proposed	Negligible	Adverse	No likely significant effect
Damage to Human Infrastructure (Subsea Cables/Pipelines)	Minor	Adverse	No likely significant effect	None proposed	Minor	Adverse	No likely significant effect
Interference with Military Exercise Areas	Negligible	n/a	No likely significant effect	None proposed	Negligible	Adverse	No likely significant effect
Interference with Shipping Activities and Commercial Fishing	Negligible	n/a	No likely significant effect	None proposed	Negligible	Adverse	No likely significant effect
Damage to Marine Archaeology/Shipwrecks	Minor	Adverse	No likely significant effect	None proposed	Minor	Adverse	No likely significant effect
Study Area B							
Effects on Ecological Receptors from Direct Strike causing Mortality	Negligible	n/a	No likely significant effect	None proposed	Negligible	n/a	No likely significant effect
Disturbance Effects on Ecological Receptors from the Return of Launch Parts	Minor	Adverse	No likely significant effect	None proposed	Minor	Adverse	No likely significant effect
Displacement of Fishing Stock	Negligible	n/a	No likely significant effect	None proposed	Negligible	n/a	No likely significant effect
Interference with Shipping Activities and Commercial Fishing	Negligible	n/a	No likely significant effect	None proposed	Negligible	n/a	No likely significant effect
Interference with Marine and Coastal Tourism Activities/Industry	Negligible	n/a	No likely significant effect	None proposed	Negligible	n/a	No likely significant effect
Climate Change							
GHG emissions arising from operation.	Moderate	Adverse	Potential significant effect	Commit to procuring goods and services locally, where feasible.	Minor	Adverse	No likely significant effect
Damage to launch vehicle, pay load and lightning tower and delay of launches due to high wind speeds.	Moderate	Adverse	Potential significant effect	Suspend launch activities in high winds.	Minor	Adverse	No likely significant effect
Suspension of ferry routes and flights due to high wind speeds will limit access to the Proposed Project for launch cycle personnel and goods.	Minor	Adverse	No likely significant effect	Materials and site personnel should be sourced in Shetland or as close to the Proposed Project as possible.	Negligible	n/a	No likely significant effect
Heavy precipitation resulting in flooding and erosion of access roads and limiting access for launch cycle vehicles.	Moderate	Adverse	Potential significant effect	Implement drainage system; ditches cut in the flatter areas of the Proposed Project to aid drainage into natural streams.	Minor	Adverse	No likely significant effect

Description of Effect	Potential Effect			Mitigation Measure(s)	Residual Effect		
	Magnitude	Beneficial / Adverse	Significance		Magnitude	Beneficial/ Adverse	Significance
Water ingress causing failure of electrical equipment (e.g., generators and deluge pumps)	Minor	Adverse	No likely significant effect	Implement drainage system; ditches cut in the flatter areas of the Proposed Project to aid drainage into natural streams.	Negligible	n/a	No likely significant effect
High temperatures causing site personnel welfare impacts such as heat stress	Minor	Adverse	No likely significant effect	Implement health and safety procedures e.g., provision of appropriate PPE.	Negligible	n/a	No likely significant effect
Overheating of equipment and potential fire due to high temperatures.	Minor	Adverse	No likely significant effect	Install deluge pumps.	Negligible	n/a	No likely significant effect
Land Soil and Peat							
Indirect effects on peat deposits	Negligible	n/a	No likely significant effect	OEMP including storage and drainage controls	Negligible	n/a	No likely significant effect
Contaminated run-off on land, soils and peat	Negligible	n/a	No likely significant effect	OEMP including storage and drainage controls	Negligible	n/a	No likely significant effect
Material Assets and Cultural Heritage							
Major significant effects on the setting and character of RAF Skaw (Site 3)	Major	Adverse	Likely significant effect	Compensatory measures including Conservation Management Plan and Interpretation Strategy designed to enhance understanding and appreciation of the asset.	Major	Adverse	**Likely significant effect**
Moderate significant effects on the setting of Inner Skaw (Site 2) Scheduled Monuments	Moderate	Adverse	Likely significant effect	Compensatory measures including an Interpretation Strategy designed to enhance understanding and appreciation of the asset.	Moderate	Adverse	**Likely significant effect**
Minor non-significant effects on the setting of St John's Church (Site 1) and The Banks (Site 4)	Minor	Adverse	No likely significant effect	None proposed	Minor	Adverse	No likely significant effect
Accidents							
This subject has not been assessed in a manner comparable with other environmental aspects as it considers scenarios which are both theoretical and extreme rather than reasonably expected occurrences. Only the accidents and disaster scenarios considered likely to cause major adverse effects were considered, as is inherent to the scope of the chapter. The pre-mitigation effects are generally major, adverse and significant . Residual effects may remain similarly significant but this would be predicated on the combined failure of design, operational and physical mitigation measures.							

