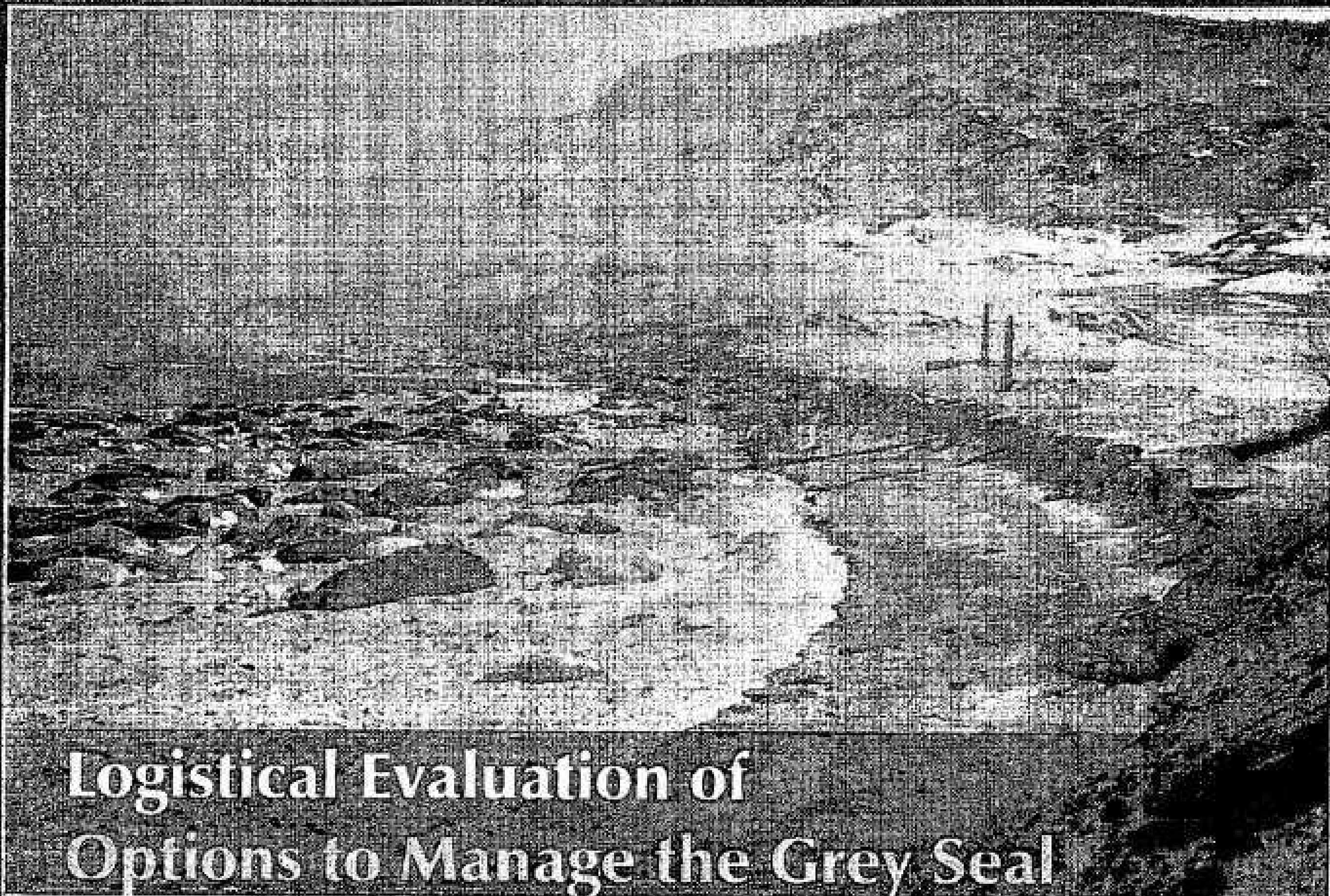
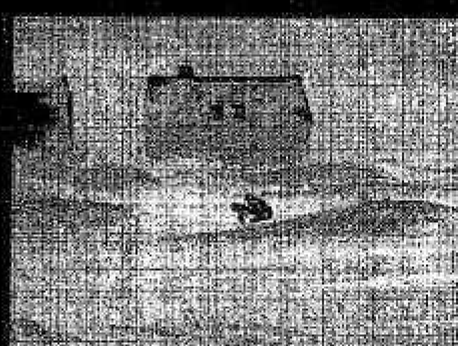


Logistical Evaluation of Options to Manage the Grey Seal Population on Sable Island



October 2009

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Prepared For:
Fisheries and Oceans Canada

Project No.: 091230

Contents

Appendices

Acronyms

ATV	All terrain vehicles
CEAA	*Canadian Environmental Assessment Act*
CCG	Canadian Coast Guard
CO	Carbon Monoxide
COSEWIC	Committee on the Status of Endangered Wildlife of Canada
CWS	Canada Wildlife Service
DFO	Fisheries and Oceans Canada
DND	Department of National Defence
HRA	Health Risk Assessment
MBS	Migratory Bird Sanctuary
MSC	Meteorological Service of Canada
NSOHSA	*Nova Scotia Occupational Health and Safety Act*
NWA	National Wildlife Area
O_3	troposphere ozone
OH&S	Occupational Health and Safety
PZP	Porcine zona pellucida
SARA	*Species at Risk Act*
ZP	Zona pellucida

Chapter 1 **Introduction**

1.1 Statement of Purpose and Approach

CBCL Limited was contracted by Fisheries and Oceans Canada (DFO) to examine the logistics and costs associated with two options for managing the grey seal population on Sable Island. The options examined in this report as required by the Statement of Work (see Appendix A) issued by DFO are:

i) a targeted population reduction, i.e., 100,000 animals removed in the first year, with 30,000 removed in each of the subsequent four years; and
ii) the implementation of an immunocontraceptive vaccine program targeting 16,000 female grey seals each year for five years.

This study covers all aspects of how each of the above options might be executed efficiently and safely while ensuring that there is minimal negative impact on the local environment.

The scope of the work undertaken assumes that the execution of either option would take place during the grey seal whelping season on Sable Island, i.e., December through to the beginning of February. The topics taken into consideration in the analysis include:

- personnel requirements and accommodation needs;
- transportation options for getting to and from Sable Island;
- transportation options for moving on and around Sable Island;
- equipment requirements to conduct and support the implementation of either options;
- waste removal to deal with carcasses (Option i) and other waste generated;
- environmental considerations; and
- safety considerations and hazard mitigation.

The subject matter is sensitive, and the timeline within which this report had to be completed was short. It was also apparent that this defined piece of work was but one component of a larger program being undertaken by DFO to address the very complex scientific and related issues surrounding the control of the grey seal population in the region. This context determined the approach taken to the execution of the research for, and the preparation of, this report. The study team, for example, was encouraged to meet with key personnel within DFO, Environment Canada and the Nova Scotia Department of Fisheries & Aquaculture to attain information on the grey seal population, on the work being done on Sable Island and the logistics of executing either of the referenced options; the team also met with key individuals within the private sector who had experience working on or in the vicinity of Sable Island, had knowledge that could facilitate the carrying out of either of the above options, or had real information with regards to the associated costs. There are certainly many other parties who might have contributed useful information to this logistical evaluation, but this was a rapid, focused round of consultations and the study team is confident that they have attained sufficient information to address the requirements of the Statement of Work. Appendix B identifies all who were consulted in the execution of this contract.

The approach adopted to respond to the Statement of Work can be summarized as follows:

- consultations as referenced above;

- the identification and review of selected materials to attain some appreciation of the problem, the work and research that is being done and the legislative context within with any action might be taken; and
- team 'brain-storming" sessions at which the options were examined, the challenges explored and the knowns and unknowns discussed.

The results are presented in the sections that follow.

1.2 Scientific Context

The grey seal *(Halichoerus grypus)* is very widely distributed in the waters of the northern and subarctic Atlantic. Although the number of grey seals off Nova Scotia has increasing rapidly during the last 30 years, the pupping grounds for the species have remained highly localized. Sable Island is the primary site, accounting for over 80% of pups born each year (DFO, 2008). It has been estimated, for example, that the grey seal population in eastern Canada has increased from around 20,000 animals in the 1970s to approximately 300,000 in 2007 (Fisheries and Oceans Canada. 2007). This is a substantial increase over the same time frame as there has been a regional collapse in fish stocks. It is therefore not surprising that the fishing industry has identified the growth of the grey seal population as a problem.

More specifically, the following five impacts of grey seals on fish stocks have been articulated:

- fish consumed directly through predation;
- fish behaviour affected due to the presence of large numbers of seals so that feeding and spawning in certain preferred habitat is affected;
- fish health and condition deteriorating due to the increased infestation of sealworms in the fish;
- the disruption of fixed gear fishing due to the destruction of the catch before it can be brought on board; and
- the negative effect on the processing sector of increased labour costs due to parasite removal, loss of yield due to the poor condition of infested fish, and customer resistance to fish that has been riddled with large numbers of parasites (Fisheries and Oceans Canada, 2007).

The above factors are articulated only to indicate that an important industry in the region believes that there is a problem. Whether or not either of the options being reviewed could address one or more of the above issues are not subject to examination in this study. Those arguments and decisions reside with the scientists and management within DFO. The focus of this study is on the logistics and costs associated with the implementation of the options identified in the Statement of Work.

1.3 Sable Island – Its Special Status

As depicted in Figure 1.1, Sable Island is a crescent shaped sandbar approximately 290 km southeast of Halifax, Nova Scotia. It is approximately 42 km long and 1.5 km at its widest; it is the only emergent portion of the Sable Island Bank. The extremities of the island terminate as submerged sand bars that extend far to the east and the west. The following provides a succinct description of the dune system:

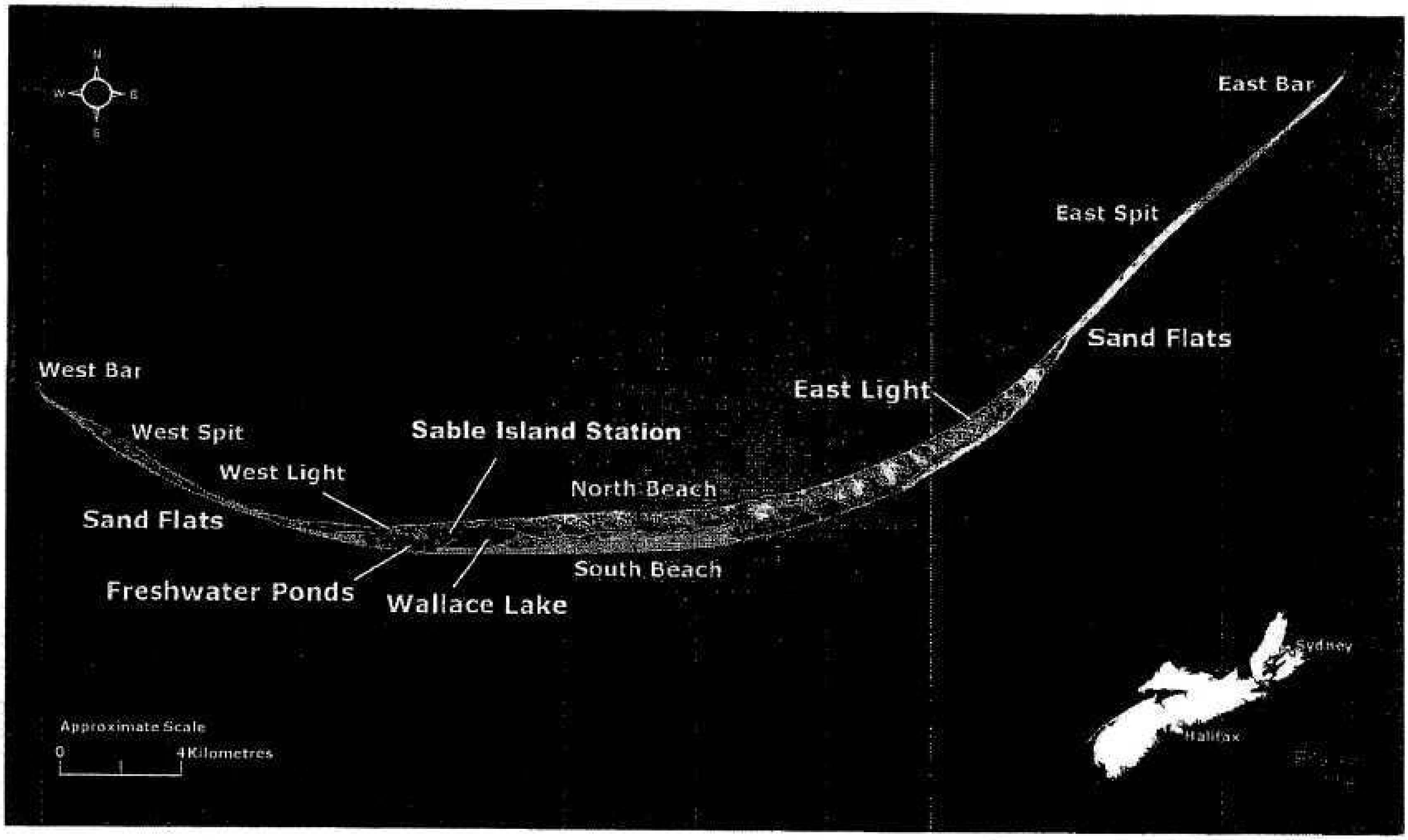


Figure 1.1: Sable Island

"The north beach is generally narrower than the south beach, but both are flanked by a foredune system formed by prevailing winds. Blowouts (wind-cut gaps in the sand dunes) are prevalent along both sides of the island. The south foredune ridge, which averages between 9 and 12 m in height, is generally less continuous than on the north beach, which reaches 25 m elevation toward the eastern end of the island". (Environment Canada, Canadian Wildlife Service. 1998).

At the present time access to, and activities on, Sable Island are regulated under the legislated mandate of the Canadian Coast Guard (CCG), DFO, through the *Canada Shipping Act, Sable Island Regulations.* The island is also protected by the *Migratory Bird Sanctuary Regulations* under the *Migratory Birds Convention Act* as administered by the Canadian Wildlife Service (CWS), Environment Canada. Certain areas on Sable Island are recognized in the Atlantic Region Management Plan for Marine Terns as providing critical habitat for the terns, including the Roseate tern, which is listed as Endangered on Schedule 1 of the *Species at Risk Act (SARA*).

The island is a unique and fragile ecosystem comprised of sand dunes, grassy fields, heath and freshwater ponds that are home to a range of flora and fauna. The island is the only known breeding ground of the Ipswich sparrow and is home to a small number of Roseate Terns. It is provides habitat for some 400 Sable Island horses (Lucas *et al.*, 2009). A Conservation Strategy for Sable Island has been prepared by Environment Canada and approved by DFO and the Province of Nova Scotia. This strategy, prepared by the Sable Island Conservation Strategy Advisory Committee, defines the environmental limits within which future activities should proceed. The strategy specifies the following "priority requirement":

"On Sable Island the priority conservation focus must be habitat, everything else devolves from this. The Island owes its very existence to the stabilizing effect of its vegetative cover and no activity can be permitted which would endanger it".

Sable Island is both a special place and a sensitive place. It is also a place that is particularly vulnerable to disturbance. The stated intent of the options being discussed is to reduce the grey seal population that pup on Sable Island. It is nevertheless recognized by all involved that any activities carried out on Sable Island should cause no damage or disturbance to the valued habitat, flora or fauna present on the island.

1.4 Activities Taking Place on Sable Island

Sable Island may be recognized as an isolated place, but the island is occupied year round and a number of specific scientific and related activities take place there annually. There is established infrastructure on the island (see Figure 1.2), and routines have been established to transport personnel and goods to and from the island. Between 200 and 250 people visit the island each year for various purposes. The following sections identify the primary activities presently occurring on Sable Island.

