

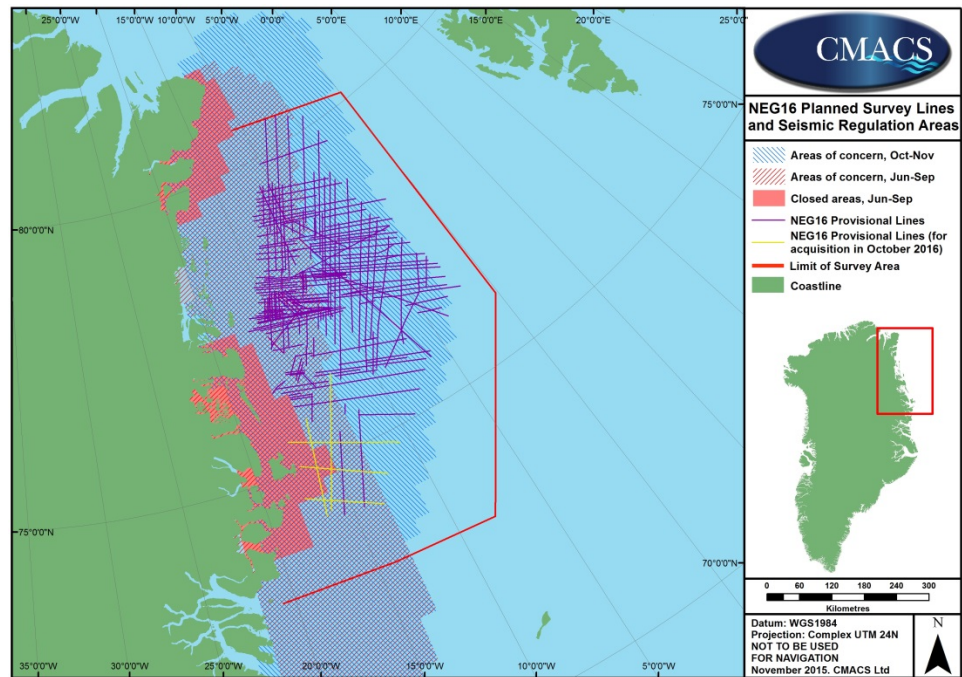
## **NON-TECHNICAL SUMMARY**

### **Proposed Project**

TGS-NOPEC Geophysical Company ASA (TGS) proposes to undertake a two dimensional (2D) seismic survey and seabed sampling in the western Greenland Sea off North East Greenland between 1 July and 31 October 2016 (inclusive). The Survey Area (Figure A) includes deep waters beyond the continental shelf but survey activities are largely planned over the continental shelf in relatively shallow waters. The survey will take place at least 12nm offshore at all times and for the most part well beyond this distance.

2D seismic surveys such as this contrast with more intensive 3D surveys where very detailed information is collected, but over smaller areas. This is an important point in relation to the assessment since it means that any environmental effects from 2D surveys at a given location will be short term. In contrast, the survey will take place over a relatively large area and thus has potential to affect a wider area.

The purpose of the survey is to acquire data that will be used by various clients (exploration companies) to prospect for hydrocarbon resources. The data acquired by the survey will contribute to a more accurate and advanced understanding of the geology and hydrocarbon potential of the area. Conducting the project as a multi-client project will eliminate (or significantly reduce) the need for the various different exploration companies to acquire the same data independently and thereby limit the overall impact to the environment.



**Figure A. Location of TGS Survey Area (thick red line). Seismic Regulation Areas for marine mammals are also indicated.**

TGS has completed survey programmes in the same area each year since 2011. In 2016 the application is to acquire data from up to 10,000 line kilometres and up to 105 seabed sediment samples. Similar maximum values were planned in previous years but survey success was limited by ice conditions and it is likely that in 2016 the total survey distance will be some way below 10,000km.