Table 16.2 Summary of Environmental Effects – Ornithology and Ecology

Description of Effect	Significance of Potential Effect			Mitigation Measure	Significance of Residual Effect		
	Magnitude	Beneficial / Adverse	Significance		Magnitude	Beneficial/ Adverse	Significance
Ornithology							
Black Guillemot	Negligible	n/a	Not significant	Implementation of a Breeding Birds Protection Plan to be informed by, and updated annually through, targeted breeding bird surveys. Avoidance of unnecessary disturbance to breeding habitats by minimising the extent of ground clearance and other construction practices as far as is practicable.		n/a	No likely significant effect
Common Guillemot	Negligible	n/a	Not significant			n/a	No likely significant effect
Puffin	Negligible	n/a	Not significant			n/a	No likely significant effect

Description of Effect	Significance of Potential Effect			Mitigation Measure	Significance of Residual Effect		
	Magnitude	Beneficial / Adverse	Significance		Magnitude	Beneficial/ Adverse	Significance
Razorbill	Negligible	n/a	Not significant	Implementation of an Outline Habitat Management Plan to: Enhance habitats for species of importance present on, or linked to, the study area. Restore important habitats and associated species. Peatland restoration.		n/a	No likely significant effect
Shag	Negligible	n/a	Not significant			n/a	No likely significant effect
Kittiwake	Negligible	n/a	Not significant			n/a	No likely significant effect
Fulmer	Negligible	n/a	Not significant			n/a	No likely significant effect
Merlin	No effect	n/a	Not significant			n/a	No likely significant effect
Ringed Plover	Negligible	n/a	Not significant			n/a	No likely significant effect
Golden Plover	Negligible	n/a	Not significant			n/a	No likely significant effect
Dunlin	Negligible	n/a	Not significant			n/a	No likely significant effect
Curlew	Negligible	n/a	Not significant			n/a	No likely significant effect
Arctic Tern	Negligible	n/a	Not significant			n/a	No likely significant effect
Arctic Skua	Negligible	n/a	Not significant			n/a	No likely significant effect
Great skua	Negligible	n/a	Not significant			n/a	No likely significant effect
Confidential species	Refer to EIA Report				Refer to EIA Report		
Ecology							
Designated sites	Negligible	n/a	Not Significant	Embedded mitigation includes: Reinstatement of habitats (e.g., preserving the topsoil from the habitat that is lost and laying it over the top of the areas to be reinstated). Micro-siting e.g., avoiding sensitive habitats. This would necessarily be carried out on the ground under supervision by the ECoW. Construction of ten artificial holts/shelters in suitable locations across the top of Lamba Ness to provide additional resting places away from the coast. Retention of an important otter underpass. Enforced low vehicle speed limits (10 mph) would greatly reduce the likelihood of otter injury or death caused by vehicle traffic.	Negligible	n/a	No likely significant effect
Bog habitats (wet modified bog and wet modified bog/wet heath combined)*	Moderate	Adverse	Not Significant		Minor	Adverse	No likely significant effect
Coastal grassland*	Moderate	Adverse	Significant		Minor-moderate	Adverse	**Likely significant effect**
Marginal and inundation vegetation**	Minor	Adverse	Not Significant		Minor-Negligible (previously Negligible)	Adverse	No likely significant effect
Saltmarsh*	Minor	Adverse	Not Significant		Negligible	n/a	No likely significant effect

Description of Effect	Significance of Potential Effect			Mitigation Measure	Significance of Residual Effect		
	Magnitude	Beneficial / Adverse	Significance		Magnitude	Beneficial/ Adverse	Significance
Unimproved acid grassland*	Moderate	Adverse	Not Significant		Minor	Adverse	No likely significant effect
Otter*	Negligible-minor	Adverse	Not Significant		Negligible	n/a	No likely significant effect

* this habitat within the EZI is evaluated at the local geographical scale/importance. ** this habitat within the EZI is evaluated at the regional geographical scale/importance.

Table 16.3 Summary of Residual Environmental Effects - Landscape, Seascape and Visual

The following table sets out a summary of the assessment of the effects on landscape and visual resources arising from operation of the Proposed Project. The effects can be thought of as 'residual' effects because they take into account embedded mitigation measures included in the design and construction stages of the Proposed Project.