1.4.1 DFO Activities

While DFO has jurisdiction over the island through CCG, the Meteorological Service of Canada (MSC) is responsible for the Sable Island Station which provides year round support for all programs undertaken on the island. The primary purpose of the Station is to support operational, scientific and conservation activities, but the Station also provides support to visitors. The Station has some accommodation and is

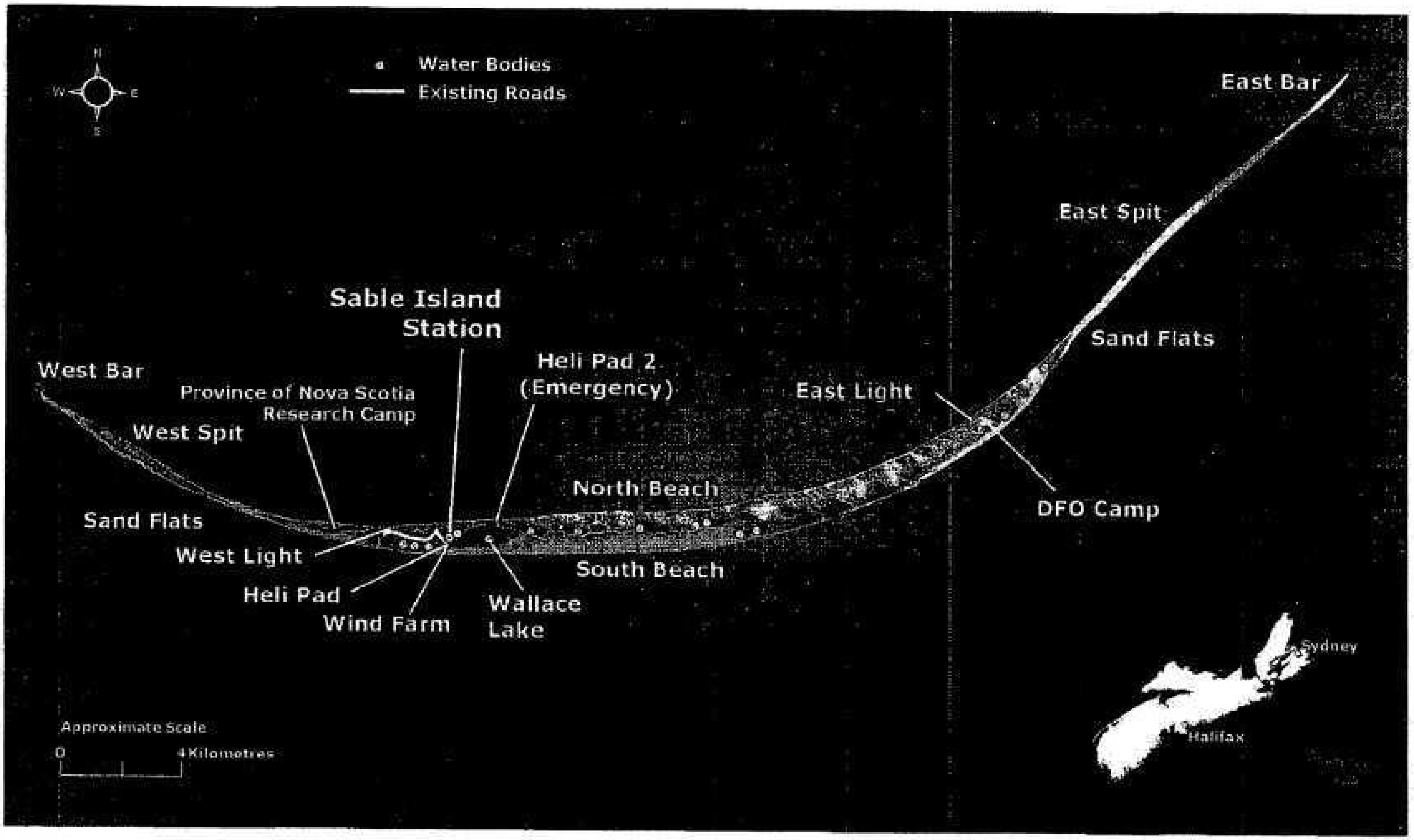


Figure 1.2: Infrastructure and Fresh Water Bodies

equipped with a variety of radio and satellite communication systems which may be available, at a cost, for use. DFO is also involved in a number of research initiatives. One is a long term population study of the grey seals that come ashore in December through late January to pup. This program involves daily observations of the seal populations in selected parts of the island and weekly censuses of seals across the entire island. As continued monitoring of the grey seal population during either option is critical, the grey seal research being conducted should be taken into consideration early in the planning process. Specifically:

- animals that have been marked by branding by the DFO scientists as part of this long term research initiative should be left alive and should not be vaccinated;
- branded animals should not be frightened or so disturbed that they abandon their pups; and
- for reasons of safety, activities associated with either option would have to be coordinated with DFO scientists to ensure both research and the options reviewed in this report can occur concurrently.

Branding of a male grey seal belonging to a population under study by DFO scientists. Photo: Don Bowen

1.4.2 Meteorological Services

The MSC, a branch of Environment Canada, has been maintaining climatological records on Sable Island since 1891 – one of the longest continuous collections of weather data in the Maritimes. MSC maintains a continuous presence on the island and is responsible for the collection of surface weather and areological observations. The Station has become a base for national and international atmospheric and climatological research and monitoring. For example, a program of continuous monitoring of carbon monoxide (CO) and tropospheric ozone (O_3) began in the late 1980s and ran until 1997. Since then, the Station has executed four summer studies and presently supports continuous O_3 measurement as part of an international airshed monitoring program. The MSC has also been responsible for the development and operation of five 7.5kW wind turbines, located some 400 m from the Station. MSC has indicated that this initiative is the first step in establishing a "green island" in which all of the energy needs of the island will be supplied by renewable energies and advanced energy storage technologies.

1.4.3 Other Research Activities

Over the years there has been considerable ecological field work undertaken on the island including work pertaining to the horses, the plant communities, the avian communities and the remains of both ships and animals, e.g., walrus skulls are being studied by the Canadian Museum of Nature.

1.4.4 Helicopter Pads and Emergency Refueling Facility

There are two helicopter pads on the island. The primary pad, located at the Sable Island Station, was constructed by the CCG in 1984. The secondary pad, located 1 km east of the Station was constructed in 1968 by the Department of National Defense (DND). Passengers and freight are normally picked up and delivered at the primary pad while the secondary pad has been used for refueling. Both CCG and DND maintain a supply of fuel at the secondary pad. For a time the offshore energy operators also maintained a supply of fuel at the secondary pad, but this has been replaced by the new fuel storage facility built by EnCana in 2003 at the primary pad.

Although offshore platforms can be seen from Sable Island, the oil and gas sector do not use the island under normal operating circumstances, and the helicopters servicing the rigs in the vicinity of Sable refuel in the normal course of events on the offshore platforms. EnCana and ExxonMobil, as referenced above, do maintain a cache of fuel on the island to be used solely in emergency situations. These operators have also developed and enforced policies and protocols to protect the island, e.g., Code of Practice – Exxon Mobil Canada Personnel Working on or Near Sable Island.

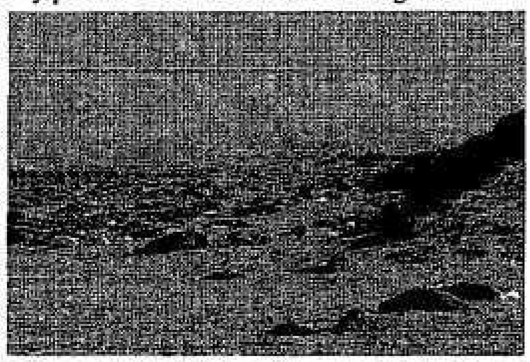
Chapter 2 **The Main Challenges**

2.1 Setting the Scene

2.1.1 Descriptive Synopsis

The environmental conditions for the activities associated with the implementation of either option are dictated by the weather, tides, daylight and the characteristics of the island. The earliest time of the day when outdoor activities might start in January is sunrise, i.e., approximately 07:30; it would be later on mornings with heavy cloud cover. The field teams could expect to battle constant winds of 30 km/h, blowing sand, rain and sometimes snow at temperatures around the freezing point. The location of the work, particularly for the implementation of Option ii), would be determined by the prevailing winds and tides each day and by the presence of the DFO science team studying seal ecology on the island.

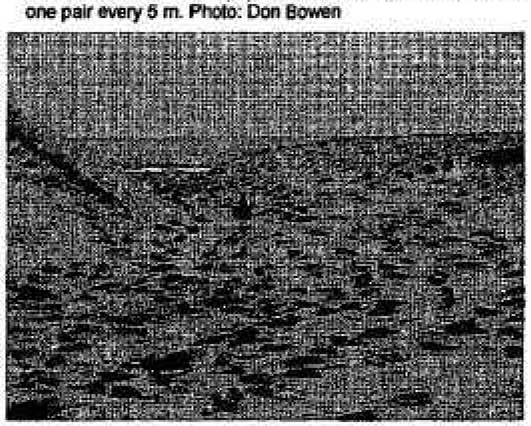
Consideration of the ecological sensitivity of the island is paramount to the planning and execution of the proposed work programs. Motorized travel, for example, is only permitted on the beaches and designated roads. The most sensitive habitats are associated with the wetlands, the vegetated interior of the island and certain dune systems; these areas must be avoided by all that would be working in the field. Further ecological considerations are described in Section 2.1.2.



Seals on North Beach. In the soft sand above the high water mark, mothers and their pups are found at densities of about one pair every 5 m. Photo: Don Bowen

Travelling on the beaches during pupping, the team(s) would encounter seals at a density of about one mother and pup group every 5 m on the soft sand. Large males would be interspersed with the females and their young and would also be found on the wet and harder parts of the beach that are exposed at low tide. Driving conditions have been likened to a city at rush hour, as the animals are slow to move, and navigation around them is often necessary.

As a result, travel to a location for a day's fieldwork from the Station may take up to two hours to more remote sites; such trips would have to be carefully planned to allow safe return considering both tides and the 16:30 sunset.



High density of seals make driving slow, but offer abundant target animals. Photo: Don Bowen

2.1.2 Weather

The most characteristic feature of the weather of Sable Island is the constant wind. In January, winds are typically westerly, blowing 31 km/h on average. During the summer, the winds are less strong, blowing around 20 km/h from a southwesterly direction. Gusting wind speeds in January regularly reach 80-90 km/h (National Climate Data and Information Archive www.climate.weatheroffice.ec.gc.ca) and have been observed as high as 141 km/h (Canadian Climate Normals, http://www.climate.weatheroffice.ec.gc.ca/climate_normals/index_e.html). The persistent winds and gusts constantly change the face of the island, moving dunes and creating blowouts in the dune faces. It can be expected that blowing sand will get into all equipment, housing and clothing and will dull and blind any transparent surfaces. The winter air temperature on Sable Island, however, is less extreme than on the mainland. The daily average for January, calculated for the years between 1971 and 2000, is -0.3°C. December is on average warmer than January (2.2°C), and February somewhat colder (-1.4°C). Wind and air temperature combine to an average wind chill index in January of -7, i.e., at -0.3°C and 31 km/h wind, the outside temperature feels like -7°C. In rare conditions, e.g., in wind speeds of 90 km/h and -10°C air temperature, the wind chill index could reach -25°C causing exposed skin to freeze (Environment Canada Wind Chill Program, http://www.msc.ec.gc.ca/education/windchill/index_e.cfm). December and January are the months with the highest monthly precipitation. The average total precipitation between 1971 and 2000 was 146 mm, most of which (80%) was in the form of rain. Precipitation in December through February may fall as snow which can stay on the ground, but snow cover does not usually exceed a few centimeters except during rare storm events.

At high tide and in strong surf conditions beaches may be narrow and unpassable. Photo shows the North Beach near East Light. Photo: Don Bowen.

2.1.3 Waves, Tides and Currents

Target animals would be found on the beaches and beyond, but the beaches would also be the most important pathway for travel whether on foot or with vehicles. Therefore, the sea level and wave action along the island's beaches will influence the extent, timing and safety of the activities undertaken. The Sable Island area has a mean tidal range of 1.1 m (James and Stanley, 1968). At high tide and within the direction of the swell, the beach can be reduced to a very narrow strip of soft sand, which will be packed with seals at that time. The most efficient time to travel on the beach is during the four hours centered around low tide. During this period, the intertidal part of the beach forms a hard surface which is suitable for driving, and there is usually a lower seal density.

Oceanographic conditions on the Sable Bank, including wave statistics, have been detailed in a technical report prepared for EnCana (EnCana 2007). The direction of the swell at Sable Island is primarily from a westerly direction, but can also be experienced from the southwest and south (see Figure 2.1). In January, wave heights of 2 – 2.5 m are regularly measured at a buoy at the Cohasset/Deep Panuke site 45 km west of Sable Island (EnCana, 2007), but waves of 6 to 7 m occur yearly (EnCana, 2009) and extreme waves of 15 -17 m have been measured (EnCana 2009, Table 3.5). As these waves approach Sable Island, however, their height will diminish as a function of the shoaling bottom.

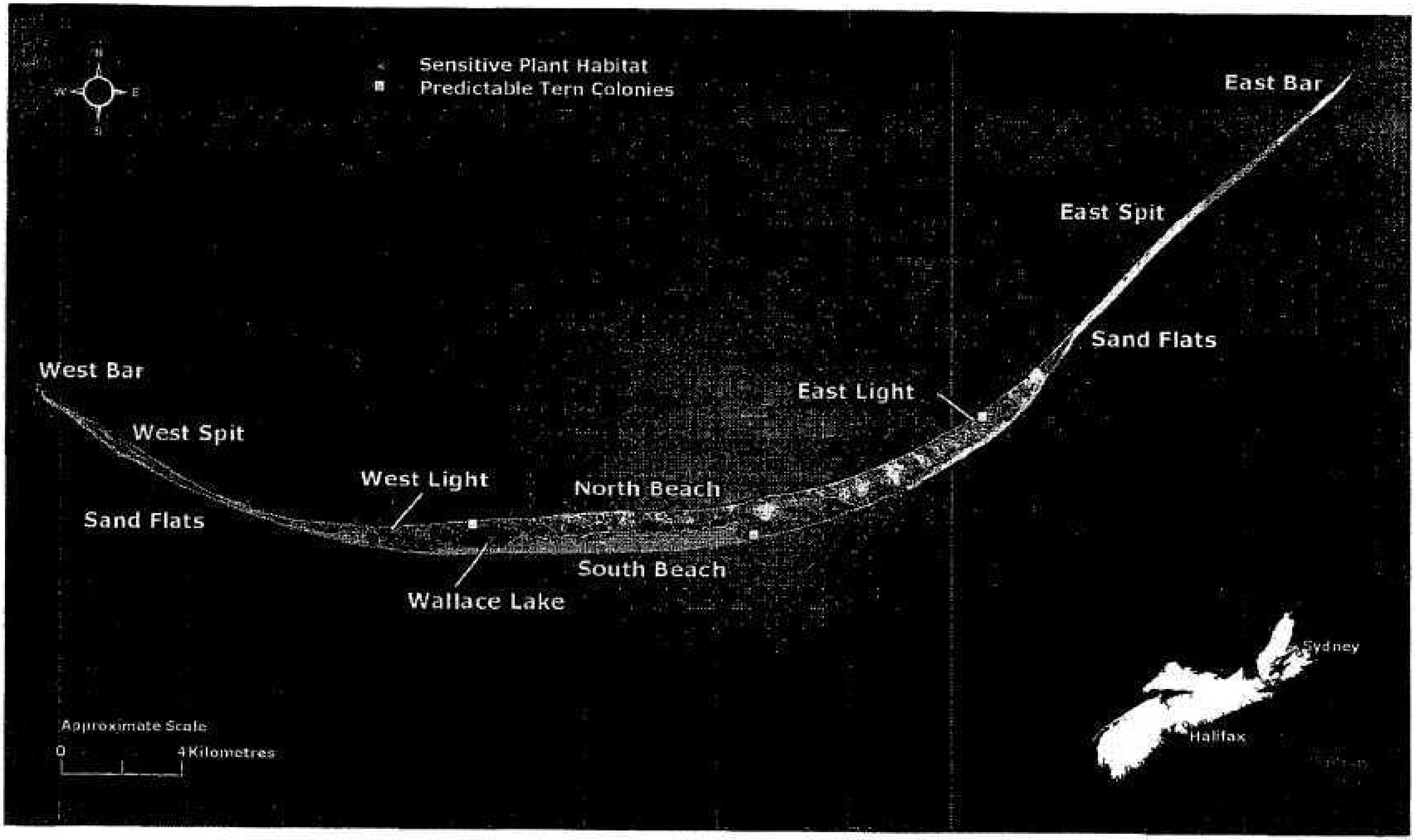


Figure 2.1: Sensitive Ecological Locations

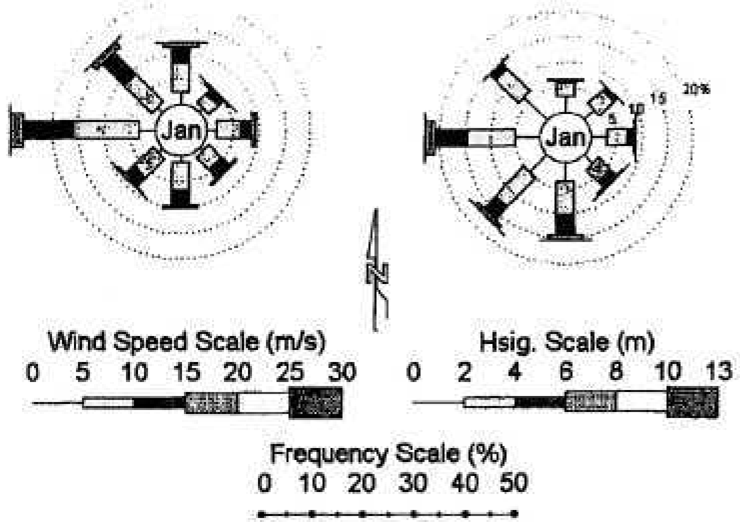


Figure 2.1: Frequency of Occurrence of Wind Speed and Significant Wave Height by Direction in January. Sources: Wind speed statistics are from the Sable Island Station; wave statistics are from an oceanographic mooring about 45 km west of Sable Island; Figures 2-6 and 3-4 from EnCana 2007.

The correlation between wind and wave direction means that the South Beach to the west of the West Light and the eastern half of North Beach would most likely pose the greatest challenges to travel and other activities in January. To predict with substantive degree of accuracy the height of breaking waves and their potential to flood the beaches, a numerical model would have to be executed; nevertheless, it has been estimated that weather and ocean conditions would prohibit activity on the beaches about 20% of the time (Gerry Forbes, pers. comm.)

2.1.4 Infrastructure in Place

2.1.4.1 Housing

The visitor facilities at the Main Station can accommodate 10 people comfortably, but this space would not be sufficient to meet the personnel needs of either option. While other accommodation exists (Table 2.1), it would most likely not be available during the time of the field program. For those, if any, staying at the Main Station, electricity, domestic waste and fresh water would be provided. Regardless of the approach taken to accommodate the field teams, consideration would have to be made for house keeping and cooking services, and all food supplies would have to be brought on to the island; plans to remove all wastes would also have to be developed.

Table 2-1: Existing Accommodation

Compound	*Details*	*Cost*	*Occupancy*
Main Station	Administered by Environment Canada	$150 per bed per night	6 bedrooms, houses 10 people comfortably
Building at West Light	DFO science camp Most likely not available	N/A	4 bedrooms, 8-9 people occupancy
Buildings at East Light	DFO science camp, 90 – 120 min travel time from Main Station. Most likely not available	N/A	-

2.1.4.2 Transportation

Movement from one part of the island to another is both difficult and restricted. There are no spare vehicles on the island to move either the people, or the equipment, required for either option. All vehicles necessary to undertake the program would have to be brought onto the island; this would include necessary fuel, spare parts and mechanical support. Movement between locations on the island is restricted to two approved roads, the beaches and the five approved and staked crossing areas. Vehicles must also avoid all wildlife which can be a serious impediment to movement.