Seismic surveys acquire data on seabed geology using subsurface acoustic (sound) reflections to identify boundaries between different geological layers. The acoustic source is provided by an array of airguns towed approximately 250m behind a 'source' vessel which also tows an array of hydrophones to 'listen' to the reflected sound. The hydrophone arrays, known as streamers will be solid (not fluid filled) and will be towed around 8km behind the source vessel. The survey lines will generally be spaced more than 10km apart although in a limited number of areas the spacing is expected to be around 1-2 km. A helicopter will be available to assess sea ice conditions ahead of the survey vessels. As in 2015, ice tracking buoys will be deployed in the NE Greenland area. The buoys will help provide a better understanding of ice drift patterns and will benefit proposed seismic survey operations as well as wider understanding of the environment.

The airgun array will have a volume of 3,350 cubic inches and as with all such technology has the potential to generate considerable levels of underwater noise which this assessment seeks to understand and wherever possible mitigate (i.e. reduce the environmental impacts). A single streamer will be deployed.

The vessel will conduct the survey whilst travelling at 5 knots with a firing interval of 10 seconds (approximately every 25m). The survey vessel is intended to be operational 24 hours a day except in periods where weather or ice conditions do not allow for data acquisition.

In addition to seismic acquisition equipment, TGS also plans to use a multibeam echo sounder (MBES) and sub-bottom profiler (SBP) to provide information on the nature of the seabed and sub-surface geology. This equipment will be used by the support vessel as part of the seabed sampling survey work before the main seismic survey programme begins. MBES and SBP both use acoustic reflections, although at a lower energy level than airguns, and the assessment considers the potential for environmental impacts.

Sea ice and icebergs may be present all year round, brought on the East Greenland Current from Arctic waters further north. Fast ice usually begins to form in the northern part of the Survey Area in September, and further south through October. At least part of the survey is likely to require use of an ice breaker to move ice away from the source vessel in order to prevent ice damaging the airgun array, hydrophone streamers or the vessel itself. The ice breaker may also be used to support the MBES and SBP survey if required.

Following submission of a Scoping Document which outlined the proposed survey specifications, the Environment Agency for the Mineral Resources Activities (EAMRA) via the Mineral Licence and Safety authority (MLSA) together with its scientific advisors National Centre for Energy and Environment (DCE) and Greenland Institute of Natural Resources (GINR) have advised TGS that an Environmental Impact Assessment (EIA) should be prepared. Comments have been received from MLSA and its technical advisers, which have been taken into account in the EIA.

The EIA has been prepared by Centre for Marine and Coastal Studies Ltd (CMACS), informed by underwater noise modelling completed by NIRAS Greenland. CMACS is a specialist marine and coastal environmental survey and consultancy company. NIRAS Greenland, part of the NIRAS

Group, is an engineering consultancy company with over 50 years of involvement in Greenland. NIRAS have also provided Danish translation services. Greenlandic translation is provided by Greenland Consulting Services.

### **Ecology of the Area and Human Activities**

The biological environment of this area of the Greenland Sea is strongly influenced by short lived phytoplankton blooms which occur after the break-up of sea ice in the spring. This fuels a period of intense biological production.

The EIA summarises the natural environment features and various human activities that could potentially be affected by the survey. The natural environment includes seabed communities which in shallow areas, especially below 100m, are important areas of production supporting wider marine species such as walrus that feed on bivalves (molluscs) living on the seabed. There is relatively little information on fish and shellfish but it is believed that diversity and abundance is lower than in the sea off South East Greenland or the commercially important South West. There is relatively little subsistence or commercial fishing or hunting. Most activities, including hunting of marine mammals, is focused in coastal areas inshore and well to the south of the survey area. Coastal areas are of considerable importance to seabirds over summer months, some of which will pass through or may forage in the Survey Area.

A wide range of marine mammal species occur off North East Greenland and may be present in or around the Survey Area. Bowhead whale and narwhal are identified as being of particular importance and potential sensitivity in relation to the proposed seismic survey. The majority of the Survey Area is highlighted as an 'Area of Concern' for bowhead whales and a substantial portion of the western (inshore) part for narwhal and walrus. There are closed areas inshore for walrus and narwhal into which the survey will not enter (see 'Mitigation' below). Seals, and potentially polar bear, could also occur on ice within the Survey Area.