Receptor	**Significance of Residual Potential Effect**	
	Magnitude of predicted effect	**Beneficial/Adverse**
Direct Landscape Effects on the Landscape Resource		
Proposed Project Site	**Major Significant (previously Major/Moderate, Significant)**	**Beneficial**
Effects on Landscape, Coastal, and Seascape Character Areas		
349 Major Uplands	**Locally Major/Moderate, Locally Significant** Elsewhere Moderate / Minor, Not Significant	**Adverse**
350 Peatland and Moorland	Locally Moderate, Not Significant Elsewhere Minor, Not Significant	Adverse
352 Inland Valleys	Minor, Not Significant	Adverse
353 Farmed and Settled Lowlands and Coast	**Major/Moderate, Significant**	**Adverse**
354 Farmed and Settled Voes and Sounds	Locally Moderate, Not Significant Elsewhere Minor, Not Significant	Adverse
355 Coastal Edge	**Major/Moderate (Lamba Ness), Significant** **Major/Moderate (Blue Jibs), Significant** Elsewhere Moderate/Minor, Not Significant	**Adverse**
CCA 16, East Unst	**Major/Moderate (Lamba Ness), Significant** **Major/Moderate (Blue Jibs), Significant** Elsewhere Minor, Not Significant	**Adverse**
CCA 20, Skaw	Locally Moderate, Not Significant Elsewhere Minor, Not Significant	Adverse
Seascape Character Type 13 D: Islands, Sounds and Voes	**Locally Major/Moderate, Significant** Elsewhere Moderate/Minor, Not Significant	**Adverse**
Implications for Designated Landscapes		
Shetland NSA – Hermaness Sub-unit	The sub-unit of the NSA includes parts of LCT 349 Major Uplands, LCT 355 Coastal Edge, LCT 354 Farmed and Settled Voes and Sounds, CCA 19 Hermaness, and CCA 13 Burrafirth. The assessment of effects on LCTs and CCAs finds no significant effects on these areas within the area of the NSA, and no potential significant additional combined effects.	The special landscape qualities of the Hermaness sub-area of the Shetland NSA will not be at risk or compromised by the Proposed Project and the overall integrity and objectives of the Shetland NSA will be maintained.

Haroldswick and Skaw, Local Landscape Area	The LLA includes parts of LCT 349 Major Uplands, LCT 350 Peatland and Moorland, LCT 353 Farmed and Settled Lowlands and Coast, LCT 354 Farmed and Settled Voes and Sounds, and LCT 355 Coastal Edge, all of which experience areas of visual influence of the Proposed Project. The assessment of effects on LCTs found locally significant effects on each of the LCTs (excluding LCT 350) within the area of the LLA, and no potential significant in-combination effects.	The key characteristics and integrity of the LLA will be locally altered by the Proposed Project across the headland between Inner Skaw and Lamba Ness, with a reduction in the scenic qualities of the LLA.
Effects on Settlements		
Booths/ Houlanbrindy	**Major/Moderate, Significant**	**Adverse**
Norwick/ Kirkaton	**Major/Moderate, Significant**	**Adverse**
Valsgarth/ Saxa Vord	**Major/Moderate, Significant**	**Adverse**
Effects on Route Corridors		
A968/National Cycle Route 1 (600m section of the route, east of Little Hoeg)	Moderate/Minor to Motorists and Moderate to Cyclists, Not Significant	Adverse
B9086 (1.2 km section of the route west of Haroldswick)	Moderate/Minor to Motorists and Moderate to Cyclists, Not Significant	Adverse
B9087 (1.2 km section of the route west between Saxa Vord/ Valsgarth and Norwick)	Moderate to Motorists and Major/Moderate to Cyclists, Not Significant	Adverse
Effects on Viewpoints		
1.1 - Bluejibs above the Wick of Skaw	**Major, Significant**	**Adverse**
1.2 - The Haa, Wick of Skaw	**Major, Significant**	**Adverse**
1.3 - The Garths, Lamba Ness	**Major - Walkers, Visitors and Cyclists, Significant** **Major/Moderate - Road Users, Significant**	**Adverse**
1.4 - Car park at The Taing, Norwick	**Major - Walkers, Visitors and Residents, Significant**	**Adverse**
1.5 - The cemetery, Norwick	**Major/Moderate - Walkers, Visitors and Residents, Significant**	**Adverse**
1.6 - B9087 Norwick	**Major/Moderate – Residents and Cyclists, Significant** Moderate - Road Users, Not Significant	**Adverse**
1.7 - Hill of Clibberswick	**Major/Moderate - Walkers, Significant**	**Adverse**
1.8 - Headland to the north of Saxa Vord radar station	Minor - Walkers, Not Significant	Adverse
1.9 - A968 beneath Little Hoeg	Moderate/Minor – Cyclists and Road Users, Not Significant	Adverse
1.10 - Hermaness Hill	None, Not Significant	Adverse

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