2.1.5 The Ecological Environment

Sable Island is composed entirely of sand which has been stabilized by ocean currents and vegetation. The island is designated as a federally protected Migratory Bird Sanctuary (MBS) with established breeding bird colonies and is recognized as an important stop over for migratory birds. Almost 200 species of plants have also been identified on the island; the highest diversity is found in proximity to the freshwater pond complex located near the West Light and Main Station (see Figure 1.2).

2.1.5.1 Sand Dunes

The dune system is dynamic due to the constant wind and water erosion and is classified into two main types: primary dunes and secondary parabolic dunes. The former are the most common along the beach and the near-shore environment. The initial vegetation is a Sandwort *(Spergularia Rubra)* and Sea Rocket (*Cakile edentula*) community followed by the colonization of marram grass (*Ammophila breviligulata*). As more sand is captured by the grass, the dune size increases. Ocean waves both erode and deposit sand in these dune areas. The North beach is bordered by a prominent primary dune line, and there is a smaller primary dune system which runs along the South beach. Secondary dunes are formed by the migration of the primary dunes across the island interior as a result of wind action. A number of secondary parabolic dunes migrate southeast from the North beach. In addition to the vegetated dunes, a large bald dune ecosystem (devoid of vegetation) is located towards the east end of the island (Beson, 1998). These systems have created a unique and apparently stable eco-system, but a system that is highly susceptible to disturbance by both vehicles and people. As a result, motor vehicle travel is limited to the established roads and beach flats to avoid impacts to the dune system.

2.1.5.2 Hydrology

The fresh water lens underlying Sable Island gives rise to fresh water ponds located in the interior of the Island (see Figure 1.2). Precipitation recharges the lens, and the ponds remain fresh as they are protected from salt water intrusion by the large dune system. The surface water, however, is non-potable due to contamination from feral horse feces. A number of ponds on the island are also brackish due to salt spray, or direct salt water intrusion. Wallace Lake, located near the southern beach, is the largest of the brackish ponds. Water levels vary during the year from a few small ponds to a flooded area 14 km in length (Davis and Browne, 1996). Water is extracted from the freshwater lens for domestic use, and the rate of water removal is monitored to prevent salt water intrusion into the lens (D. Bowen, pers comm.). Due to the high permeability of the sand, the freshwater lens is susceptible to contamination from both sewage and hydrocarbons. As a result, there are strict rules in place for the handling and storage of hydrocarbon materials to protect both the freshwater ponds and the island ecosystem.

2.1.5.3 Plant Communities

The island supports 154 native plant and 42 introduced species. Approximately 37% of the island is vegetated. Marram grass and Marram-sandwort dominated communities exist in the dynamic sandy areas; these succeed to a shrub heath community as stabilization increases. This vegetation pattern is observed from the beach margins progressing inland, with the most stable communities at the island's center. The vegetation surrounding the inland ponds is more diverse with a number of species considered endemic, or restricted in geographic range. Eight taxa on Sable Island are considered rare (Beson, 1998). As the most sensitive vegetative communities are located in the inland areas, the execution of either of the options being considered should have minimum, if any, impact on the valued resident plant communities.

2.1.5.4 Fauna

Sable Island has a long history of introduced mammals including cattle, rabbits, cats and rats. At present, only feral horses and seals are resident (Davis and Browne, 1996). The current horse population is attributed to an introduction in 1760 and is considered to be Acadian in origin. The horses are protected from interference by the *Sable Island Regulations*. At present it has been estimated that there are approximately 400 animals on the island (Lucas, 2009); the population fluctuates with annual environmental conditions including winter conditions, snow cover and precipitation (Beson, 1998). They are one of the few groups of feral horses in the world that are totally unmanaged and not subject to any kind of interference. Since the horses wander throughout the island, avoiding negative interaction with them during the execution of either option would have to be ensured.

In addition to the grey seals, harp, hooded and ringed seals *(Pusa hispida)* are found on Sable Island, but do not breed there. Harbour seals breed on the island from mid May to mid June, but there would be no interaction with the harbour seals caused by undertaking either option.

2.1.5.5 Birds

Over 300 bird species have been recorded on Sable Island. Thirteen bird species now nest regularly on Sable Island – Leach's Storm-petrel *Oceanodroma leucorhoa*; four ducks (Mallard *Anas platyrhynchos*, Black Duck *A. rubripes*, Northern Pintail *A. acuta* and Red-breasted Merganser *Mergus serrator*); two shorebirds (Spotted Sandpiper *Actitis macularia* and Least Sandpiper); two gulls (Herring and Great Black-backed Gulls); two terns (Common *Sterna hirundo* and Arctic *S. paradisaea*); Starling *Sturnus vulgaris*, and Ipswich Sparrow. Nesting Green-winged Teal A. *crecca*, Laughing Gull *L. atricilla*, Black-legged Kittiwake *Rissa tridactyla* and Catbird *Dumetella carolinensis* are sighted occasionally. Roseate Terns *S. dougallii* and Semipalmated Plover also nested, and may still do so in small numbers – adults of both species have been sighted on the island, as recently as the summer 2006, during their nesting periods. Gulls, terns and Ipswich Sparrows are the most numerous and widespread of the nesting birds on Sable Island (Zoe Lucas, 2007).

The locations of the predictable tern colonies are indicated on Figure 2.2. The two species of conservation concern are described below.

The Ipswitch sparrow is listed as Special Concern on Schedule 1 of *SARA*. Currently 1,000 to 1,500 pairs nest on the island. The birds nest in dense vegetation located in shallow depressions on the ground. As any activity associated with the options under consideration would be limited to the winter months and

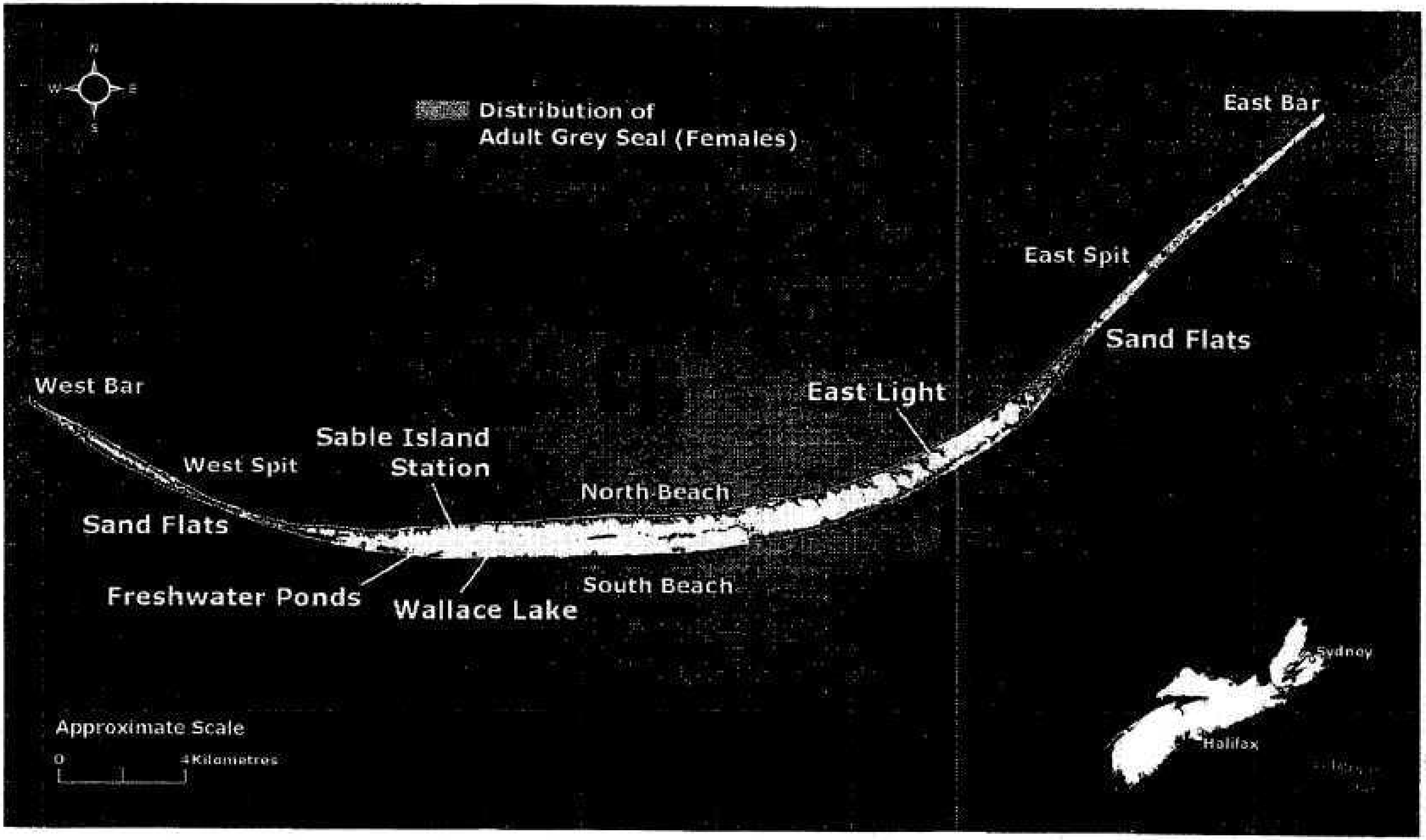


Figure 2.2: Seal Distribution

located on the beach areas, there should be no negative effects on the habitat important to the Ipswitch breeding population, or to the birds themselves.

Three species of terns nest on the island. As has been referenced, the Roseate tern has been listed as Endangered on Schedule 1 of *SARA*. Under *SARA* the areas used by the terns are recognized as "critical habitat". Critical habitat is described as "the polygons encompassing individual nesting tern colonies on Sable Island and a 200 m buffer around each polygon" (Environment Canada, 2007). This affords protection to the geographical areas described above in addition to individuals of the species. All tern species are susceptible to nest predation by gulls and are easily flushed from their nests. Two large colony sites are known to exist on the island, and they are recognized in the Atlantic Region Management Plan for Marine Terns as "core colonies" requiring careful management. The locations of the principal tern colonies are shown on Figure 2.2. The work associated with the implementation of either option would be designed to take place at a distance from the identified tern colonies and buffer areas to protect this critical habitat; the work would also be undertaken in the winters prior to the tern breeding season.

2.1.5.6 Invertebrates

Six species of endemic invertebrates have been recorded on Sable Island. It is also possible that several subspecies of butterflies and moths (Lepidoptera) are significantly different from mainland populations and could warrant subspecies classification. In addition, there are a number of undescribed Lepidopterans that may be endemics (Beson, 1998). The highest biological diversity of invertebrates is associated with the inland ponds, areas that will be avoided during the execution of either option.

2.1.6 Grey Seals: Location, Behavior and Characteristics

The grey seal (*Halichoerus grypus*) belongs to the Phocidae, true or earless seals, a family that also includes the harbour seal (*Phoca vitulina*; also called the common seal), the harp seal (*Phoca groenlandica*) and the hooded seal (*Crystophora cristata*). These true seals can be distinguished from the Otariidae (fur seals and sea lions) and the Odobenidae (Walrusses) by their lack of ears and their crawling locomotion on land, a consequence of the fact that their hind flippers are bound to the pelvis in such a way that they cannot bring them under their body to walk on them. The scientific name *Halichoerus grypus* translates to hook-nosed sea pig and in Canada, grey seals are sometimes referred to as horse-head seals (SAR 2008/061).

Grey seals are intermediate in size between the smaller harp and harbour seals and the larger hooded seal. Females grey seals reach up to 2 m in length and can weigh up to 250 kg. The larger males can reach 2.3 m in length and 350 kg in weight (SAR 2008/061). Females lose 40% of their body weight during the breeding season as they do not leave their pups to forage. At weaning, grey seal pups weigh between 50 to 70 kg and are approximately 1 m in length (D. Bowen, pers comm.).

Female grey seals produce their first pup between three to five years of age and typically continue to have a single pup every year; females up to 38 years of age have been observed to produce a pup (Hammill and Gosselin, 1995). After whelping, females nurse the pups for about two weeks and after weaning and copulation with males in the colony will return to the sea. The mean age of sexual maturity of male grey seals is 5.6 years, but the males within a colony of whelping females are typically large and no younger than 11 years (Hammill and Gosselin, 1995).

In eastern Canada, Sable Island is home to the largest whelping ground of grey seals. Other groups of grey seals whelp on the pack ice in the Gulf of St. Lawrence and along the eastern shore of Nova Scotia (Hammill and Gosselin, 1995). Between late December and the end of January, grey seals haul out onto the beaches of Sable Island to pup and mate (see Figure 2.3). At that time seals can be found on all the beaches in great numbers (D. Bowen, pers comm.).

Grey seal populations have been increasing since the 1970s with annual increases in the 1980s and 1990s and 2000s of 4%, 9% and 8% respectively. The Northwest Atlantic population is currently estimated to be over 300,000 individuals. This population is divided between the Sable Island, the Gulf of St Lawrence and Eastern Shore populations. The Sable Island population is by far the largest, with 81% of total pups being reared on the island. Small commercial, scientific and nuisance seal harvests of the northwest Atlantic population over the last six years have totaled over 5,000 animals (SAR, 2008/061). It is anticipated that 60,000 grey seal pups will be born on Sable Island in the 2010 breeding season (D. Bowen, pers comm.).

The only time of the year in which seals can be approached on land is during the breeding season. At other times of the year they will retreat to the ocean with very little provocation. During the breeding season, individuals cover the island, with the exception of the high dune and furthest inland areas. The highest densities are on the beaches, and their numbers decrease with distance from the shore. Mother and pups may migrate into the dunes, provided there is only relatively short vegetation and there are no steep physical barriers to dune access. Once pups are weaned, they tend to move further inland and disperse more widely into the dunes (D. Bowen, pers. comm). Mother pup pairs tend to remain on top of the berm as the tide recedes. Males will move into the intertidal areas and are much more mobile during the breeding season than the females.

Adult females may abandon their pups if they are separated from them due to disturbance, and care must be taken to avoid startling females into the water. They must be approached slowly and in such a way as to allow the females to observe anyone approaching from a considerable distance. Abandoned pups will starve to death if deserted by their mothers prior to weaning. Any pups abandoned due to human disturbance must be euthanized for ethical reasons.

Grey seal pups are weaned at three weeks of age and remain on the island for approximately another three weeks (from the third week in January until mid February). Shortly before weaning the adult females come into estrous and are mated multiple times by resident males. Normally within three days of mating females abandon their pups and leave the island.

During the time of female estrous, (the first week to the end of January), the males become extremely aggressive and will repeatedly charge and/or attack intruders. Males are much less aggressive when not guarding estrous females, but are more easily startled into the water than the females. Females guarding pups will also charge if approached to within one body length and will attempt to bite intruders. Seal bites are dangerous due to the size and power of the animals, but also due to a microplasm that can cause serious infections in humans. In addition, seal claws are very sharp and can inflict serious lacerations.

Travel on the beaches during the breeding season is greatly inhibited by the seal numbers. Female pup pairs will move slowly out of the way of approaching vehicles, but aggressive males may not (D. Bowen, pers. comm).

2.2 Requirements and Issues

In recognition of the environmental sensitivities associated with Sable Island and the regulatory regime that controls activities on the island, the following are amoung the requirements and issues that must be addressed in the design and execution of either option:

- protection of the environment which includes avoidance of any damage to the vegetation cover and absolutely no interference to the horses;
- in the absence of any health services on island, planning must address all medical eventualities from the most minor to the chartering of aircraft for medical evacuations or related emergencies;
- all facets in the execution of activities associated with either option would have to be planned in association with the Station Manager and, in turn, coordinated with the Director of Maritime Services, CCG;
- firearms and explosives are not permitted on the island without authorization so the requisite permits would have to be attained for Option i);
- the use of vehicles brought to the island is restricted to the two approved roads, the beaches and the five approved crossing areas identified by red posts; and
- vehicles must go out of their way to avoid horses, seals and birds, i.e., wildlife has the right of way and if wildlife is in the road, vehicles must stop and wait for it to move.

2.3 Other Factors

2.3.1 Public Relations

The adoption and implementation of either of the options evaluated in this report would engender a great deal of public interest, both supportive and critical. This in turn places an onus on the Communications Branch of DFO Maritimes Region to fully inform the media, public, clients, industry and other stakeholders of the actions being taken. It is likely that the adoption of Option i) at any level would pose a greater burden than the adoption of Option ii). Personnel from the Communication Branch would be responsible to the department to ensure that there was in place protocols to address:

- ➢ strategic communications planning;
- ➢ effective issues management;
- ➢ effective media relations;
- ➢ enhanced interaction with the public and key stakeholders; and
- ➢ successful management of communications activities.

This support would be in accordance with DFO Maritimes mandate, but would be separate and distinct from any consultative activities required by pertinent regulatory requirements, including the public consultation that would be an integral part of any environmental assessment process. The latter would be the responsibility of the responsible authority.

2.3.2 *Health and Safety*

Given the environmental conditions encountered on Sable Island, careful planning of work camps and work procedures would be required. Health and safety precautionary measures would be needed to ensure a safe working environment for project personnel. Sable Island is considered a federal work site, and as such is subject to the *Canadian Labour Code Part II*. Some project activities would be conducted in Nova Scotia by Nova Scotian contractors and would be governed by the Nova Scotia *Occupational Health and Safety Act* (*NSOHSA*). These pieces of legislation are similar, but there are a few differences. For example, the *NSOHSA* requires fall protection at a height of 2 m whereas the *Canadian Labour Code* requires fall protection if work is conducted at a height of three meters.