### **Potential Impacts**

A number of potential impacts of the seismic survey were identified. Effects potentially giving rise to impacts are summarised in Table A, below.

**Table A. Potential Impacts**

<b>Effect</b>	<b>Receptors Considered</b>	<b>Potential Impact(s)</b>
Underwater noise of airgun array, multibeam and sub-bottom profiling equipment	Fish, Marine Mammals, Fishing Activity, Pelagic Ecology	Physical injury Disturbance/displacement (fish and mammals)
Accidental oil/fuel spills	Fish, Birds, Marine Mammals, Benthic Habitats	Direct/indirect impacts through contamination of the marine environment as discussed
Attraction to vessels	Birds	Collisions/interference with normal behaviour, potentially fatal to individuals.
Ice breaking	Marine Mammals  Marine Mammals, Birds	Creating open water which re-freezes, trapping animals  Disturbing animals on the ice
Conflicts with survey vessels and helicopter	Fishing activity, hunting, tourism	Displacement/interference with activities
Noise and physical presence of helicopter	Marine mammals, birds	Disturbance/Displacement
Cumulative Effect of surveys over multiple years	Marine mammals	Disturbance/Displacement
Physical presence of seabed sampling equipment	Benthic habitats and species	Disturbance/damage
Loss of ice buoy(s) and related material	All marine environmental receptors	Toxicity

The underwater noise expected to be generated by the survey has been modelled to support the EIA. In summary:

- x sound propagation from the seismic survey is expected to be much greater for lower frequency components of the sound spectrum;
- x there will be rapid attenuation (noise reduction) over short distances (the first few hundred metres), especially of higher frequency sound;
- x levels of noise that could injure marine mammals from single air-gun shots are not expected to be present more than 500m from the airgun array (potentially dangerous levels of noise may be present close to the airguns)
- x levels of noise that may disturb marine mammals are expected for some tens of kilometres around the survey;
- x levels of noise that could injure marine mammals from cumulative sound exposure are expected to be limited to not more than 2.5km for seals and walrus and much shorter distances for other marine mammals (e.g. whales).

### **Mitigation**

Mitigation includes elements built in to survey planning, such as the presence of trained and experienced marine mammal and seabird observers (MMSOs) with Passive Acoustic Monitoring (PAM) equipment using hydrophones to listen for marine mammals underwater. The MMSOs, PAM operators and survey technicians will together implement current Greenlandic marine mammal mitigation protocols that set out appropriate responses if marine mammals approach the airguns before or during airgun firing. Furthermore, additional elements such as enhanced protective measures for bowhead whales will be implemented.

The following detailed mitigation and best practice proposals are explained in the EIA:

- x the smallest possible volume seismic array to be used throughout the survey;

- x a mitigation gun will be available if needed, this is a single gun of low power;
- x airguns will not be used unnecessarily at far distances from the transect line;
- x two qualified marine mammal and seabird observers (MMSO) will be present on the source vessel with a minimum of one observer continuously monitoring visually during pre-firing watches;
- x Passive Acoustic Monitoring (PAM) will be deployed during hours of darkness and during times of poor weather (poor visibility or above sea state 3) by one of two PAM operators (a total of four MMSOs including PAM operators);
- x Implementation of current Greenlandic marine mammal mitigation protocols that set out appropriate responses if marine mammals approach the airguns before or during airgun firing through the use of MMSOs and PAM equipment.
- x MMSOs will be especially aware of the potential for bowhead whales to occur and will act in a precautionary manner if the animals are known to be in the area. If possible the survey will move away from any area where bowheads have been reported to be active to a distance of at least 50km with survey commencing away from the area in question. This additional mitigation for bowhead whale was used successfully during seismic survey off NE Greenland by TGS in 2013 and 2015 when bowhead whales were sighted.
- x In 2016 an equivalent 50km avoidance rule will apply for narwhal sightings.
- x Survey will not approach within 2.5km of closed areas for walrus.
- x Seabed sampling over sensitive habitats will be avoided wherever possible and if there was evidence of cold water coral in samples then repeat sampling from the same area would be avoided.