Specific occupational health and safety requirements for each work component would have to be defined during project initiation and planning. A Project Specific Occupational Health and Safety Plan (OH&S Plan) would be necessary. It is anticipated that the most stringent of the regulatory requirements, i.e., federal versus provincial, would be applied. For a project of this nature and duration, a project specific Occupational Health and Safety Management System should be prepared. This would facilitate an operation of continuous improvement and risk mitigation. Depending on how the project was contracted, bridging documents would need to be prepared to link the OH&S programs and procedures of each sub-contracted resource to the overriding Project OH&S Plan. This would be needed to ensure that all resources are "on the same page" and following the same set of rules when it came to the execution of the project OH&S Plan and procedures; this would be particularly important when it came to emergency planning and response.

To facilitate the development of the OH&S Plan and due the nature and complexity of the work, a thorough and in depth Health Risk Assessment (HRA) would need to be completed by occupational health and safety professionals in association with subject matter experts for each of the jobs and job tasks to be conducted. The HRA would identify the health hazards which may be encountered, the potential health risks to project personnel and proper mitigation and/or control strategies to adequately protect all workers. The evaluation of both acute and chronic risks should be conducted. This evaluation should include the following risk factors: geographical location, and physical, chemical, biological, ergonomic and psychological factors.

The appropriate controls would have to be identified and implemented for all identified hazards based on the hierarchy of controls which are, in order of preference: elimination, substitution, engineering, procedural and personal protective equipment. Standard operating procedures and safe work practices would have to be developed for all project activities. Site control and communication management protocols would also have to be established. Project specific training would be required for project personnel based on their work assignments. The OH&S Plan would have to be implemented and regularly updated during the project. Regular project health and safety briefings would have to be conducted in accordance with the requirements of the OH&S Plan.

The OH&S Plan should also include a comprehensive emergency response strategy, particularly for incidents requiring medical intervention. Careful consideration would have to be given to response methods, times and constraints. The required level of on island medical support would have to be thoroughly evaluated during the HRA and appropriately addressed in the OH&S Plan.

In addition to the overall planning for health and safety, specific attention would have to be given to the handling and storage of fuel. Fuel, depending on the selected option and its design, could be significant and a key influencing factor for project design and execution. Thorough design and consideration for fuel supply, its transportation and on island storage would be required. Associated regulatory requirements would also need to be considered and addressed.

2.3.3 Environmental Effects

The stated intent of this report is to present the logistics and order of magnitude costs associated with the execution of two options to manage the grey seal population on Sable Island. Although reference is made to regulatory requirements, including environmental assessment, and the ecological importance of Sable Island is recognized, this report is not, and does not purport to be, an environmental assessment. It is acknowledged that the implementation of either option would be undertaken at a time of year that would pose minimal, if any, disturbance to valued bird species and that the proposed locations of camps etc. would be determined to ensure the avoidance and protection of critical habitat. It is also acknowledged, however, that the scale of the proposed activities, including the number of personnel that may be involved, the equipment necessary, the fuel required, etc., would over shadow current activities. The appropriate consideration of these factors in the context of the environmental sensitivities of Sable Island would have to be addressed pursuant to all applicable regulatory requirements.

2.3.4 Additional Personnel Requirements

The logistical analysis that follows provides estimates of the number of personnel required to execute the options under consideration. It is recognized that the execution of either option would involve the presence of personnel in addition to those specified. This would include, but would not likely be limited to, DFO personnel, wildlife inspectors, health and safety officers and other scientific observers. Given the current definition of the options, the quantification of the additional numbers of people that may be involved is not feasible; it is also possible that the costs associated with their involvement would be assumed by the parties they represent. The logistics of transporting such personnel to, and accommodating them on, the island would have to be taken into consideration in the next round of program planning.

Chapter 3 **Logistics of Option 1 – Targeted Population Reduction**

The analysis of Option i), i.e., the targeted population reduction, involved an evaluation of the scope of the proposed population reduction including the identification of the quantity of animals that could be removed efficiently each year in a practical, cost effective manner. During this analysis, the following fundamental project elements were evaluated:

- Establishment of a Shore Base;
- Mobilization of equipment and resources to Sable Island;
- Accommodation;
- Establishment of a laydown area(s) and work zone(s);
- Equipment storage, maintenance, accommodations and provisions;
- Targeted reduction, i.e., killing of seals;
- Onshore material handling, i.e., handling and movement of carcasses;
- Stockpiling and storage;
- Thermal treatment, i.e., volume and weight reduction of carcasses;
- Packaging of carcasses, or pretreated carcasses, for transport off the Island;
- Transport of carcasses or pretreated carcasses off the island;
- Offloading of material on the mainland;
- On land transport of material to a disposal facility;
- A disposal facility; and
- Demobilization of project resources.

For purposes of this evaluation, and due to the interdependencies of operational elements, the following analysis is organized in terms of the core project categories:

- Establishment of a shore base;
- Transport between Nova Scotia and Sable Island;
- Operations on Sable Island (particularly, material handling and transport);
- Carcass management; and
- Carcass disposal.

Options for each of the above are presented in the sections that follow.

3.1 Establishment of a Shore Base

A shore base from which to stage this operation should be situated on the east coast of Nova Scotia. The wharf and infrastructure must be sufficient to berth an offshore supply vessel, or ocean going tug boats and barge. The wharf must accommodate loading and off loading of equipment and cargo at a scale suitable to facilitate the proposed operation. Fixed or mobile cranes of suitable size must be available. The infrastructure and work space must be suitable to support the staging of cargo and equipment and facilitate the regular loading and off-loading of tractor trailer transport.

A variety of equipment would need to be loaded onto the ocean going vessels at the shore base. Of significance, from a size and weight perspective, would be heavy construction equipment of a scale typical to a medium sized excavator. Equipment would in turn require offloading from the supply vessels during demobilization.

During the execution of Option i), a significant quantity of material, e.g., seal carcasses (intact or pre-treated) would be off-loaded from the ocean going vessels at the shore base. The material would be contained in containers; these are anticipated to vary in construction and size depending on the scope of the operation. They are, however, anticipated to range from 1 tonne super sacks to ridged containers similar in design and size to roll-off garbage bins.

Over the course of the operations, i.e., during the first year, given a planned targeted reduction of 100,000 seals, the weight of carcasses would range from approximately 550 to 15,000 tonnes, depending on whether the carcasses are pre-treated or intact. Assuming an on land disposal site and transport via tractor trailer, the first year of the project would require in the range of 18 to 500 hauls from the shore base to an acceptable disposal facility.

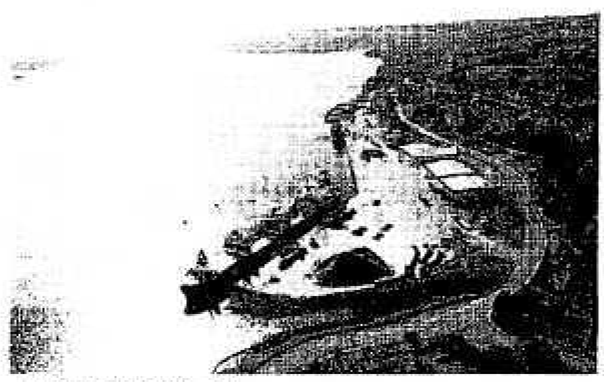
The availability of an appropriate shore base is a key consideration in the planning of Option i). Based on discussions with offshore industry representatives, suitable locations in Halifax are extremely limited. The majority of suitable sites are under contract for offshore oil and gas operations. If available, berthage and wharfage costs in Halifax are also high relative to other ports in Nova Scotia.

A suitable shore base location for this project would be the Mulgrave Marine Terminal situated on the western shore of the Strait of Canso, located between mainland Nova Scotia and Cape Breton Island. It is approximately 117 nautical miles from Sable Island. The terminal currently services the offshore oil and gas industry, and it has a range of marine cargo handling facilities including warehousing and laydown areas at the dockside.

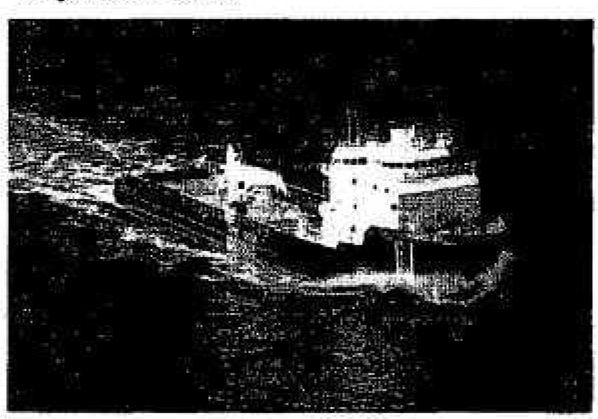
The Strait of Canso is ice free throughout the winter, and the terminal is open for docking year-round; the terminal has 500 m of docking space, with 8 to 10 m depths along the wharf face. In addition, over 4 acres of laydown area are available dockside.

The approximate rates for the use of the Mulgrave Marine Terminal at the time of this study were:

- Berthage = \$1.53 per meter of vessel per day;
- Wharfage = \$2.30 per tonne of material loaded or offloaded; and
- Laydown area = \$1.10 per square meter per month.



Mulgrave Marine Terminal



Secunda Marine Service Limited's Platform Supply Vessel 'Thebaud Sea'

3.2 Transport between Nova Scotia and Sable Island

CHC Helicopter Corporation's Eurocopter AS-332 L/L2 Super Puma

The transport of large quantities of cargo between Nova Scotia and Sable Island during the winter months requires significant planning and careful equipment selection. Based on the requirements for Option i) and logistical constraints, the transport of equipment and material to and from Sable Island would best be conducted via offshore supply vessel with Helicopter slings of material between the vessel and the island; and/or the use of offshore tug boat and barge. The barge, if used, would be driven ashore and beached on the island to facilitate offloading and loading.

Offshore supply vessels, such as Secunda Marine Services Limited's platform supply vessel the Thebaud Sea, are suitable for operations in the north Atlantic during winter months. They have large cargo capacities and are suited to supporting operations of this scale. They cannot, however, be landed on Sable Island and must remain offshore. As a result, all equipment and cargo transfers would have to be slung between the supply vessel and Sable Island by helicopter.

Helicopters suitable for offshore work and the type of operation associated with Option i) include the CHC Helicopter Corporation's Eurocopter AS-332 L/L2 Super Puma and Sikorsky S-92. These helicopters are currently used to support the offshore oil and gas industry in Atlantic Canada.

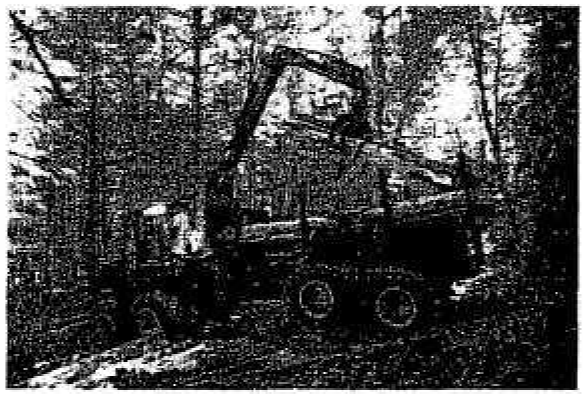
3.3 Operations on Sable Island (Particularly Material Handling and Transport)

A fundamental requirement for equipment selection for Option i) is the ability to lift and transport seal carcasses at the rate and quantity necessary to reasonably achieve the defined scope in a feasible manner.

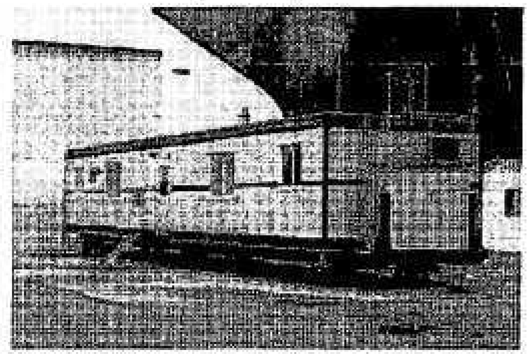
Typical material handling and transport equipment used on Sable Island includes pickup trucks, all terrain vehicles, e.g., four wheelers and gators, and tractors. Based on the weight and size of the adult seals, this equipment is not suitable to undertake a project of this scope. Heavy construction equipment is required to lift an adult seal that ranges in weight from 200 to 400 kg. Juvenile seals (pups) weighing in the range of 45 to 70 kg could be handled and transported short distances using small scale equipment such as skid steer Bob Cat tractors and trailers attached to pickup trucks and/or all terrain vehicles (ATVs). Given the proposed scope and schedule for this project, i.e., 100,000 seals between the end of December and the beginning of February, and the required transport capacities and cycle times necessary to achieve the objectives, the use of small scale equipment is not sufficient.

The equipment selected to lift and transport seal carcasses must have the capacity to transport a large number of carcasses at once. It must also be suitable to operate in winter weather conditions and navigate the terrain on Sable Island without becoming bogged down or stuck. A piece of equipment that could be practically modified and serve as a mechanism to lift, handle and transport seal carcasses is a tree Forwarder.

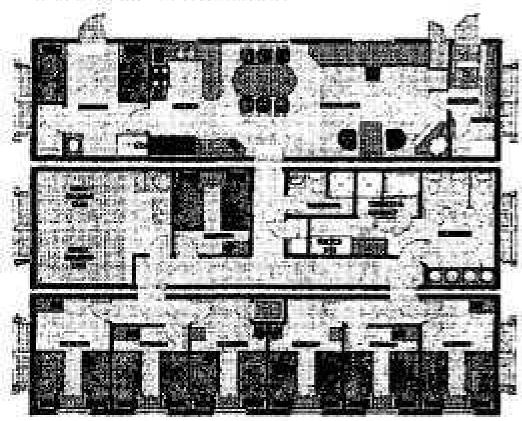
An example of this type of equipment is the John Deere Forwarder. This equipment is designed to load and transport cut trees through rough forest terrain. For use in this application, the Forwarder would have to be modified by constructing a box on the rear, in place of the typical log carrying configuration. The crane and claw could also be modified such that the claw is dulled via the use of a rubber coating to facilitate the lifting of carcasses intact without cutting through them. Carcasses would be loaded into the box for transport.


The John Deere Forwarder (Unmodified)

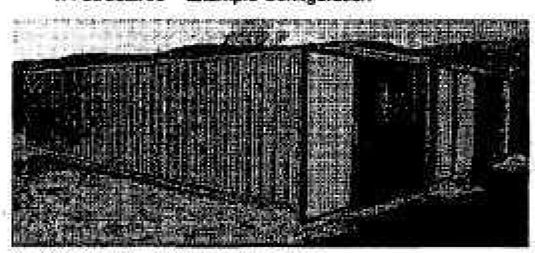
The requirements for personnel accommodation, potable water supply and wastewater and sewage treatment are also substantial. Based on the location and nature of the project, it is anticipated that portable modular accommodations such as those used on remote oil and gas, forestry and mining operations would be used. An example of such accommodation is the modular buildings for worksites manufactured by TA Structures (www.tastructures.com). Various modular camp layouts and floor plans are possible, and these units can be configured to meet project requirements.


TA Structures – Modular Trailer

The supply of potable water for project operations is a fundamental requirement and requires specific consideration. It is expected that self-contained portable desalination systems would be used to produce potable water from the seawater. Systems such at the RODI Systems PureBox™ water treatment system (www.rodisystems.com) are built inside dry cargo shipping containers and could be delivered to site and put into operation with minimum site preparation. These units are designed to treat seawater for the production of potable water, for emergency relief, remote work camps, military facilities and small communities. Similarly, portable sewage and waste water treatment units are available.


TA Structures – Example Configuration

Significant fuel storage would be required. The actual fuel storage quantities would vary depending on the operational requirements; at the high end, diesel fuel requirements could be in the order of 250,000 litres during the first year of the project. As storage of this quantity of fuel would be temporary and limited to the project life cycle, the


RODI Systems PureBox™ Water Treatment System

establishment of permanent above ground storage tanks would not be practical. The use of a fuel storage system such as SEI Industries Ltd. (www.sei-ind.com) Arctic King™ durable bladder tank which is designed for the temporary storage of fuels in arctic conditions would be a feasible option. These flexible, portable tanks are designed to provide bulk storage solutions for remote areas and can be incorporated into a complete fuel storage and supply system. The portable tanks are available in different sizes, but the use of tanks that can hold approximately 50,000 liters would appear appropriate to the circumstances.


Arctic King™ Bladder Tank

Given the capacity of the fabric tanks, a number of regulatory requirements would have to be taken into account. Under the *Petroleum Management Regulations* in Nova Scotia, any above ground storage tanks with a combined capacity greater than 4000L must be registered with provincial authorities. Federally, bulk fuel storage is governed by the *Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations;* these apply to all storage tanks with greater than 2500L capacity that are owned by a federal project, or operated on federal lands. In addition, under the *Canadian Environmental Protection Act, 1999* – Environmental Emergency Plans, a person in control of a quantity of fuel exceeding 150 tonnes may be required to submit a environmental emergency plan detailing spill prevention and mitigation procedures.

Additional unique considerations include:

- **Method of killing:** Adult seals are large animals with fat layers several centimeters thick. Therefore, adult individuals should be killed with a shot to the head with a .243 caliber rifle. Pups could be killed with smaller caliber rifles, e.g., .222 cal, or by clubbing using the hakapik;
- **Interference with science program using tagged animals:** DFO is conducting a long-term population study on grey seals on Sable Island (Don Bowen, pers. comm.). The field work associated with this evaluation would coincide with field facet of the long term research program; the latter involves daily observations of seal populations in selected parts of the island and weekly censuses of seals across the entire island. The implications are:
  - Animals marked by branding should be left alive and should not be spooked such that females would abandon their pups; and
  - For safety reasons, culling activities must be coordinated such that they occur in different parts of the island than concurrent scientific activities.
- **Ethics:**
  - To avoid suffering, animals should be killed by a well-aimed shot to the head;
  - Any orphaned pup should be killed lest it starves to death; and
  - Silencers should be used as animals will attempt to escape to the sea if they are spooked by a loud gun shot, i.e., mothers will abandon their pups, leaving them to starve. Hunters will need to be specifically trained to ensure seals are targeted appropriately and the above issues are properly addressed.

Given the density of grey seals and the need to avoid causing animals to flee into the water, silencers would be required to be installed on project firearms. Silencers are a prohibited device as described in section 84(1) of the *Criminal Code of Canada* and can only be used with a permit issued under the *Firearms Act*. It is most likely that silencers could be imported from the United States as they are mass produced and legally sold in that country. In order to obtain the requisite permits, the following steps would be required:

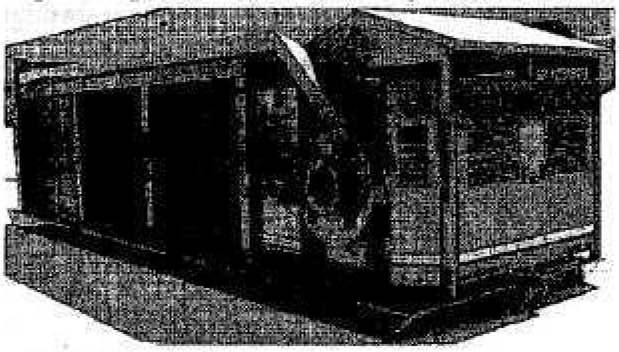
- Practitioners would first be required to obtain a business firearm license (for unrestricted, and if necessary, restricted firearms);
- The practitioner would be required to have a work contract with a government agency to justify use of the prohibited device;
- An import permit would be required under the *Export and Import Permits Act* to purchase and ship the product from the United States; these permits are administered by The Export and Import Controls Bureau in Ottawa. There is a small fee associated with the permits (pers. comm. M. Kramers);
- The exporting company would then use the import permit to obtain an export (to Canada) permit; and
- An End User Certificate would be required to take possession of the silencers, in addition to the import permit issued for the device.

Once silencers have been procured, the firearms would need to be tuned together with the devices by a professional to ensure proper functioning. This would only need to be done once prior to project activities (pers. comm. Hansen, S.). Silencers are available for any caliber of rifle required for project activities.

3.4 Carcass Management

Stockpiling of carcasses for longer than two days is not appropriate, due to several factors including the onset of rot, scavengers and the development of biological hazards. This poses several concerns, including occupational health and safety issues for workers. Therefore, this component of the project requires either the daily transport of the carcasses off the island, or the thermal treatment of the carcasses prior to stockpiling and storage. Should there be any lag time between the cull and disposal, carcasses would have to be covered to prevent access by scavengers, particularly gulls. Such prudent management practices would have to be instigated from the outset to prevent the carcasses from becoming a food source for gull species, which are of particular concern for the tern populations. Thermal pre treatment would allow for quick disposal of carcasses at a rate that would necessitate little to no stockpiling.

With respect to daily transport, the landing and loading of a barge on Sable Island on a daily basis, or with any type of regular frequency in the winter, is not considered feasible, or practical, from a sea state and safety perspective. Therefore, carcasses would have to be slung from shore to the supply vessel by helicopter. The supply vessel, once loaded would transport the carcasses to the shore base for offloading and subsequent disposal.



Air Curtain Burner by Air Burners, LLC

Alternatively, the carcasses could be pretreated on the island using a thermal treatment process.

This thermal pre-treatment procedure would be designed to match the number of seals killed on a given day. As the seals were killed, they would be transported directly to the thermal pre treatment units in trucks or trailers. The post treatment product (ash with limited bone) would be loaded into enclosed containers and stockpiled on the island. The overall weight of the material (carcasses) to be transported would be significantly less if a thermal treatment process was used. When feasible from a sea state perspective, a barge would be brought ashore and loaded with the containers. The containers would then be transported via tug boat and barge to the shore base. If landing a barge was not feasible within an acceptable time frame from a stockpiling and storage perspective, the containers could be slung by helicopter to a supply vessel.

Thermal treatment could be conducted with units such as Air Curtain Burners manufactured by Air Burners, LLC. These units have been reportedly used in animal disease outbreaks and disaster clean up operations around the world where it was necessary to incinerate animal carcasses. Technical reports from select deployments are available on the Air Burners website (www.airburners.com). Based on information published by Air Burners, LLC, the "air curtain" design is intended to control particulate matter (smoke) generated from the burning. This is done by directing an "air curtain" across the top of the open firebox. The air curtain is designed to trap a majority of the smoke particles and cause them to re-burn in the extremely hot area just below the air curtain and just above the burning waste. The temperatures in this area can reportedly exceed 1,400°C (approximately 2,500°F).

3.5 Carcass Disposal

Ocean dumping of intact carcasses is not considered feasible. The body structure and fat content would cause the carcasses to ultimately float. Ocean dumping of thermally treated carcasses, i.e., ash and limited bone, is potentially feasible; however, special considerations, including the selection of suitable equipment to handle and dump the material at sea, would be required. The material, for example, would be transported onto a barge in containers. The material would then need to be removed from the containers using a mechanized approach and manipulated and dumped overboard. Another consideration is the density of the ash and an associated tendency for it to become readily airborne and blow around during handling and dumping. Dump site selection and the necessary regulatory requirements would also need to be taken into account.

The disposal on mainland Nova Scotia of intact carcasses in existing landfill or compost facilities is not feasible. Based on our conversations with landfill and compost facility representatives, landfills will not accept organic material[1]. Compost facilities will not accept carcasses. In addition, the quantity of material proposed in general exceeds yearly material acceptance quantities of many compost facilities.

Another constraint associated with the disposal of intact carcasses is the significant associated cost and the logistical issues associated with on land haulage of this quantity of carcasses. The associated timeframes would also result in biohazard conditions from an occupational health and safety perspective. In winter, the carcasses would be likely to freeze inside the containers during transport. Prior to dumping,

[1] Should a decision be made to dispose of whole carcasses, the only option would be to construct a dedicated landfill cell, or attain a regulatory exemption.

therefore, the containers would have to be placed inside a heated facility for at least a day to sufficiently thaw the materials to facilitate safe dumping at the disposal site. If a dump trailer style transport method was used, and the dumping of a frozen load was attempted, there would be a risk the load would be only partially dumped, and the residual load frozen inside the dump compartment could cause the trailer to be off balanced and tip over. This would present a significant risk that would have to be properly controlled and mitigated.

If the carcasses were thermally treated, the disposal quantities and associated haulage costs would be significantly reduced. The thermally treated material, for example, could be stored dry in enclosed containers. Biohazard generation and odour generation due to rotting would not be an issue. The material would also not likely experience significant freezing. Disposal options could include recycling, composting and landfill disposal.

3.6 Targeted Population Reduction – Conceptual Design

This section discusses how a targeted population reduction of grey seals could occur on Sable Island. For design purposes, the scope of the population reduction is 100,000 animals removed in the first year, with 30,000 removed per year for four subsequent years.

This operational design is based on a bottom up calculation of production requirements and resource needs to accomplish the work. The size and scale of the equipment referenced is fundamentally driven by the minimum requirements necessary to reasonably handle and transport seal carcasses on Sable Island during operational conditions in December, January and February.

The equipment combinations (systems) also need to be such that they can be practically increased or decreased, to scale the operation up or down, to achieve quantity objectives. The size of the equipment required on the island to carry out the work dictates the scale of the transport method required to transport the equipment onto the island. The quantity of seal carcasses that would be removed from the island dictates the equipment requirements to transport the carcasses off the island to the disposal site. The overall execution and integration of the work associated with Option i) is fundamentally driven by the quantity (volume and weight) of seal carcasses and by the schedule requirements for execution and completion of the work.

3.7 Project Requirements – Year 1 (Reduction of 100,000 Seals)

The targeted reduction would commence at the end of December and be completed by mid February. It is assumed that the work would be conducted over a six week period. The mobilization of the necessary equipment would take place in advance, during favorable weather conditions and sea states. Project years 2, 3, 4, & 5 would be conducted over the same timeframe, with a linear reduction in production requirements based on a reduced targeted number of seals, i.e., 30,000 seals per year.

Year 1 Project duration = six weeks

Available working days to conduct the population reduction = 25

Based on:

- January to mid February = six weeks
- Assume work will take place six days per week
- Assume 20% weather delays, i.e., seven days
- Assume 10% days lost due to equipment breakdowns, etc., i.e., four days

Targeted population reduction in the first year will include:

- 50,000 pups, i.e., 30,000 initially and 20,000 after adults leave
- 30,000 adult females
- 20,000 adult males
- Total = 100,000

The above breakdown assumes 30,000 adult female and pup pairs are killed initially. Based on discussions with D. Bowen (pers comm. 2009) a quantity of 20,000 pups is assumed feasible based on overall pup quantity and availability after the adults leave the island. 20,000 adult males makes up the balance of the 100,000 seals to be culled.

Average Seal Weights:

- Average pup weight = 60 kg
- Average adult female weight = 200 kg
- Average adult male weight = 300 kg

Year 1 – Carcass Generation:

- Average unit weight of a carcass = 150 kg
- Total weight of carcasses generated = 15,000 tonnes
- Average unit weight of a carcass after thermal treatment = 5.25 kg (based on 3.5% of original weight)
- Total weight of ash if all carcasses are thermally treated = 525 tonnes

Calculations are based on an average weight to facilitate the determination of cycle times, equipment capacities, requirements, and production rates necessary to facilitate targeting of adult males, females and pups concurrently.

Production Requirements:

- Daily production requirements = (100 000 / 25 days) = 4000 seals
- Daily production weight of carcasses = 600 tonnes
- Working hours available each day = seven (based on nine hours of daylight)
- Average hourly production = approximately 571 seals (10 per minute) or 86 tonnes

Order of Magnitude Note:

- At this production rate, a tandem dump truck would be filled with seals approximately every 10 minutes. This would occur seven hours per day for 25 days.

3.8 Project Operations and Associated Costs

3.8.1 Establishment of a Shore Base

The Mulgrave Marine Terminal at the Straight of Canso would be used as the Shore Base for loading and off loading of barges. Based on the quantity of equipment and material to be transported through the facility, it is anticipated that the average yearly order of magnitude cost estimate for berthage, wharfage and use of the laydown area would be in the range of $20,000 (assuming the project spans five years).

The total order of magnitude project cost for use of the shore base is anticipated to be in the range of $100,000.

3.8.2 Transport of Equipment and Material to and from Sable Island

Due to the size and weight of the types of equipment required to conduct the work, it must be taken ashore by barge. It is not feasible to sling it ashore by helicopter. Landing a barge on Sable Island during the months of January and February is not feasible due to weather conditions and sea states. The equipment would have to be barged ashore during suitable times of the year, e.g., summer, and stored on the island. Work bases would be established and the associated equipment and supplies would be stored at each base. Similarly, thermally treated seal carcasses, i.e., ash, would be stockpiled at each base on the island and transported off island by barge during favorable conditions. Food and perishable items could be flown in during operations.

Based on the quantity of equipment and supplies to be mobilized to Sable Island, it is assumed that five barge trips would be required. One barge trip would be required to transport the approximately 525 tonnes of ash back to Nova Scotia. The resupply of fuel and similar consumable items for the following year would be delivered during the same trip. Upon completion of the project, five barge trips would be required to demobilized equipment from the island. The project is to be completed over five years.

The yearly average order of magnitude transport costs (based on five years) are anticipated to be $650,000.

Total project order of magnitude transport costs are anticipated to be $3,250,000.

3.8.3 Operations on Sable Island – Year 1 (100,000 seals)

To achieve the required numbers, five bases would be established at relatively even spacing across the island. Each base would have two population reduction teams assigned to it. Each team would consist of two hunters and be assigned a work zone with a lateral distance of 4 km.

A hunter can kill approximately one seal every two minutes, or 30 seals per hour (210 seals per day). According to D. Bowen (pers comm. 2009) on a productive day, 200 seal pups were tagged by one person. Given that tagging is likely more time consuming than culling, 210 seals per day, per hunter is an equitable estimate. To achieve the required daily project production, 20 hunters would be required. Each hunter would be assigned a partner for security and assistance.

A modified Forwarder would be used to load and transport seals from the work zone to the base. Each team would be assigned three modified Forwarders.

Estimated Forwarder production = 21 tonnes per day
Based on:

- Loading rate of one seal every two minutes;
- Load capacity of 9 tonnes; and
- Average travel speed of 7 km/h.

Production rate per team = 400 seals per day or 60 tonnes
Production rate per base = 800 seals per day or 120 tonnes

Four Air Curtain thermal treatment units would be established at each base. The four units would process approximately 120 tonnes per day. The thermal treatment operation would be conducted 24 hours per day with two 12 hour work shifts. The ash would be loaded into rigid, watertight containers or super sacks.

Each base would generate 4.2 tonnes of ash per day.
Each base would generate 105 tonnes of ash during the project. The total ash generated during Year 1 would be approximately 525 tonnes.

The containers would be stockpiled in a laydown area. The approximate foot print of the laydown required per base, to store all of the ash for the entire duration of Year 1, would be approximately 10 m by 15 m.

The foot print of each base would be approximately 80 m by 80 m. All of the equipment required for the operation of each base along with accommodations for the base personnel and associated supplies would be contained within the base perimeter.

Summary of Base Resources:

Personnel per Base = 23

- four hunters
- four hunter security personnel
- six forwarder operators
- six thermal processing station operators (two shifts of four)
- one mechanic
- one cook and general support personnel
- one supervisor

Core Equipment per Base:

- six forwarders
- four ATVs
- four air curtain thermal processing units
- one excavator (e.g. Cat 311CU – 6 m reach)

- Diesel fuel tanks (to accommodate 2000 L of consumption per day)
- Diesel generator
- Accommodation trailer(s)[2]

Scale perspective of the overall operation, i.e., five bases, for Year 1, highlighting core operational components:
- 115 personnel
- 250,000 liters of diesel fuel (approximately 1470, 45 gal drums)
- 30 Forwarders
- 20 Air Curtain thermal units
- 20 ATVs
- five excavators

Year 1 Order of Magnitude Operation Cost Estimate:
- $5,060,000 personnel (including accommodations and food)
- $370,000 of fuel and associated storage
- $2,000,000 Forwarders
- $1,500,000 Air Curtain thermal units
- $200,000 ATVs
- $500,000 excavators
- $630,000 other, i.e., generators, lights, transport of fresh food, containers, miscellaneous equipment and supplies, ammunition, rifles, etc.
- Total $10,260,000

The order of magnitude cost estimates presented above are based on the work being conducted by a private contractor with profit expectations. As such, the order of magnitude costs for the equipment presented are not necessarily the cost of purchase, rather the anticipated cost of supply and utilization. Consideration is also given to the standby cost associated with storing the equipment on the island for several months; equipment mobilization and demobilization would need to be conducted during favorable sea states and weather conditions as discussed above. Personnel costs including accommodations and food are based on a daily rate of $1,000 per person, i.e., $55/hr x 12 hours/day labour and $340/day for food and accommodations per person. The costs associated with potable water supply and wastewater and sewage treatment are included in the accommodation costs.

3.8.4 Disposal of Thermally Treated Carcasses

Thermally treated carcasses (ash) would be transported back to the shore base by barge. The quantity of ash is estimated to be approximately 525 tonnes. The material would be off loaded from the barge at the shore base and loaded on tractor trailers. Each tractor trailer would transport a load of approximately 30 tonnes. Based on this transport quantity, 18 tractor trailer loads would be required. The material will be transported and disposed at a selected site.

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[2] No camping is allowed on the island and the establishment of five base camps, including trailer accommodations, would necessitate the granting of special approvals.

Assuming a haul distance of 50 km from the shore base to a landfill disposal site, e.g. Guysborough Waste Management Facility, total transport costs would be in the order of $18,000. Assuming a high end scenario from a cost perspective, landfill disposal would cost in the order of $40,000 for tipping fees (pers. Comm., D. Murphy).

Total order of magnitude costs for the disposal of carcasses in Year 1 of the project are estimated to be $58,000.

3.9 Order of Magnitude Cost Estimates

The order of magnitude cost estimates for project Years 2 through 5 assume a reduction to 30% of Year 1 operational requirements and associated costs. The costing presented has been developed through a bottom up calculation and can be linearly scaled down by these magnitudes, i.e., 30% of original. However, costs associated with operational reductions less than 30% of Year 1 operations will not continue in a linear fashion due to fixed base costs such as those associated with mobilization, accommodations, equipment, etc. It is expected that during Years 2 through 5 that the operations would be scaled down and the equipment and bases consolidated into one (1.5 times larger) base, or two slightly smaller bases. A contingency reserve for risk mitigation and a management reserve for unplanned and unknown costs have been included. The amount set for each, i.e., 20% of the base cost, has been selected based on professional judgment and experience, and the knowledge and understanding of the order of magnitude cost estimates and associated calculations developed for this project.

Year 1 Order of Magnitude Cost Estimate:
- Base cost = $10,988,000
- Contingency reserve for risk mitigation = $2,197,600
- Management reserve for unplanned and unknown costs = $2,197,600
- **Total order of magnitude cost estimate = $15,383,200**

Year 2 Order of Magnitude Cost Estimate:
- Cost estimate = $4,614,960
- Inflationary increase of 3% = $138,448
- **Total order of magnitude cost estimate = $4,753,408**

Year 3 Order of Magnitude Cost Estimate:
- Cost estimate = $4,753,408
- Inflationary increase of 3% = $142,602
- **Total order of magnitude cost estimate = $4,896,011**

Year 4 Order of Magnitude Cost Estimate:
- Cost estimate = $4,896,011
- Inflationary increase of 3% = $146,880
- **Total order of magnitude cost estimate = $5,042,891**

Year 5 Order of Magnitude Cost Estimate:

- Cost estimate = $5,042,891
- Inflationary increase of 3% = $151,286
- **Total order of magnitude cost estimate = $5,194,178**

Total Project (5 years) Order of Magnitude Cost Estimate = $35,269,689

Chapter 4 **Logistics of Option 2 – Immunocontraceptive Program**

4.1 The Immunocontraceptive Approach

Although still in its infancy, immunocontraception is regarded by many as being more humane than the traditional methods of controlling wild animal populations. Immunocontraception is a birth control method that uses the body's immune response to prevent pregnancy. Zona pellucida (ZP) proteins surround the unfertilized eggs of all mammals. Sperm must attach to ZP before an egg can be fertilized. When porcine zona pellucida (PZP) is injected into a female animal, that animal's body produces antibodies to it. These antibodies attach to the female's ZP proteins, preventing sperm from attaching and therefore blocking fertilization.

Research as to the effectiveness of the approach has been conducted on several species including both captive and wild seal populations. This has included field application of a vaccine on grey seals on Sable Island were carried out in the early 1990s by scientists from the Department of Biology and the College of Pharmacy at Dalhousie University and from DFO. The results as reported showed that a single-administration of a birth control vaccine based on lipsome delivery of PZP antigens reduced pup production in grey seals by about 90% (Brown et al. 1997).

The contraceptive serum, which is an oily liquid, has been developed [redacted] by Immunovaccine Inc. in Halifax, Nova Scotia. The vaccine technology is known as SpayVac® vaccine and is currently classified as a research product only and not licensed for sale (Ella Korets-Smith, pers. comm.). According to Immunovaccine, the SpayVac® vaccine can be produced in the quantities required, i.e., about 17,600 doses a year (16,000 plus 10% in reserve) [redacted]

s.20(1)(b)
s.20(1)(c)
s.20(1)(d)

The shelf life of the vaccine is several months, but can be longer if frozen. Due to the current focus of Immunovaccine Inc. on human health products and the research-status of SpayVac®, no further research or development of the immunocontraceptive is planned by the company. If any additional studies are required, Immunovaccine Inc. may consider participating in such studies if external funding is provided.

4.2 Targeted Population

As stipulated in the Statement of Work, the scope of the contraception option is 16,000 female grey seals each year for five years. This can be achieved by targeting either female adults or female babies. The logistics and feasibility associated with a program that is aimed at adults differs significantly from one aimed only at pups. The latter are most easily targeted at the end of the breeding season when the females return to the sea, leaving the weaned pups behind. As long as the mother has already left the scene, pup vaccination could be performed by two people, one handling the jab stick while the other determines the gender of the pup. If the mother is still around, significant effort and manpower must be expended to ward her off from aggressively protecting her pup. In contrast, a program that focuses on the adult females would have to be undertaken when there was a very high population density of seals on the beaches, i.e., earlier in the pupping season. Such a program would have the added danger of generating aggressive behaviour from both mothers and adult males. Given these circumstances, a vaccination program which targeted adult females should consist of three people: one to assist the jab-stick operator with exchanging syringes and one to keep an eye on the animals in the vicinity[3]. The latter should possibly be equipped with a large sheet of plywood to block off the line of sight to the vaccination team.

4.3 Administration of the Vaccine

The objective in the field is to deliver by injection the immunocontraceptive in a single, 1 ml dose into the muscle of the animal. The recommended body parts of the seal to receive the injection are the shoulders or hips (Don Bowen, pers. comm.), or the flipper (Robert Brown, pers. comm.). For injection into the shoulders or hips, the syringe must be long enough to penetrate through the blubber into the muscle, i.e. five to ten centimeters; for injection into the flipper, because there is a thinner layer of fat, the syringe can be shorter. Since the animal would have to be restrained to enable injections into the flipper, this approach would add both time and effort. The following four mechanisms of intramuscular vaccine delivery have been used and are discussed below:

- Hand-held syringe;
- Jab sticks;
- Dart guns; and
- Ballistic delivery.

Given the advantages and disadvantages of the above options and the scale of the proposed vaccination program, it is suggested that a field trial should be conducted to determine the suitability and efficiency of each option before a final choice of the delivery mechanism is made.

4.3.1 Hand-Held Syringe

During previous vaccination programs undertaken on Sable Island, the grey seals were vaccinated using hand-held syringes. To achieve this safely with adult seals, the animal has to be restrained by two people using a specialized net. The advantages of this approach are the accuracy of the injection through the blubber, the certainty of delivery of a full dose and the lack of need for mechanical or explosive devices. The disadvantages include the hard physical labour involved, which has been likened to being in a car accident every five minutes (Jim Eddington, pers. comm.), and the danger of bites.

4.3.2 Jab Sticks

A jab stick is a pole with a compartment at the end that holds the syringe and a spring-fitted mechanism that presses the plunger to inject the vaccine. Jab sticks are used for wildlife that is best handled from a distance of 1 to 2 m, or through the fence of an enclosure. The use of a jab stick to vaccinate grey seal adults may reduce the need to immobilize the animals manually. The use of a jab stick would also increase safety for the vaccination team and may reduce the time required to vaccinate an animal due to lesser handling requirements.

[3] Note that a vaccination team must be made up of males only as any accidental injection of the vaccine could lead to infertility in women. There are no known health effects of the vaccine on men.

4.3.3 Dart Guns

Dart guns can also be used to deliver the contraceptive serum; this involves the shooting of a specialized syringe whose plunger is pressed by a powder charge upon contact with the animal. The advantages of this method include the delivery of the vaccine from a safe distance, i.e., tens of meters; this may also increase the number of animals which could be vaccinated in a given time period. Dart guns are typically powered by compressed gas, but this method is prone to malfunction under cold conditions (pers. comm. sales representative of Palmer Cap-Chure Equipment Inc.). A dart rifle powered by blank powder charges (Long Range Applicator by Palmer Cap-Chure) is the applicator of choice under cold conditions and has been used on polar bears. The powder charges that inject the vaccine, however, have been found to malfunction when sudden temperature changes cause condensation on the inside. Other disadvantages and safety hazards associated with dart guns include the following:

- the darts used would need to be retrieved from the ground, (while biodegradable syringes could be used, the needles and the powder charge that ejects the vaccine are made of metal);
- the dart guns would be subject to the regulations associated with the use of firearms on Sable Island;
- the equipment and associated supplies are more expensive than any equipment associated with the other delivery options; and
- the training required, i.e., the skills necessary, to operate and maintain the dart guns would be greater than those required to operate the jab sticks.

4.3.4 Ballistic Delivery

Biodegradable, thermoplastically molded cellulose-based projectiles can be used to vaccinate animals, or administer medication, from a distance of up to 30 m (Hansen, 2002). These Biobullets® are shot from a specialized air rifle (Figure 4.1) and dissolve inside the animal within 24 hours (Christie *et al.*, 2005). The Biobullets are hollow and open at the back end to receive a pellet of a freeze-dried vaccine. They have been successfully deployed to treat, for example, cattle against bovine rhinotracheitis or pinkeye.

During trials of the single-dose PZP contraceptive for grey seals, undertaken at Dalhousie University in the early 1990s vaccine delivery via Biobullets® was attempted. The oil-based nature of the PZP contraceptive, however, prevented its freeze drying; an attempt was made to fill the bullet with the liquid and seal it. This changed the bullet's ballistic properties, and leakage frequently occurred due to the mechanical stresses caused in firing (Jim Eddington, pers. comm.). As a result, the original grey seal contraceptive experiment on Sable Island (Brown *et al.*, 1996) reverted to 'jumping' seals with a net and injecting the vaccine with hand-held syringes (Jim Eddington, pers. comm.). It was indicated by both the manufacturer of the bullets and an experienced technician that the reliable encasement of the PZP vaccine in biodegradable bullets was feasible subject to further development (Dr. R. Hansen and Jim Eddington, pers. comm.). The solution may be of a mechanical nature, e.g., encapsulation of the existing vaccine, or of a chemical nature, i.e., altering the form of the vaccine. Recently, some success has been achieved towards the latter: an aqueous solution of a live brucella virus vaccine was embedded in a hydrogel matrix and successfully delivered to bison in Yellowstone National Park (Christie *et al.*, 2005).

Figure 4.1: Ballistic Delivery Rifle

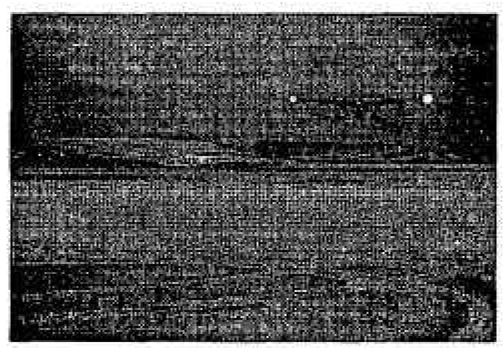
The rifle used in delivery is powered from a tank of compressed air carried in a backpack; this lasts for between 200-300 shots. Larger, scuba-tank like compressed-air bottles are also available and could be transported on ATVs. The tanks normally contain regular air at 2,200 psi, but could be filled with nitrogen for added performance. The use of air, or nitrogen, makes this system less sensitive to low outside temperatures compared with carbon dioxide cartridges. The rifles are pump-action with clips of ten or fifteen bullets.

The ballistic delivery of the vaccine appears to the most efficient approach to address the scale of the proposed grey seal contraceptive program. There is, however, some uncertainty associated with both the time and financing necessary to solve the problem of vaccine encapsulation. The manufacturer of the vaccine, Immunovaccine Inc., cautions that research and development of an alternate form of the vaccine, e.g., a freeze dried product, is not within the current scope of the company's mandate; to move forward would necessitate negotiations in regard to funding. An altered vaccine would also require testing under controlled conditions to ensure its efficacy[4].

4.4 Equipment, Storage and Transportation Requirements

One season's supply of pre-filled syringes can be contained in 36 coolers of 28 quart capacity; the approximate dimensions of the cooler is 50 cm × 31 cm × 35 cm. A chartered aircraft can transport a payload of up to 635 kg and has sufficient capacity for 36 coolers (Maritime Air Charter, pers. comm.). The vaccine could be delivered to Sable Island in one trip at a cost of $5,025 (Maritime Air Charter fees plus landing costs on Sable Island as per Visitors' Guide). Pre-filled syringes can be stored at room, or ambient, temperature as indicated above for a considerable period of time. They can be stored for longer periods if frozen. Before the syringes and serum are deployed, they would have to be thawed, if previously frozen. Thawing may require moving a day's supply of syringes indoors overnight, then storing them in coolers with heat packs during field operations. Alternatively, coolboxes equipped with electrical cooling/heating systems are available for about $250 (Coleman.com) and can be run from 12V outlets in ATVs.

Moving to and from the accommodations to the seal colonies would require the use of ATVs. Two people can ride on one ATV, but a three-person team would require two vehicles.



4.5 Option ii) Requirements

The following discussion is based on a vaccination target of 16,000 animals per year. Four cases are considered:

- Case 1: Adult grey seals only are targeted;
- Case 1b: Adults are targeted using ballistic delivery;
- Case 2: Only pups are targeted; and

[4] This report evaluates the application of biodegradable bullets as a delivery system for the contraceptive vaccine in terms of its efficiency of use in the field only. It is not within the scope of this report to quantify the time or costs required to produce a reliable solution using biodegradable bullets.

- Case 3: Adults and pups targeted.

Targeting adults (Case 1) is divided into two scenarios. In Case 1, adult females are targeted using hand-held syringes or jab-stick applicators. In Case 1b, contraceptive containing bullets are fired from air rifles with a range of about 30 m. Ballistic delivery reduces the risk to the vaccinators, and it requires a smaller field team, i.e., two people. Only adult grey seals should be targeted using the vaccine in biodegradable bullets, as the identification of the gender of the pups would require handling, increasing both time and risk.

Vaccinating pups poses different challenges to targeting adults. Pups should be targeted after their mothers and the males have left the island at the end of January since adult aggressive behavior could make it difficult to approach the pups. A vaccination team in a pup-only colony would consist of two people, not three as would be required in a colony with females and males. The smaller teams required to conduct pup vaccinations for Case 2 affects the costs associated with travel, salaries, housing and transport.

The feasibility of a Case 3, i.e., a combination of Case 1 and 2 is discussed in Section 4.5.1.1.

4.5.1 Timing and Effort

The appropriate timing for an immunocontraceptive program targeting grey seals on Sable Island is dictated by the arrival of females, the time of their departure after weaning and the departure time of the pups as described in Section 2.1.6. As a consequence of these factors, a vaccination program that targets adults only could be performed between the end of December and the beginning of February. A program targeting pups only would best be undertaken after sufficient mothers have left the island, most likely by the end of January; this program could last until mid-February. The time window for the on-site activities associated with an immunocontraceptive program depends on the target population; it is:

- six weeks if only adult females are targeted, i.e., end of December to beginning of February;
- three weeks if only weaned pups are targeted; and
- seven weeks if adult females and weaned pups are targeted, i.e., end of December to mid-February.

Table 4-1: Team Requirement for Case 1 and Case 2

	Case 1	*Case 1b*	*Case 2*
Team size	3	2	2
Animals vaccinated per team per day	54	270	54
Time window (weeks)	6	6	3
Work days	30	30	15
Teams needed to achieve vaccination target	10	2	20

Table 4.1 lists the number of teams required to fulfill the vaccination target of 16,000 animals. It is assumed that it takes between two and 10 minutes to approach, handle and vaccinate a seal using hand-held syringes or jab sticks (Mike Hammill, Don Bowen, Jim Eddington, pers. comm.). Five minutes to vaccinate each seal was used as an average over the day. The time spent vaccinating pups versus adults is assumed to be the same, as the greater effort required to handle adults is matched by the lower density of

pups and the time spent determining their gender. Vaccination by firing biodegradable bullets is assumed to take two minutes per seal. 4.5 hours of working time in the colony is assumed; the remainder of the day will be spent in preparation and travel to and from the colony.

The time available to conduct the field operations is in the first instance dictated by the presence or absence of seals. Other factors, however, will also reduce the time available. The following assumptions have been made to calculate the number of days available to conduct the program:

- Six weeks with six working days per week;
- Assume 10% days lost due to weather; and
- Assume 5% days lost due to equipment breakdown.

These assumptions and the other information presented has been used to estimate the number of vaccinators and support personnel required to attain the target of 16,000 animals. The results are summarized in Table 4.1. In Case 1 (adults only), for example, three teams can reach the target in six weeks.

4.5.1.1 Optimizing Field Operations

The vaccination of pups after the adults have left the island is favorable for reasons of both safety and efficiency. It does, however, require a greater number of people to achieve the desired target of 16,000 animals per year due to the short time window. A vaccination program combining pup and adult treatment appears to be the most efficient approach. Based on the assumptions in the previous section, the vaccination target of 16,000 animals can be achieved with 22 people. That is to say, 22 people could vaccinate 16,470 animals in seven weeks, targeting adults during the first four weeks and pups during the three weeks at the end of the field season (Table 4.2). This scenario is identified as Case 3 in the costing section.

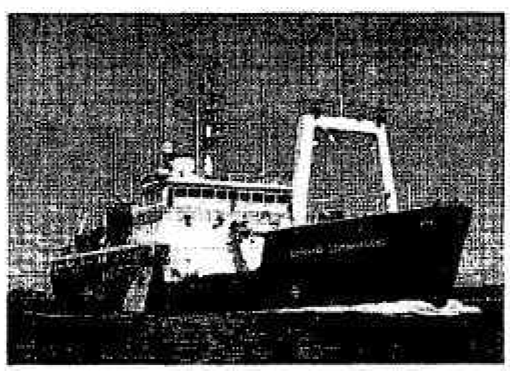
Table 4-2: Anticipated Number of Vaccinated Animals

	Case 3
Number workers	22
Number of teams for adults	7[1]
Number of teams for pups	11
Number of adults vaccinated	7,560
Number of pups vaccinated	8,910
Total number of vaccinations	**16,470**

1 Only 21 people are needed for the first four weeks. Costing, below, is based on 22 people.

4.6 Project Operations and Associated Costs

4.6.1 Transport of Equipment and Personnel to and from Sable Island



The main mode of transport to and from Sable Island to undertake this option is by air. The most common aircraft used is a fixed-wing airplane, the Britten-Norman Islander chartered from Maritime Air Charter. This fast year-round service is restricted to personnel and/or small pieces of cargo.

Large cargo volumes and equipment up to the lift capacity of the helicopter used, i.e., 1 to 2 tons, are supplied to the island annually during the sea-lift operation. During the sea lift, a helicopter slings goods from an anchored ship, e.g., the *CCGS Edward Cornwallis*, to shore. The CCG has indicated that vessel and aircraft support for a seal population control program on Sable Island are within their scope and ability, but due to limited number of suitable vessels and aircraft, there are scheduling constraints and the CCG's contribution is uncertain at this point (Mike Voight, pers. comm.). For example, additional cargo space exists during regular sea-lift supply operations to bring ashore significant amounts of equipment, e.g., 10 ATVs and 100 fuel drums, to support a seal population control program (Burt Chestnut, pers. comm.). However, due to the added effort required to load and sling the extra cargo, advance notice is required to schedule ship and aircraft availability.

Items that are too large to be lifted by helicopter must be brought ashore using a barge. This type of delivery is only feasible during favorable weather and ocean state and should therefore be undertaken well ahead of the field operations. The order of magnitude costs associated with the transportation of personnel and equipment is provided in Table 4.3.

Table 4-3: Transportation Costs

Transport Option	*Capacity*	*Order of Magnitude Cost for a dedicated trip*
Fixed-wing aircraft	635 kg payload (seats for six passengers and space for some luggage)	$5,025
Helicopter sling from offshore supply vessel	Helicopter lift capacity: 1 – 2 tons, e.g., items such as fuel drums and ATVs	$750,000
Barge and tug	Large items, e.g., accommodation trailers	$280,000

Over the five year duration of the vaccination program, it is anticipated that one barge transport would be needed at the outset for the delivery of accommodation trailers, ATVs and equipment shelter structures. A second barge service would be needed at the end of the five-year program to remove the structures and the vehicles.

Special waste, such as syringes and empty fuel drums, could be removed during the annual sea lift operations that supply Sable Island in June every year.

4.6.2 Operations on Sable Island

It is suggested that two bases would be established on the island, one in or near the Main Station, and one in the vicinity of East Light. The Main Station offers accommodation for 10 people, but additional accommodation in trailers would have to be set up nearby to house the balance of the field team. The base near East Light would have to be set up in its entirety, as the DFO camp at that location is in use at that time. The distance between the bases facilitates access to previously untreated target populations and reduces daily travel time.

Each base accommodates the vaccinators and associated support personnel. The layout of the bases follows the design described in Chapter 3 and includes living quarters, desalination units for freshwater supply, wastewater treatment and domestic garbage facilities.

4.6.2.1 Summary of Resources Required

Personnel and equipment requirements for each option are summarized in Tables 4.4 and 4.5.

Table 4-4: Personnel Requirements

	Quantity (units)			
	Case 1	*Case 1b*	*Case 2*	*Case 3*
Vaccinators	10	2	20	11
Vaccinator assistants	20	2	20	11
Mechanic	2	1	2	2
Cook and Housekeeping	4	1	4	4
Supervisor / Medical Officer	2	1	2	2
Total	38	7	48	30

Table 4-5: Equipment Requirements

	Quality (units)			
	Case 1	*Case 1b*	*Case 2*	*Case 3*
Accommodation trailers[1]	3	0	3	3
Vaccine	17,600	17,600	17,600	16,500
Jab Sticks	15	0	30	16
Air Rifles	0	4	0	0
ATVs	22	3	22	16
Equipment Shelters	2	3	2	2
Generators	2	1	2	2
Fuel (liters)	22,000	4,620	11,000	13,000

1 Note that the cost of leasing accommodation trailers is included in the personnel costs.

4.6.2.2 Order of Magnitude Cost Estimate for Equipment Supply and Personnel Travel, per Year

The personnel costs are based on a daily rate of $1,000 which includes wages, meals and accommodation infrastructure, i.e., trailers, septic systems, freshwater supply and garbage handling. The prices assumed for accommodation infrastructure are based on the purchase price of new items, but were deflated to account for costs recovered from selling the items after the field program. For ATVs on the other hand, a purchase price is assumed as their market value will likely becomes negligible towards the end of the five years. The resultant costs for each option are detailed in Table 4.6.

Table 4-6: Estimated Personnel and Equipment Costs

	Cost			
	Case 1	*Case 1b*	*Case 2*	*Case 3*
Personnel	$1,596,000	$294,000	$1,008,000	$1,470,000
Vaccine	[redacted]			
Air Rifles	$0	$10,000	$0	$0
ATVs	$220,000	$30,000	$220,000	$160,000
Equipment Shelters	$10,000	$10,000	$10,000	$10,000
Generators	$10,000	$5,000	$10,000	$10,000
Fuel	$22,000	$4,620	$11,000	$13,000
Other	$300,000	$150,000	$300,000	$300,000
Total	[redacted]			

Costs included in "Other" in Table 4.6 cover items such as jab sticks, radios for communication, medical equipment, outdoor lights, outerwear, nets for handling seals, spray paint, spare mechanical parts, construction of equipment shelters and accommodations, etc.

The cost of transporting goods and people is provided in Table 4.7. Each case has different transportation requirements due to the number of people involved and the program's duration. The following considerations were taken into account:

- Maritime Air charter's fixed-wing aircraft has seats for six people; and
- Supply of fresh groceries and other items are anticipated to be required twice a month.

Furthermore, the delivery of large items at the beginning of the field program and their retrieval after five years requires two barge services. The total cost for this is estimated to be $560,000. This cost, averaged over the five year duration of the program is $112,000 per year.

Table 4-7: Transport Costs of Personnel and Supplies

	Cost per year			
	Case 1	*Case 1b*	*Case 2*	*Case 3*
Personnel travel	$70,350	$20,100	$80,400	$50,250
Vaccine supply	$5,025	$5,025	$5,025	$5,025
Grocery supply	$20,100	$10,050	$10,050	$20,100
Barge Service	$112,000	$0	$112,000	$112,000
Total	**$207,475**	**$35,175**	**$207,475**	**$187,375**

4.7 Immunocontraception Program - Order of Magnitude Cost Estimate

Tables 4.8 – 4.12 summarize the order of magnitude costs for the execution of Option ii) for Years 1 through 5. The estimate of the Base Cost for Year 1 of the field operations are calculated from the totals provided in Tables 4.6 and Table 4.7.

Table 4-8: Year 1 Order of Magnitude Cost Estimate

	Case 1	*Case 1b*	*Case 2*	*Case 3*
Base Cost	$3,773,475	$1,946,795	$3,174,475	$3,470,375
Contingency reserve for risk mitigation (20%)	$754,695	$389,359	$634,895	$694,075
Management reserve for unplanned and unknown costs (20%)	$754,695	$389,359	$634,895	$694,075
Total	**$5,282,865**	**$2,725,513**	**$4,444,265**	**$4,858,525**

Table 4-9: Year 2 Order of Magnitude Cost Estimate

	Case 1	*Case 1b*	*Case 2*	*Case 3*
Base cost*	$3,533,475	$1,891,795	$2,934,475	$3,290,375
Inflationary increase of 3%	$106,004	$56,754	$88,034	$98,711
Management reserve for unplanned and unknown costs (20%)	$706,695	$378,359	$586,895	$658,075
Total	**$4,346,174**	**$2,326,908**	**$3,609,404**	**$4,047,161**

*The base cost for year 2 is equal to the base cost of year 1 less the cost of purchasing equipment such as ATVs etc.

Table 4-10: Year 3 Order of Magnitude Cost Estimate

	Case 1	*Case 1b*	*Case 2*	*Case 3*
Base cost*	$3,639,479	$1,948,549	$3,022,509	$3,389,086
Inflationary increase of 3%	$109,184	$58,456	$90,675	$101,673
Management reserve for unplanned and unknown costs (20%)	$727,896	$389,710	$604,502	$677,817
Total	**$4,476,559**	**$2,396,715**	**$3,717,686**	**$4,168,576**

*The base cost for year 3 is equal to the base cost of year 2 plus 3% inflationary increase

Table 4-11: Year 4 Order of Magnitude Cost Estimate

	Case 1	*Case 1b*	*Case 2*	*Case 3*
Base cost*	$3,748,664	$2,007,005	$3,113,185	$3,490,759
Inflationary increase of 3%	$112,460	$60,210	$93,396	$104,723
Management reserve for unplanned and unknown costs (20%)	$749,733	$401,401	$622,637	$698,152
Total	**$4,610,857**	**$2,468,616**	**$3,829,218**	**$4,293,634**

*The base cost for year 4 is equal to the base cost of year 3 plus 3% inflationary increase

Table 4-12: Year 5 Order of Magnitude Cost Estimate

	Case 1	*Case 1b*	*Case 2*	*Case 3*
Base cost*	$3,861,124	$2,067,215	$3,206,580	$3,595,482
Inflationary increase of 3%	$115,834	$62,016	$96,197	$107,864
Management reserve for unplanned and unknown costs (20%)	$772,225	$413,443	$641,316	$719,096
Total	**$4,749,183**	**$2,542,674**	**$3,944,093**	**$4,422,442**

*The base cost for year 5 is equal to the base cost of year 4 plus 3% inflationary increase

Based on the information provided above, the order of magnitude costs for the execution of the five year immunocontraceptive program for each of the cases are as follows:

- Case 1: $23,465,637
- Case 1b: $12,640,428
- Case 2: $19,544,666
- Case 3: $21,790,338

Chapter 5 **Regulatory and Policy Issues**

5.1 Jurisdictional Factors

As indicated in Section 1.3, Sable Island is currently administered by the *Sable Island Regulations* under the *Canada Shipping Act* and by the *Migratory Birds Convention Act*. The former identifies activities that are prohibited on the island and controls access to the island. More specifically, no one can, without written permission, erect any building or structure on the island or within one mile of the island; excavate, construct a roadway or otherwise disturb the natural contours of the island; use any explosive on the island or within one mile of the island; or molest, interfere with, feed or other wise have anything to do with the ponies on the island. Further, access to the island is strictly controlled. At the present time authority in these matters resides with the CCG DFO.

In June of 2008, the Minister of Environment announced new funding for the weather station on the island and actions to further protect the island's ecosystems. The intent is the eventual designation of Sable Island as a National Wildlife Area (NWA). This would involve the designation of the island as a NWA under the *Canada Wildlife Act* and the transference of jurisdiction over the island from DFO to Environment Canada. This announcement recognizes that Sable Island provides "nationally significant" habitat for migratory birds, supports wildlife and ecosystems at risk and represents a unique biogeographic region. Although currently designated as a MBS, which provides protection to migratory birds and their nests during the actual breeding season, the suggested designation as a NWA would raise the level of potential protection substantially and recognize the unique physical and ecological attributes of this isolated island off the coast of Nova Scotia.

5.2 Need for Environmental Assessment

The *Canadian Environmental Assessment Act (CEAA)* establishes the framework and requirements for the federal environmental assessment process whereby an assessment is required before a federal authority:

i) carries out a project;
ii) provides financial assistance to enable a process to be carried out;
iii) sells, leases or otherwise transfers control or administration of land to enable a project to be undertaken; or
iv) permits, approves or takes any other action specified in the Law List Regulations for the purposes of enabling a project to be carried out.

Not only would either option be instigated and financed by DFO, but certain actions associated with one or both options would also require permits or approvals pursuant to legislation specified in the Law List Regulations. *CEAA* is therefore a primary piece of legislation that must be taken into account regardless of which option might be advocated. To facilitate the regulatory review, consideration is given in the first instance to Option i) the targeted population reduction. Once the regulatory path associated with the execution of this option is detailed, the regulatory differences associated with the execution of Option ii) are identified.

5.2.1 Regulatory Path for Option i)

Although Option i) would be instigated and financed by DFO, are the works proposed a "project" under the terms of *CEAA*, or are there other permits or approvals required that would serve as a trigger for the implementation of the act? In the absence of examining all facets of the actions and infrastructure that would be required to execute Option i), there are two potential regulatory triggers:

- section 4 of the *Migratory Bird Sanctuary Regulations* requires that a permit for the possession and use of a firearm within a MBS be obtained and the issuance of such a permit triggers the requirement for environmental assessment; and similarly,
- should it be determined that the seal carcasses would be disposed of at sea, the permit required under Division 3 of Part 7 of the *Canadian Environmental Protection Act* would trigger the requirement for environmental assessment.

Since the execution of Option i) would necessitate the use of firearms within an MBS, *CEAA* would be triggered regardless of any other facets of the project that might require permits or be categorized as a "project" for purposes of *CEAA*. The question then arises as to the type of assessment and scope of the assessment that would be required. There are four possibilities: an environmental screening, a comprehensive study, mediation and a panel review.

An environmental screening, conducted by the project's responsible authority, which in this instance would be DFO and/or Environment Canada, is the most flexible type of assessment, accommodating both simple, routine projects as well as larger undertakings. The screening process involves a systematic approach to documenting the environmental effects of a proposed project and determining the need to eliminate or mitigate these effects. An environmental screening can encompass a large project and can involve many interests. The Wind Turbine project undertaken by MSC, for example, was subject to an environmental screening pursuant to *CEAA*.

Specific projects, as defined in the Comprehensive Study List Regulation, are subject from the outset to a more intensive and detailed assessment, i.e., a comprehensive study. These tend to be larger projects, e.g., larger water dams, or an uranium mine, etc., projects having the known potential to generate significant adverse environmental effects and/or generate public concern. The works associated with Option i) would certainly generate public concern and may have the potential to generate significant adverse environmental effects, but they are not works identified in the referenced regulations. Option i) would not therefore be subject to comprehensive study.

Mediation is a voluntary process of negotiation in which an independent and impartial mediator appointed by the Minister of the Environment assist the involved parties to resolve their differences on the issues involved and to attain consensus on such questions as the likely environmental effects of a project and the most effective mitigation that might be deployed. Given the nature of the works envisaged and the opposing views that are held by the various parties and interests that are likely to be involved, it is highly unlikely that consensus could be achieved. Mediation in such circumstances would not be a realistic option.

As detailed in Section 3, the removal of up to 100,000 grey seals during the pupping season in the early part of the year would be a large and challenging undertaking which, given the bases that would have to be established, would pose a number of risks to the environment. It would also inevitably be controversial both in Canada and overseas. There are three primary reasons that a responsible authority might ask the Minister of Environment to appoint a review panel:

- the use of new technologies;
- a project that may cause unknown environmental consequences; and
- a project that generates vocal public opposition.

Option i) would not entail the use of new untested technologies, but the necessity for personnel and equipment as described would pose potential impacts on a fragile environment and the project, as stated would certainly generate considerable opposition from a national and likely international perspective. Whether or not this would be sufficient cause for the Minister of Environment to appoint a Panel cannot be predicted; the Minister is the only person that may order an assessment by a review panel.

Review panels, appointed by the Minister, have the unique capacity to facilitate the exchange of scientific data and opinion from scientists and others in a public forum, and the panel on conclusion of the hearings would prepare an environmental assessment report which would summarizes its rationale, conclusions and recommendations; the panel would also prepare a summary of the comments received from the public. This report would be submitted to the responsible authority and to the Minister of Environment who then would make it public. The responsible authority must take the panel's report into consideration before making a decision with respect to the project and must also respond to the report.

Many large projects are successfully assessed at the screening level, but those responsible for taking a decision on whether or not to proceed with Option i) must be cognizant of the circumstances that would lead to a panel hearing and what could be a lengthy and costly environmental assessment and permitting process.

5.2.2 Regulatory Path for Option ii)

The parameters associated with the execution of Option ii) are distinctly different from those associated with Option 1: there are fewer personnel involved in the execution of the tasks on the ground; there is a need for less equipment and there is no obvious trigger to initiate *CEAA*. Reference to the *Inclusion List Regulations* would suggest that there is no project. What is proposed is a seasonal activity for a defined number of years with a specific purpose; the activity could also be framed, and would likely be framed given its nature, as a continuation of prior research activities. In this context no environmental assessment pursuant to *CEAA* would be required. However, should Sable Island be designated a NWA, careful consideration would have to be given to the requirements of the Wildlife Area Regulations to determine whether a permit is required under Section 4 from the Minister of Environment to undertake the Immunocontraception program. If such a permit was deemed necessary, a federal environmental assessment pursuant to *CEAA* would be required.

Although no project based environmental assessment would be required under the present status of the island, given the nature of the questions involved and the regional environmental and socio-economic issues that underpin not only Option ii) , but Option i), DFO might be advised to consider undertaking a strategic environmental assessment. As stated in the 2004 Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals

----- ministers expect a strategic environmental assessment of a policy, plan or program proposal to be conducted when the following two conditions are met:

1. *the proposal is submitted to an individual Minister or Cabinet for approval; and*
2. *implementation of the proposal may result in important environmental effects, either positive or negative. (Privy Council office and Canadian Environmental Assessment Agency. 2004.1).*

Given that the intent of both options is to reduce the size of the grey seal population in the region and incidentally to bring about changes in fish stocks, there would appear to be a sound rationale associated with taking the time to review and consider the considerable literature that exists on the subject and to provide a structured means of affording the many interested parties the opportunity to provide input to the decision making process. This is particularly relevant given the status of Sable Island itself and the fact the consideration is being given to designating this area as a NWA under the *Canadian Wildlife Act*

A recent publication of the Canadian Council of Ministers of the Environment states:

A strategic approach is one that offers a foundation on which to base decision-making, and ensures the full consideration of alternative options at an early stage where there is greater flexibility with respect to decision outcomes. A strategic approach to environmental assessment is one that is proactive, asking "what is the preferred option?" and "what is the preferred attainable end(s)?" rather than predicting the most likely outcomes of a predetermined action. (Canadian Council of Ministers of the Environment. 2009. 12).

5.2.3 Other Regulatory Considerations

In addition to the above described regulatory implications with respect to environmental assessment, different facets in the implementation of either option under consideration will have to be executed with regard to specific legislation of general application and will have to address regulatory requirements for specific activities. Of relevance are the following:

- *Canadian Environmental Protection Act*;
- *Species at Risk Act;*
- *Migratory Birds Convention Act;*
- *Canada Shipping Act;*
- *Canada Wildlife Act;*
- *Fisheries Act*; and
- *Criminal Code of Canada.*

Once a decision is made as to whether one or other options will be undertaken, a detailed regulatory schedule should be prepared.

5.3 Regulatory Costs

The costs associated with working through the regulatory processes are dependent on multiple factors including the range of work undertaken in-house. There are considerable databases available to DFO and Environment Canada, but should Option i) be accepted, the execution of an environment assessment that could go forward to an environmental assessment panel would likely involve one or more consultants. It is also likely that consultants could be contracted to provide expertise and support in the preparation of other documentation, e.g., environmental management plans and occupational health and safety plans. The costs presented in Table 5.1 are order of magnitudes estimates only based on comparable situations and experience from a private consulting basis. These costs are in addition to those detailed in Chapters 3 and 4 for the options under consideration.

Table 5-1: Regulatory Costs

Environmental assessment of Option i)[1]	$250,000 - $2.5 m
Strategic Environmental Assessment of either option[2]	$150,000 - $250,000
Contingency re. above[3]	$25,000 - $250,000
Supplementary Permitting[4]	$50,000 - $100,000
Preparation of Environmental Management Plan for either option[4]	$60,000 - $75,000
Preparation of Occupational Health and Safety Plans for either option[4]	$50,000 - $100,000

1 The order of magnitude cost estimate for completing an environmental assessment of Option i) is based on experience of executing larger federal environmental screenings involving a marine dimension and assessments that were subject to Panel Review. The former include the environmental screening undertaken of the Pubnico Point Wind Farm which included the assessment of a 1,200 m sub-sea cable to an electrical substation; the latter include order of magnitude costs associated with the preparation and defense of the environmental assessment in front of a federal panel for the Sable Island Offshore Energy and the Maritime and Northeast Pipeline projects. Costs associated with highly controversial projects, for example, the assessment of low level flying in Labrador and Quebec which went to a Panel in the early 1990s, can be substantially greater.

2 The order of magnitude costs for undertaking a strategic environmental assessment are based on comparable work undertaken for DFO and Parks Canada in PEI and the preparation of strategic assessments for seismic and drilling activities off Nova Scotia.

3 Contingency estimate is industry norm for projects with many uncertainties, i.e., 10% of overall costs.

4 These costs, for example, would include attaining permits for guns, silencers, fuel storage, etc., to meet specific requirements of applicable legislation; the estimate is based on experience of executing comparable work for a range of public and private sector clients.

Chapter 6 **Observations on Findings**

6.1 Reiteration of Purpose

As stated in Section 1.1, the intent of this report was to examine the logistics and costs associated with two options for managing the grey seal population on Sable Island. The options subject to review are:

i) a targeted population reduction, i.e., 100,000 animals removed in the first year, with 30,000 removed in each of the subsequent four years; and
ii) the implementation of an immunocontraceptive vaccine program targeting 16,000 female grey seals each year for five years.

The logistics and costs associated with both have been presented in Chapters 3 and 4 respectively. The regulatory parameters have been discussed in Chapter 5. Based on the data compiled, the following sections provide observations on the findings and on what might actually be feasible given:

- the physical and logistical factors associated with any such activities undertaken in winter on Sable Island;
- the environmental and ecological value and status on the island now and the status proposed; and
- the regulatory regime that protects and governs activities on the island.

6.2 Feasibility Options

6.2.1 Option i) Targeted Population Reduction

The operational and resource requirements necessary to undertake a cull of 100,000 grey seals on Sable Island from the end of December to mid February during project Year 1 and a subsequent cull of 30,000 seals per year for four years are substantial. The fundamental challenges associated with this proposed scope and scale is driven by:

- The remote nature of Sable Island and limited transport options onto and off the island;
- The very limited supply of accommodations, potable water, sewage treatment and fuel;
- The magnitude of the proposed operation from a materials handling and quantity perspective;
- The weather conditions and time of year for the proposed work; and
- The narrow time frame in which to complete the work each year.

As presented in Chapter 3, there are readily available equipment and technologies suitable to address each challenge and accomplish the objectives of the proposed project. Costs associated with this work have been presented and discussed. The costs are considered reasonable based on the requirements and nature of the operation; and in line with logistically similar large scale construction earthwork and offshore oil and gas operations. The most considerable factor in evaluating the suitability and feasibility of this project from a logistical design perspective, is the invasive nature and overall magnitude of the operations required on Sable Island to undertake the work. The quantity of personnel, heavy equipment, fuel storage and size of operational bases will significantly overshadow current operations on the island and dominate the landscape.

With these considerations in mind, a reduced operational scope should be considered. Based on the design elements presented in Chapter 3, and our understanding of Sable Island, a cull of 20,000 grey seals per year would represent a more feasible operational undertaking. To accomplish this work, one operational base and associated equipment and resources as described in Chapter 3 would be necessary. The base components, i.e., operational equipment and accommodations, would be mobilized and established in Year 1 and remain in place until the project is completed. The duration of the project is dependent on overall quantity reduction objectives; which for evaluation purposes we assume is 20,000 seals per year for five years.

The order of magnitude cost associated with this proposed operation is presented below. The cost reduction for the majority of project components represents a linear reduction to 20% of the originally scoped Year 1 objective of 100,000 seals. The cost, however, associated with barge transport of equipment to and from Sable Island cannot be calculated in this manner, as yearly barge trips to resupply operations and remove generated ash and waste would still be required.

The following presents an order of magnitude cost estimate associated with a cull of 20,000 seals per year for five years, based on the conceptual operational design presented in Chapter 3:

Yearly Order of Magnitude Operational Cost Components:

- $270,000 for barge transport and shore base operations (assuming a 5 year operation)
- $11,600 for land transport and landfill disposal of ash
- $1,012,000 personnel (including accommodations and food)
- $74,000 of fuel and associated storage
- $400,000 forwarders
- $300,000 Air Curtain thermal units
- $40,000 ATVs
- $100,000 excavators
- $126,000 other, i.e., generators, lights, transport of fresh food, containers, miscellaneous equipment and supplies, ammunition, rifles, etc.
- Total $ 2,333,600

Year 1 Order of Magnitude Cost Estimate:

- Base cost = $ 2,333,600
- Contingency reserve for risk mitigation = $ 466,720
- Management reserve for unplanned and unknown costs = $ 466,720
- **Total order of magnitude cost estimate = $ 3,267,040**

Year 2 Order of Magnitude Cost Estimate:

- Cost estimate = $ 3,276,040
- Inflationary increase of 3% = $ 98,011
- **Total order of magnitude cost estimate = $ 3,365,051**

Year 3 Order of Magnitude Cost Estimate:

- Cost estimate = $ 3,365,051

- Inflationary increase of 3% = $ 100,951
- **Total order of magnitude cost estimate = $ 3,466,002**

Year 4 Order of Magnitude Cost Estimate:

- Cost estimate = $ 3,466,002
- Inflationary increase of 3% = $ 103,980
- **Total order of magnitude cost estimate = $ 3,569,982**

Year 5 Order of Magnitude Cost Estimate:

- Cost estimate = $ 3,569,982
- Inflationary increase of 3% = $ 107,099
- **Total order of magnitude cost estimate = $ 3,677,082**

Total Project (5 years) Order of Magnitude Cost Estimate = $ 17,345,159

6.2.2 Option ii) Immunocontraceptive Program

The vaccination of thousands of grey seals on Sable Island in winter poses a number of logistical challenges including manpower requirements, time constraints and the infrastructure and equipment required. The order-of-magnitude costs to execute this option were presented in Chapter 4 based on a vaccination target of 16,000 animals per year for five years; the estimated cost varies by millions of dollars depending on the means of vaccine delivery and the targeted population. To provide sufficient information to inform recommendations and decisions, four cases studies were described:

- Case 1: Adult grey seals only targeted over a six-week period;
- Case 1b: Adult grey seals targeted using ballistic delivery over a six-week period;
- Case 2: Only pups targeted over a three-week period; and
- Case 3: Adults and pups targeted over a seven-week period.

In all cases, except Case 1b, the vaccine is delivered using hand-held syringes or by jab-sticks; additional caveats apply for Case 1b.

The comparative order of magnitude costs for a five-year program with an annual vaccination target of 16,000 seals are estimated as follows:

- Case 1: $23.5 mil;
- Case 1b: $12.5 mil;
- Case 2: $19.5 mil; and
- Case 3: $22 mil.

The similar magnitude of cost for the scenarios using hand-applied vaccination, i.e., Cases 1, 2 and 3, is due to the number of workers involved, which requires the mobilization of additional accommodations and associated support facilities including water purification, wastewater treatment, fuel reservoirs, etc. From Cases 1, 2 and 3, vaccinating the pups only (Case 2) appears to be the most efficient approach, primarily due to the reduced labour costs associated with a field season which lasts only three weeks.

The accommodation requirements for Cases 1, 2 and 3 add significantly to both capital costs and logistics. The necessary accommodations and associated support infrastructure could also adversely impact the areas used. The likelihood of any such consequences can be minimized by the careful siting of the necessary accommodations and by scaling the vaccination program to better fit within the existing infrastructure of Sable Island, i.e. reducing the personnel numbers to fit accommodations at, or in proximity to, the Main Station.

The personnel necessary to execute a contraception program using the ballistic delivery of the vaccine over a six-week program could be accommodated in the Main Station, where domestic water and power supply and wastewater treatment are provided. It must, however, be noted that the cost of such a field program using the ballistic delivery of the vaccine as quoted above does not allow for the development of a reliable method to encapsulate the vaccine. This development may be costly in terms of both time and money, especially if the chemical texture of the vaccine is altered and additional animal tests are needed. These factors must be taken into account in considering the lower cost attributed to Case 1b, i.e., $12.5 mil.

Given the significant costs associated with accommodating more people on Sable Island than can be supported by the existing infrastructure, the scale of the operation for Cases 1, 2 and 3 could be scaled back to be carried out by 10 people. The costs and the number of vaccinations that could be achieved in such a scenario were estimated based on the assumptions provided in Chapter 4 (see Table 6.1). If the vaccinations are performed by hand, the targeting of pups and adults over a seven week period is the most efficient approach in terms of both total vaccinations and the cost per vaccination. The least favourable approach is Case 2, the targeting of pups only, as the time window of three weeks is too short to achieve a large number of vaccinations.

Table 6-1: Project Scope for 10 Workers Over Five Years

	Case 1	*Case 1b*	*Case 2*	*Case 3*
Total cost	$6,831,753	$12,556,136	$3,482,480	$7,878,877
Vaccinations	3,240	16,200	1,620	4,590
Cost per vaccination	$2,109	$776	$2,150	$1,717

Control of the birth rate of wild populations of carnivorous animals became feasible with the development of a contraceptive method which requires only a single administration of the vaccine. Such a contraceptive was developed and tested in the early 1990s (Brown *et al.*, 1996) and is based on an immune reaction to the presence of the glycoproteins derived from the eggs of pigs. The vaccine was administered to captured seals and found to produce the antibodies required for successful contraception (Brown *et al.*, 1997b). During a field test on Sable Island in January 1992, 205 adult grey seals were either administered the vaccine or a placebo, and in subsequent years, significantly fewer immunized females returned to the island than did females given the placebo vaccine (Brown *et al.*, 1997). Since typically only pregnant females return to Sable Island during the breeding season, this reduction in the number of recaptured vaccinated females is taken as evidence for the efficacy of the contraceptive. Since these original studies, unpublished experiments suggest that the vaccine produces antibodies when administered to pups, but no controlled experiment has been conducted to suggest the long-term prevention of pregnancy resulting from pup vaccination (Dr. Robert Brown, pers. comm.). The scientific validity of PZP immunization in grey seals has been questioned on the following:

- the assumption that the failure of immunized seals to return during subsequent breeding seasons is reflective of a successful contraception; and
- the lack of a peer-reviewed long-term study that demonstrates that the contraceptive prevents pregnancy (Anonymous, pers. comm.).

A controlled scientific study on the long-term efficacy of actually preventing pregnancy may be advisable to demonstrate that the proposed program would have the desired outcome and to achieve increased acceptance for such a large-scale and expensive program. Such a study would likely use animals in captivity to achieve the controlled environment. If such a study is not feasible given the urgency of the demand for seal population control, a scientific program with the aim of monitoring the effectiveness of contraception similar to the 1992 study (Brown *et al.*, 1997), should be conducted as an integral part of the vaccination activities.

6.3 Environmental Context and Regulatory Route

Sable Island is a remote location characterized by a distinct and valued ecology. What can be done on the island is subject to the requirements of several pieces of federal legislation. The responsible authority, however, may in the near future change as a result of the Minister of Environment's announcement to designate Sable Island as a NWA under the *Canada Wildlife Act,* a step that would involve the transference of jurisdiction over the island from DFO to Environment Canada.

Regardless of the regime in place, the implementation of either option would require consideration of several acts and associated regulations which have been instigated to protect the environment, valued species, critical habitat and human health and safety. The execution of option i), as referenced in section 5.2.1, would undoubtedly trigger *CEAA;* the unknown is the level of environmental assessment that would be involved. The execution of option ii) may not trigger *CEAA,* particularly if the program is framed in terms of continued research. Whichever option is favoured, it would be prudent to execute a strategic environmental evaluation of all facets of the proposed works to ensure that activities are executed in accordance with the requirements of all legislation of general application and that all necessary permits are attained and adhered to. This will include development of the necessary environmental management systems and occupational health and safety systems.

6.4 Looking Ahead

This study has presented and considered the logistics and costs associated with undertaking one or other of the options identified by DFO to manage the grey seal population on Sable Island. Consideration has been given to the scale and feasibility of both options given the remoteness and ecological value of the island. The materials presented will generate discussion and many facets will certainly be challenged, but a context has been established that can, it is suggested, provide the framework for the debate that needs to take place before decisions are made.

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Appendix A

Statement of Work

Statement of Work

Background:

Fisheries and Oceans Canada wishes to engage the services of a consulting firm to undertake a feasibility study to determine practicable options, including logistics and cost, for managing the Grey Seal population on Sable Island through 1) a targeted population reduction and 2) the use of an immunocontraceptive vaccine.

The study should cover all aspects of how a targeted population reduction of Grey Seals or a contraception program for Grey Seals could occur on Sable Island efficiently and safely while ensuring there is minimal negative impact to the local environment. For costing purposes, the scope of the population reduction is 100,000 animals removed in the first year, with 30,000 removed per year for 4 subsequent years. The scope of the contraception project is 16,000 female Grey Seals vaccinated each year for 5 years.

Sable Island, a sandbar approximately 42 km long and 1.5 km at its widest, is located approximately 290 km southeast of Halifax, Nova Scotia. It is home to the largest breeding colony of Northwest Atlantic Grey Seals, accounting for over 80% of pupping that occurs. The Grey Seal population was estimated in 2007 to be over 300,000 and increasing approximately 8% per year. Sable Island is also a Migratory Bird Sanctuary, with species such as the endangered Roseate Tern residing there. In addition, there are other vulnerable species that may be impacted by the proposed activity.

Mandatory Requirements:

- The contractor will commit in writing to produce a final copy of the study by no later then September 30th, 2009.

- The contractor will provide a multi-person, multi-disciplinary team including both Environmental Scientists and Engineers with appropriate accreditation, work experience and educational background.

- The contractor will have a minimum of 3 years of experience conducting Canadian Environmental Assessment Act compliant environmental assessments.

Analysis:

The contractor will:

1) Conduct an appropriate literature review.

2) Consult with knowledgeable government and non-government personnel.

3) Produce a draft copy of the study for review by September 11th, 2009, including, at a minimum, topics such as:

- Personnel Requirements
  - How many people will be required and for how long?
  - What are options for who could do the work?
  - What's the most efficient team set up for conducting a population reduction or a contraception program? What mix of skills is needed to complete the task?

- Accommodations
  - Options for and pros/cons of staying on island vs. off island

- Transportation
  - Options for getting to and from Sable Island.
  - Options for moving on and around Sable Island.

- Equipment
  - What will be needed to conduct the population reduction?
  - What will be needed to conduct the contraception program?
  - What will be needed to support the projects when underway?

- Waste Removal
  - Options for dealing with carcass removal.
  - Options for dealing with other waste generated.

- Environmental
  - What are the potential environmental impacts of all the various options for conducting a population reduction or a contraception program on Sable Island?
  - Would a CEAA Environmental Assessment be necessary? If so, clearly expressed associated requirements and timelines.
  - Options for mitigating potential environmental impacts.

- Safety
  - Safety concerns related to conducting a population reduction or a contraception program should be clearly expressed, highlighting possible mitigation options.

- Volume
  - Evaluate the feasibility of the scope of the projects as provided.
  - If found to not be feasible, what number of seals could efficiently be removed or vaccinated per year?

- Cost
  - Each aspect will include an associated cost for each option listed, summarized into an estimated total cost for both a targeted population reduction and a contraception program.

4) Submit a final copy of the completed study by September 30th, 2009.

Appendix B
Contact and Meeting Record

Contact Name	*Affiliation*	*Subject*	*Contact/ Meeting*
Don Bowen	DFO-Science	• Mapping and aerial photos • Details of research activities	27 08 09 28 08 09 16 09 09 24 09 09
Bob Mohn	DFO-Science		
Mike Hammill	DFO-Science (Quebec)	• Seal biology and procedures	03 09 09
Mike Voight	DFO-CCG	• Logistics and use of CGC vessels	28 09 09
Chastity McKinnon	DFO Communications	• Details of hunt on Hay Island • Mandate of DFO communications	27 08 09 31 08 09 29 09 09
Ted Potter	DFO Regional Manager EAMP	• Meeting re. regulatory and jurisdictional issues	02 09 09
Cyril Boudreau	NS Fisheries and Aquaculture	• Meeting re. provincial interests on Sable Island	30 09 09
Dr. Pierre Yves Daoust	Atlantic Vet College	• Animal welfare and waste disposal	03 09 09
Gerry Forbes	Environment Canada	• Infrastructure on Sable Island, weather conditions and ecological implications	28 09 09
Derek Fenton	Environment Canada	• Infrastructure on Sable Island and ecological implications	23 09 09
Bill Coulter	Canadian Environmental Assessment Agency	• Meeting on environmental assessment process	01 01 09
Cal Ross	Exxon Mobil	• Meeting on status of and logistics of working in and around Sable Island in winter	31 08 09
Robert Orr	Waste Resources Engineer, HRM	• Landfilling of organic material	18 09 09
Marc Mansour	Immunovaccine Inc.	• Vaccine supply and application	08 09 09
Sean Tucker	CHC Global Operations, Base Manager	• Helicopter capabilities and logistics	24 09 09
Jerry Scott	Manager, Technical Services, Newalta Corporation	• Thermal treatment of carcasses • Equipment and logistics for a population reduction project	25 09 09
Rick Edwards	Atlantic Towing Limited	• Supply vessels and offshore barge operations and transport logistics	25 09 09
Tim Gilfoy	CEO, Mulgrave Marine Terminal	• Shore Base Logistics	25 09 09
Burt Chestnut	DFO-CCG	• Logistics of supply	20 10 09
Robert Brown	Immunovaccine Inc.	• Vaccine logistics	08 09 09
Jim Eddington	Dalhousie University	• Seal handling • Bio bullets	15 10 09
Ella Korets-Smith	Immunovaccine Inc.	• R&D for bio bullet application	08 09 09 16 10 09

Contact Name	***Affiliation***	***Subject***	***Contact/ Meeting***
Martin Kramers	Chief Firearms Officer Nova Scotia	• Logistics and legislation of specialized firearms	17 10 09
Sean Hansen	IPSC Range Master, Owner Freedom Ventures Firearms	• Procurement of specialized firearms	20 10 09

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